Marsden Park Wastewater Servicing - Strategic Planning Report

Final

- June 2012

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Document Approval

This document describes the strategic planning that was undertaken for the provision of wastewater services to the Marsden Park Precinct.

This document was prepared by SKM with input from a number of project stakeholders including property developers (Winten and Stockland), consultants (Cardno and SKM) and Sydney Water Corporation, using the best information available at the time of investigation. Stakeholder endorsement for the issues and principles contained in the document were achieved through information workshops and reviews.

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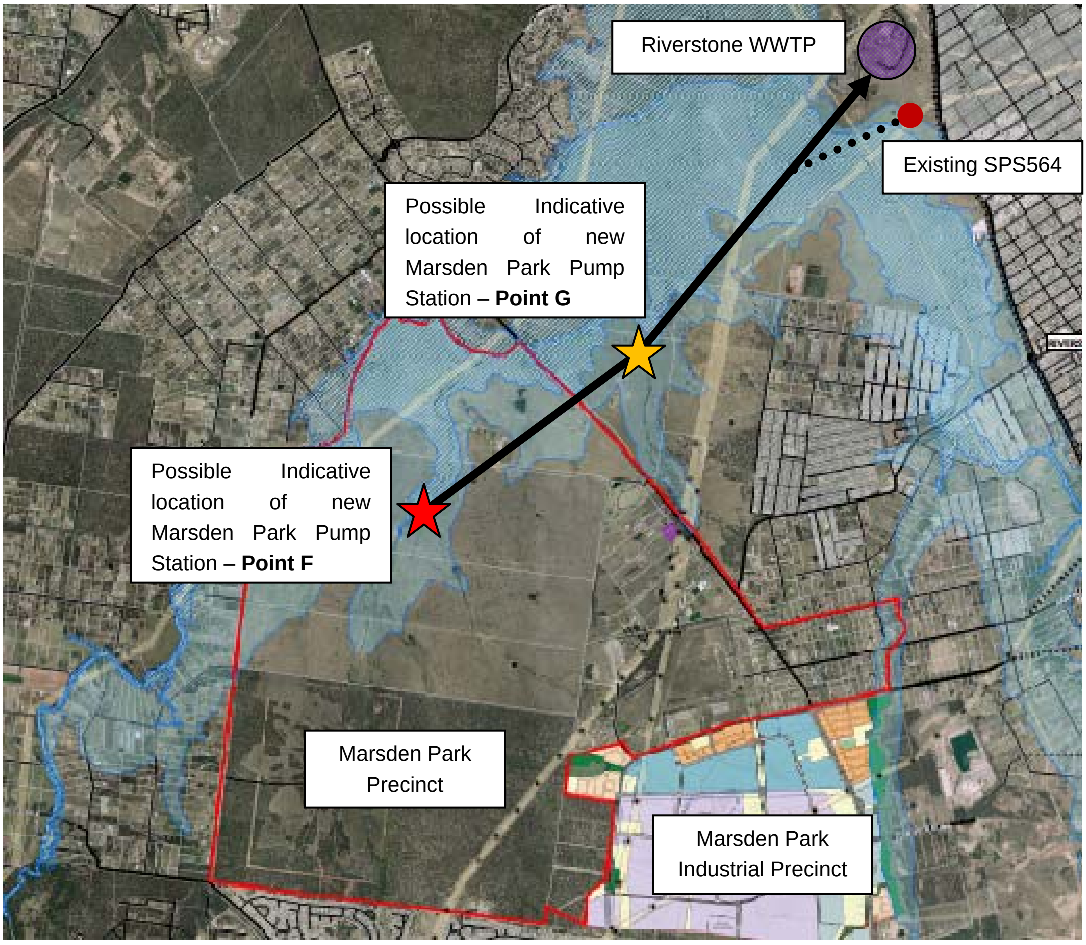
Executive Summary

This report is the strategic planning report for the provision of wastewater services to Marsden Park Precinct. It investigates feasible servicing options and identifies the preferred servicing strategy for the Stage 1 development of Marsden Park.

A companion document, the detailed planning report, provides further specific details of the preferred servicing strategy, such as the preferred location of new wastewater infrastructure.

The preferred wastewater servicing strategy for Marsden Park Precinct is transfer to Riverstone WWTP. This requires the construction of new wastewater infrastructure, particularly a Marsden Park pump station and rising main. Various options for the location of the new pump station were investigated, including a pump station at Point F and Point G, as shown in **Figure A**.



▪ **Figure A Preferred Wastewater Servicing Strategy – Transfer to Riverstone WWTP**

The report investigates servicing constraints and identifies that until a new inlet works is constructed at Riverstone WWTP, as part of the planned plant amplification, the rising main from the new Marsden Park pump station would need to discharge to the existing pump station SPS564.

This report shows that development of Marsden Park Stage 1 can be accommodated by the Riverstone Wastewater System, including the treatment plant and network.

In order to identify the preferred location of the new Marsden Park pump station, as well as design details, further work is required to be undertaken, including:

- Investigation of the staging of any gravity mains that are required
- Optimising SPS F so that it replaces SPS A
- Mitigation measures for odour and corrosion associated with long rising mains
- Details of connecting to the SPS564 system
- Risk assessment using Sydney Water's risk assessment tool

The results of this further work would be documented in the Marsden Park Wastewater Servicing – Detailed Planning Report.

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Document history and status

Revision	Date issued	Reviewed by	Approved by	Date approved	Revision type
Draft v4	13/4/2012				Work in progress report issued for comment
Draft v5	17/4/2012				Work in progress report issued for comment
Draft v7	21/5/2012	K Fung	P Von Huben	21/5/2012	Report issued for comment
Draft v8	23/5/2012	K Fung	P Von Huben	23/5/2012	Draft for discussion
Draft v9	15/06/2012		P Von Huben	15/06/2012	Report issued for comment
Final	20/06/2012	P Von Huben	P Banks	21/06/2012	Report issued to SWC
Report split into Strategic Planning and Detailed Planning					
Final	9/7/2012	P Von Huben	P Banks	9/7/2012	Report issued to SWC

Distribution of copies

Revision	Copy no	Quantity	Issued to
Draft v4	Electronic	1	Winten (Bill Sarkis), Stockland (Stephen Barlow), Cardno (Cameron Vella) – for comment
Draft v5	Electronic	1	Sydney Water (Kate Wild)
Draft v7	Electronic	1	Winten (Bill Sarkis), Stockland (Stephen Barlow), Cardno (Cameron Vella) – for comment
Draft v8	Electronic	1	Winten (Bill Sarkis), Stockland (Stephen Barlow), Cardno (Cameron Vella), Sydney Water (Kate Wild) – draft for discussion
Draft v9	Electronic	1	Winten (Bill Sarkis), Stockland (Stephen Barlow), Cardno (Cameron Vella) – for comment
Final	Electronic	1	Sydney Water (Cassandra Loughlin) – for review
Report split into Strategic Planning and Detailed Planning			
Final	Electronic	1	Sydney Water (Cassandra Loughlin) – for review

Printed:	5 July 2012
Last saved:	5 July 2012 04:39 PM
File name:	Marsden Park Wastewater Servicing - Strategic Planning Report_draft.docx
Author:	Phil Von Huben
Project manager:	Phil Von Huben
Name of organisation:	Winten Property Group
Name of project:	Marsden Park Utility Servicing
Name of document:	Marsden Park Wastewater Servicing – Strategic Planning Report
Document version:	Final
Project number:	EN03192

1. Introduction

1.1. Purpose of Report

This report is the strategic planning report for the provision of wastewater services to Marsden Park Precinct. It investigates feasible servicing options and identifies the preferred servicing strategy for the Stage 1 development of Marsden Park.

A companion document, the detailed planning report, provides further specific details of the preferred servicing strategy, such as the preferred location of new wastewater infrastructure.

1.2. Overview

The Marsden Park Precinct is located in Sydney's North West Growth Centre and is being developed via the Precinct Acceleration Protocol (PAP). The PAP proponent for the Marsden Park Precinct is Winten Property Group.

The Marsden Park Precinct will be developed over a number of stages. This report provides results from an investigation of possible options to provide wastewater services to the initial stage of development of the Marsden Park Precinct (Stage 1), and considers the servicing of future stages of development.

This report and its companion document (Marsden Park Wastewater Servicing – Detailed Planning Report) would be used as an input for the production of a Services Infrastructure Implementation Plan (to be prepared by others). The Services Infrastructure Implementation Plan will outline how the Marsden Park Precinct would be serviced by utilities including potable water, wastewater, electricity, gas and telecommunications.

1.3. Other Developments

The Marsden Park Industrial Precinct (MPIP), which shares a border with the Marsden Park Precinct, is also currently being developed via the Precinct Acceleration Protocol by a different developer (Marsden Park Developments Pty Ltd). The initial stage of development of the MPIP (Stage 1) will include a new sewage pump station that is located within the MPIP Stage 1 site to transfer wastewater to Sydney Water's existing sewer system via a new rising main.

This study has included consideration of future stages of development of MPIP.

1.4. Background

The Services Infrastructure Strategy for Marsden Park Precinct outlines a number of possible wastewater servicing options for the first stage of development of the Marsden Park Precinct. These included:

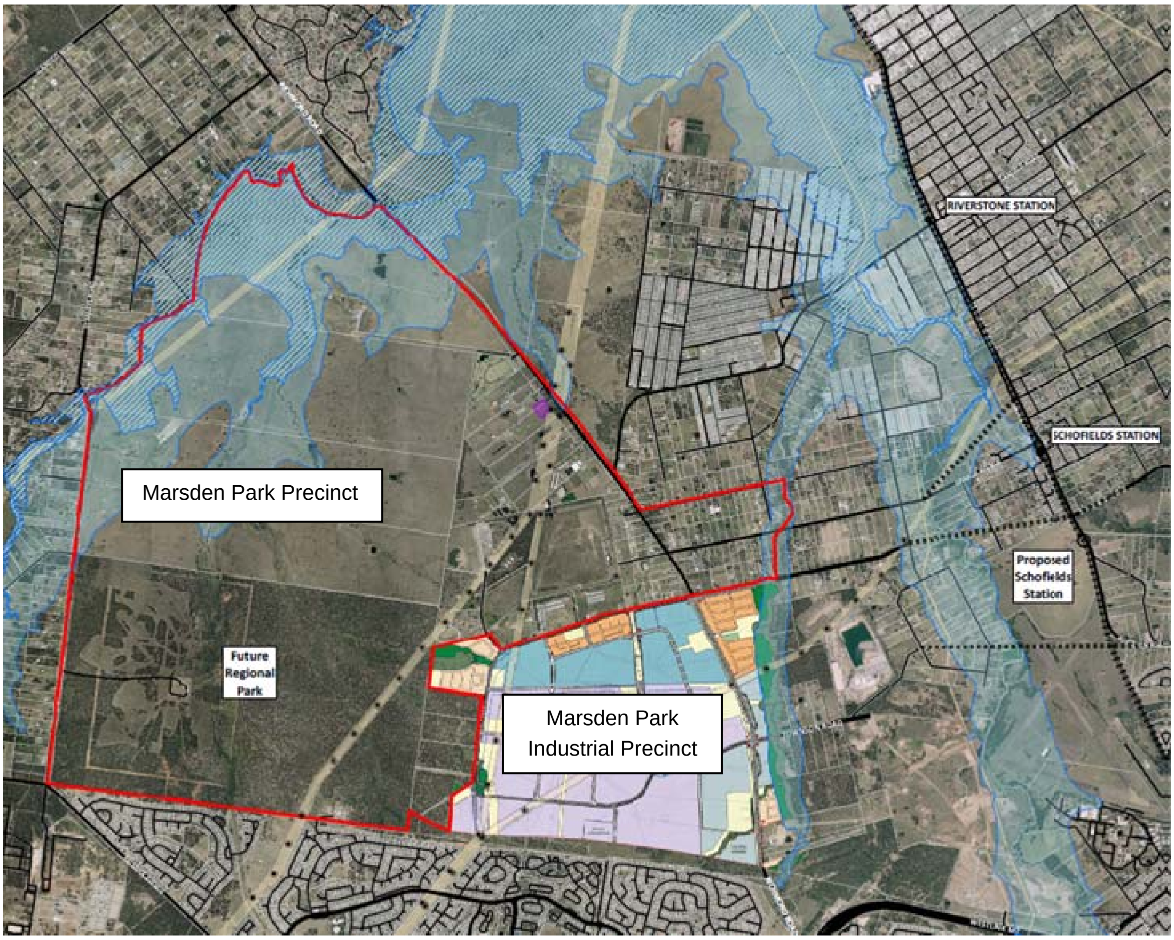
- Pumped transfer to Riverstone WWTP
- Gravity transfer to Riverstone WWTP
- Onsite treatment, with various types of recycling
- Any other feasible option

This report will investigate each of the feasible options in sufficient detail to enable comparison of the options and selection of the preferred option.

1.5. Marsden Park Development

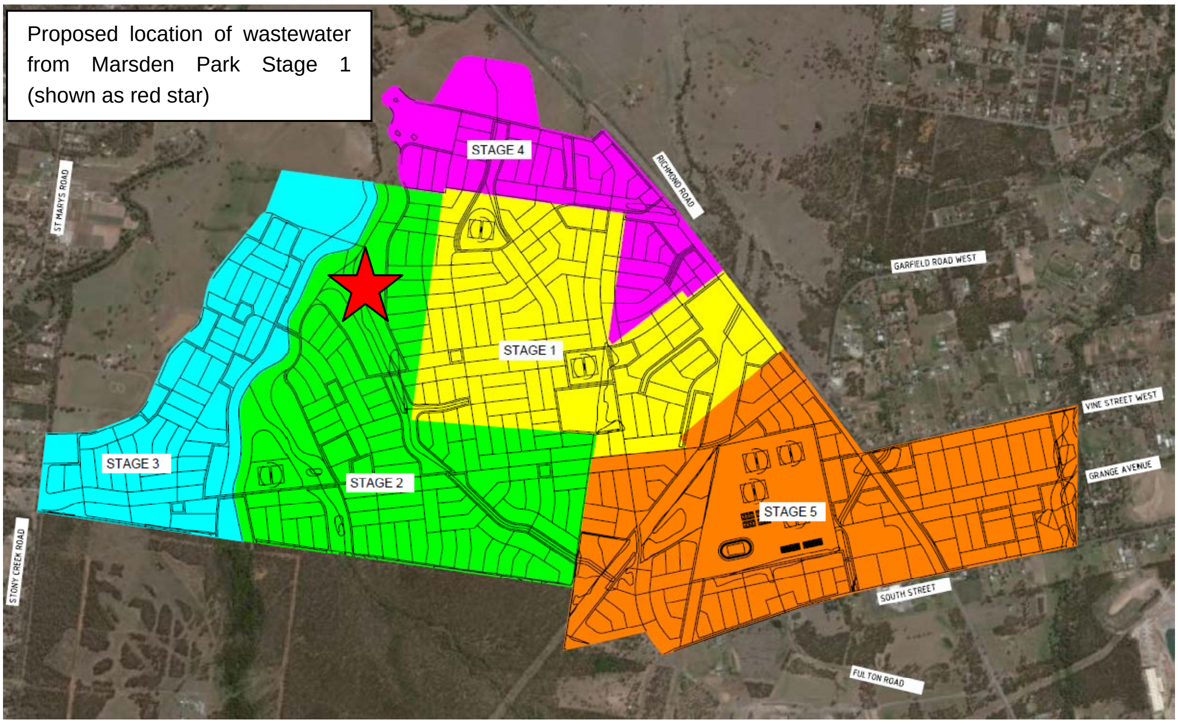
The initial stage of development of Marsden Park consists of low density residential dwellings with approximately 2,500 lots as Stage 1 over a gross area of 163 ha.

Figure 1 shows the extent of the Marsden Park Precinct.



- **Figure 1 Marsden Park Study Area**

Figure 2 shows the staging plan for Marsden Park including the planned site for Stage 1. For the purposes of this investigation, it was assumed that wastewater generated by Marsden Park Stage 1 would be collected at a single point, located as shown by the red star. Hence it was assumed that the reticulation system that is constructed in Stage 1 would convey the wastewater to the adopted location. This location was adopted as it is a low point close to Stage 1.



- **Figure 2 Marsden Park Staging Plan**

2. Existing and Planned Wastewater Infrastructure

2.1. Existing Wastewater Infrastructure

2.1.1. Within the Marsden Park Precinct

The majority of the existing wastewater infrastructure within the Marsden Park Precinct consists of on-site household systems as there is no existing wastewater reticulation system.

2.1.2. Within the North West Growth Centre

There are existing wastewater reticulation systems within the North West Growth Centre, with the remainder being serviced by on-site household systems. The majority of the wastewater from the wastewater reticulation system is transferred to Riverstone Wastewater Treatment Plant (WWTP), by a combination of gravity and pumped flows. Riverstone WWTP is owned and operated by Sydney Water and is located in the northern portion of the NWGC.

Other Sydney Water owned and operated treatment plants that are in the vicinity of the North West Growth Centre include the Rouse Hill Recycled Water Plant (RWP) (located to the east of the NWGC), Quakers Hill WWTP (located to the south east of the NWGC) and St Marys RWP (located to the south west of the NWGC).

South Windsor WWTP is located to the northwest of Riverstone WWTP and is owned and operated by Hawkesbury City Council.

Table 1 gives the straight line distances from Marsden Park (the red star) to the various treatment plants.

- **Table 1 Straight Line Distance to Treatment Plants**

Treatment Plant	Distance from Marsden Park
Riverstone WWTP (Sydney Water)	5.6 km
Rouse Hill RWP (Sydney Water)	11.2 km
Quakers Hill WWTPP (Sydney Water)	8.6 km
St Marys RWP (Sydney Water)	6.0 km
South Windsor WWTP (Hawkesbury Council)	5.2 km

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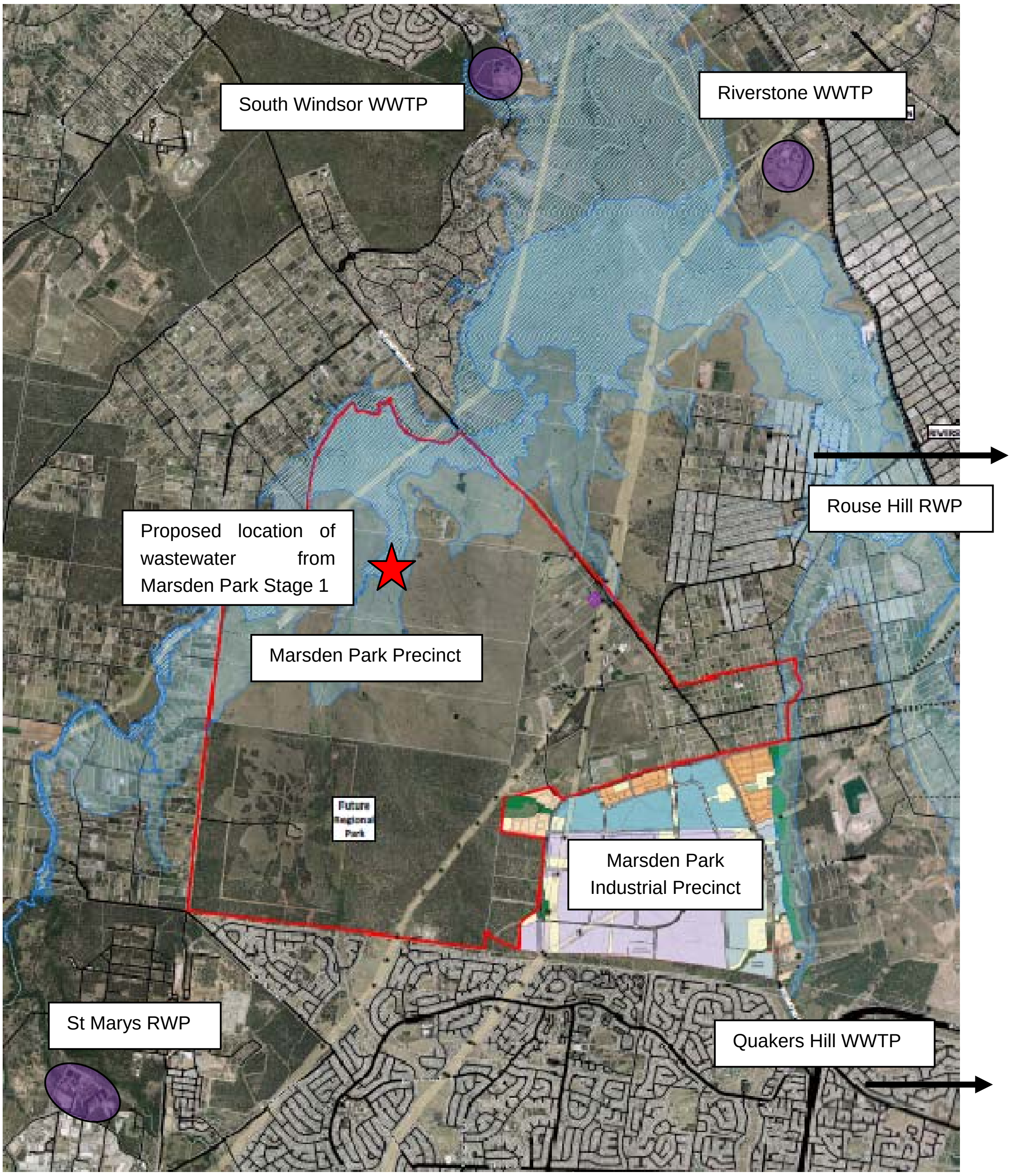

- **Figure 3 Existing Wastewater Treatment Plants**

2.2. Planned New Wastewater Infrastructure

2.2.1. Within the Marsden Park Precinct

Sydney Water has no current plans to install new wastewater infrastructure within the Marsden Park Precinct in the near future (within 10 years).

2.2.2. Within the North West Growth Centre

Sydney Water is currently undertaking Package 2 works to service the planned release of the NWGC, as per the current Sydney Water Growth Servicing Plan (2010-2015). The Package 2 works include new wastewater infrastructure to transfer wastewater from a number of the NWGC precincts (not including the Marsden Park Precinct) to Riverstone WWTP.

In addition, Sydney Water has stated that they plan to amplify Riverstone WWTP in the time horizon of 2015-2020. The amplification of Riverstone WWTP, and the timing for the amplification, is being driven by development within the NWGC.

2.3. Sydney Water's Ultimate Servicing Strategy

Sydney Water has previously investigated what infrastructure is required to service the ultimate development of the NWGC, including Marsden Park. This was documented in "Sydney Water's Ultimate Water Servicing Strategy" in July 2008 (the Ultimate Strategy) and included the plan for the ultimate potable water, recycled water and wastewater infrastructure.

2.3.1. Ultimate Servicing Strategy – Wastewater

The Ultimate Strategy outlines what infrastructure is required to provide wastewater services for the ultimate development of the NWGC, including both the Marsden Park Precinct and MPIP. The strategy for wastewater services is to service both precincts via a common sewerage system with transfer of wastewater to Riverstone WWTP.

Under the Ultimate Strategy, large gravity carrier mains will be constructed throughout the Marsden Park Precinct and neighbouring precincts, along with a number of pump stations and rising mains. These assets will transfer wastewater to Riverstone WWTP which will be augmented to provide treatment of the additional wastewater flows.

Figure 4 shows the ultimate wastewater infrastructure for the NWGC based on the 2009 Area Plan. **Figure 5** is a more recent version and shows the wastewater infrastructure that is going to be constructed in the Package 2 project which is currently being tendered by Sydney Water. Note that **Figure 5** shows the correct location for the planned new pump station SPS1154 to be constructed as part of Package 2.

Figure 6 shows the wastewater infrastructure that is required for the two PAP precincts, MPP and MPIP and shows that the required wastewater carrier mains are:

- Bells Creek Carrier
- Marsden Park North Carrier
- Marsden Park Carrier
- Richmond Road Carrier

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It should be noted that Sydney Water has no current plans to install any of the infrastructure shown in **Figure 6** in the near future as the infrastructure is not included in Sydney Water's Growth Servicing Plan which covers the period of 2010-2015.

This study will investigate the staged delivery of wastewater infrastructure. Staging of the wastewater infrastructure involves installing the right assets at the right time to service specific developments. This is important as it minimises upfront capital expenditure and minimises operational issues that can occur when oversized infrastructure is installed.

Sydney Water follow a similar strategy of staging assets, as can be seen from the current Package 2 works being undertaken for the NWGC.

It is noted that Sydney Water have stated that the Ultimate Strategy would be reviewed and revised in the near future, once the current investigations on the preferred servicing of the South West Growth Centre have been completed. Hence one of the considerations for the options being investigated for the servicing of Stage 1 is flexibility in being able to integrate with different ultimate servicing strategies.

