Ripley Valley – AMEX Ripley Project

Interim Waste Water Strategy

Version 4

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Shaping the Future

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Table of Contents

Tables

Figures

1 Background

The nature of Ripley Valley is that it is separated into two primary sewer catchments; one on Bundamba Creek and the other on Deebing Creek. This report considers the Bundamba Creek Catchment with respect to the interim sewer servicing strategy for the Secondary Urban Centre East (SUCE) and the first stages of the Urban Core (UC). Land in the SUCE is predominantly in the ownership of AMEX Corporation (AMEX) and the first stages of development land in the Urban Core are wholly owned by Sekisui House Development Services (SHDS).

Interim servicing strategies and potential combinations have been considered in a number of previous reports including:

- Ripley Valley Sewerage Planning (RVSP) (Opus 2009 for Ipswich Water);
- Draft Ripley Valley Bundamba Sewerage Planning – Interim Stages Report (MWH, July 2010 for Ipswich Water);
- SUCE Water & Sewerage Report (Cardno 2009);
- UC Water & Sewerage Report (Cardno 2009); and
- Neighbourhood Master Plans & the SUCE NMP Water Supply & Sewerage Supplementary Report (Cardno, May 2010).
- Ripley Valley-AMEX Ripley Project, Interim Waste Water Strategy, Cardno Report September 2011

This interim wastewater strategy includes updates to previous documented strategies based on recent discussions with Queensland Urban Utilities (QUU), the Urban Land Development Authority (ULDA), AMEX and SHDS. This document provides an overview of the infrastructure required in both the short and medium term. The short term strategy discusses the detailed sequencing of infrastructure required in the initial stages of development (first few hundred lots) to ensure that the sewerage system is developed in a suitable manner. The medium term strategy considers the servicing options for the early stages of development within Ripley Valley (first 8 to 9 years or so) prior to the construction of the Bundamba Creek trunk sewer (long term strategy). It should be noted that proposed infrastructure is not expected to be for the exclusive use of any one developer and that available capacity may be used by 3rd parties subject to entering into an infrastructure agreement with the ULDA.

2 Design Criteria

2.1 Desired standards of service

The following key Desired Standards of Service (DSS) criteria have been adopted in developing this servicing strategy. The previous report utilised criteria based on the original Planning Scheme Policy adopted for Ripley. This report adopts flows from the proposed new SEQ Design & Construction Code for SmartSewers (NuSewers).

Table 2-1 Design Criteria

Criteria	Description
Development Density	
Equivalent Person (EP)	2.7/residential lot
Peaking Factors	
Average Dry Weather Flow (ADWF)	180 L/EP/d
Peak Dry Weather Flow	D x SF + GWI (D=peaking factor, SF = 150 L/EP/day, GWI=30 L/EP/day)
Peak Wet Weather Flow (PWWF)	PDWF + 360 L/EP/day
Peak Wet Weather Flow (PWWF)	5 x ADWF (for sewage pump stations)
Gravity Main Design	
Design depth	75% at PWWF
Minimum Velocity	0.7 m/s at PDWF
Rising Main Design	
Minimum Velocity (m/s)	1
Maximum Velocity (m/s)	3
Pump Station Design	
Single Pump Flow	PWWF
Operating Volume	0.9 * Single Pump Flow / N Where N = 12 < 50kW and N= 5 >50 kW

Population and Flow Projections

An adopted growth rate for the SUCE was developed based on information provided from Amex in regard to the projected development and sales of land. To account for development occurring outside of the identified SUCE an additional growth rate has been included. The adopted growth rates have been projected based on a 14 year projection and are detailed as follows.

Table 2-2 Population Projections

Year	SUCE			Additional Growth			Combined EP
	Dwellings per year	EP per year	Total EP	Dwellings per year	EP per year	Total EP	
1	150	405	405	0	0	0	405
2	150	405	810	0	0	0	810
3	200	540	1,350	0	0	0	1,350
4	300	810	2,160	0	0	0	2,160
5	400	1080	3,240	0	0	0	3,240
6	400	1080	4,320	150	405	405	4,725
7	400	1080	5,400	200	540	945	6,345
8	400	1080	6,480	300	810	1755	8,235
9	400	1080	7,560	400	1,080	2835	10,395
10	400	1080	8,640	400	1,080	3915	12,555
11	400	1080	9,720	400	1,080	4995	14,715
12	400	1080	10,800	400	1,080	6075	16,875
13	400	1080	11,880	400	1,080	7155	19,035
14	400	1080	12,960	400	1,080	8235	21,195

Based on the adopted population model the projected flows from the SUCE are detailed as follows.

Table 2-3 Flow Projections

Design Year	EP	ADWF (L/s)	PDWF (L/s) D x SF + GWI	PWWF (L/s) 5 x ADWF
1	405	0.8	2.9	4.2
2	810	1.7	5.2	8.4
3	1,350	2.8	7.7	14.1
4	2,160	4.5	11.5	22.5
5	3,240	6.8	16.1	33.8
6	4,725	9.8	22.4	49.2
7	6,345	13.2	28.9	66.1
8	8,235	17.2	36.2	85.8
Design Stage 1	9,011	18.8	39.1	93.9
9	10,395	21.7	44.0	130.8
10	12,555	26.2	51.9	153.3
11	14,715	30.7	58.8	153.3
12	16,875	35.2	65.6	175.8
13	19,035	39.7	73.0	198.3
14	21,195	44.2	80.6	220.8

3 Medium Term Servicing Strategy

Sewerage infrastructure to service the SUCE development is proposed to occur in phases, with temporary pressure main infrastructure being utilised in the first instance and being replaced thereafter by the installation of a gravity network in line with the Ultimate servicing strategy.

The initial stages of development are proposed to be serviced via a pump station and rising main from the southern boundary of the SUCE, near the Centenary Highway Extension (CHE). This rising main is proposed to discharge into a gravity main within the Urban Core (UC) which, in turn, discharges to a proposed pump station at Aulds Rd. Once capacity in the rising main is exhausted, the installation of the first stage of the ultimate trunk gravity network is proposed.

This assessment only considers the infrastructure required to connect to the proposed sewage pump station within the UC. It is understood that QUU are currently preparing an investigation into the capacity and augmentations required further downstream to accommodate development in the region.

To assist in developing the strategy, staging of infrastructure from the SUCE to the UC has been identified. The key aspects of the proposed servicing strategy are:

- The installation of a pump station and rising main to service development south of the Centenary highway. The capacity of this pump station and rising main will be sufficient such that major network upgrades will not be triggered within the first eight (8) years.
- The rising main will connect to a gravity main north of the intersection of Ripley and Aulds Roads. The gravity main will partly service the proposed first stages of the UC development and will convey flow from the rising main and local catchment to a proposed pump station
- Once capacity is exhausted in the network identified above, the implementation of the ultimate gravity trunk main will need to be completed.

Figure 1B illustrates the conveyance network considered in this report.

3.1 Infrastructure Assessment

The assessment considered the service life of the proposed infrastructure and the limitations in regard to operational aspects. The assessment considered the following:

- Gravity Mains;
- Rising Mains; and
- Pump Stations

It is recognised that the limiting infrastructure in terms of capacity are the gravity and rising main sections of the proposed network. The following assessment has considered the capacities of the mains and then aligned the capacity of the pump station.

3.1.1 Rising Mains

A rising main (or mains) from the proposed pump station south of the Centenary Highway will convey flow to the Urban Core. The proposed alignment of the rising main will follow Ripley Road to Aulds Road and discharge to a gravity main north of Aulds Road. The total length of rising main required is estimated to be 2,135 metres.

Four rising main sizes, 100 mm, 150 mm, 200 mm and 250 mm were assessed to determine their capacity both in terms of EP and service life. A target head loss of around 50 metres was adopted, based on nominal sewerage pump station design head, to determine the carrying capacity of the rising mains. Based on the projected flows the capacity of each option is detailed below.