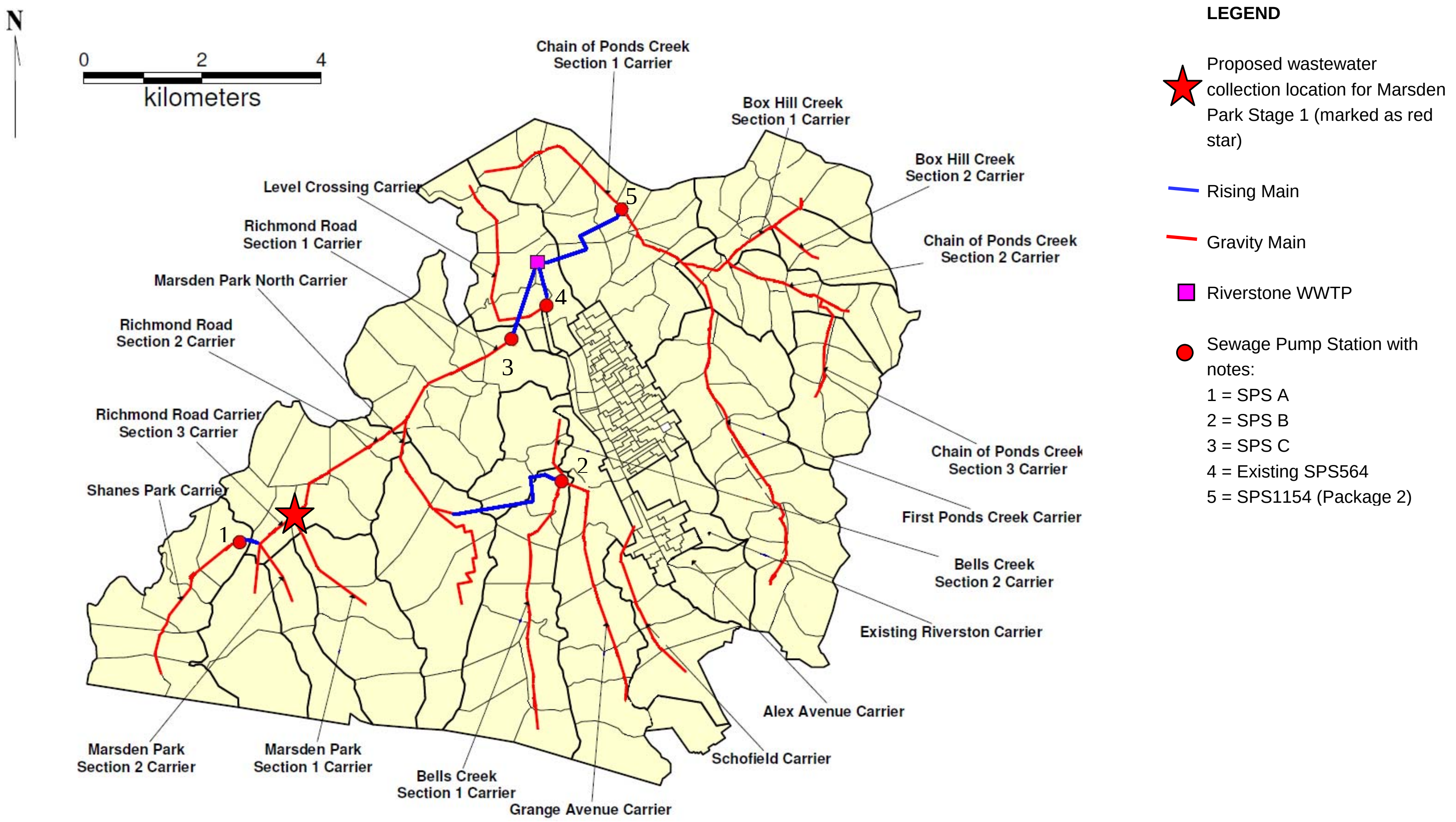
However, up till the time that a later version is released, the current version of the Ultimate Strategy will be adopted, with the following amendment:

- Sydney Water has stated that the current version of the Ultimate Strategy was developed on the basis that a conventional gravity sewer reticulation system would be adopted in all developments. However the current Sydney Water policy is to install 'low infiltration' sewer reticulation systems. Hence Sydney Water has requested that the carrier mains shown in the Ultimate Strategy be revised (downsized) on the basis of low infiltration sewers.

The adopted location for the collection of wastewater from Marsden Park Stage 1 is shown in the figures in this report (including **Figure 4**, **Figure 5** and **Figure 6**) as a red star at the junction of the Richmond Rd Carrier and Marsden Park Carrier Section 1. This indicates that to service Marsden Park Stage 1 as per the Ultimate Strategy would require construction of:

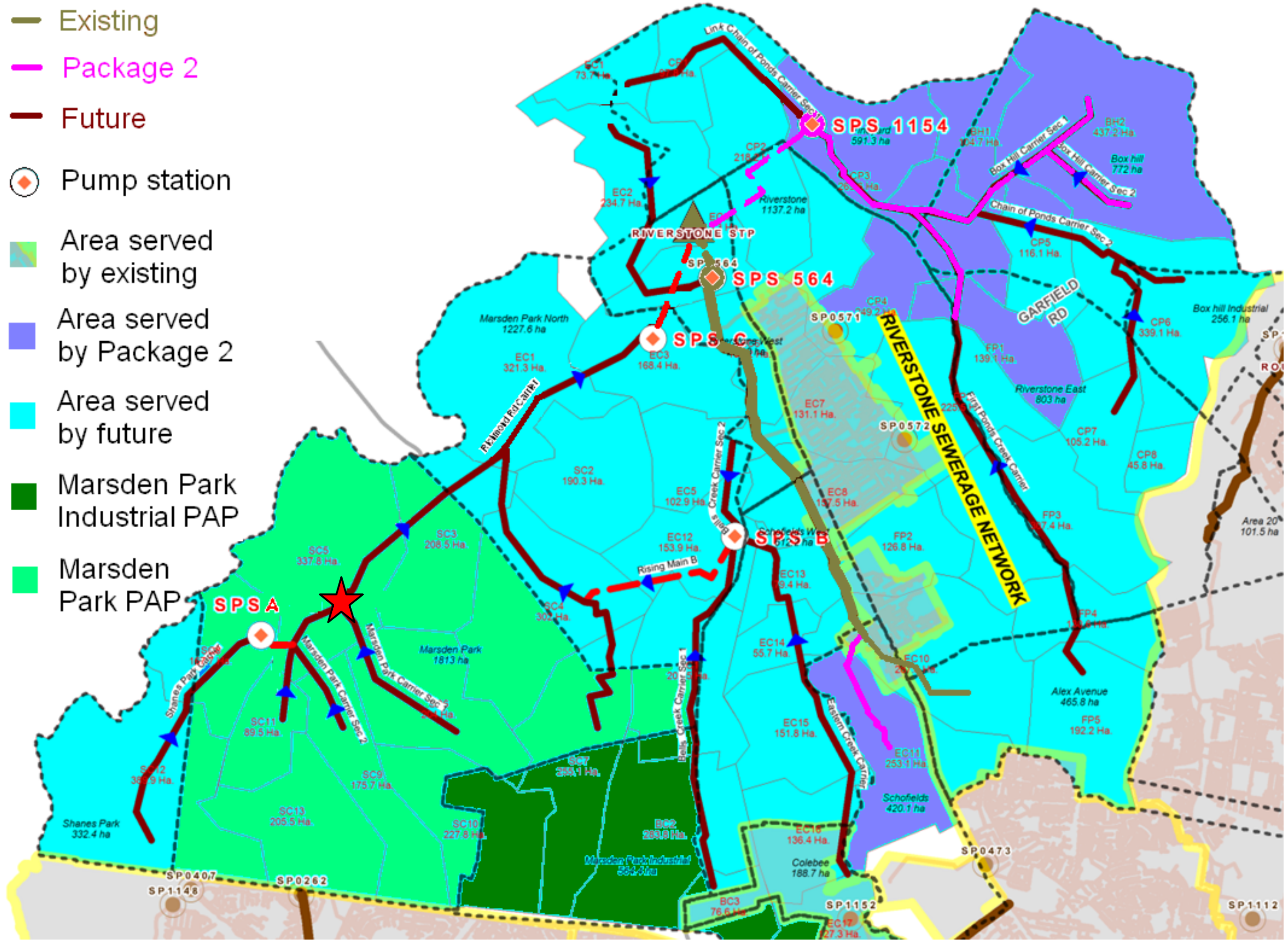
- Richmond Rd Carrier from Marsden Park Carrier Section 1 northwards to the location of the new pump station (marked as 'SPS C')
- New pump station at SPS C
- Rising main from the new pump station to Riverstone WWTP

Therefore, in this study the capacity of the above infrastructure was resized to account for ultimate development of the NWGC using low infiltration sewer reticulation systems. Other infrastructure that is not required to service Marsden Park Stage 1 was not investigated further in this study.

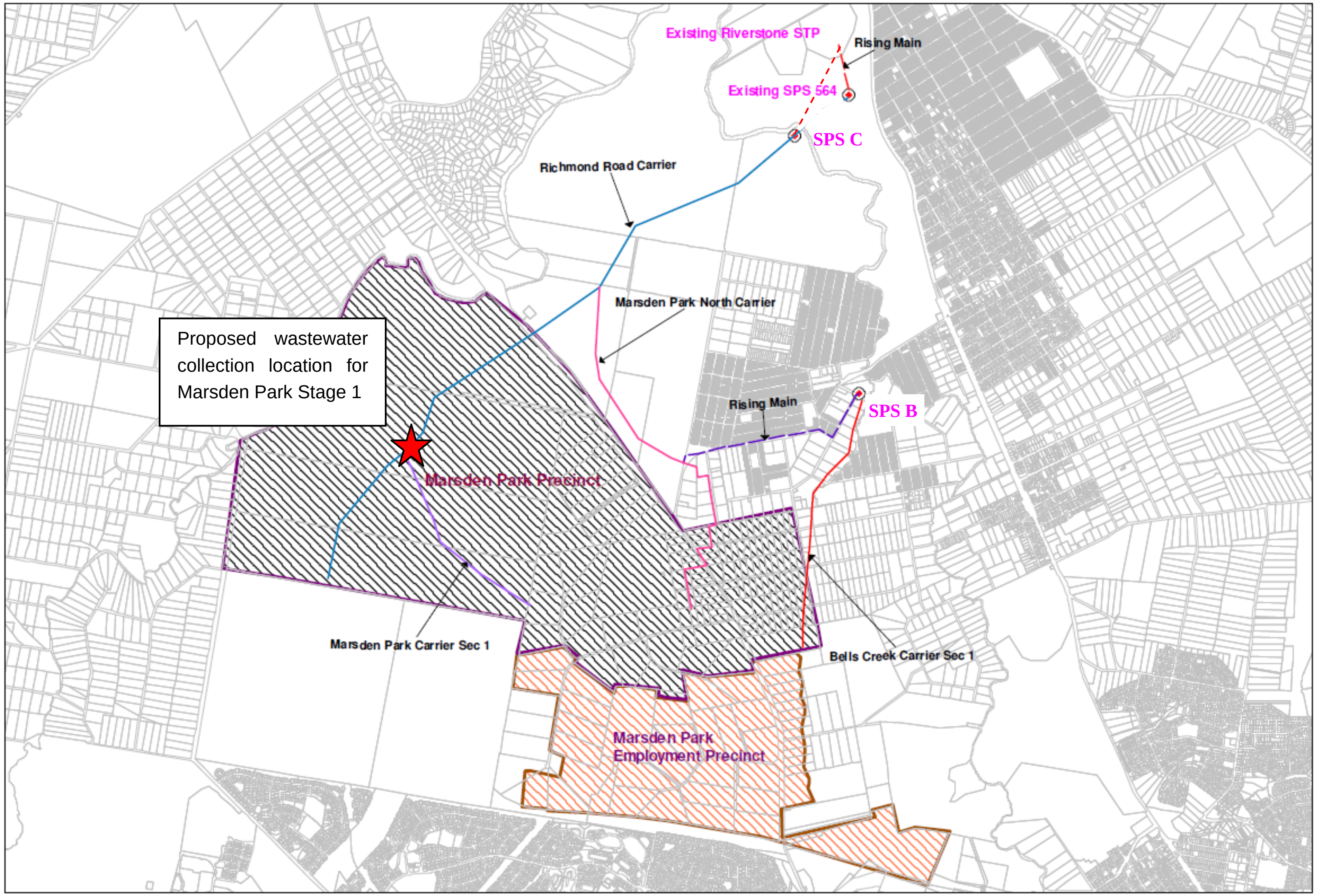


- **Figure 4 Sydney Water's Ultimate Wastewater Strategy – NWGC**

(Source: Area Plan – Wastewater Servicing Major Branch Lines, SWC, April 2009)



■ **Figure 5 Sydney Water's Ultimate Wastewater Strategy – NWGC (Updated for Package 2)**



- **Figure 6 Sydney Water's Ultimate Wastewater Strategy – MPP and MPIP**

(Source: Sydney Water's Ultimate Water Servicing Strategy, SWC, July 2008)

2.3.2. Ultimate Servicing Strategy – Recycled Water

Sydney Water's Ultimate Water Servicing Strategy (SWC, July 2008) included the provision of recycled water to the Marsden Park Precinct via new recycled water mains, pump stations and reservoirs. The recycled water infrastructure would transfer recycled water from Rouse Hill RWP to both MPP and MPIP.

A media release from Sydney Water dated 13 January 2011 outlines that Sydney Water will not build any new recycled water infrastructure in precincts in the North West Growth Centre that have not yet been released. This includes both MPP and MPIP.

The media release states that Sydney Water would continue to investigate the viability of recycled water in new residential areas on a case-by-case basis.

Recycled water is mentioned in this report because some of the wastewater servicing strategies include the supply of recycled water to homes in Marsden Park Stage 1 from an on-site treatment plant.

3. Wastewater System Requirements

3.1. Assumptions

The following assumptions have been adopted for all wastewater options:

- Assumptions relating to wastewater generation rates:
  - Marsden Park Stage 1 of 2,500 residential lots on 163 ha (gross)
  - Assumed occupancy of 3 EP per dwelling for all precincts
  - Wastewater generation rate of 150 L/EP/d for all precincts
  - 46 EP per ha (gross) adopted for density of all residential developments in all precincts. This value is based on Marsden Park Stage 1 and reflects low density residential development
  - 75 EP per ha (gross) adopted for industrial and commercial development in all precincts
  - All precincts would be serviced by a low infiltration gravity sewer reticulation system and thus Sydney Water's "Low Infiltration Sewer Flow Schedule" (Nov 2010) was used for estimating wastewater flows
- Assumptions relating to infrastructure requirements:
  - Any on-site wastewater treatment plant would be located above the 1 in 20 year flood level, with electrics protected up to the 1 in 100 year flood level (e.g. electrics raised, levee provided, or entire plant is located above 1 in 100 year flood level)
  - The electrics for any sewage pump station would be located at least 300 mm above the 1 in 100 year flood level
  - All comments relating to the 1 in 100 year flood level in this report refer to the regional 1 in 100 year flood level which is at RL 17.3 m
  - Rising mains were sized to ensure velocity in the rising main is in the range of 1.2 – 1.8 m/s when pumping PWWF
  - In addition, the rising main sizing was selected to ensure that the pumping head for the associated pump station is not more than 70 m when pumping PWWF

3.2. Equivalent Population Estimates

In order to resize the Richmond Rd Carrier for the ultimate capacity with low infiltration gravity sewers, the total ultimate development that is serviced by the Richmond Rd Carrier was determined.

It is noted that in Sydney Water's Ultimate Strategy for the NWGC (**Figure 4** and **Figure 5**) there are two pump stations that feed into the Richmond Rd Carrier:

- SPS A is located in the western portion of the NWGC and takes the flow from Shanes Park Carrier and discharges to Richmond Rd Carrier Section 2
- SPS B takes flow from the Bells Creek Carrier Sections 1 and 2 and the Grange Avenue Carrier, and discharges to the Marsden Park North Carrier.

Based on **Figure 4** the following carriers feed into the Richmond Rd Carrier Section 1 (RR1). Note that the abbreviations that shown in the brackets are used in this report to refer to that asset:

- Richmond Rd Carrier Section 2 (RR2), which is fed from:
  - Richmond Rd Carrier Section 3 (RR3)
  - Marsden Park Carrier Section 1 (MP1)
  - Marsden Park Carrier Section 2 (MP2)
  - Shanes Park Carrier (via pump station (SPS A))
- Marsden Park North Carrier (MPN), which is fed from:
  - A pump station (SPS B) which receives flow from:
    - Bells Creek Carrier Section 1
    - Bells Creek Carrier Section 2
    - Grange Avenue Carrier

The wastewater flow that enters these carriers is dependent on the development that occurs within the catchments of these carriers, with the catchments shown in **Figure 4** and **Figure 5**.

Equivalent population (EP) estimates at ultimate development for the relevant precincts are shown in **Table 2**. The lot estimates were obtained from the Department of Planning and Infrastructure (August 2011).

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Table 2 Ultimate EP Estimates for Relevant Precincts

Precinct	Residential		Commercial & Industrial		Total Ultimate EP
	Lots	EP	Area (ha)	EP	
Schofields	3,301	9,903	0	0	9,903
Schofields West	3,278	9,834	0	0	9,834
Marsden Park North	5,693	17,079	0	0	17,079
Marsden Park	9,591	28,773	0	0	28,773
Shanes Park	1,679	5,037	0	0	5,037
Marsden Park Industrial	1,228	3,684	317	23,775	27,459

The EP estimates in **Table 2** are on a precinct basis. As the precinct boundaries (**Figure 7**) do not match with the sewer carrier catchments, it was necessary to convert the lot estimates from a precinct basis to a catchment basis.

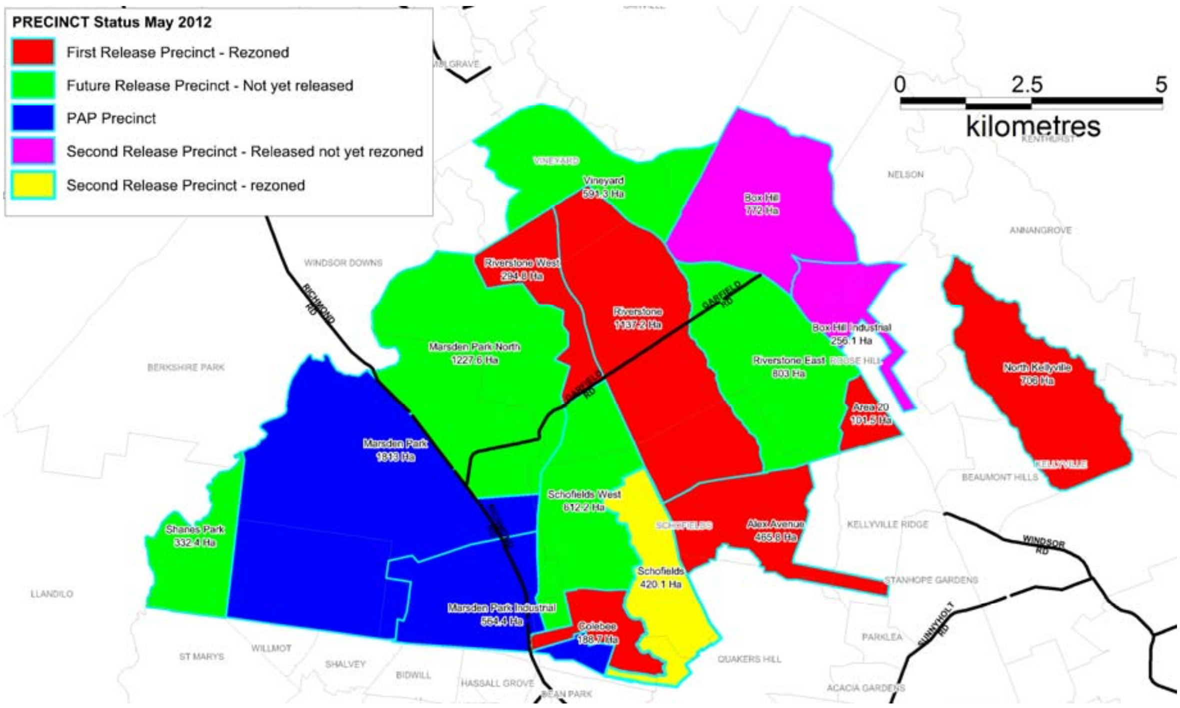

Figure 7 NWGC Precincts

To do this the proportion of the developable area of each precinct was split into the catchments of the sewer carriers, as shown in **Table 3**. For development of **Table 3** it is noted that:

- The estimates inherently assume that each precinct would be serviced by a gravity sewer reticulation system that drains to the relevant carrier as per the Sydney Water's Ultimate Wastewater Strategy for the NWGC as shown in **Figure 4** based on the existing ground levels and slopes
- The developable area of each precinct was determined by taking the total area of a precinct and deleting the areas that are below the 1 in 100 year flood level and deleting any area of parks/conservation areas
- The proportion of area was rounded to the nearest 5%
- It was assumed that development within each precinct would occur evenly within the developable area of that precinct (i.e. uniform development density in terms of wastewater generation)
- Whilst the southern portions of the Schofields Precinct lies within the catchment of SPS B (via the Grange Avenue Carrier), the wastewater generated from this portion of the Schofields Precinct would need to flow through the Colebee Precinct to reach the Grange Avenue Carrier. As the Colebee Precinct is currently being serviced by transfer to Quakers Hill WWTP (via a new pump station and rising main), it was assumed that the southern portion of the Schofields Precinct would not drain to the Grange Avenue Carrier
- Whilst a small portion of the Schofields West Precinct (~6%) drains to the Schofield Carrier (and hence doesn't enter the Richmond Rd Carrier), partly to compensate for the previous dot point, it was assumed that all of the Schofields West Precinct drains to SPS B (and hence enters the Richmond Rd Carrier)

Together this means that the EP estimates for each precinct, as shown in **Table 2**, can be split into the various sewer carrier catchments based on the breakup of the area of the precinct for each catchment, as shown in **Table 3**. It is noted that this would need to be investigated in further detail during concept design as the EP allocation to the sewer catchment would depend on the actual development zoning layout plan which should be reviewed during concept design when further information is available. This has the potential to affect the size of the carriers.

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▪ **Table 3 Breakup of Precinct Area on Catchment Basis**

Precinct	MPN	RR2	RR1	SPS A	SPS B	Other *	Total
Schofields	0%	0%	0%	0%	0%	100%	100%
Schofields West	0%	0%	0%	0%	100%	0%	100%
Marsden Park North	25%	0%	40%	0%	35%	0%	100%
Marsden Park	30%	60%	0%	5%	5%	0%	100%
Shanes Park	0%	0%	0%	100%	0%	0%	100%
Marsden Park Industrial	25%	25%	0%	0%	50%	0%	100%

* Other = Not draining to carrier that ultimately drains to the Richmond Rd Carrier

3.3. Wastewater Flows

3.3.1. Flows at Ultimate Development

In order to estimate the ultimate wastewater flows for the key carriers, the Sydney Water Low Infiltration Sewer Flow Schedule was used.

The ultimate wastewater flows for each carrier was determined from the ultimate EP estimates for each carrier. The ultimate EP estimates for each carrier was determined by splitting the total ultimate EP estimates from **Table 2** amongst the carriers based on the breakup of the precinct area as shown in **Table 3**. This inherently assumes that development within a precinct would occur evenly across the entire precinct area.

Table 4 outlines the estimated ultimate wastewater flows for the pump stations and key carriers that drain to the Richmond Rd Carrier, including average dry weather flow (ADWF) and peak wet weather flow (PWWF).

- **Table 4 Ultimate Wastewater Flows**

Carrier / Pump Station	Estimated Ultimate EP	Estimated Ultimate ADWF	Estimated Ultimate PWWF
SPS A	6,476	11.2 L/s	79 L/s
SPS B	30,980	53.8 L/s	316 L/s
Marsden Park North Carrier (MPN)	50,746	88.1 L/s	527 L/s
Richmond Rd Carrier Section 2 (RR2)	30,604	53.1 L/s	330 L/s
Richmond Rd Carrier Section 1 (RR1)	88,182	153.1 L/s	889 L/s
SPS C (same flow as RR1)	88,182	153.1 L/s	889 L/s

3.3.2. Marsden Park Stage 1 Flows

Table 5 below shows the estimated wastewater flows for the Stage 1 development of the Marsden Park Precinct of 2,500 lots.

- **Table 5 Wastewater Flows for Marsden Park Precinct Stage1**

Carrier / Pump Station	Estimated MPP Stage 1 EP	Estimated Ultimate ADWF	Estimated Ultimate PWWF
SPS A	0	-	-
SPS B	0	-	-
Marsden Park North Carrier (MPN)	0	-	-
Richmond Rd Carrier Section 2 (RR2)	7,500	13.0 L/s	90 L/s
Richmond Rd Carrier Section 1 (RR1)	7,500	13.0 L/s	90 L/s
SPS C (same flow as RR1)	7,500	13.0 L/s	90 L/s

3.4. Proposed Capacity of Infrastructure

The following section of the report (**Section 4**) outlines a range of possible servicing options for Marsden Park Stage 1. The servicing options relate to different types of infrastructure that could be constructed to provide wastewater services for Marsden Park Stage 1.

For each servicing option there are a range of possible capacities for the infrastructure that is installed to service Marsden Park Stage 1. Installing infrastructure with a larger capacity requires additional upfront capital expenditure, but it delays the need for the next stage of infrastructure. There are also potential technical issues with installing infrastructure of a capacity that is too large or too small.

This study investigates different servicing options as well as different capacities for the infrastructure that is installed to service Marsden Park Stage 1.

Sydney Water have indicated that possible capacity scenarios for gravity sewer carriers is to construct the carriers to service ultimate development of the NWGC, as well as to service NWGC ultimate development in two stages (i.e. initially install carriers sized to service half of ultimate development and then install duplicate carriers in the future).

As discussed in **Section 4.2.2** it is easier to stage the installation of rising mains, hence a larger range of capacities is feasible.

The following capacity scenarios (**Table 6**) were investigated for the Marsden Park Stage 1 infrastructure.

These are indicative capacities only, and would require further detail to be developed during concept design stage. Also, as pipes are supplied in standard sizes, the capacity of the infrastructure won’t match exactly to the flows outlined in **Table 6**. Instead the approach outlined below would be used to size the infrastructure.

The Sydney Water Low Infiltration Sewer Flow Schedule was used to estimate the PWWF in **Table 6**, for the following capacity scenarios:

- Capacity Scenario A: Stage 1 of Marsden Park Precinct. It was assumed that the wastewater from all 2,500 lots within Marsden Park Stage 1 would be transferred to the start of the Richmond Rd Carrier Section 2, as shown by the red star in **Figure 4**
- Capacity Scenario B: Stage 1 + Stage 2 of Marsden Park Precinct. It was assumed that Stage 2 of Marsden Park would consist of a further 2,500 lots (in addition to Stage 1) with the wastewater from these lots also transferred to the start of Richmond Rd Carrier Section 2, as shown by the red star in **Figure 4**
- Capacity Scenario C: Ultimate Development of Marsden Park Precinct, with wastewater flows allocated to sewer carriers by gravity catchments (**Table 3**).
- Capacity Scenario D: Half of Ultimate Development of the NWGC. It was assumed that development would occur in all precincts with half the total number of lots as per ultimate development, with wastewater flows allocated to sewer carriers by gravity catchments (**Table 3**).

- Capacity Scenario E: Ultimate Development of MPP and MPIP, with wastewater flows allocated to sewer carriers by gravity catchments (**Table 3**).
- Capacity Scenario F: Ultimate Development of the NWGC. Ultimate development would occur in all precincts, with wastewater flows allocated to sewer carriers by gravity catchments (**Table 3**).

3.5. Development Rates

For this project, development projections from the Department of Planning and Infrastructure (DPI) (August 2011) were used along with information from developers.

DPI data included residential dwelling forecasts for each precinct on the basis of financial years. These were converted into equivalent population by multiplying by the adopted occupancy rate of 3.0. The approach adopted in this study was to attribute the projected EP for a financial year to the end of that financial year, which is equivalent to the middle of the calendar year. For example, development projections for the financial year 2015-2016 are shown as development projections for 2016 in **Table 7** and would numerically relate to 2016.5 being halfway through calendar year 2016 (end of financial year 2015-2016).