Table 3-1 Rising Main Service Capacities

Rising Main Diameter (mm)	Design Capacity (L/s)	Velocity (m/s)	Service Capacity (EP)	Service Life (Years from Initial Development)
100	10.0	1.27	821	2
150	22.5	1.27	2,160	4
200[1]	52.5	1.67	5,038	5
250	93.9	1.91	9,011	8

3.1.2 Gravity Mains – AULDS ROAD

The gravity pipe that the rising main will connect into in Aulds Road, will be designed and constructed by the developer for the Urban Core development. Flow from the gravity main will discharge into an interim sewage pump station also to be designed and constructed by the developer for the Urban Core development.

Preliminary planning undertaken in 2009 indicated this gravity main would be a 300 mm diameter pipeline increasing to 375 mm diameter at the downstream end.

A preliminary desktop model of the gravity main was developed to assess the capacity of the main to accommodate the projected loads from the SUCE and the local UC catchment. The grade adopted for the desktop model is detailed in Figure 3-1. The preliminary grade of this main would achieve sufficient shear to ensure slime stripping of the trunk main should self-cleansing velocities not be achieved.

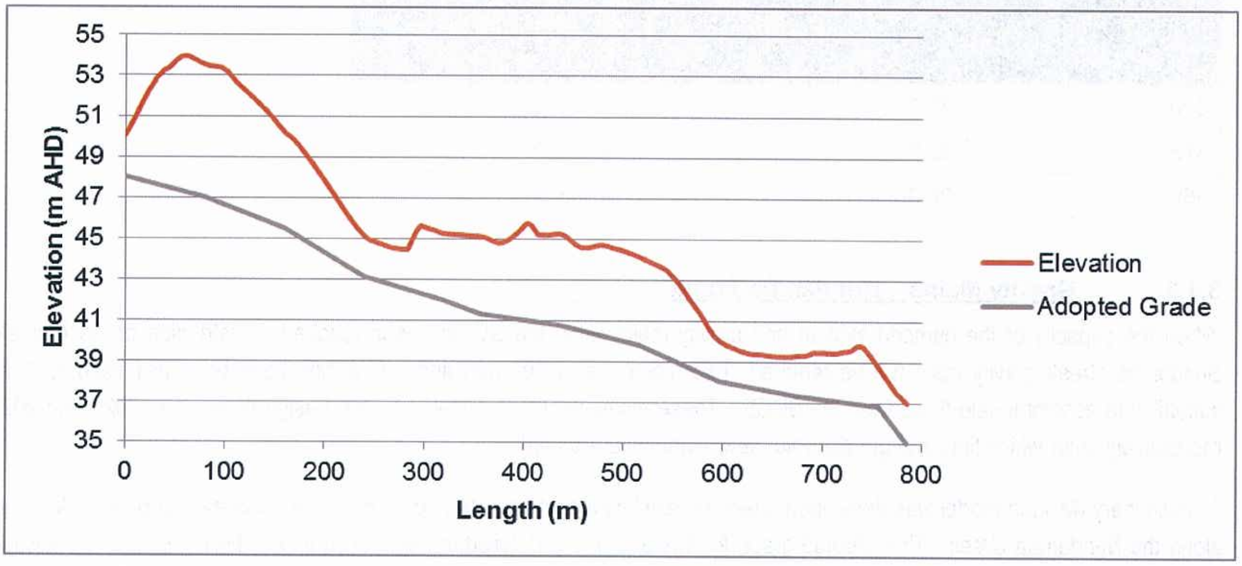


Figure 3-1 Desktop Gravity Model

It should be noted that the existing elevations may be subject to change due to development earthworks, therefore final depths are subject to confirmation during detailed design.

Based on the adopted grades, the capacities of the proposed the gravity main are detailed below, both for the previous planning and two design cases where a uniform diameter is retained through the entire length of the gravity main.

Diameter (mm)	Length (m)	Adopted Minimum Grade (%)	Maximum Capacity at Adopted Minimum Grade (EP)	Service Life (Years from Initial Development)
300	0-356	0.013	9,877	9
375	356-785	0.013	17,542	13
375	785	0.013	17,542	13
450	785	0.013	28,525	19

The design of the gravity main will also require consideration of growth within the service catchment. It is anticipated that during the early stages of development flows will be lower than required to achieve self-cleansing velocities. The velocities required to achieve self-cleansing are detailed below. It should be noted that while self-cleansing velocity is required at Peak Dry weather flow (PDWF), the major contributor of flows to the main will be via the proposed SUCE rising main, pumping at PWWF so will be okay.