For MPIP, the rate of industrial development was based on information that was provided by APP Corporation who is working on behalf of the developer of MPIP. The adopted rate was 12 ha/yr for the Stage 1 development, starting off with 24 ha in 2014, until 60 ha is developed which occurs in 2018. Following this it was assumed that industrial development would occur at an increased rate of 24 ha/yr with full development (317 ha) occurring in 2029. This means that MPIP is fully developed in 2029, the same year as MPP is fully developed.

Table 6 Capacity Scenarios for Investigation for Stage 1 of Marsden Park

Capacity Scenario	Description	EP Serviced			PWWF in Carriers / Pump Stations (L/s)				
		MPP	MPIP	Other Precincts	SPS A	SPS B	MPN	RR2	RR1 / SPS C
A	Sized for Marsden Park Stage 1 only	7,500	-	-	0	0	0	90	90
B	Sized for Marsden Park Stage 1 and Stage 2	15,000	-	-	0	0	0	163	163
C	Sized for ultimate development of Marsden Park Precicnt only	28,773	-	-	24	24	125	208	312
D	Sized for ultimate development of NWGC in two stages (i.e. half of ultimate development)	14,387	13,730	15,975	45	171	286	181	478
E	Sized for ultimate development of MPP and MPIP	28,773	27,459	-	24	45	216	275	463
F	Sized for ultimate development of NWGC	28,773	27,459	31,950	79	316	527	330	889

- **Table 7 Development Projections (EP)**

Precincts	Total EP	Development Projections (EP)														
		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
West Schofields	9,834	-	-	-	-	-	300	600	1,050	1,950	2,850	3,750	4,650	5,550	6,450	7,350
Marsden Park North	17,079	-	-	-	-	-	-	-	-	-	-	-	-	-	-	600
Marsden Park	28,773	-	-	600	1,800	3,000	4,800	7,200	9,600	12,000	14,400	16,800	19,200	21,600	24,000	26,100
Shanes Park	5,037	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marsden Park Industrial	27,459	-	-	2,250	3,600	4,950	6,300	8,550	10,800	13,050	15,150	17,184	18,984	20,784	22,584	24,384
Precincts	**Total EP**	**Development Projections (EP)**														
		2028	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
West Schofields	9,834	8,100	8,850	9,600	9,834	9,834	9,834	9,834	9,834	9,834	9,834	9,834	9,834	9,834	9,834	9,834
Marsden Park North	17,079	2,400	4,800	7,200	9,600	12,000	14,400	16,800	17,079	17,079	17,079	17,079	17,079	17,079	17,079	17,079
Marsden Park	28,773	27,600	28,773	28,773	28,773	28,773	28,773	28,773	28,773	28,773	28,773	28,773	28,773	28,773	28,773	28,773
Shanes Park	5,037	-	-	-	-	-	-	-	-	-	-	-	600	2,100	3,600	5,037
Marsden Park Industrial	27,459	26,184	27,459	27,459	27,459	27,459	27,459	27,459	27,459	27,459	27,459	27,459	27,459	27,459	27,459	27,459

4. Wastewater Servicing Options

4.1. Overview

The first step was to produce a list of the feasible wastewater servicing solutions (options) for Marsden Park Stage 1 within the context of the ultimate servicing strategy. The options included combinations of the type of reticulation system, the type of transfer system, the location of the treatment, and the capacity of infrastructure. The options were developed by making sensible combinations of these components, as discussed in **Section 4.2**.

4.2. Components of Options

4.2.1. Wastewater Treatment Plant

There are a number of existing wastewater treatment plants in the vicinity of MPP including, Riverstone WWTP, Rouse Hill WWTP, Quakers Hill WWTP, St Marys RWP and South Windsor WWTP. The following comments are pertinent to the options for treatment of wastewater from MPP Stage 1:

- Hawkesbury City Council has said that there is no spare un-allocated capacity at South Windsor WWTP. Hence significant amplification of the plant would be required to treat any flows from Marsden Park. In addition the MPP is located outside of the boundary of Hawkesbury City Council, hence it is outside of their area of operations. Therefore transfer to South Windsor WWTP was not investigated further.
- Riverstone WWTP is the logical place to treat wastewater from Stage 1 of Marsden Park for the following reasons:
  - Sydney Water's Ultimate Servicing Strategy shows that wastewater from Marsden Park, and the majority of the NWGC, would ultimately be transferred to Riverstone WWTP. In addition, Sydney Water has plans to amplify Riverstone WWTP in the medium term (2015-2020) specifically to amplify capacity for the additional flows from the NWGC. Sydney Water have indicated that over the long term Riverstone WWTP would be further amplified in a number of stages (in addition to the medium term planned amplification) to accommodate flows from the NWGC including from the Marsden Park Precinct as per the ultimate servicing strategy.
  - Spare capacity within Riverstone WWTP prior to the planned amplification of the plant is discussed in detail in **Section 6.5**.
  - Riverstone WWTP is the closest of the nearby Sydney Water owned and operated plants, with a straight line (as the crow flies) distance of around 5.5 km, compared to 11 km for Rouse Hill RWP, 9 km for Quakers Hill WWTP and 6 km for St Marys RWP.

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- Riverstone WWTP lies roughly to the north of Marsden Park across mainly undeveloped land. This makes it easier to install pipelines to convey the wastewater (easier than installing pipes in developed areas) and hence reduces the cost.

- Another alternative to Riverstone WWTP is an on-site treatment plant. This would be a community scale treatment plant which would be located within the MPP. The advantage of on-site treatment compared to treatment at Riverstone WWTP is that the on-site plant could be used as a source of recycled water, and it removes the need to build transfer infrastructure from Stage 1 to Riverstone WWTP. An on-site treatment plant of the capacity required to service the proposed Stage 1 development would require an environmental impact assessment to be prepared and submitted to the relevant planning approval authority for approval. This could place a significant time impact on the project. There are a number of options of what can be done with the treated effluent from the on-site plant, including various forms of recycling and reuse. It should be noted that even with effluent recycling there would be times when the volume of treated effluent is in excess of the recycling demand, hence a suitable location of disposal of excess treated effluent is required. The possible options for on-site treatment include:
  - Disposal of treated effluent:
    - The logical solution for excess effluent is disposal to South Creek which forms the western border of the MPP, or one of its tributaries that pass through the MPP. Treated effluent from Riverstone WWTP is currently discharged to a tributary of South Creek, and the future planned amplifications of Riverstone WWTP would involve an increase in the amount of effluent that is discharged to South Creek. So one could argue that it terms of environmental impact there is only a minor difference if the on-site plant discharged effluent into South Creek upstream of the current Riverstone WWTP discharge point, assuming similar effluent quality is achieved from the on-site treatment plant as from Riverstone WWTP. This is because on-site treatment and discharge of effluent reduces the amount of effluent that is discharged by Riverstone WWTP. In order to discharge effluent to South Creek, the on-site treatment plant would require a new Environment Protection Licence. It is assumed that effluent that is discharged to South Creek would need to be of a similar quality as the effluent that would be produced from Riverstone WWTP following the planned amplification. **Table 8** was obtained from the Environmental Assessment for the North West Growth Centre First Release Precincts and shows the proposed effluent quality for Riverstone WWTP following amplification. The issue of effluent quality is somewhat more complex due to the existence of the South Creek Bubble Licence, which is discussed in **Section 4.3**.
    - An alternate is to transfer excess effluent to the Riverstone WWTP to be discharged at its licensed discharge point. However this would require transfer infrastructure, not dissimilar to the transfer infrastructure that would be required if there was no on-site

treatment and sewage was sent to Riverstone. Hence this eliminates one of the two advantages of on-site treatment. Hence this approach was not investigated further.

Table 8 Effluent Quality Targets for Effluent Discharge

Parameter	50%ile Target Concentration
Total Nitrogen (mg/L-N)	5
Total Phosphorous (mg/L-P)	0.05
Ammonia (mg/L-N)	0.5
Faecal Coliforms (cfu/100mL)	150
Residual Chlorine (mg/L)	0.01 (90%ile)

- Effluent recycling has a number of benefits, namely that it reduces the amount of effluent that is discharged to South Creek, and recycled water acts as an alternate water source. The following options are available:
  - Open space irrigation. Within the MPP there is significant area of land that will not be developed because it is lower than the 1 in 100 year regional flood level. This land could have a range of land uses, some of which could accommodate irrigation, such as agricultural uses or sports fields or parks/gardens. Using treated effluent for irrigation of these areas would reduce the amount of potable water that otherwise would be used, and it also reduces the amount of effluent that is discharge to South Creek. With reference to the discussion on the South Creek Bubble Licence (**Section 4.3**) recycling effluent has the potential to enable higher concentrations of nutrients in the effluent that is discharged to the South Creek than if all of the effluent is discharged. In terms of pathogens (e.g. faecal coliforms) the effluent quality shown in **Table 8** should be suitable for most open space irrigation, provided suitable management controls are in place to prevent human access during and immediately after irrigation has occurred. Open space irrigation would require some storage of effluent, such as in the existing dams located within MPP, to enable the irrigation system to be operated efficiently. Excess effluent would be discharged to South Creek or one of its tributaries. The cost for this would depend on the type of irrigation system required and the location of the irrigation areas, both of which are dependent on the land use and land ownership. It would also be possible to expand the irrigation system to land outside of the MPP, however this would require suitable legal agreements being put in place, and additional infrastructure to service the expanded irrigation area. It is proposed that expansion of the open space irrigation system beyond the MPP would only be considered in future

stages, so as not to delay the servicing of Stage 1. Constraints for this type of reuse include land use and land ownership. This affects how much irrigation water can be sourced from treated effluent and may require suitable legal arrangements being put in place.

- Urban recycling. This would involve a dual reticulation system (also known as third pipe system) to provide recycled water back to each home. The recycled water would be used for outdoor uses as well as toilet flushing and washing machine use (optional for each homeowner). This would require further treatment of the effluent to a suitable level, particularly to reduce pathogens, compared to the effluent quality shown in **Table 8**. There would be additional cost for the dual reticulation system due to the need for a separate water system including storage, pumping and reticulation system. However the demand for potable water for Stage 1 would be reduced, meaning that the number of lots that can be serviced from the potable water lead in infrastructure would be significantly increased. This means that either the potable water infrastructure required for Stage 1 can be downsized, or consequently that more lots can be serviced from the same infrastructure and hence the Stage 2 potable water infrastructure can be delayed further into the future. Likewise with open space irrigation, urban recycling reduces the volume of effluent that is discharged to South Creek and hence, with reference to the discussion on the South Creek Bubble Licence (**Section 4.3**), it may be possible to allow higher concentrations of nutrients in the effluent that is discharged to the South Creek than if all of the effluent is discharged. For a community scale dual reticulation system (as opposed to a centralised system such as the Rouse Hill Recycled Water Scheme) it is proposed that the recycled water be supplied from a pressurised system using booster pumps and pressure vessels. This avoids the need of installing elevated reservoirs at high elevations (and the associated transfer infrastructure). However it would mean that the recycled water system is operated on a lower security of supply, namely power failure could result in a lack of recycled water being available. As Sydney Water has ruled out expansion of the existing centralise recycled water system, a possible source of treated effluent for urban recycling is an on-site treatment plant.
- Both open space irrigation and urban recycling. This maximises the amount of effluent that is recycled and hence minimises the amount of effluent that needs to be discharged. This brings the benefits of both types of recycling. At times, such as during hot summer periods, there may not be sufficient effluent available to meet both demands and typically urban recycling would be given priority over irrigation.

4.2.2. Transfer System

The transfer system conveys wastewater from the reticulation system to the treatment plant.

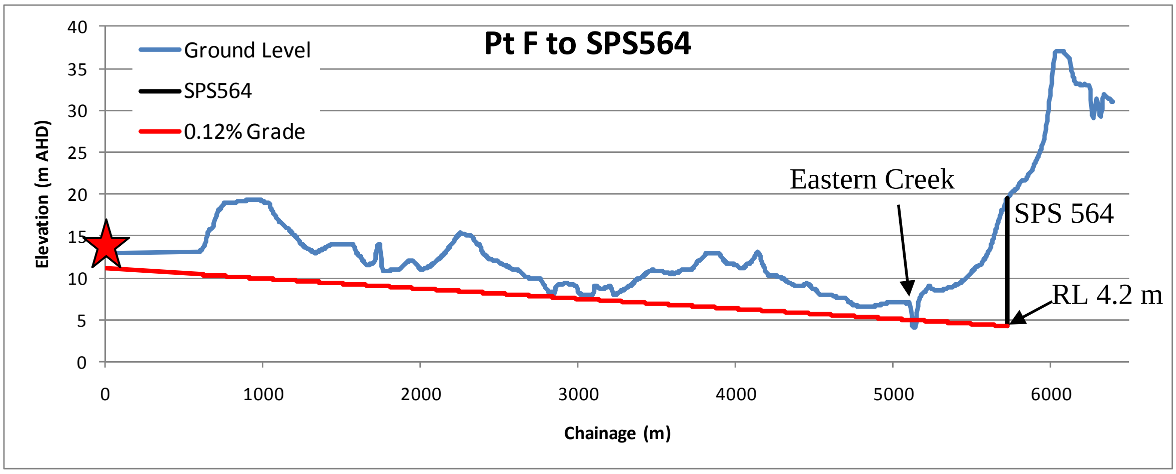
Where there is sufficient gradient in the land, gravity sewer mains are adopted. If the wastewater has to travel uphill then pumping is required. Typically a combination of gravity and pumping is adopted to overcome undulating terrain.

The land that generally lies between the MPP and Riverstone WWTP slopes downwards towards Riverstone WWTP. However Riverstone WWTP is located on a hill (located above the 1 in 100 year flood level) that is at a higher elevation than the majority of the MPP. This means that gravity transfer of wastewater is possible for most of the distance between MPP Stage 1 and Riverstone WWTP, however the wastewater would need to be pumped to reach the plant. Hence a pump station is required at some point in the transfer system. This essentially gives the following options for transfer to Riverstone WWTP, with the key difference being where the pump station is located:

- Gravity transfer for the majority of the distance to Riverstone WWTP with the pump station located closer to Riverstone WWTP. There are a number of variants of this approach, as identified in Sydney Water's Ultimate Servicing Strategy (the preferred option was not identified in the Ultimate Servicing Strategy):
  - Construct a new pump station on the southern side of Eastern Creek, at SPS C in **Figure 6** and **Figure 9**. This pump station would pump either directly to Riverstone WWTP or would pump to existing SPS564 which would then pump the wastewater to Riverstone WWTP. This second approach requires sufficient spare capacity within SPS564 or would require amplification of SPS564.
  - Construct an aqueduct across Eastern Creek to convey wastewater to existing pump station SPS564, and amplify SPS564 as required. To connect into SPS564 via an aqueduct, the hydraulic grade line (liquid level of the wastewater) within the new wastewater transfer system at Eastern Creek would need to be above the level of Eastern Creek (> 7 m RL), otherwise wastewater wouldn't be able to pass over Eastern Creek. Based on the slope of the land along the Richmond Rd Carrier Section 1 and 2 (**Table 9**) this approach is not feasible and hence this option was not investigated further in this report.
  - Construct a siphon under Eastern Creek to convey wastewater to existing pump station SPS564, and amplify SPS564 as required. The siphon would need to connect into SPS564 and hence would need to discharge at a similar level as the existing collection manhole for SPS564. The ground level at SPS564 is around RL 18 m (**Figure 11**), and the invert of the existing collection manhole for SPS564 is at RL 4.2 m. Hence to be able to gravitate into SPS564 the new transfer main would need to be at around RL 4.2 m at SPS564. Working backwards from this elevation, at a pipe slope of 0.12% over a distance of 5725 m from SPS564 to Pt F (**Figure 9**), the pipe invert would be RL 11.1 m at Pt F which is about 1.9 m below the ground level at Pt F. A long section for this is shown in **Figure 8**. Hence a siphon connection to the existing SPS564 is a potential option only where the pipe slopes of RR1 and RR2 is sufficiently low (0.12% or less). Amplification of SPS564 would be required: the current capacity of SPS564 is around 427 L/s (with pump flow currently

limited to 190 L/s to prevent dry weather bypass of the secondary/tertiary treatment process at Riverstone WWTP) with ultimate capacity of around 710 L/s (according to the original needs specification).

- For consistency of options, for options involving SPS C it was assumed that a new pump station at SPS C would be constructed rather than construction of a siphon under Eastern Creek and amplification of SPS564.

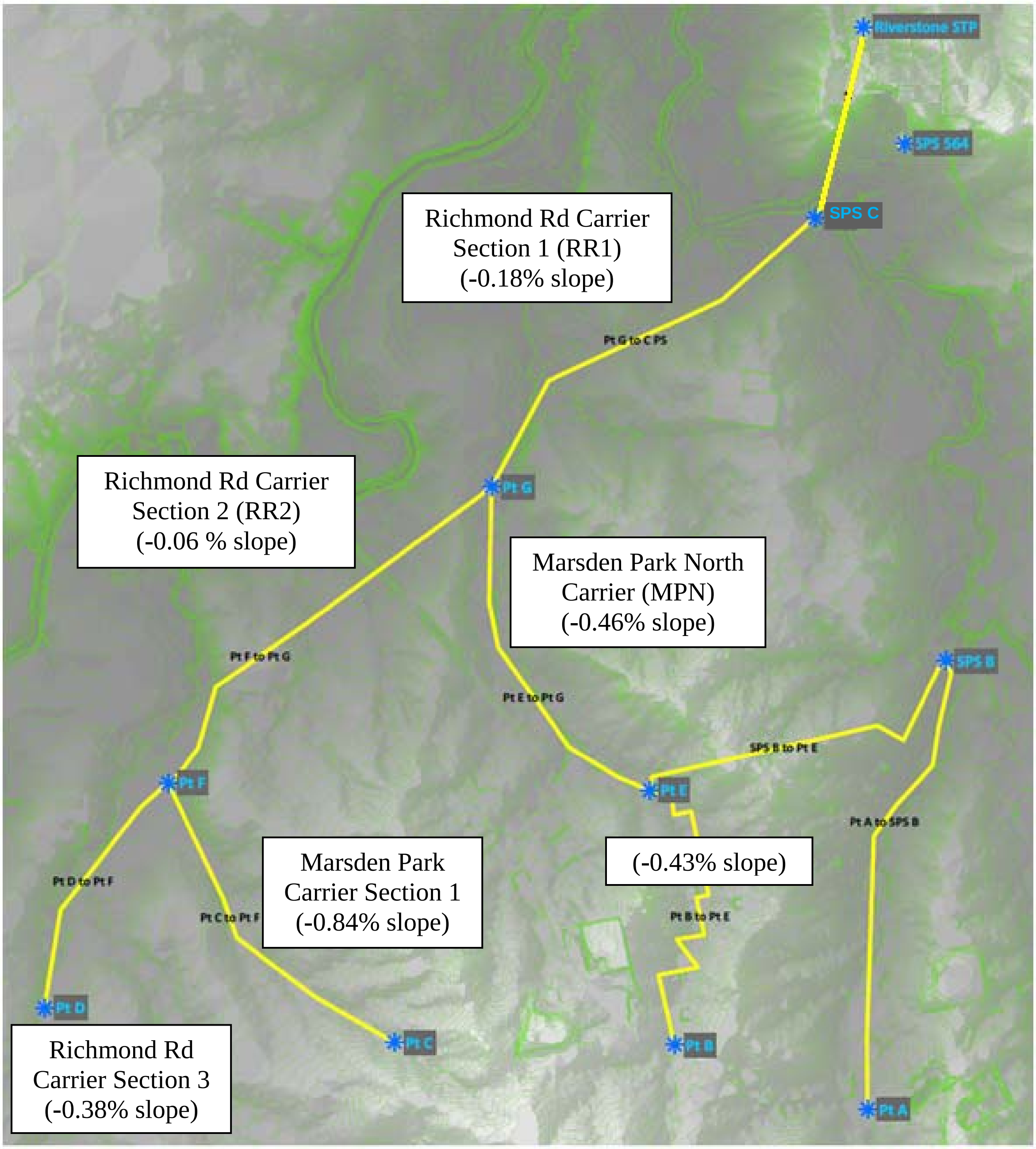


- **Figure 8 Long Section for 0.12% Grade from Pt F to SPS564**

- Locate the pump station within the MPP and have a rising main for all of the distance to Riverstone WWTP. There are a number of advantages of this approach, namely:
  - Rising mains are generally cheaper to construct than gravity mains. This is because they can be constructed at a minimum depth to follow the ground profile, and can be a smaller diameter. This reduces the required earthworks and minimises construction difficulty and disturbances to adjacent ground.
  - This means that it is easier in the future to install additional rising mains following the same pipe route, whereas it is comparatively more difficult to install additional gravity mains adjacent to the existing gravity mains. In some cases the spacing between the new and existing gravity mains would need to be increased to provide sufficient working space for the installation of temporary shoring works for deep trench excavation.
- Intermediate approach, whereby the pump station is located in between the MPP and SPS C. One possible approach is to locate the pump station at the junction of the Marsden Park North Carrier and the Richmond Rd Carrier in **Figure 6** which is ‘Pt G’ in **Figure 9**. This would allow wastewater from both these carriers to be pumped to Riverstone WWTP.

In order to investigate the transfer system, the ground elevation along the Sydney Water proposed pipe route was investigated in **Figure 9** and **Table 9**.

It is noted that in **Figure 9** the point marked as 'Pt F' is the adopted location for the source of wastewater from Marsden Park Stage 1 (i.e. equivalent to the red star in **Figure 6**).



▪ **Figure 9 Ground Elevations and Gravity Carriers**

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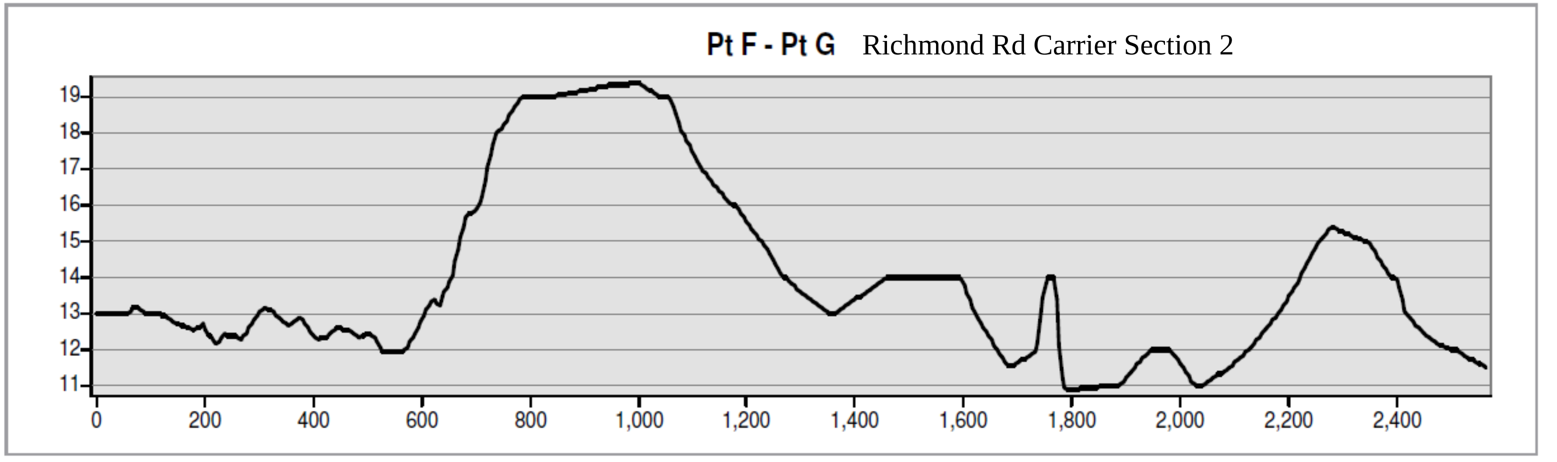
It can be seen from **Table 9** that the average slope of the land along the Richmond Rd Carrier Sections 1 and 2 is very low (gradient of -0.18% and -0.06% respectively). This means that either large diameter sewer mains will need to be installed (that have relatively smaller minimum grades to achieve self-cleansing velocity) or that the sewer mains would be installed at greater gradients, meaning increased excavations to install the sewer at the required slope or the use of trenchless methods as an alternative solution to minimise construction difficulties. Either approach results in larger capital expenditure.

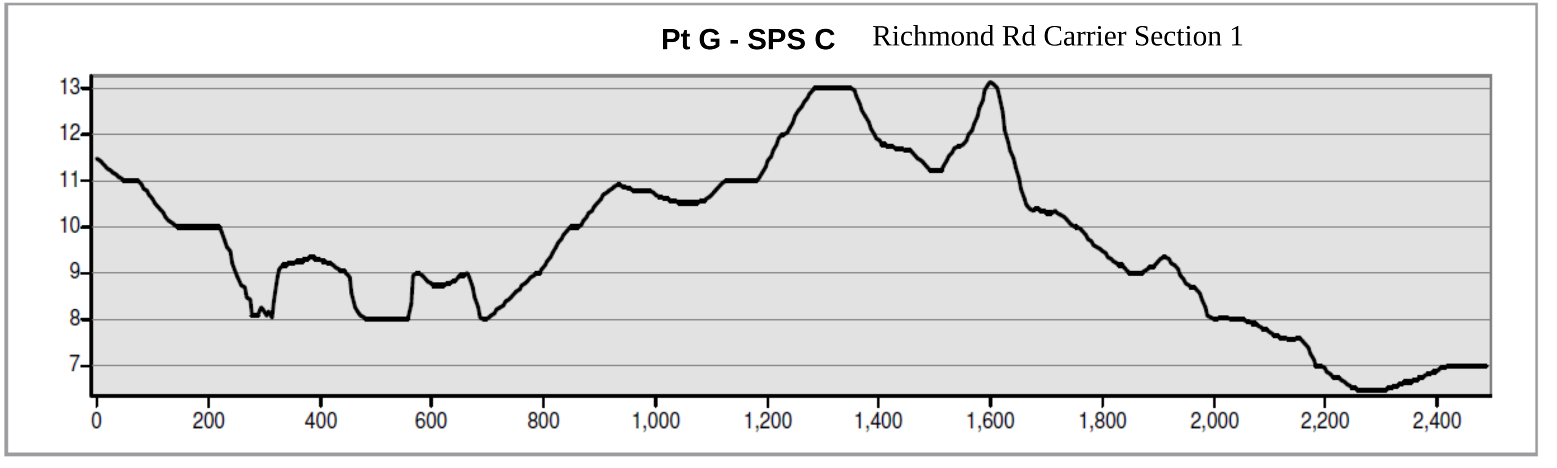
Table 9 Ground Elevations and Slopes

Gravity Main	Points	Elevation (m RL)	Length (m)	Average Slope
Richmond Rd Carrier Section 3	Pt D to Pt F	18.8 to 13.0	1,515	-0.38%
Marsden Park Carrier Section 1	Pt C to Pt F	30.2 to 13.0	2,055	-0.84%
Richmond Rd Carrier Section 2	Pt F to Pt G	13.0 to 11.5	2,560	-0.06%
Marsden Park North Carrier	Pt E to Pt G	21.4 to 11.5	2,130	-0.46%
Richmond Rd Carrier Section 1	Pt G to SPS C	11.5 to 7.0	2,490	-0.18%

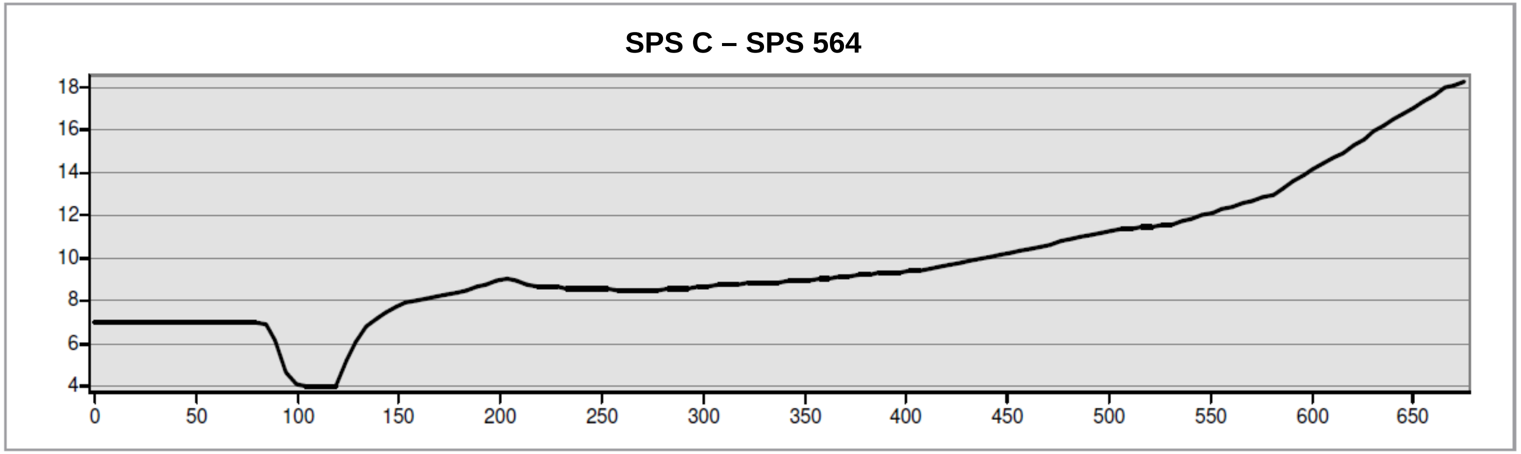
The ground profiles for the Richmond Rd Carrier Section 2 (Pt F to Pt G) and the Richmond Rd Carrier Section 1 (Pt G to SPS C) are shown in **Figure 10**. These indicate that there are some high points along these pipe routes that would require excavations of over 5 m even with a horizontal pipe gradient.

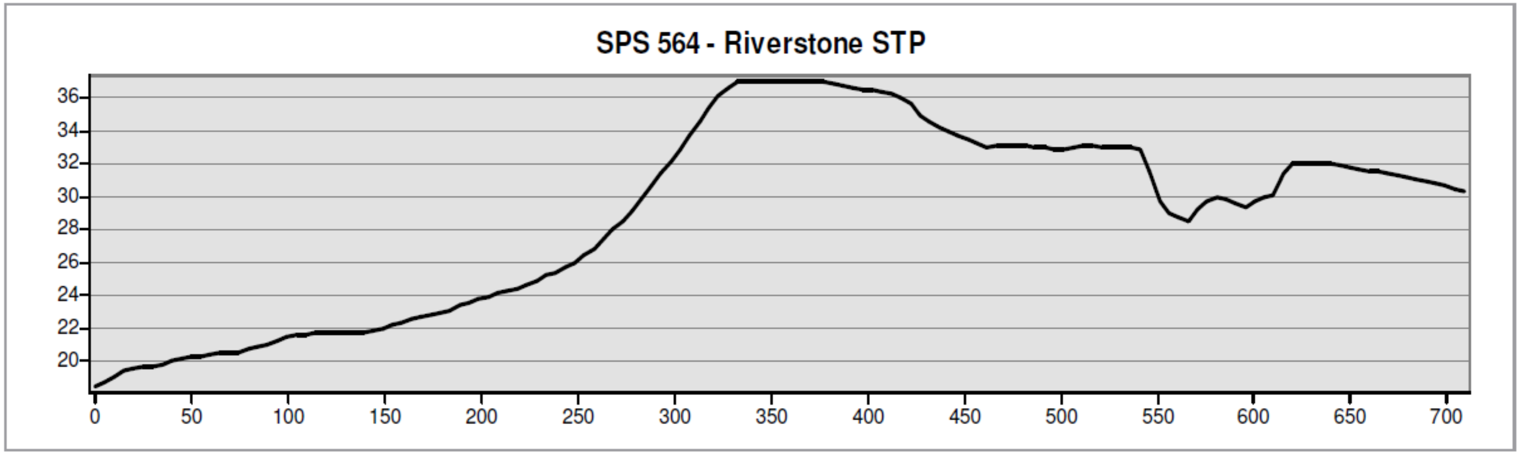
The ground profiles for the rising main proposed under the Ultimate Strategy from SPS C to Riverstone WWTP via the location of the existing pump station SPS564 and its rising main route are shown in **Figure 11**. These indicate that Riverstone WWTP is at a significantly higher elevation than the start of Richmond Rd Carrier Section 2 (Pt F).





- **Figure 10 Ground Profiles for Richmond Rd Carrier Sections 1 and 2**





- **Figure 11 Ground Profiles for Rising Main from SPS C to Riverstone WWTP via SPS564**

4.2.3. Reticulation System

The reticulation system is a network of pipes including property connection sewers that receives wastewater flows from customer properties (residential, industrial and commercial), and conveys the wastewater to the receiving carriers and ultimately to a treatment plant.

The standard type of reticulation system is gravity reticulation systems. All new gravity sewer reticulation systems in Sydney Water's area of operations required to be designed to be low infiltration sewers. This reduces the amount of inflow and infiltration that occur during wet weather and hence reduce the Peak Wet Weather Flow (PWWF) compared to conventional gravity sewer reticulation systems which have a higher risk of inflow and infiltration. There are other types of sewer reticulation systems (such as pressure sewer and vacuum sewer systems) that provide benefits in specific circumstances.

For the Marsden Park Precinct, particularly the land associated with Stage 1, there is generally sufficient slope in the land to support a gravity sewer reticulation system, so there is no real driver forcing an alternate sewer reticulation system to be adopted. Hence low infiltration gravity sewer reticulation system was adopted as the default for the majority of options.

It was identified that a pressure sewer system may be suitable in some specific options. In particular, for the options involving onsite treatment of wastewater, a pressure sewer reticulation system could be applicable because the pumping distance is within the capacity of a typical pressure system. The advantage would be that a centralised pump station would not be required as each home would be equipped with a pressure sewer which connects into a common rising main that discharges to an onsite treatment plant. This also assists with reducing upfront costs as the cost of each pressure sewer pump station would be incurred only when each dwelling is constructed.

For options involving long distance transfer of wastewater to existing (offsite) wastewater treatment plants, due to the distances involved, pressure sewer systems would typically not be able to generate sufficient pressure to transfer the wastewater the entire distance to the offsite WWTP. This would require additional transfer pumping, which partially negates one of the benefits of the pressure sewer reticulation system.

The decision on the sewer reticulation system to be adopted can be made at a later stage of the project. It is possible that the adopted sewer reticulation system for MPP Stage 1 could involve both gravity and pressure systems, with pressure sewer system a possible approach to service areas that do not gravitate to the same location as the remainder of the Stage 1 area (e.g. the eastern portion near Richmond Rd).

4.2.4. Capacity of Infrastructure

The following comments are made relating to capacity of the infrastructure:

- The reticulation system would be installed based on the staging of land release within Stage 1, and would be sized for a suitable capacity based on the design and land topography. The capacity is governed by design codes and hence there are no options relating to the capacity of the reticulation system.
- With regards to treatment infrastructure, the capacity of the stages of amplification of Riverstone WWTP will be governed by Sydney Water to suit their requirements. This includes growth within the remainder of the wastewater network that is serviced by Riverstone WWTP. Hence this is outside the scope of this study. Based on information supplied by Sydney Water, the existing Riverstone WWTP has some spare capacity to accommodate wastewater flows from MPP Stage 1. Due to development occurring in the remainder of the NWGC over the time frame of Stage 1, Riverstone WWTP would not have sufficient spare capacity to accommodate the entire Stage 1 flow. However once Riverstone WWTP is amplified in the near future (2015-2020) it would have sufficient capacity for all of Marsden Park Stage 1 (as well as other growth in the NWGC).
- For the on-site treatment options, it would be possible to stage the implementation of the treatment plant that is required to service Stage 1. The staging would depend on the design and supplier of the treatment plant. For the purposes of costing, it was assumed that the on-site treatment plant would be installed in four packages each of capacity sufficient for around 600 lots (quarter of Stage 1 each).
- The issue of capacity of infrastructure relates primarily to the transfer system, both for the gravity mains and rising mains. **Section 3.4** outlines the various capacities that would be investigated for the transfer options.
  - ❖ As discussed in **Section 4.2.2** it is more difficult to stage gravity mains than rising mains, due to the increased difficulty of construction. Hence at one extreme it could be argued that the gravity main to be installed to service Stage 1 should be sized to accommodate the ultimate development, alternatively a gravity main that is sized only for Stage 1 could be installed. The later approach would require future gravity mains to be installed (or another servicing solution adopted in the future).
  - ❖ As rising mains are relatively easier to install than gravity mains, it is relatively easier to install a number of parallel rising mains over time than a number of parallel gravity mains.

4.3. Discussion of South Creek Bubble Licence

There are three existing Sydney Water WWTPs that discharge to South Creek and its tributaries: Riverstone WWTP, Quakers Hill WWTP and St Marys RTP. These three plants are subject to the South Creek Bubble Licence. That is, the Environment Protection Licence for each of these three plants includes a common load target of how much mass of pollutants can be discharged. This means that if less pollutants are discharged at one of these three plants, more pollutant mass can be discharged at the other two plants, as long as the total mass does not exceed the targets. This approach gives Sydney Water better flexibility to operate and optimise the three treatment plants.

It is assumed that any discharge of effluent from a new on-site treatment plant for Stage 1 to South Creek (or any of its tributaries) would need to fall under the South Creek Bubble Licence.

The South Creek Bubble Licence puts a limit on the total mass of pollutants that can be discharged. The mass of pollutant is equal to the multiplication of the concentration of pollutant and the volume of effluent that is discharged. This means that for the same load (mass) of pollutant, reducing the volume of effluent that is discharged (such as through recycling) enables higher concentrations of pollutants in the effluent that is discharged.

Sydney Water is currently reviewing the South Creek Bubble Licence, particularly taking into consideration the possible volumes of additional effluent that would be discharged to South Creek from the South West Growth Centre, which could also fall under the South Creek Bubble Licence.

4.4. Marsden Park Servicing Strategies

Based on the above discussions, two feasible servicing strategies for Marsden Park were identified:

- Transfer to Riverstone WWTP
- Onsite treatment

For each of the two servicing strategies a number of options were identified:

- Transfer strategy options:
  - As Riverstone WWTP is on a hill, some pumping of wastewater is required. The transfer strategy options were based on the location of the pump station that feeds Riverstone WWTP. Three possible locations were identified to give three transfer options correlating to a pump station at SPS C, Pt G and Pt F in **Figure 9**.
- Onsite treatment strategy options:
  - The identified options for onsite treatment relate to effluent management including discharge to South Creek, irrigation reuse, urban recycling via a community scale dual reticulation system, and combinations of these.

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4.5. List of Options

Based on the above discussions, the following wastewater servicing options are considered for Stage 1 of MPP:

- Transfer Strategy options:
  1) Transfer to Riverstone WWTP via gravity sewer carriers to SPS C with a rising main to Riverstone WWTP (for this option a gravity sewer reticulation system was adopted)
  2) Transfer to Riverstone WWTP via gravity main to new pump station located at the junction of the Marsden Park North Carrier and the Richmond Rd Carrier (Pt G in **Figure 9**) with a rising main to Riverstone WWTP (for this option a gravity sewer reticulation system was adopted)
  3) Transfer to Riverstone WWTP via new pump station located within MPP (nominally at the location marked with a red star in **Figure 6**) with a rising main to Riverstone WWTP (for this option a gravity sewer reticulation system was adopted)
- Onsite Treatment Strategy options:
  4) On-site wastewater treatment plant within MPP with discharge of effluent to South Creek (for this option a gravity sewer reticulation system with pump station and rising main to the on-site plant was adopted, however a pressure sewer system may present a viable alternative)
  5) Option 4 with effluent recycling for open spare irrigation and discharge of excess effluent to South Creek
  6) Option 4 with effluent recycling for urban uses (dual reticulation system) with discharge of excess effluent to South Creek
  7) Option 4 with effluent recycling for both open space irrigation and urban uses (dual reticulation system) with discharge of excess effluent to South Creek
  8) Option 5 but with expanded irrigation system to maximise reuse of effluent and minimise effluent discharge. The goal is to achieve only wet weather discharge of effluent, with no discharge during dry weather

5. Options Investigation

5.1. Matrix of Options

Based on the wastewater servicing options outlined in **Section 4.4** and the capacity scenarios outlined in **Section 3.4** (**Table 6**), the following matrix of options was developed. These options relate to what infrastructure could be installed in the immediate future (2013/2014) to service Marsden Park Stage 1. Staged rollout of infrastructure in the future is investigated further in the Detailed Planning Report.

Table 10 Matrix of Servicing Solutions and Capacity Scenarios

Servicing Option	Capacity Scenario					
	A - MPP Stage 1	B - MPP Stage 1 + 2	C - MPP Ultimate	D - Half of NWGC Ultimate	E - MPP + MPIP Ultimate	F - NWGC Ultimate
Transfer Strategy Options						
1 - SPS C	X	X	X	X	X	X
2 - SPS G	X	X	X	X	X	X
3 - SPS F	X	X	X	X	X	X
Onsite Treatment Strategy Options						
4 - Onsite with discharge	X	-	-	-	-	-
5 - Onsite with irrigation reuse	X	-	-	-	-	-
6 - Onsite with urban reuse	X	-	-	-	-	-
7 - Onsite with urban + irrigation reuse	X	-	-	-	-	-
8 - Onsite with expanded irrigation reuse	X	-	-	-	-	-

5.2. Servicing Option 1

5.2.1. Overview

This option involves the construction of:

- RR2: the Richmond Rd Carrier Section 2 from Marsden Park Stage 1 to the junction with the future Marsden Park North Carrier (‘Pt F’ to ‘Pt G’ in **Figure 9**) (2.6 km)
- RR1: the Richmond Rd Carrier Section 1 to the SPS C (‘Pt G’ to ‘SPS C’ in **Figure 9**) (2.5 km)
- SPS C: a pump station at SPS C (at ‘SPS C’ in **Figure 9**)
- RM: a rising main from SPS C to Riverstone WWTP (‘SPS C’ to ‘Riverstone STP’ as shown in **Figure 9**) (1.4 km). It was assumed that the rising main would first head to the location of the existing pump station SPS564 and then run parallel to the existing rising mains from SPS564 to Riverstone WWTP, however a more direct route could be adopted (depending on further investigation)

Table 11 summarises the required infrastructure for Option 1 for the various capacity scenarios. It is noted that the adopted pipe grades for gravity carriers shown in **Table 11** were selected to conform to the self cleansing requirements, but they do not meet Sydney Water’s requirements with regards to slime control. Hence these grades were selected in order to minimise the excavation depth.

In order to conform to Sydney Water’s slime control requirements the pipe grades were increased accordingly, with results shown in **Table 12**. In some cases increasing the pipe grade enabled the pipe diameter to be reduced, whilst still meeting the self cleansing and slime control requirements.

It is noted that the increased grade of the sewer carriers shown in **Table 12** compared to **Table 11** generally results in a deeper sewer and hence the downstream pump station (SPS C) needs to be deeper. This increases the pumping head, which for the case of Option 1A results in an upsizing of the rising main from DN250 to DN300 to ensure that the required pump head is not more than 70 m.

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Table 11 Servicing Option 1 Summary – Minimum Depth

Components	Capacity Scenario					
	A - MPP Stage 1	B - MPP Stage 1 + 2	C - MPP Ultimate	D - Half of NWGC Ultimate	E - MPP + MPIP Ultimate	F - NWGC Ultimate
Reticulation system	Low infiltration gravity adopted for all precincts					
RR2 Diameter / Grade / Avg. Depth	DN375 / 0.26% / 7.4 m	DN525 / 0.17% / 6.0 m	DN600 / 0.15% / 5.7 m	DN600 / 0.15% / 5.7 m	DN750 / 0.12% / 5.2 m	DN750 / 0.12% / 5.2 m
RR1 Diameter / Grade / Avg. Depth	DN375 / 0.26% / 8.4 m	DN525 / 0.17% / 5.0 m	DN750 / 0.12% / 3.9 m	DN900 / 0.10% / 3.6 m	DN900 / 0.10% / 2.8 m	DN1050 / 0.12% / 3.1 m
SPS C Flow / Power / SPS Depth	90 L/s / 96 kW / 11.3 m	163 L/s / 125 kW / 6.7 m	312 L/s / 212 kW / 4.9 m	478 L/s / 329 kW / 4.4 m	463 L/s / 310 kW / 3.6 m	889 L/s / 551 kW / 4.1 m
RM Diameter / Residence	DN250 / 1.5 hrs	DN375 / 3.3 hrs	DN525 / 6.5 hrs	DN600 / 8.5 hrs	DN600 / 8.5 hrs	DN900 / 19.0 hrs
Treatment Plant	All wastewater treated at Riverstone WWTP					
Effluent Management	Discharge to South Creek (no reuse of effluent assumed)					

Table 12 Servicing Option 1 Summary – Slime Control

Components	Capacity Scenario					
	A - MPP Stage 1	B - MPP Stage 1 + 2	C - MPP Ultimate	D - Half of NWGC Ultimate	E - MPP + MPIP Ultimate	F - NWGC Ultimate
Reticulation system	Low infiltration gravity adopted for all precincts					
RR2 Diameter / Grade / Avg. Depth	DN375 / 0.58% / 12.4 m	DN450 / 0.43% / 10.1 m	DN525 / 0.35% / 8.8 m	DN525 / 0.33% / 8.5 m	DN600 / 0.31% / 8.2 m	DN750 / 0.26% / 7.4 m
RR1 Diameter / Grade / Avg. Depth	DN375 / 0.58% / 20.6 m	DN450 / 0.43% / 14.9 m	DN600 / 0.27% / 10.9 m	DN825 / 0.19% / 9.3 m	DN825 / 0.24% / 9.5 m	DN1050 / 0.14% / 6.9 m
SPS C Flow / Power / SPS Depth	90 L/s / 99 kW / 27.6 m	163 L/s / 160 kW / 19.9 m	312 L/s / 258 kW / 13.9 m	478 L/s / 383 kW / 11.3 m	463 L/s / 374 kW / 12.1 m	889 L/s / 611 kW / 8.3 m
RM Diameter / Residence	DN300 / 2.2 hrs	DN375 / 3.3 hrs	DN525 / 6.5 hrs	DN600 / 8.5 hrs	DN600 / 8.5 hrs	DN900 / 19.0 hrs
Treatment Plant	All wastewater treated at Riverstone WWTP					
Effluent Management	Discharge to South Creek (no reuse of effluent assumed)					

5.2.2. Discussion

The following factors were considered:

- Precincts that can gravity feed to the pump station: Based on Sydney Water's Ultimate Strategy, locating the new pump station on the banks of Eastern Creek at SPS C allows for gravity flows to feed the pump station from a large number of other precincts within the NWGC (assuming sufficient capacity is available).
- Electrical considerations:
  - A supply of electricity is required to the pump station, which could potentially be brought in along the access road to the pump station (see comments on 'easements').
  - The ground level at the location of the proposed pump station is around RL 7.0 m. Standard Sydney Water design practice is to locate the electrical kiosk for the pump station 0.3 m above the 1 in 100 year flood level of RL 17.3 m. This means that the kiosk would be located around 10.6 m above the ground level, requiring a steel support structure with suitable access ladder and platform. This has cost implications and potential visual amenity impacts.
- Depth of carriers: The average gradient of the land along the Richmond Rd Carrier Sections 1 and 2 is relatively flat (0.18% and 0.06% respectively as shown in **Table 9**). This means that if these carriers are installed with low grades to minimise installation depths (**Table 11**), Sydney Water's slime control requirements will not be met (but self cleansing requirements are met). Conversely, if the pipe grades are increased to conform to the slime control requirements (**Table 12**), the depths of the carriers increases significantly, particularly for the capacity scenarios that have small diameter carriers, though in some cases the pipe diameter can be reduced due to the increased pipe grade.
- Depth of pump station: Adopting steeper grades to conform to the slime control requirements also increases the required depth of the pump station to between 11 – 28 m, compared to 4 – 11 m for the lower carrier grades. Deeper pump stations require additional excavation and a deeper wet well, and hence result in additional capital costs.
- Capacity issues – carriers: Installing the carriers at low grades (**Table 11**) means that the MPP Stage 1 wastewater peak dry weather flow (PDWF) of 30 L/s (**Table 5**) is not sufficient for self cleansing for the carriers except for Scenario A (where the carrier is sized to only take MPP Stage 1 flows). However installing the carriers at higher grades to provide for slime control of each capacity scenario (**Table 12**) means that the Marsden Park Stage 1 PDWF of 30 L/s is sufficient for self cleansing for all capacity scenarios, except for RR1 for Capacity Scenario D and F.
- Rising main residence time: The residence time in the rising main was calculated at the MPP Stage 1 average dry weather flow (ADWF) of 13 L/s (**Table 5**) for all capacity scenarios. The rising main residence time varied from 1.5 hrs for Capacity Scenario A to 16.0 hrs for Capacity Scenario F. WSAA recommends an acceptable rising main residence time of 2 hrs

without any mitigating measures. Hence mitigation measures (such as oxygenation or chemical dosing) would be required for all capacity scenarios except for Capacity Scenario A.

- Easements and land acquisition: Easements and land acquisition are required for the land occupied by the pump station, for access to the pump station, and for the rising main and large diameter gravity carriers:
  - Easements are required for all gravity mains that are DN600 or larger. Hence easements are required for RR2 for a number of the Capacity Scenarios, depending on conformance with the slime control criteria
  - The pump station is located outside of MPP hence land would need to be acquired for the pump station (2,000 m^2 based on SPS 564 which is an existing pump station near Riverstone WWTP including ring road)
  - Sydney Water requires vehicular access to the pump station via a bitumen access road. The closest existing bitumen public road to the location of the pump station is The Avenue which is within the Marsden Park North Precinct. This is a straight line distance of around 1.5 km to the pump station location, hence a road of around 2 km length was assumed (4 m wide land acquisition). An easement (or change in ownership of land) would be required for this land as well as construction of a new bitumen access road. Electricity to the pump station could be brought in along this access road, assuming there is sufficient capacity in the upstream network at a suitable nearby location to the junction of the new road with The Avenue.
  - An easement would also be required for the rising main from the pump station to the location of SPS564 from where it is assumed that the rising main could be located within the easement of the existing rising main. Hence an easement of around 0.7 km length (easement width is 3 – 8 m depending on pipe diameter) would be required for the rising main.
- Effluent discharge to South Ck: All of the wastewater generated by MPP Stage 1 would be transferred to Riverstone WWTP for treatment. The majority of the effluent from Riverstone WWTP is currently discharged to South Ck (with some minor on-site reuse, the majority of which is returned back to the effluent flow), and it is assumed that this would be the case in the immediate future. Therefore it has been assumed that all of the wastewater that is transferred to Riverstone WWTP would be treated and discharged to South Ck. This equates to 445 ML/yr, which includes a volume allowance of 8.5% to account for wet weather infiltration to the sewer system (the value of 8.5% was obtained from calculations and is an indicative value).
- Effluent reuse: This option does not include any reuse of treated effluent reuse.
- Time to implement: The key factor affecting the time required to implement this option is the design and construction time for the infrastructure.
- Servicing of first few hundred lots: The wastewater generated by the first few hundred lots could be transferred to a suitable treatment facility by road tanker. The pump station wet well

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(and emergency storage) are to be constructed first which could provide a possible receiving and storage point for the road tankers.

5.3. Servicing Option 2

5.3.1. Overview

This option involves the construction of:

- RR2: the Richmond Rd Carrier Section 2 from Marsden Park Stage 1 to the junction with the future Marsden Park North Carrier (2.6 km) ('Pt F' to 'Pt G' in **Figure 9**)
- SPS G: a pump station located at the junction of the Marsden Park North Carrier and the Richmond Rd Carrier (at 'Pt G' in **Figure 9**). In this option SPS G would replace SPS C
- RM: a rising main from G PS to Riverstone WWTP ('Pt G' to 'Riverstone STP' in **Figure 9**) (3.9 km). It was assumed that the rising main would generally follow the proposed path of RR1 and then to the location of the existing pump station SPS564 and then run parallel to the existing rising mains from SPS564

Similar to Servicing Option 1, the results shown in **Table 13** are based on minimal pipe grades in order to minimise the depth of the sewer carriers. These generally do not meet Sydney Water's slime control requirements but do meet the self cleansing requirements.

Table 14 shows the required increased pipe grades and average depths in order to meet Sydney Water's slime control requirements.

In this servicing option, because RR1 is not constructed, it was assumed that the areas that directly drain to RR1 (the 40% of Marsden North Precinct as shown in **Table 3**) would instead drain to the pump station at Pt G. Hence the same EP is serviced in Option 2 as in Option 1 for the relevant capacity scenarios.