The required flows to achieve self-cleaning have been determined and converted to an EP based on the PWWF.

Diameter (mm)	Minimum Flow for Self Cleansing Velocity (L/s)	Capacity (EP)
300	39.8	3,276
375	62.2	5,119
450	89.6	7,371

3.1.3 Gravity Mains – Bundamba Trunk

When the capacity of the pumped system and gravity main within the UC has been reached, construction of the Ultimate Bundamba Creek gravity main will be required. Two diameters, a 600 mm and a 675 mm, have been assessed for their suitability to accommodate flows from the SUCE. These mains would be suitable for the design flows up to 2024 and 2028 respectively, after which time a larger diameter sewer would be required.

A preliminary desktop model was developed based on existing elevation data to determine the serviceability of a trunk sewer along the Bundamba Creek. The adopted grade for this analysis is detailed in Figure 1. It should be noted that the existing elevations, may be subject to earthworks and final depths and are therefore subject to confirmation during detailed design. In addition, it is assumed the main will be constructed on the east side of Bundamba Creek as existing topographic features on the western side of the creek (sheer exposed rock faces) would make the construction of the main on that side unfeasible.

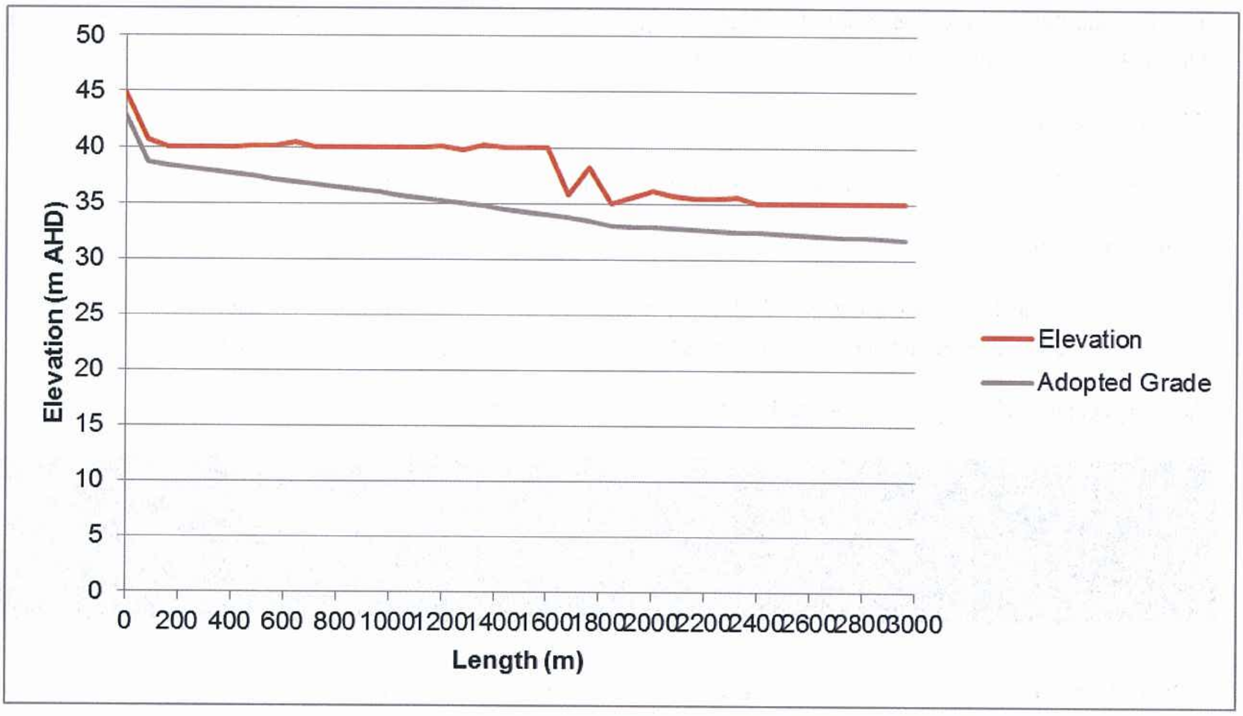


Table 3-2 Desktop Gravity Model

The design capacities of this main are detailed below. Similar to the initial stages of the rising main, a design grade is required to achieve a minimum velocity to ensure self-cleaning within the main. Should the minimum velocity not be achieved, a grade suitable to achieve shear pressure is required. The preliminary grade of this main would achieve sufficient shear to ensure slime stripping of the trunk main should self-cleansing velocities not be achieved.

The table below details the capacities of both diameters gravity mains.

Diameter (mm)	Length (m)	Adopted Minimum Grade (%)	Maximum Capacity at Adopted Minimum Grade (EP)	Minimum Flow for Self Cleansing Velocity (L/s)	EP required for Self Cleansing Flows
600	2,960	0.0011	18,115	160	12,555
675	2,960	0.0011	24,800	202	16,875

3.1.4 Pump Stations

Based on the design capacities of the gravity and rising mains detailed above, pump station requirements for 200mm or 250mm rising mains have been considered as follows:

200 mm rising main:

- Capacity to ensure self-cleaning velocities within the 200 mm rising main and UC gravity main

250 mm rising main:

- Stage 1: Capacity to ensure self-cleaning velocities within the 250 mm rising main; then
- Stage 2: Flow and population increases to utilise the full capacity of the 250 mm rising main.

The design pump station capacities are detailed below, including that for a 150mm rising main.

Design Case	EP	Pump Rate (PWWF)	Total Pump Head (m)	Min. Wet Well Diameter (m)	Single Pump Rating (kW)	Total Pump Station Rating (kW)
SPS + 150 mm RM	2160	22.5	49.9	3.6	22	44
SPS + 200 mm RM	5,038	52.5	59.2	3.6	85	170
SPS + 250 mm RM	9,011	93.9	53.3	3.6	85	170

With any proposed pump station, septicity during the early stages is a potential issue. To mitigate septicity, a program of increasing initial flows by adding water (flushing), along with pump station operation and monitoring can assist in reducing detention times. It is proposed that for any selected pump station design the duty flow rate will be such to ensure minimal detention in the rising main, as detailed in the table above. As a result, detention will be held within the wet well and monitoring will be required to measure odour. Should odour levels reach an unacceptable level, chemical dosing at the pump station is recommended.

Servicing strategies during the early stages of development are discussed further in the Short Term Servicing Strategy outlined in Section 4.

3.2 Options

Based on the assessment above a range of infrastructure options have been developed and costed. The potential infrastructure configurations are detailed in the table below.

Options A to E include for either a 600 or 675 mm trunk sewer to be constructed, after which an 800mm trunk sewer is likely to be required. Option E assumes the 800mm trunk sewer is constructed instead of the 600 or 675mm trunk sewers.

Table 3-3 Potential Infrastructure Configurations

Option	Capital Cost ($M)	NPV ($M)	Asset	Size	Indicative Service period	
A	$ 28.1	$ 20.7	Aulds Rd Gravity Main	375	2013	Ultimate
			Rising Main	200 mm	2013	2019
			Pump Station Stage	85kW	2013	2019
			Storage	156	2015	2019
			Bundamba Creek Gravity Main Stage 1	600 mm	2019	2024
			Bundamba Creek Gravity Main Stage 2	800 mm	2025	Ultimate
B	$ 28.2	$ 19.5	Aulds Rd Gravity Main	375	2013	Ultimate
			Rising Main	200 mm	2013	2019
			Pump Station Stage	85kW	2013	2019
			Storage	156	2015	2019
			Bundamba Creek Gravity Main Stage 1	675 mm	2019	2028
			Bundamba Creek Gravity Main Stage 2	800 mm	2028	Ultimate
C	$ 29.1	$ 20.9	Aulds Rd Gravity Main	375	2013	Ultimate
			Rising Main	250 mm	2013	2021
			Pump Station Stage	85kW	2013	2021
			Storage	366	2015	2021
			Bundamba Creek Gravity Main Stage 1	600 mm	2021	2024
			Bundamba Creek Gravity Main Stage 2	800 mm	2025	Ultimate
D	$ 29.1	$ 19.6	Aulds Rd Gravity Main	375	2013	Ultimate
			Rising Main	250 mm	2013	2021
			Pump Station Stage	85kW	2013	2021
			Storage	366	2015	2021
			Bundamba Creek Gravity Main Stage 1	675 mm	2021	2028
			Bundamba Creek Gravity Main Stage 2	800 mm	2028	Ultimate
E	$ 17.5	$ 13.9	Aulds Rd Gravity Main	375	2013	Ultimate
			Rising Main	250 mm	2013	2021
			Pump Station Stage	85kW	2013	2021
			Storage	366	2015	2021
			Bundamba Creek Gravity Main Stage 1	800 mm	2021	ULTIMATE