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Table 13 Servicing Option 2 Summary – Minimum Depth

Components	Capacity Scenario					
	A - MPP Stage 1	B - MPP Stage 1 + 2	C - MPP Ultimate	D - Half of NWGC Ultimate	E - MPP + MPIP Ultimate	F - NWGC Ultimate
Reticulation system	Low infiltration gravity adopted for all precincts					
RR2 Diameter / Grade / Avg. Depth	DN375 / 0.26% / 7.4 m	DN525 / 0.17% / 6.0 m	DN600 / 0.15% / 5.7 m	DN600 / 0.15% / 5.7 m	DN750 / 0.12% / 5.2 m	DN750 / 0.12% / 5.2 m
RR1 Diameter / Grade / Avg. Depth	Not required					
SPS G Flow / Power / SPS Depth	90 L/s / 89 kW / 9.1 m	163 L/s / 157 kW / 6.7 m	312L/s / 250 kW / 6.2 m	478 L/s / 403 kW / 6.2 m	463 L/s / 376 kW / 5.4 m	889 L/s / 581 kW / 5.4 m
RM Diameter / Residence	DN300 / 5.9 hrs	DN375 / 9.2 hrs	DN525 / 18.1 hrs	DN600 / 23.6 hrs	DN600 / 23.6 hrs	DN900 / 53.0 hrs
Treatment Plant	All wastewater treated at Riverstone WWTP					
Effluent Management	Discharge to South Creek (no reuse of effluent assumed)					

Table 14 Servicing Option 2 Summary – Slime Control

Components	Capacity Scenario					
	A - MPP Stage 1	B - MPP Stage 1 + 2	C - MPP Ultimate	D - Half of NWGC Ultimate	E - MPP + MPIP Ultimate	F - NWGC Ultimate
Reticulation system	Low infiltration gravity adopted for all precincts					
RR2 Diameter / Grade / Avg. Depth	DN375 / 0.58% / 12.4 m	DN450 / 0.43% / 10.1 m	DN525 / 0.35% / 8.8 m	DN525 / 0.33% / 8.5 m	DN600 / 0.31% / 8.2 m	DN750 / 0.26% / 7.4 m
RR1 Diameter / Grade / Avg. Depth	Not required					
SPS G Flow / Power / SPS Depth	90 L/s / 102 kW / 17.4 m	163 L/s / 175 kW / 13.5 m	312 L/s / 276 kW / 11.4 m	478 L/s / 440 kW / 10.9 m	463 L/s / 414 kW / 10.4 m	889 L/s / 634 kW / 9.1 m
RM Diameter / Residence	DN300 / 5.9 hrs	DN375 / 9.2 hrs	DN525 / 18.1 hrs	DN600 / 23.6 hrs	DN600 / 23.6 hrs	DN900 / 53.0 hrs
Treatment Plant	All wastewater treated at Riverstone WWTP					
Effluent Management	Discharge to South Creek (no reuse of effluent assumed)					

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5.3.2. Discussion

The following factors were considered:

- Precincts that can gravity feed to the pump station: Locating the pump station at the junction of the Marsden Park North Carrier with the Richmond Rd Carrier Section 2 allows for gravity flows to feed the pump station from these two carriers. Based on Sydney Water's Ultimate Strategy a pump station at this location would allow wastewater from a large number of other precincts within the NWGC to be transferred to the proposed pump station (assuming sufficient capacity is available). Compared to Option 1, the 40% of the Marsden Park North Precinct which lies within the direct catchment of RR1 would discharge to the pump station at Pt G via an appropriately designed sewer reticulation system. SPS G would need to be installed to a suitable depth to allow connection of both the Marsden Park North Carrier and the Richmond Rd Carrier Section 2, as well as the small diameter reticulation mains from within the Marsden Park North Precinct.
- Electrical considerations:
  - A supply of electricity is required to the pump station, which could potentially be brought in along the access road to the pump station (see comments on 'easements').
  - The ground level at the location of the proposed pump station is higher than for Option 1, at around RL 11.2 m. This reduces the height of the platform for the pump station electrical kiosk to around 6.3 m above the ground level. This reduces cost and potential visual impacts compared to Option 1.
- Depth of carriers: The average gradient of the land along the Richmond Rd Carrier Section 2 is relatively flat (0.06%). If RR2 is installed with a low grade to minimise installation depth, Sydney Water's slime control requirements will not be met. Conversely, if the pipe grade is increased to conform to the slime control requirements, the depth of RR2 increases though in some cases the pipe diameter can be reduced due to the increased pipe grade.
- Depth of pump station: Adopting steeper grades to conform to the slime control requirements also increases the required depth of the pump station to between 9 – 17 m, compared to 5 – 9 m for the lower carrier grades. Due to the elimination of RR1, the pump station depths are not as large for this option compared to Option 1.
- Capacity issues – carriers: Installing the carriers at low grades means that the MPP Stage 1 wastewater peak dry weather flow (PDWF) of 30 L/s is not sufficient for self cleansing for the carriers except for Scenario A (where the carrier is sized to only take MPP Stage 1 flows). However installing the carriers at higher grades to provide for slime control means that the Marsden Park Stage 1 PDWF of 30 L/s is sufficient for self cleansing for all capacity scenarios.
- Rising main residence time: The residence time in the rising main for this option is larger than for Option 1 because the rising main is longer (3.9 km). The residence time is longer than the

WSAA recommended 2 hrs for all capacity scenarios, hence mitigation measures (such as oxygenation or chemical dosing) would be required for all capacity scenarios.

- Easements and land acquisition: Easements and land acquisition are required for the land occupied by the pump station, for access to the pump station, and for the rising main and large diameter gravity carriers:
  - Easements are required for all gravity mains that are DN600 or larger. Hence easements are required for RR2 for a number of the Capacity Scenarios, depending on conformance with the slime control criteria
  - The pump station is located outside of MPP hence land would need to be acquired for the pump station (2,000 m^2)
  - The closest existing bitumen public road to the location of the pump station is Richmond Road at a distance of around 0.8 km. However connecting to Richmond Rd could be a significant undertaking, possibly requiring a turning lane. Alternatively a new road could be constructed to connect to Park Rd which is within the Marsden Park North Precinct. This is a straight line distance of around 1.2 km from the pump station, hence a road of 1.5 km length was assumed (4 m wide land acquisition). An easement (or change in ownership of land) would be required for this land as well as construction of a new bitumen access road. Electricity to the pump station could be brought in along this access road, assuming there is sufficient capacity in the upstream network at a suitable nearby location to the junction of the new road with Park Rd.
  - An easement would also be required for the rising main from the pump station to the location of SPS564 from where it is assumed that the rising main could be located within the easement of the existing rising main. Hence an easement of around 3.2 km length (easement width is 3 – 8 m depending on pipe diameter) would be required for the rising main.
- Effluent discharge to South Ck: As for Option 1, all of the wastewater generated by MPP Stage 1 would be transferred to Riverstone WWTP for treatment and discharge to South Ck. This equates to a discharge of 445 ML/yr, which includes a volume allowance of 8.5% to account for wet weather infiltration to the sewer system.
- Effluent reuse: This option does not include any reuse of treated effluent reuse.
- Time to implement: The key factor affecting the time required to implement this option is the design and construction time for the infrastructure.
- Servicing of first few hundred lots: As for Option 1 the wastewater generated by the first few hundred lots could be transferred to a suitable treatment facility by road tanker from the pump station wet well (and emergency storage).

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5.4. Servicing Option 3

5.4.1. Overview

This option involves the construction of:

- SPS F: a pump station located at the junction of the Marsden Park Carrier Section 1 and the Richmond Rd Carrier (at 'Pt F' in **Figure 9** – note that this location is shown as a red star in other figures in this report)
- RM: a rising main from F PS to Riverstone WWTP ('Pt F' to 'Riverstone STP' in **Figure 9**) (6.5 km). It was assumed that the rising main would generally follow the proposed path of RR2 and RR1 and then to the location of the existing pump station SPS564 and then run parallel to the existing rising mains from SPS564

In this servicing option, because the pump station is constructed at Pt F, the areas that drain to RR1 and MPN are not serviced by the infrastructure outlined below. Only the areas that drain to Pt F are serviced by this option. Note that for this option, because of the flatness of the land along RR2, it has been assumed that wastewater from the direct catchment of RR2 would be able to drain to SPS F. From **Table 3** the area that is serviced by this option is 100% of Shanes Park Precinct (via SPS A as shown in **Figure 5**), 65% of Marsden Park Precinct, and 25% of Marsden Park Industrial Precinct.

Hence for Capacity Scenario C, which is equivalent to servicing the ultimate development of the Marsden Park Precinct, SPS F is sized to accommodate development of 65% of Marsden Park Precinct. For Capacity Scenario D, which is equivalent to servicing half of the ultimate development of the NWGC, SPS F is sized for development of 50% of Shanes Park Precinct, 32.5% of Marsden Park Precinct, and 12.5% of Marsden Park Industrial Precinct. For Capacity Scenario E, which is equivalent to servicing ultimate development of Marsden Park Precinct and Marsden Park Industrial Precinct, SPS F is sized for development of 32.5% of Marsden Park Precinct, and 12.5% of Marsden Park Industrial Precinct. And for Capacity Scenario F, which is equivalent to servicing ultimate development of the NWGC, SPS F is sized for development of 100% of Shanes Park Precinct, 65% of Marsden Park Precinct, and 25% of Marsden Park Industrial Precinct.

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- **Table 15 Servicing Option 3 Summary**

Components	Capacity Scenario					
	A - MPP Stage 1	B - MPP Stage 1 + 2	C - MPP Ultimate	D - Half of NWGC Ultimate	E - MPP + MPIP Ultimate	F - NWGC Ultimate
Reticulation system	Low infiltration gravity adopted for all precincts					
RR2 Diameter / Grade / Avg. Depth	Not required					
RR1 Diameter / Grade / Avg. Depth	Not required					
SPS F Flow / Power / SPS Depth	90 L/s / 104kW / 4.0 m	163 L/s / 191 kW / 4.0 m	208 L/s / 190 kW / 4.0 m	181 L/s / 147 kW / 4.0 m	275 L/s / 224 kW / 4.0 m	330 L/s / 319 kW / 4.0 m
RM Diameter / Residence	DN300 / 9.8 hrs	DN375 / 15.4 hrs	DN450 / 22.1 hrs	DN450 / 22.1 hrs	DN525 / 30.1 hrs	DN525 / 30.1 hrs
Treatment Plant	All wastewater treated at Riverstone WWTP					
Effluent Management	Discharge to South Creek (no reuse of effluent assumed)					

5.4.2. Discussion

The following factors were considered:

- Precincts that can gravity feed to the pump station: In this option the pump station would be located within the Marsden Park Precinct. This limits the area that can gravitate directly to the pump station. Other development areas could be serviced by SPS F if the wastewater from these areas is pumped (by other pump station/s) to a location that drains to SPS F, potentially as a temporary servicing approach. With reference to Sydney Water's Ultimate Strategy (**Figure 5**) SPS F could replace the future proposed SPS A which is required to service Shanes Park Precinct. This would be on the basis that SPS F is constructed at a suitable depth to intercept the Shanes Park Carrier, which would be extended to reach SPS F. This is further discussed in **Section Error! Reference source not found.**.
- Electrical considerations:
  - A supply of electricity is required to the pump station, which could potentially be brought in along the access road to the pump station (see comments on 'easements'). As the pump station for this option is located close to the Stage 1 development of MPP, there are less issues and costs associated with supply of electricity to the pump station than for Options 1 and 2.

- The ground level at the location of the proposed pump station is higher than for Options 1 and 2, at around RL 13.0 m. This reduces the height of the platform for the pump station electrical kiosk to around 4.6 m above the ground level. This reduces cost and potential visual impacts compared to Options 1 and 2.

- Depth of carriers: This option removes the issues associated with the depth of the carriers.
- Depth of pump station: This option removes the issues associated with the depth of the pump station, and a nominal depth of 4.0 m was adopted.
- Capacity issues – carriers: This option removes the issues associated with the capacity of the carriers.
- Rising main residence time: The residence time in the rising main for this option is larger than for Option 1 and 2 because the rising main is longer (6.5 km). The residence time is longer than the WSAA recommended 2 hrs for all capacity scenarios, hence mitigation measures (such as oxygenation or chemical dosing) would be required for all capacity scenarios.
- Easements and land acquisition: Easements and land acquisition are required for the land occupied by the pump station, for access to the pump station, and for the rising main:
  - As the pump station is located within the MPP on land that is owned by Winten, suitable area of land (1,000 m^2) would need to be set aside for pump station. This is anticipated to be easier than for Options 1 and 2 where the land is owned by another entity
  - As the pump station is close to boundary of MPP Stage 1, vehicular access to the pump station can be provided by extending one of the roads that will be constructed in Stage 1. The road would be constructed on land owned by Winten and ideally would be a road that is required to service Stage 2 development of MPP. Hence the cost to provide vehicular access to the pump station is less than for Options 1 and 2. Electricity to the pump station could also be brought in along this access road to connect to the new electricity network that will be constructed in Stage 1. For the purposes of costing, a road of 0.5 km length was adopted (4 m wide land acquisition).
  - An easement would also be required for the rising main from the pump station to the location of SPS564 from where it is assumed that the rising main could be located within the easement of the existing rising main. Hence an easement of around 5.8 km length (easement width is 3 – 8 m depending on pipe diameter) would be required for the rising main.
- Effluent discharge to South Ck: As for Options 1 and 2, all of the wastewater generated by MPP Stage 1 would be transferred to Riverstone WWTP for treatment and discharge to South Ck. This equates to a discharge of 445 ML/yr, which includes a volume allowance of 8.5% to account for wet weather infiltration to the sewer system.
- Effluent reuse: This option does not include any reuse of treated effluent reuse.
- Time to implement: The key factor affecting the time required to implement this option is the design and construction time for the infrastructure.

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- Servicing of first few hundred lots: As for Options 1 and 2 the wastewater generated by the first few hundred lots could be transferred to a suitable treatment facility by road tanker from the pump station wet well (and emergency storage).

5.5. Servicing Option 4

5.5.1. Overview

This servicing option relates to the construction of a 'community scale package treatment plant' within MPP. It is noted that Options 1, 2 and 3 involve transfer of wastewater to Riverstone WWTP, which is a 'centralised treatment plant' that Sydney Water is planning to amplify to accommodate growth within the NWGC. Hence construction of a new centralised wastewater treatment plant within MPP was not considered as a viable servicing option. For these reasons only Capacity Scenario A was investigated for this servicing option.

Due to the significant costs associated with the construction of the treatment plant, and the operational issues that occur when the flow to the plant is significantly less than its design capacity, it is proposed that the plant is constructed in a number of stages. Based on discussions with a potential plant supplier (GE Infrastructure) it would be possible to construct the plant in four stages with each stage having a capacity of around 625 lots, which is 3.3 L/s or 281 kL/d as ADWF. The initial stage would be built so that future stages could be easily added with minimal interruption to the plant operation.

For this option, to be consistent with Options 1, 2 and 3, it was assumed that a gravity sewer reticulation system would be adopted with a pump station and rising main to transfer wastewater to the on-site treatment plant, rather than a pressure sewer system. However, it is noted that this assumption is made for the basis of simplifying the option comparison, and doesn't preclude the adoption of a pressure sewer system. It is noted that for this option a pressure sewer system would provide some benefits over a gravity reticulation system, such as minimising the upfront capital investment associated with the pump station.

It is anticipated that the treatment plant would be located in the western side of MPP to be close to the effluent discharge point. It is likely that the plant would be located above the 1 in 100 year flood level. The exact location of the on-site treatment plant was not investigated, and hence for the rising main from the pump station to the on-site treatment plant a nominal length of 1.5 km was adopted.

In summary this option involves the construction of:

- SPS F: a pump station located at the junction of the Marsden Park Carrier Section 1 and the Richmond Rd Carrier (at 'Pt F' in **Figure 9**)

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- RM: a rising main to transfer wastewater to the on-site plant (nominal length of 1.5 km).
- Onsite WWTP: a new wastewater treatment plant located within the MPP. The effluent from the WWTP would be discharged to South Ck (either directly or via a tributary) with no reuse.

Table 16 Servicing Option 4 Summary

Components	Capacity Scenario
	A - MPP Stage 1
Reticulation system	Low infiltration gravity assumed
RR2 Diameter / Grade / Avg. Depth	These gravity mains are not required but allowance was made for a DN375 pipe to discharge eflfuent to South Creek with nominal distance of 1 km
RR1 Diameter / Grade / Avg. Depth	
SPS F Flow / Power / SPS Depth	90 L/s / 53 kW / 4.0 m
RM Diameter / Residence	DN250 / 1.6 hrs
Treatment Plant	All wastewater treated at on-site treatment plant
Effluent Management	Discharge to South Creek (no reuse of effluent assumed)

5.5.2. Discussion

The following factors were considered:

- Precincts that can gravity feed to the pump station: Similar to Option 3.
- Electrical considerations:
  - A supply of electricity is required to the on-site treatment plant, which could potentially be brought in along the access road to the treatment plant (see comments on ‘easements’).
  - A supply of electricity is required to the pump station, which could potentially be brought in along the access road to the pump station (see comments on ‘easements’). The issues and costs associated with supply of electricity to the pump station is the same as for Option 3.
  - The ground level at the location of the proposed pump station is the same as for Option 3 which requires a platform for the pump station electrics to around 4.6 m above the ground level.

- Depth of carriers: This option removes the issues associated with the depth of the carriers.
- Depth of pump station: This option removes the issues associated with the depth of the pump station, and a nominal depth of 4.0 m was adopted.
- Capacity issues – carriers: This option removes the issues associated with the capacity of the carriers.
- Rising main residence time: The residence time in the rising main for this option is less than the WSAA recommended 2 hrs, hence mitigation measures are not required. This is because the adopted rising main length is only 1.5 km.
- Easements and land acquisition: Easements and land acquisition are required for the land occupied by the pump station and the on-site treatment plant, for access to the pump station and to the on-site treatment plant, and for the rising main:
  - Similar to Option 3, as the pump station is located within the MPP on land that is owned by Winten, suitable area of land would need to be set aside for pump station.
  - For an on-site treatment plant of the required capacity for MPP Stage 1, an area of around 4,000 m^2 would be required. As the plant is likely to be built on land that is above the 1 in 100 year flood level, the plant is likely to be located on land that would otherwise be developed. Whilst the land that the plant would be located on is owned by Winten, the use of this area of land for an on-site treatment plant represents a cost in terms of loss of revenue from developing that land.
  - Vehicular access to the pump station would be required, similar to Option 3. For the purposes of costing, a road of 0.5 km length was adopted (4 m wide land acquisition).
  - Vehicular access to the on-site treatment plant would be required. This would require the extension of one of the roads that is constructed in Stage 1, with the length of road depending on the adopted location of the on-site treatment plant. The plant location is likely to be on land that would form part of MPP Stage 2 or Stage 3 as shown in **Figure 2**. A nominal road length of 1.5 km has been adopted for this option (4 m wide land acquisition). The electricity supply to the plant would be along this road.
  - An easement is required for the rising main from the pump station to the on-site treatment plant, but this should be relatively easy to obtain as it is through land owned by Winten. It is possible that the rising main could also follow the route of the access road to the on-site plant. An easement of 1.5 km length (easement width is 3 – 8 m depending on pipe diameter) was allowed for.
- Effluent discharge to South Ck: The effluent from the on-site treatment plant would be discharged either directly to South Ck, or to one of its tributaries, depending on the location of the plant and environmental considerations. This would involve discharge of 445 ML/yr, which includes a volume allowance of 8.5% to account for wet weather infiltration to the sewer system. Compared to Options 1, 2 and 3, the key difference is that the effluent would be discharged upstream of the discharge point of Riverstone WWTP. It is assumed that the

effluent quality from the on-site plant would be similar to the quality to be achieved from the future amplified Riverstone WWTP (**Table 8**).

- Effluent reuse: This option does not include any reuse of treated effluent reuse.
- Time to implement: In order to construct the on-site treatment plant, environmental assessment and approvals would be required. This has the potential to significantly affect the timing of the Stage 1 development and hence presents a real risk for this option.
- Servicing of first few hundred lots: As for Option 3, the wastewater generated by the first few hundred lots could be transferred to a suitable treatment facility by road tanker from the pump station wet well (and emergency storage).

5.6. Servicing Option 5

5.6.1. Overview

This option is the same as Option 4 except that this option includes reuse of some of the effluent from the on-site treatment plant for open space irrigation.

In order to estimate the area of land that would be irrigated in this option, the area of land below the 1 in 100 year flood level was estimated. Within the MPP there is around 430 ha of land below the 1 in 100 year flood level. Of this Winten own 230 ha.

That is, Winten's landholding within MPP includes around 230 ha of land that is below the 1 in 100 year flood level. Potentially some of this land could be irrigated relatively easily as it is currently largely cleared of vegetation and this land includes two storage dams that could be used to feed the irrigation system. Preliminary calculations indicate that the total storage volume in these dams could be in the order of 40 ML, based on an average water depth of 1.5 m.

No investigation has been undertaken in this study regarding the suitability of the site or soils of the land below the 1 in 100 year flood level for effluent irrigation, either for land currently owned by Winten or other land.

Possible constraints to using land for effluent irrigation include future compatible land use and future land ownership. Also there would be setback distances required for irrigation using treated effluent from water bodies and incompatible land uses. Also there could be site specific limitations, such as soil characteristics that are not suited to effluent irrigation. In addition, establishing an effluent irrigation scheme on land that is owned by others would require contractual agreements to be put in place.

Therefore, for this servicing option for MPP Stage 1, it is assumed that only 50% of the land owned currently by Winten that is below the (regional) 1 in 100 year flood level would be available for irrigation. This gives an irrigation area of 115 ha.

This assumption of available land area would need to be further examined in detail if this option is identified as the preferred option. This would include undertaking site and soil suitability investigations to determine the feasibility of irrigating specific areas with treated effluent, as well as considering future land use and land ownership issues.

SKM undertook water balance modelling using a computer model that estimates irrigation demand based on daily rainfall and evaporation data.

Based on water balance modelling over 50 years this would result in about 380 ML/yr of effluent (86% of the yearly total volume of effluent) being recycled and 65 ML/yr of effluent (14%) discharged to South Ck. The water balance modelling assumed that the 115 ha of irrigated area was pasture, with 40 ML of storage.

In summary this option involves the construction of:

- SPS F: a pump station located at the junction of the Marsden Park Carrier Section 1 and the Richmond Rd Carrier (at 'Pt F' in **Figure 9**)
- RM: a rising main to transfer wastewater to the on-site plant (nominal length of 1.5 km).
- Onsite WWTP: a new wastewater treatment plant located within the MPP.
- Irrigation system for effluent reuse (115 ha irrigation area and 40 ML storage): The effluent from the WWTP would be used for irrigation of open space. The remainder of the effluent would be discharged to South Ck (either directly or via a tributary).

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- **Table 17 Servicing Option 5 Summary**

Components	Capacity Scenario
	A - MPP Stage 1
Reticulation system	Low infiltration gravity assumed
RR2 Diameter / Grade / Avg. Depth	These gravity mains are not required but allowance was made for a DN375 pipe to discharge effluent to South Creek with nominal distance of 1 km
RR1 Diameter / Grade / Avg. Depth	
SPS F Flow / Power / SPS Depth	90 L/s / 53 kW / 4.0 m
RM Diameter / Residence	DN250 / 1.6 hrs
Treatment Plant	All wastewater treated at on-site treatment plant
Effluent Management	Irrigation of 115 ha of low lying land, with 14% discharged to South Creek

5.6.2. Discussion

The following factors were considered:

- Precincts that can gravity feed to the pump station: Similar to Option 4.
- Electrical considerations: Similar to Option 4.
- Depth of carriers: Similar to Option 4.
- Depth of pump station: Similar to Option 4.
- Capacity issues – carriers: Similar to Option 4.
- Rising main residence time: Similar to Option 4.
- Easements and land acquisition: Similar to Option 4.
- Effluent discharge to South Ck: Compared to Option 4, on average 86% of the effluent (380 ML/yr) would be used for irrigation and hence only 65 ML/yr (14% of the effluent) would be discharged to South Creek. This provides environmental benefits compared to Options 1, 2, 3 and 4 by reducing the loads of nutrients that are discharged to South Ck.
- Effluent reuse: In this option the majority of the effluent (86%) is reused for irrigation of 115 ha of low lying areas within MPP. This has environmental benefits by reducing the loads of nutrients discharged to South Ck and social benefits through a reliable source of irrigation water. This could include irrigation of parks and gardens, as well as for agriculture on suitable

land. The area of land that could be irrigated with treated effluent would require further investigation, taking into consideration future land uses and other factors.

- Time to implement: Similar to Option 4.
- Servicing of first few hundred lots: Similar to Option 4.

5.7. Servicing Option 6

5.7.1. Overview

This option is the same as Option 4 except that this option includes reuse of some of the effluent from the on-site treatment plant for urban recycling through a dual reticulation system.

The treated effluent would be fed to a recycled water system to enable the water to be used in homes for outdoor uses as well as toilet flushing and for cold water use in the washing machine (optional for homeowners). A dual reticulation system would be required to provide the recycled water to the MPP Stage 1 development. This would include a system of pipes as well as storage tanks and pressure pumps.

The recycled water would remove the need for household rainwater tanks for BASIX compliance, hence the cost for this option would be partly offset by the cost of the rainwater tanks that all of the other options would require (except Option 7).

In addition, the investigation of potable water servicing options for MPP Stage 1 identified that the supply of recycled water to MPP Stage 1 significantly reduces the maximum hourly potable water demand compared to rainwater tanks. This means that the potable water infrastructure that is installed to service MPP Stage 1 can service many more lots. For instance:

- The preferred potable water servicing strategy for MPP Stage 1 could service around 3,000 lots assuming all lots would be equipped with rainwater tanks

- If MPP Stage 1 (2,500 lots) are serviced by a recycled water system, based on maximum hour demand calculations, the same potable water infrastructure would be able to service an additional 2,000 lots that are equipped with rainwater tanks (to be confirmed by detailed modelling). That is, the same infrastructure could service a total of 4,500 lots. This delays the need to construct additional potable water infrastructure.

No investigation has been undertaken in this study regarding the suitability of the site or soils of the Stage 1 site for irrigation with recycled water.

The daily water balance model that was used to investigate Servicing Option 5 was used to investigate this option. Modelling over 50 years indicates that this option would result in an average of 230 ML/yr of effluent (52%) being recycled and 215 ML/yr of effluent (48%)

discharged to South Ck. The water balance modelling assumed household garden usage was equivalent to 100 m^2 of pasture at each of the 2,500 lots.

In summary this option involves the construction of:

- SPS F: a pump station located at the junction of the Marsden Park Carrier Section 1 and the Richmond Rd Carrier (at 'Pt F' in **Figure 9**)
- RM: a rising main to transfer wastewater to the on-site plant (nominal length of 1.5 km).
- Onsite WWTP: a new wastewater treatment plant located within the MPP.
- Dual reticulation system consisting of storage reservoir (nominal 1 ML storage), pressure pumps and pipe network for 2,500 lots.

Table 18 Servicing Option 6 Summary

Components	Capacity Scenario
	A - MPP Stage 1
Reticulation system	Low infiltration gravity assumed
RR2 Diameter / Grade / Avg. Depth	These gravity mains are not required but allowance was made for a DN375 pipe to discharge eflfuent to South Creek with nominal distance of 1 km
RR1 Diameter / Grade / Avg. Depth	
SPS F Flow / Power / SPS Depth	90 L/s / 53 kW / 4.0 m
RM Diameter / Residence	DN250 / 1.6 hrs
Treatment Plant	All wastewater treated at on-site treatment plant
Effluent Management	Dual reticulation system, with 48% discharged to South Creek

5.7.2. Discussion

The following factors were considered:

- Precincts that can gravity feed to the pump station: Similar to Option 4.
- Electrical considerations: Similar to Option 4.
- Depth of carriers: Similar to Option 4.
- Depth of pump station: Similar to Option 4.

- Capacity issues – carriers: Similar to Option 4.
- Rising main residence time: Similar to Option 4.
- Easements and land acquisition: Similar to Option 4.
- Effluent discharge to South Ck: Compared to Option 4, on average 52% of the effluent (230 ML/yr) would be used in the dual reticulation system and hence 215 ML/yr (48% of the effluent) would be discharged to South Creek. This provides environmental benefits compared to Options 1, 2, 3 and 4 by reducing the loads of nutrients that are discharged to South Ck.
- Effluent reuse: This option includes a dual reticulation system to provide recycled water to each home. This reduces the reliance on potable water and enables more lots to be serviced by the potable water infrastructure that is installed to service MPP Stage 1. This delays the need for future potable water infrastructure. This also provides environmental benefits by reducing the loads of nutrients discharged to South Ck and social benefits through a reliable source of water for home outdoor usage, even during periods of minimal rain and water restrictions. This is likely to positively affect the marketability of the homes.
- Time to implement: Similar to Option 4.
- Servicing of first few hundred lots: Similar to Option 4.

5.8. Servicing Option 7

5.8.1. Overview

This option is a combination of Options 5 and 6. That is, this option involves an on-site treatment plant with the effluent reused both for irrigation of suitable land t and for urban recycling through a dual reticulation system. Hence this option attempts to maximise the reuse of treated effluent. This option provides the benefits of Options 5 and 6.

Water balance modelling was undertaken over 50 years with 115 ha of irrigated area as pasture and 40 ML of storage, along with recycling to 2,500 homes, each with 100 m^2 of pasture for garden usage and recycling indoors for toilet flushing and washing machine use. The water balance modelling indicated that on average 230 ML/yr would be recycled to homes via the dual reticulation system, 190 ML/yr would be recycled for irrigation of low lying areas, and the remainder of 25 ML/yr would be discharged. This represents a discharge of 6% of the effluent and reuse of the remaining 94%.

It is noted that the water balance model included an allowance of 8.5% of the yearly average effluent volume to account for wet weather infiltration to the sewer system, which equates to an average volume of 35 ML/yr. It is noted that the average yearly volume of effluent that is discharged (25 ML/yr) in this option is less than the average yearly wet weather infiltration (35 ML/yr). Therefore on an average yearly volumetric basis the effluent that is discharged is less than the wet weather infiltration to the sewer system. However this doesn’t mean that effluent is only

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discharged during wet weather. The modelling indicates that unless a precautionary discharge approach is adopted, only about a third of the days that involve discharge of effluent correspond to rainfall days (rainfall days are defined as days with more than 0 mm of rain). The other two thirds of the discharge occur on days where there is no rainfall.

A precautionary discharge approach was not modelled due to its complexity. Such an approach would require additional infrastructure to store effluent and control the discharge of effluent at allowable times, possibly including measurement of creek flows. Hence if the approval for an on-site treatment plant required 'no dry weather discharges' there would be cost implications which have not been investigated in this report.

In summary this option involves the construction of:

- SPS F: a pump station located at the junction of the Marsden Park Carrier Section 1 and the Richmond Rd Carrier (at 'Pt F' in **Figure 9**)
- RM: a rising main to transfer wastewater to the on-site plant (nominal length of 1.5 km).
- Onsite WWTP: a new wastewater treatment plant located within the MPP.
- Irrigation system for effluent reuse (115 ha irrigation area and 40 ML storage): The effluent from the WWTP would be used for irrigation of suitable land.
- Dual reticulation system consisting of storage reservoir (nominal 1 ML storage), pressure pumps and pipe network for 2,500 lots.

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- **Table 19 Servicing Option 7 Summary**

Components	Capacity Scenario
	A - MPP Stage 1
Reticulation system	Low infiltration gravity assumed
RR2 Diameter / Grade / Avg. Depth	These gravity mains are not required but allowance was made for a DN375 pipe to discharge eflfuent to South Creek with nominal distance of 1 km
RR1 Diameter / Grade / Avg. Depth	
SPS F Flow / Power / SPS Depth	90 L/s / 53 kW / 4.0 m
RM Diameter / Residence	DN250 / 1.6 hrs
Treatment Plant	All wastewater treated at on-site treatment plant
Effluent Management	Irrigation of 115 ha of low lying land combined with a dual reticaultion system, with 6% discharged to South Creek

5.8.2. Discussion

The following factors were considered:

- Precincts that can gravity feed to the pump station: Similar to Option 4.
- Electrical considerations: Similar to Option 4.
- Depth of carriers: Similar to Option 4.
- Depth of pump station: Similar to Option 4.
- Capacity issues – carriers: Similar to Option 4.
- Rising main residence time: Similar to Option 4.
- Easements and land acquisition: Similar to Option 4.
- Effluent discharge to South Ck: Compared to Option 4, on average 94% of the effluent (420 ML/yr) would be used and hence only 25 ML/yr (6% of the effluent) would be discharged to South Creek. This provides environmental benefits compared to all of the other options by significantly reducing the loads of nutrients that are discharged to South Ck.
- Effluent reuse: This option includes a dual reticulation system to provide recycled water to each home. This reduces the reliance on potable water and enables more lots to be serviced by the potable water infrastructure that is installed to service MPP Stage 1. This delays the need for future potable water infrastructure. In addition this option includes irrigation of suitable land within MPP. This could include irrigation of parks and gardens, as well as for agriculture

on suitable land. The area of land that could be irrigated with treated effluent would require further investigation, taking into consideration future land uses and other factors. Together these features provide environmental benefits by reducing the loads of nutrients discharged to South Ck and social benefits through a reliable source of water for home outdoor usage, even during periods of minimal rain and water restrictions, as well as a reliable source of irrigation water. This is may improve the marketability/attractiveness of the homes.

- Time to implement: Similar to Option 4.
- Servicing of first few hundred lots: Similar to Option 4.

5.9. Servicing Option 8

5.9.1. Overview

This option is the similar to Option 5 except that the irrigation reuse system is expanded in order to achieve the same level of reuse as for Option 7. That is, the discharge volume for this option is close to the volume discharged for Option 7 (i.e. 25 ML/yr).

The water balance model was used to investigate different combinations of irrigation area and storage volume in order to minimise the discharge of effluent. The modelling indicates that if the storage volume is increased to 60 ML and the irrigation area is increased to 175 ha, the average yearly volume of effluent that is discharged to South Ck drops to 26 ML/yr (6% of the effluent). This is similar to Option 7.

As noted for Option 7, this doesn't mean that effluent would only be discharged on days that there is rainfall. The modelling indicates that, similar to Option 7, only a third of the days that effluent is discharged correspond to rain days, with the other two thirds being non-rain days. In order to only discharge weather during rainy days, a precautionary discharge approach would need to be adopted which would require additional infrastructure and hence additional cost. Complex modelling of the flow in South Creek would need to be undertaken to further investigate a precautionary discharge approach. It is noted that the flow in South Creek would be dependent on development of the South West Growth Centre (SWGC), including the fate of effluent discharges from any new wastewater treatment plants that would be constructed in the SWGC. Hence a precautionary discharge approach has not been further investigated in this report.

Also as noted for Option 5, the area of land that is suitable and available for effluent irrigation would need to be further examined in detail if this option is identified as the preferred option. This would include undertaking site and soil suitability investigations to determine the feasibility of irrigating specific areas with treated effluent, as well as considering future land use and land ownership issues.

In summary this option involves the construction of:

- SPS F: a pump station located at the junction of the Marsden Park Carrier Section 1 and the Richmond Rd Carrier (i.e. at the location marked as 'Pt F' in **Figure 9**)
- RM: a rising main to transfer wastewater to the on-site plant (1.5 km).
- Onsite WWTP: a new wastewater treatment plant located within the MPP.
- Irrigation system for effluent reuse (175 ha irrigation area and 60 ML of storage): The effluent from the WWTP would be used for irrigation of suitable land, particularly land that is below the 1 in 100 year flood level. The remainder of the effluent would be discharged to South Ck (either directly or via a tributary).

Table 20 Servicing Option 8 Summary

Components	Capacity Scenario
	A - MPP Stage 1
Reticulation system	Low infiltration gravity assumed
RR2 Diameter / Grade / Avg. Depth	These gravity mains are not required but allowance was made for a DN375 pipe to discharge eflfuent to South Creek with nominal distance of 1 km
RR1 Diameter / Grade / Avg. Depth	
SPS F Flow / Power / SPS Depth	90 L/s / 53 kW / 4.0 m
RM Diameter / Residence	DN250 / 1.6 hrs
Treatment Plant	All wastewater treated at on-site treatment plant
Effluent Management	Irrigation of 175 ha of low lying land, with 6% discharged to South Creek

5.9.2. Discussion

The following factors were considered:

- <u>Precincts that can gravity feed to the pump station</u>: Similar to Option 5.
- <u>Electrical considerations</u>: Similar to Option 5.
- <u>Depth of carriers</u>: Similar to Option 5.
- <u>Depth of pump station</u>: Similar to Option 5.
- <u>Capacity issues – carriers</u>: Similar to Option 5.
- <u>Rising main residence time</u>: Similar to Option 5.

- Easements and land acquisition: Similar to Option 5.
- Effluent discharge to South Ck: Compared to Option 5, on average only 26 ML/yr (6% of the effluent) would be discharged to South Creek. This provides environmental benefits similar to Option 7 by reducing the loads of nutrients that are discharged to South Ck.
- Effluent reuse: In this option the majority of the effluent (94%) is reused for irrigation of 175 ha of low lying areas within MPP (and possibly other areas). This has environmental benefits by reducing the loads of nutrients discharged to South Ck and social benefits through a reliable source of irrigation water. This could include irrigation of parks and gardens, as well as for agriculture on land that is below the 1 in 100 year flood level.
- Time to implement: Similar to Option 5.
- Servicing of first few hundred lots: Similar to Option 5.

6. Options Shortlisting

6.1. Overview

A stakeholder workshop was held on 8th June to compare options and gain input from a range of stakeholders. Prior to the workshop three options were selected in conjunction with Sydney Water for presentation at the workshop. Following the workshop additional work was undertaken to further investigate selected options.

This section of the report outlines the work that was undertaken prior to the workshop including the selection of the three options to workshop from the matrix of options and capacities that were outlined in **Section 5**.

Section 7 discusses the workshop and outcomes, and **Section Error! Reference source not found.** covers the work that was undertaken following the workshop.

6.2. Capital Cost

6.2.1. Basis for Costing

Capital cost estimates were developed for the options based on the following:

- Gravity main unit rates are shown in **Appendix A**,**Error! Reference source not found.** including the unit rates adopted for additional costs where the average depth of the gravity main exceeded 1.5 m. The average depth was rounded to the nearest 0.5 m.
- Rising main unit rates are shown in **Appendix AError! Reference source not found.**.**Error! Reference source not found.**
- Land acquisition based on $2 M per ha
  - Land area for SPS C for Option 1 and SPS G for Option 2 of 2,000 m^2
  - Land area for SPS F for Option 3 of 1,000 m^2
  - Width of land for road of 4 m
  - Land area for onsite treatment plant for Option 4 of 4,000 m^2
- Easement costs based on $0.667 M per ha
  - Easements for gravity mains DN600 and over (5 - 7 m depending on diameter)
  - Easements for all rising mains (3 - 6 m depending on diameter)
- Cost for on-site treatment plant considered only liquids treatment (i.e. no biosolids treatment) and was based on package MBR with a cost of $9.0 M for 7,500 EP excluding land acquisition and access road (and land acquisition for access road)
- Pump station costs based on Sydney Water Cost Estimating Manual (with graphs provided in **Appendix A**) with additional cost of emergency storage added based on 6 hours storage of PDWF at $1,600 per m^3 of concrete required (based on a circular tank with wall and floor

thickness of 0.4 m). This approach was taken because it is understood that the manual can tend to underestimate the costs for small pump stations, hence a conservative approach was taken for estimating the emergency storage costs

- Allowance of $500,000 direct cost was included for mitigation of issues associated with long (> 2 hr) retention time in rising mains
- Site establishment equal to 5% of sewer main and pump station/treatment plant costs
- Professional services equal to 10% of direct costs (excluding site establishment)
- Contingency equal to 15% of costs
- Gravity mains for all options were sized to complying with self cleansing requirements but not slime control requirements

6.2.2. Capital Cost Estimates

Indicative capital cost estimates were prepared for comparison of options as shown in **Table 21**.

- **Table 21 Capital Cost Estimates**

Servicing Option	Capacity Scenario					
	A - MPP Stage 1	B - MPP Stage 1 + 2	C - MPP Ultimate	D - Half of NWGC Ultimate	E - MPP + MPIP Ultimate	F - NWGC Ultimate
Transfer Strategy Options						
1 - SPS C	$18.2 M	$21.0 M	$28.0 M	$30.8 M	$32.4 M	$40.2 M
2 - SPS G	$15.6 M	$18.3 M	$23.3 M	$25.4 M	$27.2 M	$36.4 M
3 - SPS F	$11.7 M	$14.2 M	$16.3 M	$15.9 M	$18.5 M	$19.3 M
Onsite Treatment Strategy Options						
4 - Onsite with discharge	$20.2 M	-	-	-	-	-
5 - Onsite with irrigation reuse	Not Costed	-	-	-	-	-
6 - Onsite with urban reuse	Not Costed	-	-	-	-	-
7 - Onsite with urban + irrigation reuse	Not Costed	-	-	-	-	-
8 - Onsite with expanded	Not Costed	-	-	-	-	-

Servicing Option	Capacity Scenario					
	A - MPP Stage 1	B - MPP Stage 1 + 2	C - MPP Ultimate	D - Half of NWGC Ultimate	E - MPP + MPIP Ultimate	F - NWGC Ultimate
irrigation reuse						

It is noted that the capital cost estimates are for the design and construction contract costs (and include the costs for land acquisition and easements which would typically not be incurred by the design and construction contractor). Hence the allowance of 10% for professional services is for costs incurred by the design and construct contractor. It does not include costs typically incurred by Sydney Water (or other parties) such as Sydney Water design review costs, tender costs, planning costs, project management, and project insurances.

Further work, such as concept design and detail design, would be required to be completed in order to improve the accuracy of the cost estimates.

As noted previously, the options shown in **Table 21** relate to the costs of the infrastructure that could be installed in the immediate future (2013/2014) to service Marsden Park Stage 1. Costs for staged rollout of infrastructure in the future is discussed in **Section Error! Reference source not found.**.

6.2.3. Discussion

General comments on the capital cost estimates:

- Comparison of Option 1D (this is Servicing Option 1 (SPS C) at Capacity Scenario D (Half of NWGC Ultimate)) against Option 1F (this is Servicing Option 1 (SPS C) at Capacity Scenario F (NWGC Ultimate)) indicates that there is an anticipated saving of around $9.3 M by initially constructing infrastructure at a capacity to service half of the ultimate development instead of all of ultimate development.
  - A cost estimate was developed to gain an indication of the possible capital cost for constructing the second stage of Option 1D after the first Option 1D is constructed. Together the two stages of Option 1D would service all of ultimate development of the NWGC, similar to Option 1F. This indicates that an additional $24.1 M would need to be spent at some time in the future.
  - Using a discount rate of 7.5%, a future cost of $24.1 M equates to a present cost of $9.3 M over 13 years.
  - Therefore, if the second stage of Option 1D can be delayed by significantly more than 13 years, the net present cost of Option 1D (Stage 1 and Stage 2) is less than the net present cost of constructing Option 1F. Option 1D services a total of around 44,000 EP (within the

NWGC, or at least the precincts serviced by RR1) including both residential and industrial EP.

  - Based on the development projections, 44,000 EP would be reached in 2024-2025, which is close to 13 years. Based on these development projections there would be no cost savings to construct Option 1F instead of Option 1D x 2. However, there are other impacts, such as operational benefits, that need to be considered in conjunction with Sydney Water. Furthermore, this comparison of Option 1F against Option 1D is only a high level comparison as it does not provide a cost comparison of staging of individual assets, such as gravity mains and rising mains.

- A cost estimate was developed for Option 1F for the gravity carriers at a steeper grade to comply with the slime control requirements: $44.6 M. This is $4.4 M (or 11%) larger than the cost for Option 1F shown in **Table 21** which ignores the slime control requirement ($40.2 M).
- Servicing Option 2 is cheaper than Servicing Option 1 for each capacity scenario. This is because Option 2 avoids the need to construct Richmond Rd Carrier Section 1 which is a large diameter gravity main.
- Servicing Option 3 is the cheapest for all capacity scenarios. This is because in this option RR2 and RR1 are replaced with a rising main which is smaller in diameter and installed at less depth. However due to the location of the pump station in Option 3 (SPS F), this option does not service all of the precincts that are serviced by Option 1 and Option 2. Hence additional infrastructure would be required to service the remaining precincts. This would increase the capital cost above what is shown, with the cost depending on the servicing solution that is adopted for these precincts.
- Servicing Option 4 (on-site treatment) has a higher capital expenditure than the other options for Capacity Scenario A (MPP Stage 1). Cost estimates were not developed for Options 5 to 8 as these would be higher than Option 4 due to additional infrastructure associated with reuse of effluent.
- To service MPP Stage 1, the option with the lowest capital cost is Option 3A. However it would be possible to upsize the infrastructure to service MPP Stage 1 and 2 for an additional cost of $2.5 M and implement Option 3B (capital estimate of $14.2 M). This involves constructing a pump station with capacity of around 163 L/s with a DN375 rising main.

6.3. Time to Implement

Another important consideration for comparison of the options is the time required to implement the option. This includes the time required to undertake planning and approvals, acquire the easements and land, as well as design, construction and commissioning. The time required for each of these project phases depends on a number of factors. For example the construction time for a particular option would depend on the number of construction crews that are working simultaneously as well as other factors such as ease of access to the construction sites and any environmental controls, such as location of spoil stockpiles.

As such the servicing options have been assigned a relative rating in terms of the time to implement: longer, mid, and shorter. The following factors were considered when determining the relative rating:

- The options consist of various combinations of gravity mains, rising mains, pump stations and on-site treatment, with differences in the magnitude/scale of these assets
- Generally the pump stations are on the critical path as they require time for testing and commissioning, which can only be completed once the entire length of rising main has been completed
- The rising mains and gravity mains generally require easements to be obtained, whereas the pump stations (and associated access road) and on-site treatment (and associated access road) requires land to be acquired. It is anticipated that:
  - Acquiring land that is owned by others (not Winten / Stockland) has significant potential to increase the time to implement, particularly if compulsory acquisition is required (which could take in the order of 12 months to be completed and requires Minister approval for Sydney Water to act)
  - Acquiring land that is owned by Winten / Stockland has minimal timing implications
  - Purchasing an easement over land that is owned by others (not Winten / Stockland) has the potential to increase the time to implement, similarly to acquiring land that is owned by others
  - Purchasing an easement over land that is owned by Winten / Stockland has minimal timing implications
- Rising mains and gravity mains generally can be constructed with multiple crews working simultaneously. This is particularly the case where there are fixed points to work from, such as underbores of Richmond Rd and South Ck. Other factors that affect the time to construct these assets include the diameter of the main, with larger diameter mains generally taking longer to construct, as well as the depth of the main, with deeper mains taking longer to construct. Also points of access along the pipe route can affect construction time.
- In summary, for the transfer strategy options:
  - Servicing Options 3A and 3B were considered to have a shorter time to implement as these options had pump stations on land owned by Winten/Stockland and had small diameter rising mains (DN300 and DN375) that would be plastic (PE) as opposed to metal (e.g. DICL or SCL)
  - Servicing Options 1D, 1E, 1F were considered to have a longer time to implement due to large diameter (DN900 and above) diameter gravity mains with the pump station and long access road through non Winten/Stockland owned land

- Servicing Option 2F was considered to have a longer time to implement due to large diameter (DN900) rising main which is SCL (welded) with the pump station and long access road through non Winten/Stockland owned land
- On-site treatment is anticipated to have a significant planning and approvals time, due to the environmental studies and approvals required for the discharge of treated effluent.
  - For this reason Servicing Options 4 to 8 are considered to have the longest time to implement.

Table 22 Time to Implement

Servicing Option	Capacity Scenario					
	A - MPP Stage 1	B - MPP Stage 1 + 2	C - MPP Ultimate	D - Half of NWGC Ultimate	E - MPP + MPIP Ultimate	F - NWGC Ultimate
Transfer Strategy Options						
1 - SPS C	Mid	Mid	Mid	Longer	Longer	Longer
2 - SPS G	Mid	Mid	Mid	Mid	Mid	Longer
3 - SPS F	Shorter	Shorter	Mid	Mid	Mid	Mid
Onsite Treatment Strategy Options						
4 - Onsite with discharge	Longer	-	-	-	-	-
5 - Onsite with irrigation reuse	Longer	-	-	-	-	-
6 - Onsite with urban reuse	Longer	-	-	-	-	-
7 - Onsite with urban + irrigation reuse	Longer	-	-	-	-	-
8 - Onsite with expanded irrigation reuse	Longer	-	-	-	-	-

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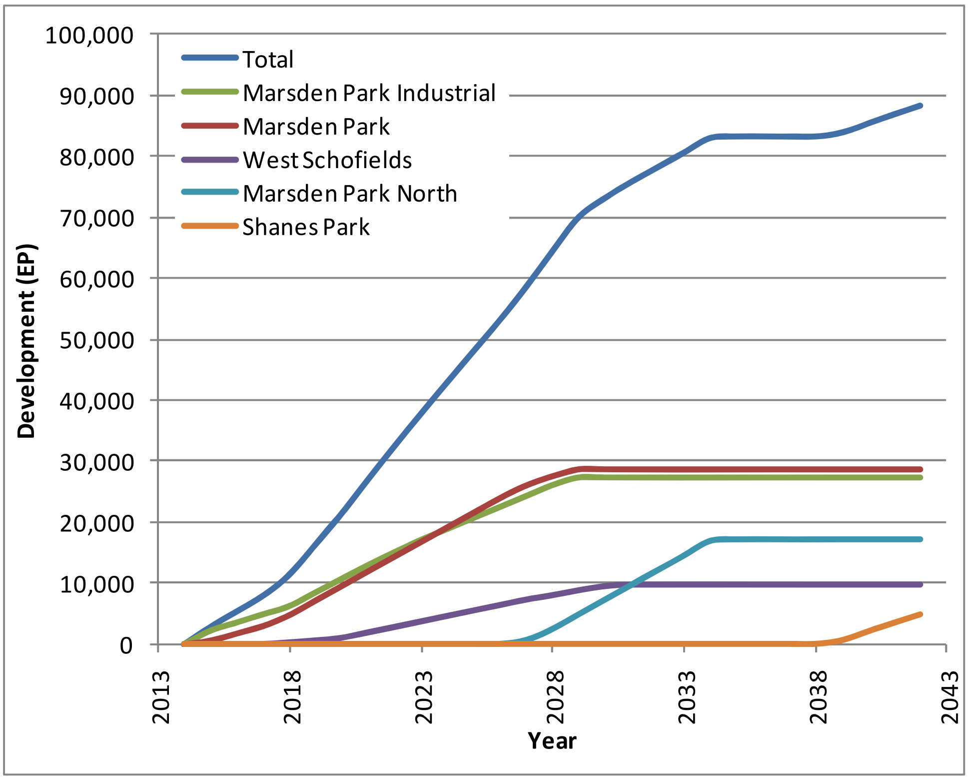
6.4. Sequencing of Other Precincts

The precincts that ultimately drain to RR1 are Marsden Park, Marsden Park Industrial, West Schofields, Marsden Park North and Shanes Park. The development projections for these precincts are outlined in **Table 7** and are shown graphically in **Figure 12**.



- **Figure 12 Development of Precincts**

This information indicates that development would start at a similar time within Marsden Park and Marsden Park Industrial and would occur over a similar timeframe with both precincts being fully developed by around the end of 2029 with around 28,000 EP each.

MPIP Stage 1 wastewater infrastructure (which includes a pump station and rising main for transfer of wastewater to the Quakers Hill system) services 60 ha of industrial development which is equivalent to around 4,500 EP based on 75 EP per ha. Based on the development projections this capacity would be reached in around 2017-2018 depending partly on the rate of residential development within MPIP. Once the capacity of the Stage 1 infrastructure is reached additional wastewater infrastructure will need to be installed. APP Corporation (who is working on behalf of the developer of MPIP) have indicated that the next stage of development within MPIP would occur in the areas that drain to the Marsden Park North Carrier (refer **Figure 5**), either directly or via SPS B, rather than within the catchment of Richmond Road Carrier Section 2 as these areas are likely to be the last to be developed.

Marsden Park Stage 1 services 7,500 EP which would be reached by the end of 2019. The next two stages of Marsden Park, as shown in **Figure 2**, are within the catchment of Richmond Road Carrier Section 2, with later stages occurring within the catchment of the Marsden Park North Carrier.

The development projections indicate that West Schofields would start to develop in around 2018 and would be completely developed by around 2031 (9,834 EP). The West Schofields precinct lies within the catchment of the Marsden Park North Carrier, via SPS B. Marsden Park North would be the next precinct to be developed with development commencing in 2027, followed by Shanes Park in 2039.

Based on the above, the timing for the Marsden Park North Carrier is primarily governed by development within MPIP, and secondly by development within West Schofields. That is, in terms of timing, the construction of the Marsden Park North Carrier is first required to service Marsden Park Industrial and West Schofields. Later stages of development of Marsden Park (Stages 4 and 5) would drain to the Marsden Park North Carrier, but based on **Figure 12** these stages are anticipated to occur well after the Marsden Park North Carrier has been constructed to service Marsden Park Industrial and West Schofields.

In summary, the timing for the Richmond Road Carrier Section 2 is governed by development within Marsden Park, and the timing for the Marsden Park North Carrier is governed by development within Marsden Park Industrial and West Schofields.

- Capacity Scenario A, which is equivalent to Stage 1 of Marsden Park (7,500 EP) would be reached at the end of 2019 based on development of the Marsden Park Precinct.
- For Capacity Scenario B, which is equivalent to Stage 1 and 2 of Marsden Park (15,000 EP):
  - For the Richmond Rd Carrier Section 2 and SPS F, this capacity would be reached by the end of 2022 based on development within the Marsden Park Precinct. It is understood that the next stage of development within the Marsden Park Industrial Precinct would occur on the middle and eastern side of the precinct which does not drain to Richmond Rd Carrier Section 2, hence development within MPIP would not affect the timing for exceeding the capacity of these assets for Capacity Scenario B.
  - For the Richmond Rd Carrier Section 1 and SPS G and SPS C, this capacity would be reached in early to middle of 2020. This includes development within the Marsden Park Industrial Precinct in excess of the MPIP Stage 1 capacity. Hence it assumes that MPIP Stage 1 would continue to transfer wastewater from 4,500 EP to the Quakers Hill System.
- MPIP Stage 1 wastewater infrastructure capacity would be reached in around 2017-2018 depending partly on the rate of residential development within MPIP

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6.5. Capacity of Riverstone WWTP and Network

There are two types of capacity constraints:

- Dry weather constraints relate mainly to the capacity of Riverstone WWTP
- Wet weather capacity constraints include wet weather overflow targets for both the treatment plant and the sewer system / network (pipes and pumps).

These two types of constrains are discussed below.

6.5.1. Dry Weather Capacity

Sydney Water has stated that Riverstone WWTP will be amplified in the near future 2015-2020, with further future amplifications as required to service development within the NWGC. Therefore the issue of dry weather capacity is restricted to the short term period prior to amplification of the plant.

The future flow to Riverstone WWTP was estimated based on development projections provided for the existing catchment, as well as the development rates for precincts shown in **Table 7**. These have been shown in **Table 23** up to 2020 by which time the plant would have been amplified. The development projections were converted into equivalent population using both an occupancy rate of 3.0 EP/dwelling (as was adopted in the remainder of this document) as well as an occupancy rate of 2.8 EP/dwelling for sensitivity analysis.

The EP projections were converted into average dry weather flow (ADWF) using a per capita flow of 150 L/EP/d and a current flow to the plant of 1.8 ML/d. Graphs (**Figure 13** and **Figure 14**) were produced to investigate the time at which the existing plant capacity would be exceeded, both for an existing plant capacity of 5.4 ML/d and 4.0 ML/d. The lower value of 4.0 ML/d was investigated as Sydney Water is currently reviewing the rated capacity of their plant and have indicated that the capacity may be downgraded to as low as 4.0 ML/d.

For the graphs, the yearly development projections were allocated to occur at the middle of the calendar year (which is the same as the end of the financial year) as per the development projections shown in **Table 7**.

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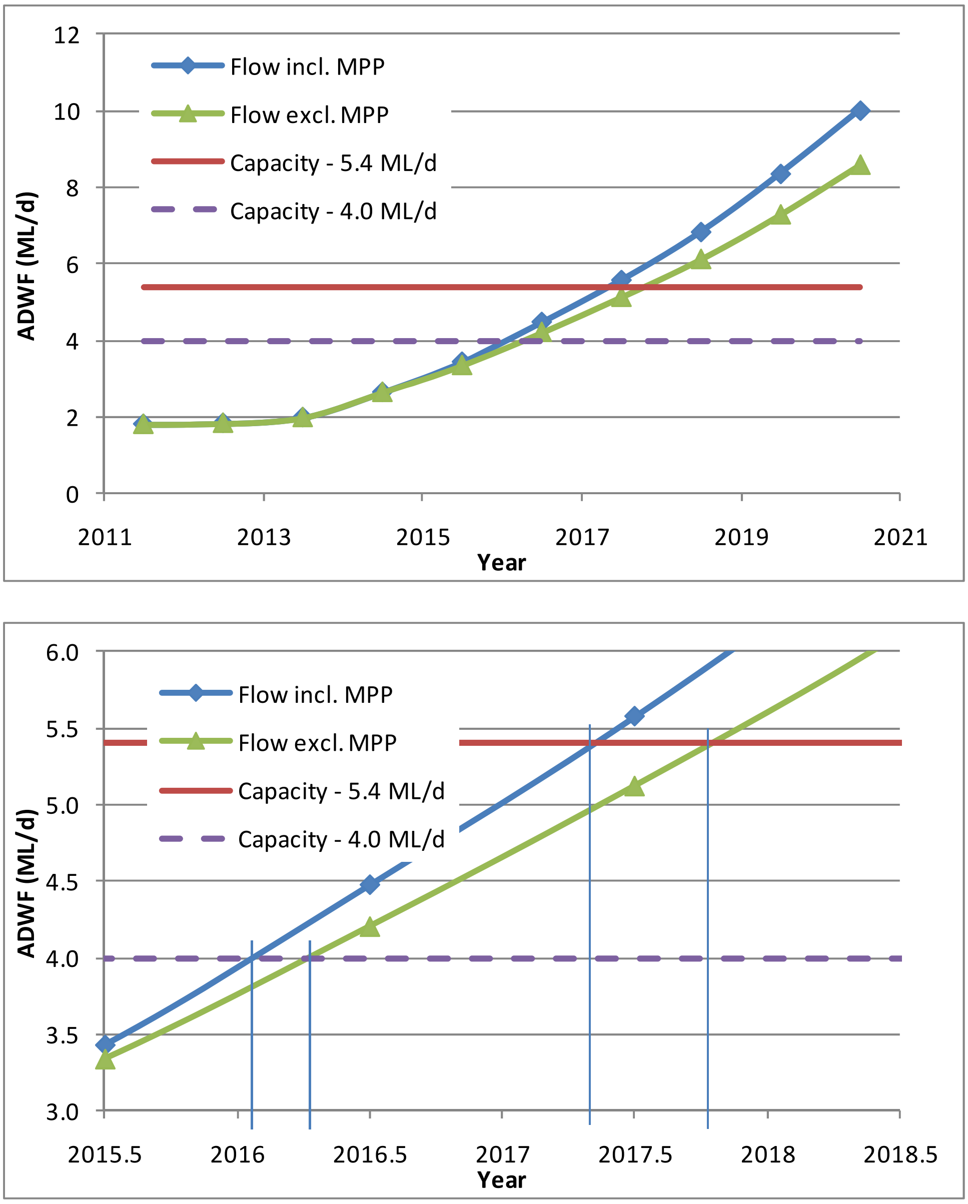
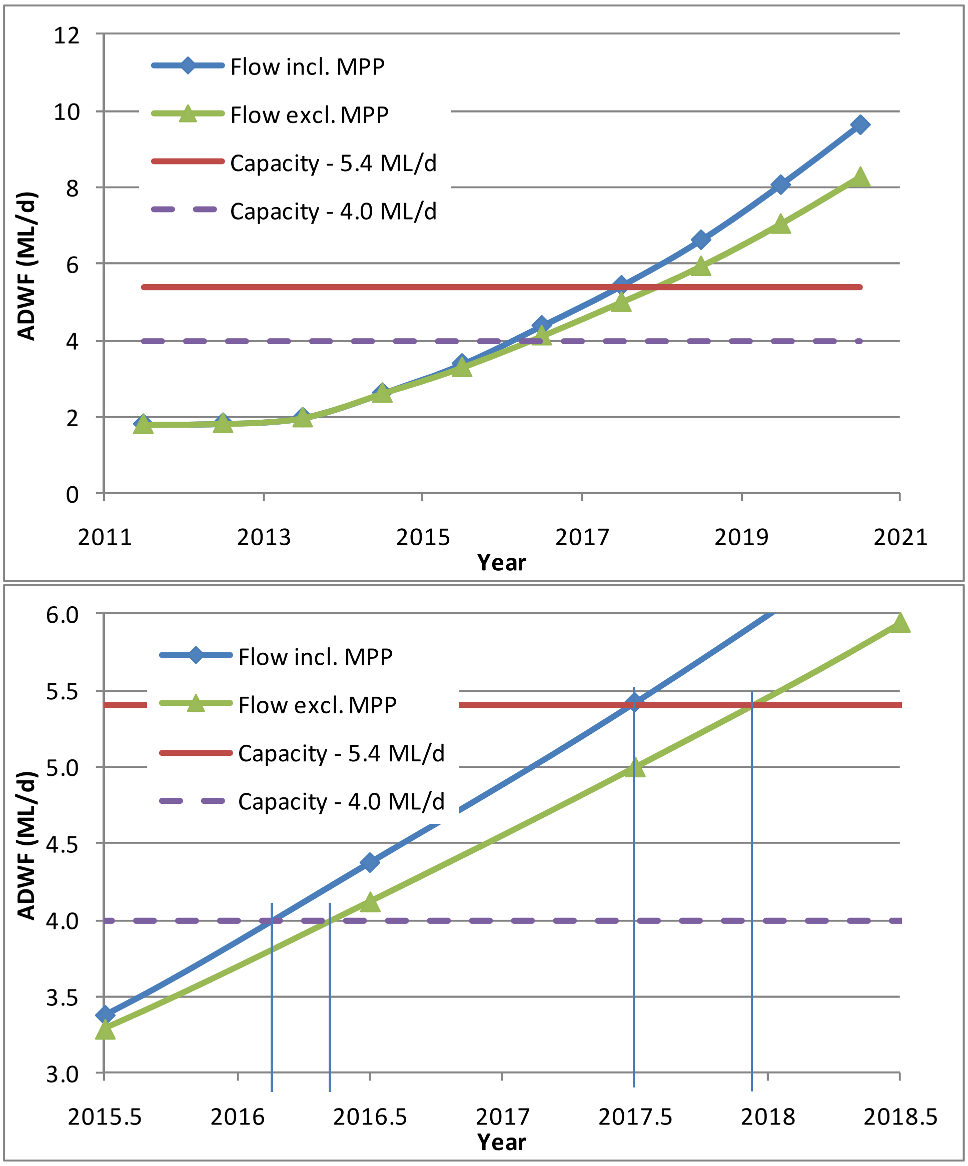
▪ **Table 23 Projected Development within Catchment of Riverstone WWTP**

Precinct / Development	Unit	Development Projections (Dwellings or EP)								
		2012	2013	2014	2015	2016	2017	2018	2019	2020
Riverstone	Dwl	25	25	50	50	200	300	400	400	400
Schofields	Dwl		-	100	150	200	275	350	400	400
West Schofields	Dwl							100	100	150
Box Hill	Dwl		-	100	200	400	400	400	400	600
Alex Avenue	Dwl			410	450	450	400	400	500	500
Riverstone East	Dwl								50	100
Vineyard	Dwl								50	75
Marsden Park	Dwl				200	400	400	600	800	800
Marsden Park Industrial	Dwl	Excluded as MPIP Stage 1 trasnfers flow to Quakers Hill							150	150
Riverstone West (Industrial)	EP		450	1,500	1,125	750	750	750	750	750
Other Industry	EP		375	375	375	475	475	500	375	375
Commercial / Retail	EP			375	375	450	450	150	200	175
Schools	EP	100	100	150	200	300	250	200	250	200
Parks / Sport fields	EP			25	50	50	75	50	50	50
EXCLUDING MARSDEN PARK										
Total excl. MP	Dwl	25	25	660	850	1,250	1,375	1,650	2,050	2,375
TOTAL with 2.8 EP/Dwl	EP	170	995	4,273	4,505	5,525	5,850	6,270	7,365	8,200
TOTAL with 3.0 EP/Dwl	EP	175	1,000	4,405	4,675	5,775	6,125	6,600	7,775	8,675
INCLUDING MARSDEN PARK										
Total incl. MP	Dwl	25	25	660	1,050	1,650	1,775	2,250	2,850	3,175
TOTAL with 2.8 EP/Dwl	EP	170	995	4,273	5,065	6,645	6,970	7,950	9,605	10,440
TOTAL with 3.0 EP/Dwl	EP	175	1,000	4,405	5,275	6,975	7,325	8,400	10,175	11,075



- **Figure 13 Project Flow to Riverstone WWTP at 3.0 EP/Dwelling**



- **Figure 14 Project Flow to Riverstone WWTP at 2.8 EP/Dwelling**

Table 24 summarises the results from **Figure 13** and **Figure 14** in terms of the required date for the completion of the upgrade of Riverstone WWTP. In addition, the analysis was repeated for a reduced rate of development within the catchment of Riverstone WWTP by multiplying all development (excluding Marsden Park) by a factor of 80%. This effectively slows down development and pushes back the required date for amplification of Riverstone WWTP. These results are shown in **Figure 15** and **Figure 16**.

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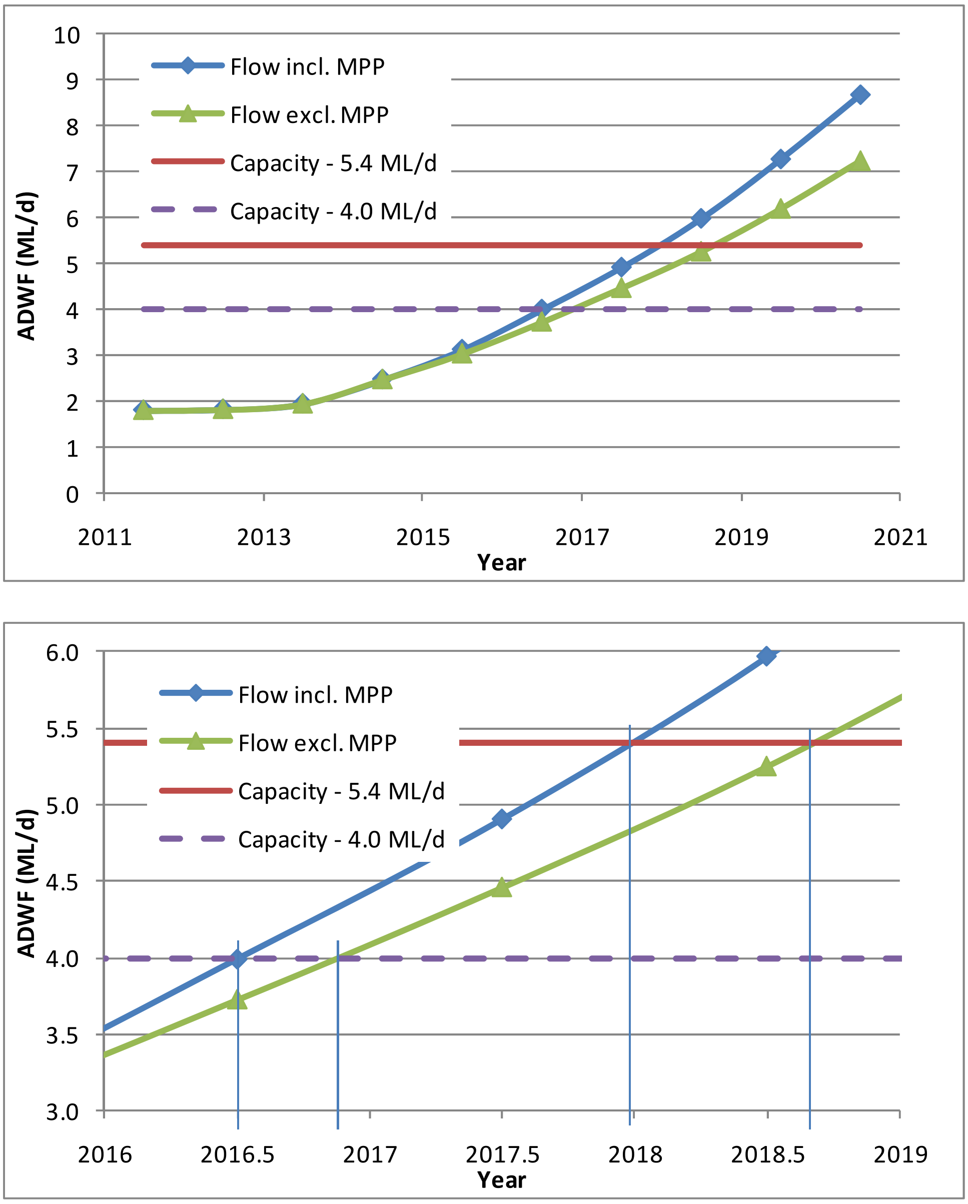
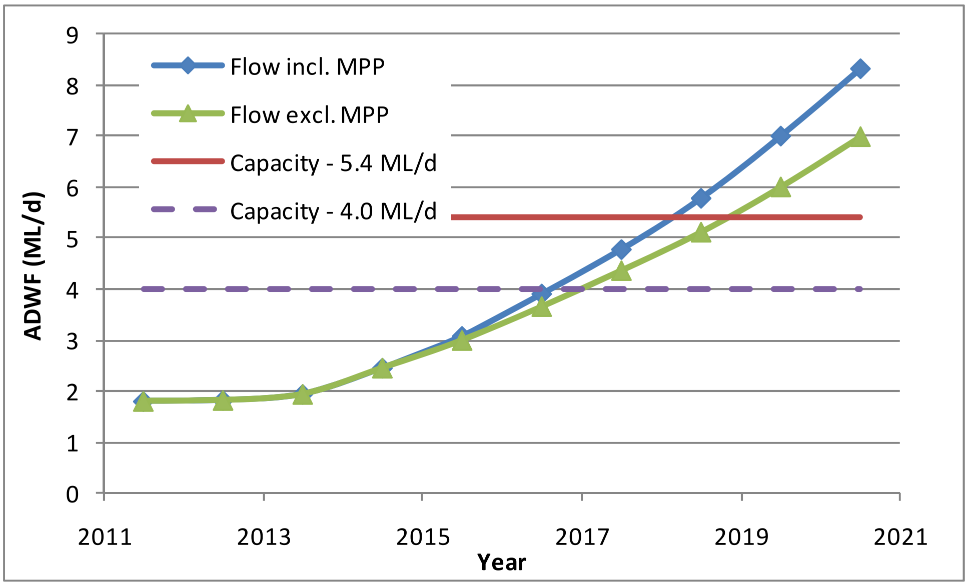
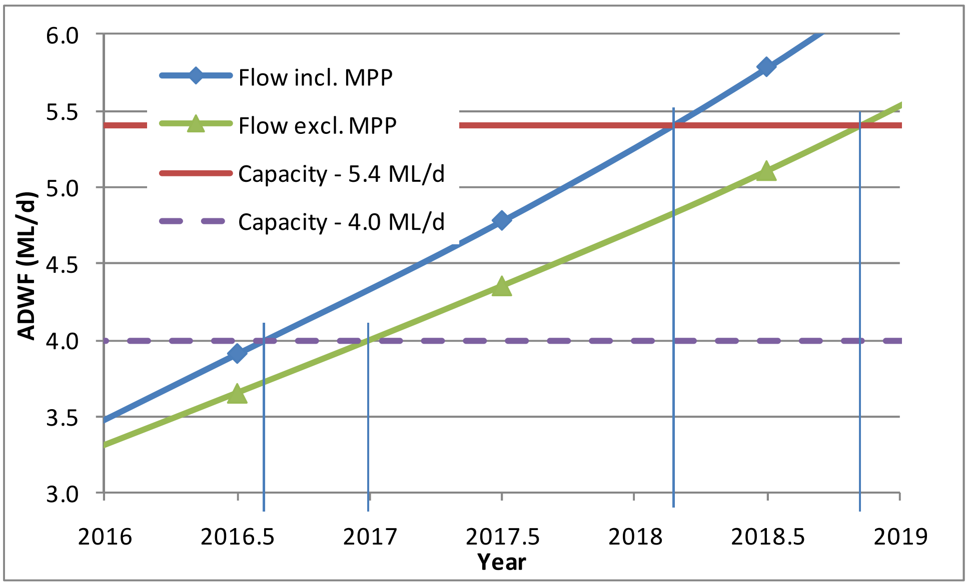


- **Figure 15 Project Flow to Riverstone WWTP at 3.0 EP/Dwelling at 80% of Projections**





- **Figure 16 Project Flow to Riverstone WWTP at 2.8 EP/Dwelling at 80% of Projections**

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- **Table 24 Required Date for Amplification of Riverstone WWTP**

	Riverstone WWTP = 5.4 ML/d		Riverstone WWTP = 4.0 ML/d	
	Excluding MP	Including MP	Excluding MP	Including MP
Development at 100% of Projections				
Occupancy rate of 3.0 EP/Dwl	End 2017	Mid 2017	Mid 2016	Early 2016
Occupancy rate of 2.8 EP/Dwl	End 2017	Mid 2017	Mid 2016	Early 2016
Development at 80% of Projections (MP at 100% of Projections)				
Occupancy rate of 3.0 EP/Dwl	Mid 2018	End 2017	End 2016	Mid 2016
Occupancy rate of 2.8 EP/Dwl	End 2018	Early 2018	End 2016	Mid 2016

At the projected development rates, the inclusion of Marsden Park brings forward the required timing for the upgrade of Riverstone WWTP by less than 6 months to around the middle of 2017 if the plant capacity is set at 5.4 ML/d. At a lower plant capacity of 4.0 ML/d the plant upgrade is required much earlier in 2016, and in this case the inclusion of Marsden Park has a smaller impact of a few months.

If the development rate within the existing catchment occurs at only 80% of the projected rate, with a plant capacity of 5.4 ML/d the upgrade of Riverstone WWTP can be pushed back to around the middle or end of 2018 (depending on the occupancy rate), whilst the inclusion of Marsden Park would require the upgrade to occur at the start of 2018. With a plant capacity of 4.0 ML/d the upgrade would need to occur at the end of 2016 without Marsden Park, and middle of 2016 with Marsden Park.

Hence the timing for the upgrade of Riverstone WWTP is mostly affected by its rated capacity with relatively minor impact due to Marsden Park Stage 1.

With regards to the dry weather capacity of the wastewater network, the key consideration is periodically operating the pump stations at a sufficient flow to flush out the rising mains. This particularly applies to the new SPS1154 that will be constructed as part of the Package 2 works. In the automatic pump station control system this could be timed to occur so as to not cause an impact on the remainder of the network, particularly to avoid dry weather overflows.

Typically dry weather overflows from the wastewater network are mitigated by adopting Sydney Water's risk management approach, with potential solutions including providing emergency storage at the pump stations. In this project, for the purposes of costing, a general allowance has been made for emergency storage at the new pump stations as outlined in **Section 6.2.1**. The actual requirements to mitigate the risk of dry weather overflows would be determined at a later stage of the project (design) and would be clearly outlined on the Needs Specification for any new pump station.

6.5.2. Wet Weather Capacity

Sydney Water has informed SKM that until Riverstone WWTP is upgraded, wastewater from any new pump station that feeds Riverstone WWTP would need to discharge to the existing SPS564 from where flow would be pumped to Riverstone WWTP via the existing rising mains. This avoids the need to connect new rising mains into the existing inlet works. A similar approach is being adopted for the new SPS1154 which will be constructed in the near future as part of the Package 2 works.

Once a new inlet works has been constructed at Riverstone WWTP, the rising mains from all pump stations would discharge directly to the new inlet works, hence this is a temporary issue. However in the meantime there is the potential that discharging wastewater from a new pump station to service Marsden Park and SPS1154 to SPS564 may negatively impact the operation of the existing network. In particular the frequency of overflows which are regulated through the Environment Protection Licence for the Riverstone Wastewater System. Therefore network modelling has been undertaken to better understand the potential impacts and possible mitigation measures.

As Riverstone WWTP is likely to be amplified by 2018, wastewater network modelling was undertaken for the future 2018 conditions. This included growth within the existing catchment as well as discharge from SPS1154 to SPS564.

When originally constructed in 1978 SPS564 had a design capacity of 427 L/s with two rising mains (DN250 and DN375). In 1995 works were undertaken at SPS564 to limit the maximum pump rate (via the use of a variable speed controller) to 200 L/s. Since that time the maximum flowrate of SPS564 has been limited to 190 L/s in order to prevent exceedance of the WWTP disinfection capacity. Recent pump tests undertaken in 2010 confirm that the capacity of the pump station is considerably higher than 190 L/s, hence it would be possible to increase the pumping rate of SPS564, subject to meeting a number of licence criteria.

The following criteria are contained in the Environment Protection Licence (Licence 1796, 28-Jun-2012) that governs the operation of the plant and the wastewater network, and relate to the allowable frequency of wet weather overflow of the reticulation system (Clause L7.2) and the allowable frequency of exceedance of the WWTP disinfection capacity (Clause O4.9):

- Clause L7.2 states “The frequency of wet weather overflows from the reticulation system must not exceed 14 overflows per 10 years. Compliance with this condition must be determined at the end of each reporting period against the frequency predicted using the hydraulic sewer system model required by condition L7.1 with the 10 year rainfall time series data.”
- Clause O4.9 states:

  “a) The sewage treatment system must be operated and maintained such that the operational and maintenance works and activities must not at any time increase the

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frequency at which the effluent flow rate exceeds the design capacity of the primary disinfection process.

b) For the purposes of determining compliance with (a), the licensee must compare the number of times the design capacity of the primary disinfection process is exceeded per 10 years as predicted by the hydraulic sewer system model for 2001 to the number of times the design capacity of the primary disinfection process is exceeded per 10 years as predicted by the hydraulic sewer system model for the reporting period. This comparison must use the 10 year rainfall time series data in each model.

c) An exceedance of the design capacity of the primary disinfection process occurs when the effluent flow rate of sewage from the sewage treatment plant equals or exceeds 200 L/s."

Based on the above, preliminary network modelling was undertaken to determine the impact of a new 'Marsden Park' pump station on the wastewater network. The results from the preliminary network modelling are outlined in **Table 25**, with results that exceed the licence targets highlighted.

- **Table 25 Preliminary Network Modelling Results**

	Model Runs					
	Base Case	Run 1	Run 2	Run 3	Run 4	Run 5
Model Inputs						
Capacity of SPS564	190 L/s	190 L/s	210 L/s	200 L/s	200 L/s	199.5 L/s
Capacity of SPS1154	25 L/s	25 L/s	25 L/s	25 L/s	25 L/s	25 L/s
Capacity of Marsden Park PS	-	52 L/s	52 L/s	10 L/s	52 L/s	52 L/s
Model Outputs						
Total system overflows per 10 years	13	18	13	13	13	13
Overflows at SPS564 per 10 years	12	17	12	12	12	12
Overflows at SPS1154 per 10 years	1	1	1	1	1	1
Overflows at Marsden Park PS per 10 years	-	0	0	9	0	0
Exceedance of disinfection capacity at Riverstone WWTP per 10 years*	0	0	52	46	52	0

* In the network model the capacity of the disinfection system was set at 199.9 L/s, hence a flow of 200 L/s exceeds the capacity of the disinfection system in accordance with EPL Clause O6.

Run 5 shows that the proposed system design can comply with the Environment Protection Licence for the Riverstone System whilst servicing Marsden Park Stage 1. This is achieved by limiting

SPS564 to 199.5 L/s and limiting SPS1154 to 25 L/s. The new Marsden Park Pump Station can be set to 52 L/s to prevent any overflows at this pump station.

	Model Runs					
	Base Case	Run 1	Run 2	Run 3	Run 4	Run 5
Model Inputs						
Capacity of SPS564	190 L/s	190 L/s	210 L/s	200 L/s	200 L/s	199.5 L/s
Capacity of SPS1154	25 L/s	25 L/s	25 L/s	25 L/s	25 L/s	25 L/s
Capacity of Marsden Park PS	-	52 L/s	52 L/s	10 L/s	52 L/s	52 L/s
Model Outputs						
Total system overflows per 10 years	13	18	13	13	13	13
Overflows at SPS564 per 10 years	12	17	12	12	12	12
Overflows at SPS1154 per 10 years	1	1	1	1	1	1
Overflows at Marsden Park PS per 10 years	-	0	0	9	0	0
Exceedance of disinfection capacity at Riverstone WWTP per 10 years*	0	0	52	46	52	0

* In the network model the capacity of the disinfection system was set at 199.9 L/s, hence a flow of 200 L/s exceeds the capacity of the disinfection system in accordance with EPL Clause O4.9.

Run 5 shows that the proposed system design can comply with the Environment Protection Licence for the Riverstone System whilst servicing Marsden Park Stage 1. This is achieved by limiting SPS564 to 199.5 L/s and limiting SPS1154 to 25 L/s. Setting the new Marsden Park Pump Station to 52 L/s prevents any overflows at this pump station.

6.6. Staging of Infrastructure

As discussed in **Section 4.2**, it is easier to stage rising mains and pump station components (e.g. pumps) than gravity mains:

- Gravity mains: These would either be installed at ultimate capacity, or be installed at half ultimate capacity so that at ultimate development there would be two parallel mains.
- Pump stations: Pump station wet wells need to be constructed at the ultimate capacity and at suitable depth to allow the connection of all future gravity mains that feed the pump station. The pumps within the pump station, and emergency storage, can be installed/constructed in stages.
- Rising mains: Rising mains can be installed in stages. For example, the existing pump stations that feeds Riverstone WWTP (SPS564) currently has a DN250 rising main and parallel DN375

rising main. At ultimate capacity another DN375 rising main is planned to be installed, along with additional pumps.

6.7. Selection of Options for Workshop

Prior to the stakeholder workshop, a draft version of this report was provided to Sydney Water and developers (Winten, Stockland) and a meeting was held to discuss which options should be presented at the workshop.

General discussion points included the following:

- At least one transfer strategy option should be shortlisted along with at least one on-site treatment strategy option.
- Option 3, with a pump station at Pt F, has minimal cost for servicing of Marsden Park Stage 1
- Option 2, with a pump station at Pt G, provides greater flexibility for servicing of precincts other than Marsden Park
- Rising mains would initially be installed to service Marsden Park Stage 1 (7,500 EP) with future staged amplification
- Gravity mains would be installed at ultimate capacity

Based on the above, three options were selected for presentation at the stakeholder workshop:

- Transfer strategy options:
  - SPS F: Pump station at Pt F with rising main to Riverstone WWTP sized for 7,500 EP
  - SPS G: Pump station at Pt G with rising main to Riverstone WWTP sized for 7,500 EP with gravity main from Pt F to Pt G sized for ultimate (30,600 EP)
- On-site treatment strategy option:
  - On-site treatment with pump station at Pt F and effluent discharge to South Creek, sized for 7,500 EP

7. Stakeholder Workshop

7.1. Overview

A stakeholder workshop was held at Sydney Water's offices on 8th June 2012 to compare the selected options and gain input from a range of stakeholders. Prior to the workshop a briefing paper was prepared to provide the workshop participants with sufficient background on the project. A presentation was given by SKM at the workshop to facilitate discussion and comparison of the possible options.

The workshop was attended by various Sydney Water personnel representing the management, planning, operations and maintenance teams. The relevant developers also attended with Winten and Stockland representing the Marsden Park Precinct, and APP Corporation representing the Marsden Park Industrial Precinct.

The key outcome from the workshop was that additional work was required to be undertaken by SKM before a preferred option could be selected.

This section of the report summarises the workshop and its outcomes, and **Section Error! Reference source not found.** outlines the additional work that was undertaken following the workshop.

7.2. Options Presented at Workshop

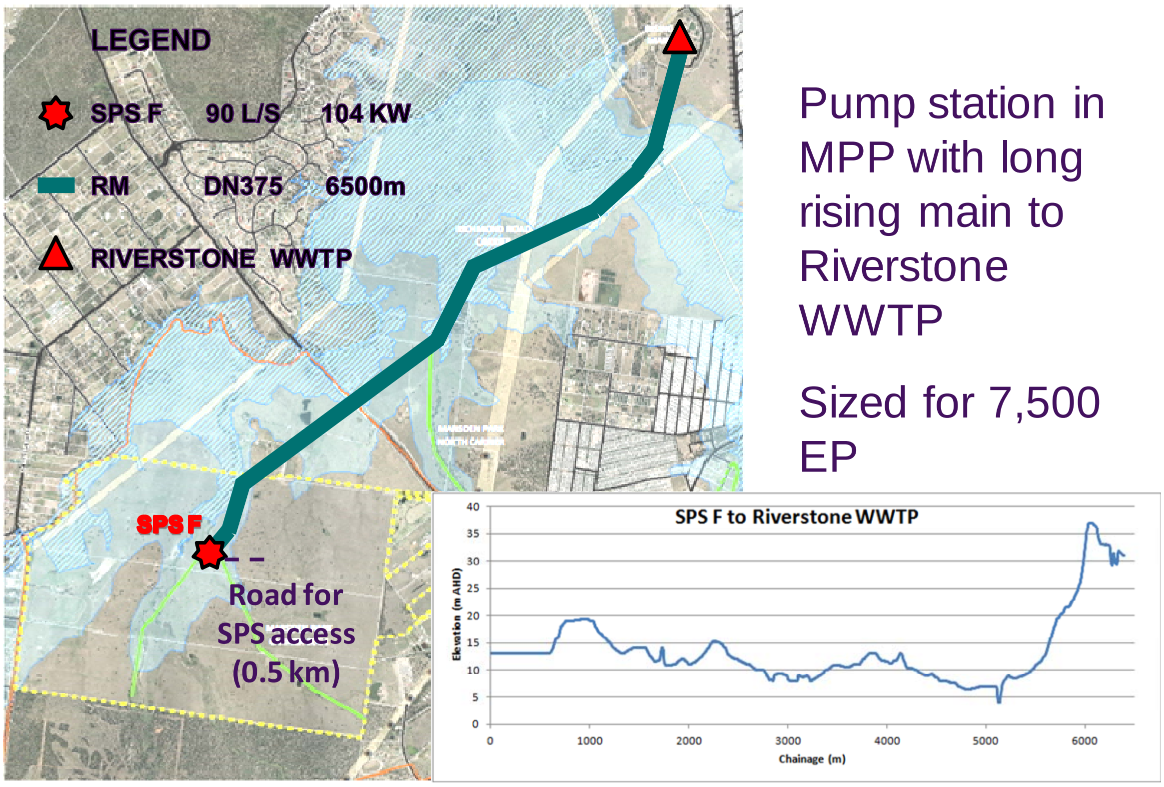
Three options were presented at the stakeholder workshop:

- Transfer strategy options:
  - SPS F: Pump station at Pt F with rising main to Riverstone WWTP sized for 7,500 EP
  - SPS G: Pump station at Pt G with rising main to Riverstone WWTP sized for 7,500 EP with gravity main from Pt F to Pt G sized for ultimate (30,600 EP). The gravity main was analysed for two different grades representing compliance with self cleansing requirements (0.12% grade) and compliance with both self cleansing and slime control requirements (0.26% grade)
- On-site treatment strategy option:
  - On-site treatment with pump station at Pt F and effluent discharge to South Creek, sized for 7,500 EP

It is noted that in the following figures of the two transfer options (SPS F and SPS G), the rising main from the Marsden Park pump station is shown as connecting directly to Riverstone WWTP. As noted in **Section 6.5.2**, initially the rising main from these pump stations would need to discharge to SPS564 until the time that the new inlet works is constructed at Riverstone WWTP.

SKM

Transfer Option - SPS F

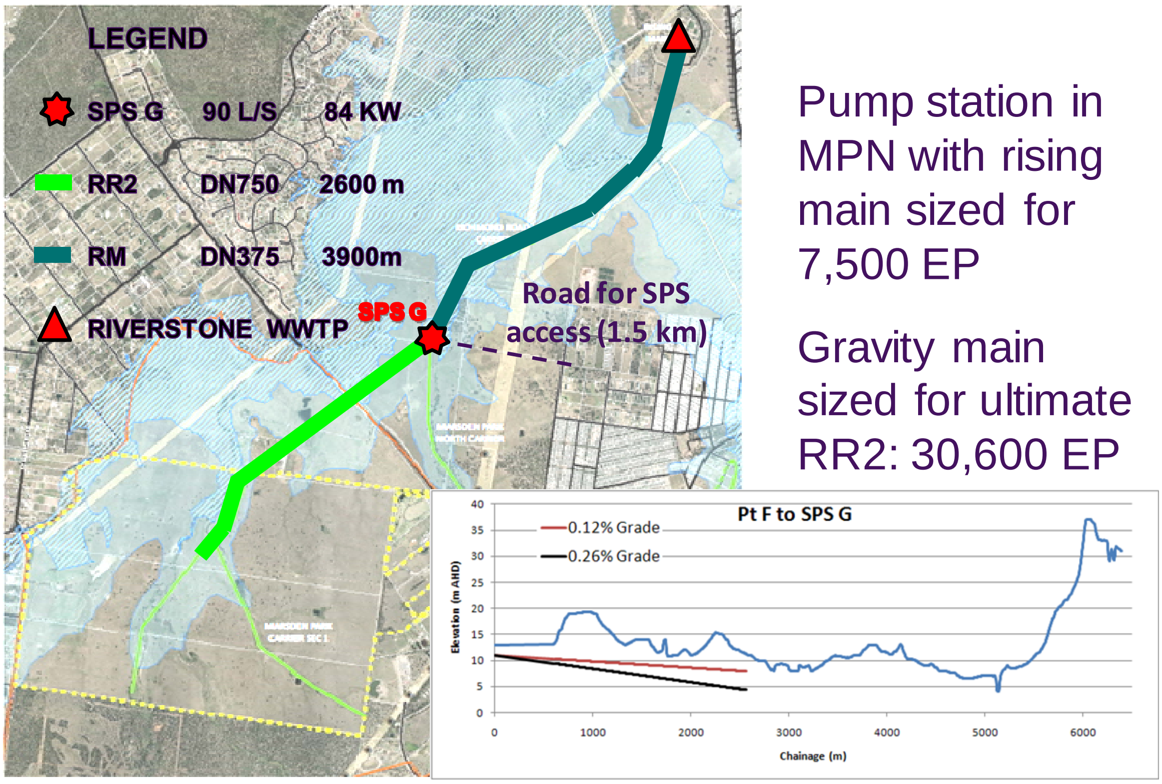


Pump station in MPP with long rising main to Riverstone WWTP

Sized for 7,500 EP

SKM

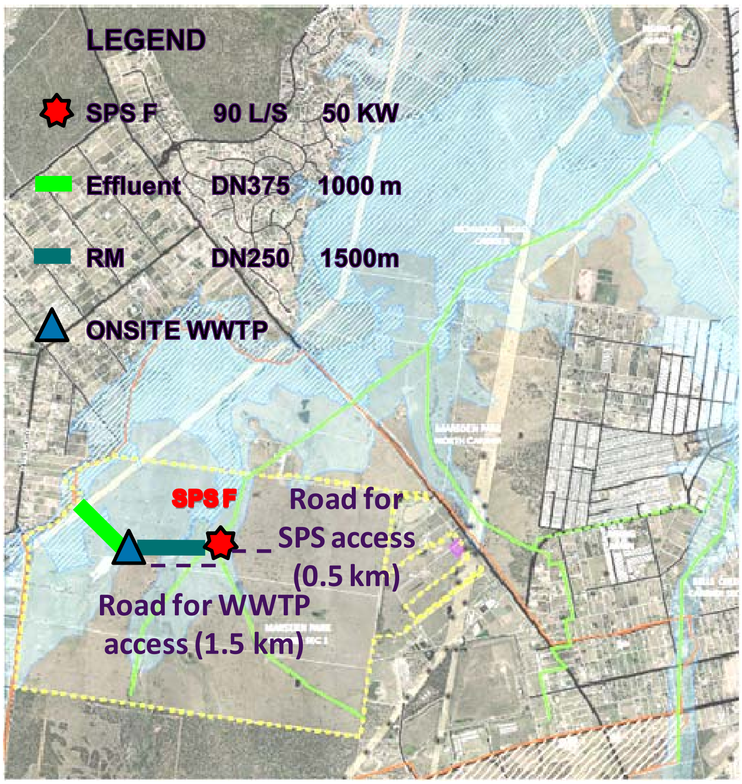
Transfer Option – SPS G



Pump station in MPN with rising main sized for 7,500 EP

Gravity main sized for ultimate RR2: 30,600 EP

Onsite Treatment Option



Pump station in MPP sized for 7,500 EP

Onsite treatment sized for 7,500 EP

Effluent discharge to South Creek via DN375 main

7.3. Option Analysis

Each option was analysed across a number of criteria including:

- Net present cost over 20 years at a discount rate of 7.5%. This included capital costs and operating costs for the infrastructure.
- The EP serviced
- Flexibility to service other precincts, including the additional cost to upsize the infrastructure to service another 7,500 EP
- Time to implement
- Connection to Riverstone WWTP

The following assumptions were adopted for estimating the operating costs:

- Annual operating costs for gravity mains and rising mains are 0.76% of the capital cost
- Annual operating costs for pump stations (excluding electricity usage) are 3.59% of the capital cost including emergency storage
- Annual operating costs for road and power supply are 0.50% of the capital cost
- Pump station electricity costs escalating each year from $0.134 / kWh in 2012 to $0.218 / kWh in 2026
- Treatment costs of $1000 / ML treated at Riverstone WWTP
- Treatment costs of $3000 / ML treated at the on-site treatment plant. This higher operating cost is based on MBR package treatment plant with removal of biosolids offsite for treatment and disposal
- Additional cost of $100 / ML for operating costs associated with chemical dosing (or other suitable approach) for septicity control for transfer strategy options

Table 26 Comparison of Workshop Options

Costing 7.5% over 20 years	Workshop Option			
	SPS F	SPS G		On-site Treatment with Discharge
		DN750 @ 0.12%	DN750 @ 0.26%	
Yearly OPEX	$0.6 M	$0.7 M	$0.7 M	$1.3 M
Net Present OPEX	$6.6 M	$7.8 M	$8.1 M	$14.6 M
CAPEX	$12.3 M	$22.7 M	$24.6 M	$20.2 M

Net Present Cost (NPC)	$18.9 M	$30.6 M	$32.7 M	$34.8 M
EP Serviced	7,500 EP	7,500 EP+ (30,600 EP)		7,500 EP
Flexibility for other precincts	Some For +7,500 EP increase RM from DN300 to DN375 for +$2.3M CAPEX	Most flexible For +7,500 EP increase RM from DN300 to DN375 for +$1.8M CAPEX		Least flexible For +7,500 EP costs +$14.7M CAPEX
Time to implement	Shortest (Lowest Time Risk)	Intermediate		Longest (Highest Time Risk)
Connection to Riverstone WWTP	Yes	Yes		No

7.4. Workshop Discussion

With regards to comparison of options that were presented at the workshop, key discussion points included the following:

- On-site treatment is not preferred as a servicing strategy for Marsden Park due to a number of factors including its high cost, both capital and operating, and because it does not provide any flexibility to service other precincts. The additional cost to upsize the treatment plant to service an additional 7,500 EP is significant. It also has a high risk in terms of time to implement because of the time required to gain the necessary approvals for the plant. Therefore this servicing strategy was not considered further.
  - **Hence the preferred servicing strategy for Marsden Park is transfer to Riverstone WWTP**
- Transfer strategy option 'SPS F' has the lowest cost and the shortest time to implement, as well as the least time risk. This is because with this option the pump station would be constructed on land that is owned by Winten/Stockland and hence there is no delay for building the pump station associated with acquiring land. Whilst an easement is required for the rising main, delays in obtaining the easement could be managed by tanker pump-out of sewage from the pump station wet well. This option can provide flexibility to service the future development of the Shanes Park Precinct, as discussed in the following dot point.
- If a pump station at Pt F is adopted, it should be designed and constructed in such a way that it replaces the future SPS A that is shown in the ultimate strategy as servicing Shanes Park (**Figure 5**). This would mean that SPS F needs to be constructed at a suitable depth to enable the future Shanes Park Carrier to gravitate to it. This is further investigated in **Section Error! Reference source not found.**.
- Transfer strategy option 'SPS G' requires more upfront capital expenditure than SPS F, mainly due to gravity main from Pt F to Pt G, the Richmond Rd Carrier Section 2. However as a pump

station at Pt G would also accommodate flow from the Marsden Park North Carrier, which services a large portion of MPIP, this option provides greater flexibility in servicing other precincts. However the key disadvantage of constructing SPS G to service stage 1 of Marsden Park is that the pump station would be located on land that is not currently owned by the developers associated with MPP and MPIP. Hence the land for the pump station, as well as land for an access road to the pump station, would need to be acquired before the pump station could be constructed. As the access road, and possibly the pump station itself, would be located on developable land, acquiring the land may require compulsory acquisition by Sydney Water (if the developer is unable to acquire the land on reasonable terms). Compulsory acquisition by Sydney Water would require ministerial approval and could take in the order of 12 months or longer. This would have a serious impact on the timing of development of Marsden Park Stage 1. As the timing issue is associated with the pump station, if there is a problem with land acquisition it would not be possible to use the pump station wet well for tanker pump-out. Hence a dedicated temporary pump-out facility would need to be built within Marsden Park, which would increase the capital cost and would create an asset for which an alternate useful function would need to be found in the future (such as stormwater storage). Hence this option has a higher risk in terms of project timing.

- If a pump station at Pt G is adopted, it should be designed and constructed in such a way that it replaces the future SPS C that is shown in the ultimate strategy (**Figure 5**). This would mean that SPS G needs to be constructed at a suitable depth to enable the future connection of the Marsden Park North Carrier and to allow connection of the future reticulation mains that would service the Marsden Park North Precinct. This is further investigated in **Section** Error! Reference source not found..
- Sydney Water indicated a strong preference for gravity carriers to be sized and graded to comply with both the self cleansing and slime control requirements.
- Sydney Water stated that based on the work undertaken the transfer servicing strategy is supported and 'in principle' endorsed over the on-site treatment servicing strategy. However further work (as detailed below) would be required to be completed to enable the preferred location of the pump station at Pt F or Pt G to be selected.

7.5. Further Work Required

The stakeholder workshop identified that the preferred wastewater servicing strategy for Marsden Park is transfer to Riverstone WWTP.

However further work is required to be undertaken to confirm the specific details of the preferred option to transfer wastewater from Marsden Park to Riverstone WWTP. The following work was requested to be undertaken following the stakeholder workshop:

- Investigation of the possibility of SPS F replacing the future SPS A

- Investigation of the possibility of SPS G replacing the future SPS C
- Investigation of the impact of staging the gravity main from Pt F to Pt G to minimise upfront capital expenditure for the SPS G option.
- Development of cost estimates for staged implementation of infrastructure to service ultimate development
- Risk assessment using Sydney Water’s risk assessment tool

The outcomes from investigating these items are outlined in a separate report: Marsden Park Wastewater Servicing – Detailed Planning Report. This approach was taken to so that the strategic planning and the detailed planning are covered in separate reports to facilitate endorsement from the relevant divisions within Sydney Water.

8. Conclusion

The work presented in this strategic planning report demonstrates that the preferred wastewater servicing strategy for Marsden Park Precinct is transfer to Riverstone WWTP.

The report investigates servicing constraints and identifies that until a new inlet works is constructed at Riverstone WWTP as part of the planned amplification, the rising main from the new Marsden Park pump station would need to discharge to the existing pump station SPS564.

This report shows that development of Marsden Park Stage 1 can be accommodated by the Riverstone Wastewater System, including the treatment plant and network.

In order to identify the preferred location of the new Marsden Park pump station, as well as design details, further work is required to be undertaken, including:

- Investigation of the staging of any gravity mains that are required
- Optimising SPS F so that it replaces SPS A
- Mitigation measures for odour and corrosion associated with long rising mains
- Details of connecting to the SPS564 system
- Risk assessment using Sydney Water's risk assessment tool

The results of this further work would be documented in the Marsden Park Wastewater Servicing – Detailed Planning Report.

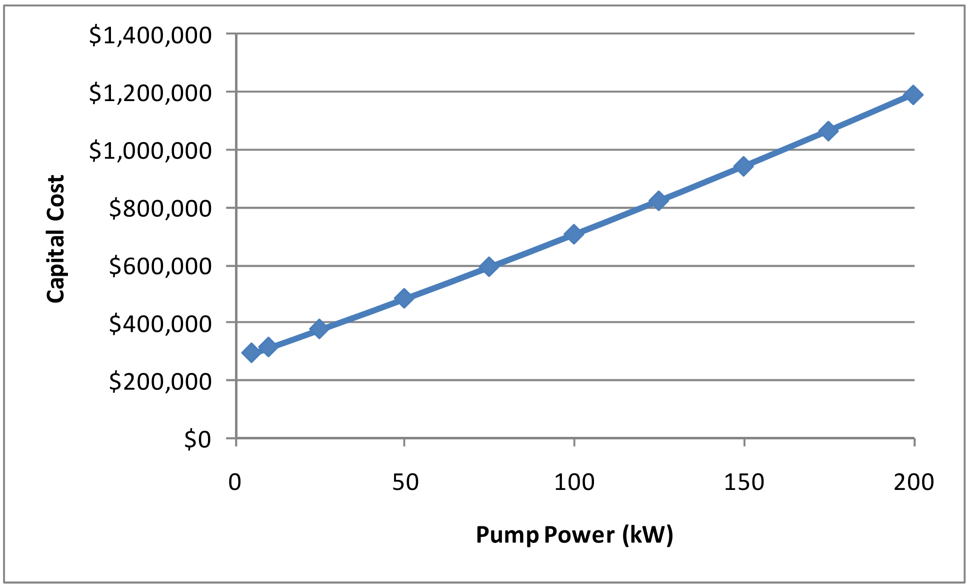
APPENDIX A Capital Cost Unit Rates

Table 27 Units Rates for Mains (Greenfields Construction at 1.5 m Depth)

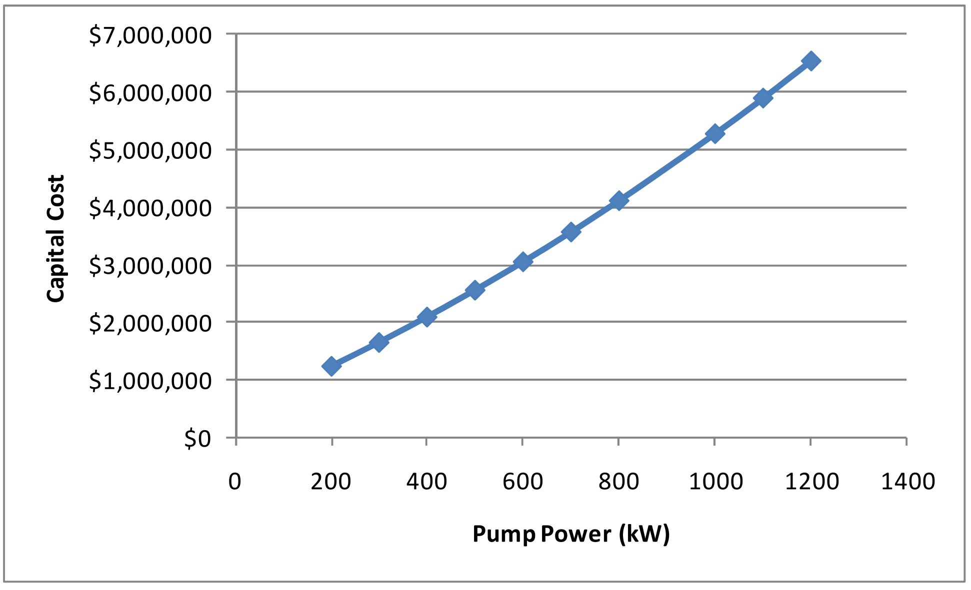
Item	DN250	DN300	DN375	DN450	DN525	DN600	DN750	DN900	DN1050
Gravity Mains	$487	$645	$834	$1,023	$1,214	$1,406	$1,844	$2,217	$2,744
Rising Mains	$475	$635	$827	$1,021	$1,215	$1,411	$1,781	$2,664	$3,271

Table 28 Unit Rates for Gravity Mains at Depth

Average Depth	Additional Cost								
	DN250	DN300	DN375	DN450	DN525	DN600	DN750	DN900	DN1050
2.0 m	$80	$76	$93	$100	$144	$149	$67	$110	$124
2.5 m	$112	$111	$142	$155	$209	$223	$159	$220	$247
3.0 m	$151	$152	$191	$210	$273	$299	$247	$320	$377
3.5 m	$195	$194	$241	$268	$334	$371	$327	$429	$490
4.0 m	$116	$242	$334	$323	$404	$445	$424	$535	$612
4.5 m	$145	$283	$394	$379	$469	$520	$513	$642	$734
5.0 m	$168	$324	$454	$435	$535	$594	$602	$748	$856
5.5 m	$187	$365	$514	$490	$600	$668	$691	$854	$978
6.0 m	$203	$407	$574	$546	$665	$742	$781	$961	$1,100
6.5 m			$634	$601	$730	$816	$871	$1,068	$1,222
7.0 m			$694	$656	$795	$890	$961	$1,175	$1,344
7.5 m			$754	$711	$860	$964	$1,051	$1,282	$1,466
8.0 m			$814	$766	$925	$1038	$1,141	$1,389	$1,588



- **Table 29 Capital Cost for Pump Stations < 200 kW**



- **Table 30 Capital Cost for Pump Stations > 200 kW**