3.3 Costs

Cardno standard unit rates have been adopted for the costs and are based on Cardno's recent experience in the region. Departures from the adopted rates include reduced condition factors where pipes are laid in the same trench and the inclusion of a contingency for directional drilling for the Bundamba Creek gravity trunk main. Cardno standard unit rates have been developed with benchmarking and recent construction costs.

Based on the options outlined above, costs for each of the schemes have been determined.

The capital and NPV costs for constructing the 800mm trunk sewer in option E would be significantly lower than constructing the 600 and 675mm trunk sewers before a later upgrade. The decision over which diameter trunk sewer to construct is best made closer to the time required (2021) based on actual development progress and forecasting for maintenance costs where the larger diameter sewer will have potentially higher maintenance costs early on.

3.4 Recommended Medium Term Staging Strategy

The NPV assessment indicates that the most significant consideration in the whole life costing is the size and timing of the 1st stage gravity main on Bundamba Creek. The configuration of the interim rising main works has little bearing on the NPV assessment.

The recommended approach to the interim works is therefore driven by operational factors associated with forecast growth. Given the uncertainties around which development fronts will progress in Ripley Valley as a whole, and at what rate, it is recommended that capacity is developed for beyond the expected yield wherever practically possible and where there are no significant additional costs.

Therefore it is recommended that the adopted solution should include a 250mm dia. rising main from the SUCE to north of Aulds Rd, with a staged storage at the SUCE. This would feed into a 375mm dia gravity main to connect to the UC pump station. A review on the replacement gravity trunk main diameter (600, 675 or 800 dia) should be carried out closer to the replacement time.

The following additional assessment considers the short term implications of constructing a 250mm dia. rising main from the SUCE to the UC.

4 Short Term Staging

To complement the above, a strategy has been developed which covers the early stages of development. In these early stages (first few hundred lots) the flows are too low to enable the efficient operation of the medium to long term infrastructure. The low flows generated in the early stages lead to long detention times in the mains.

A number of options have been considered in relation to the short term staging of infrastructure as follows:

- **Tankering** of flows from the pump station site. Note that this is not a favoured option for QUU or developers, however may be appropriate in specific circumstances;
- Installation of a **small diameter rising main** in parallel with the rising main required for the medium term strategy; and
- **Flushing** of the rising main with water to reduce detention times to an acceptable level.

Each of these is discussed in turn below. Note that the key criterion for selection of short term infrastructure is cost and operability.

4.1 Tankering

Tankering is typically used to convey flows via vacuum truck to the treatment plant when the operation of a sewerage network is unviable. However, it is recognised as being an expensive option, due to regular operation of the trucks required to convey flow. Due to the cost implications, the uncertainty of operation during wet weather and the resulting traffic flows (ie vacuum trucks through a residential area), this option is generally not the preferred option by any of the parties. However, it is recognised that there may be some specific circumstances (first few lots) where it is the most appropriate option.

Daily costs (ADWF) for interim low flow scenarios in the first year are included in the table below.

Table 4-1 Tankering Costs

Year	ET	EP	Cost ($/day)	Cost over one year ($)
2014	10	27	$ 135	
	35	95	$ 473	
	60	162	$ 810	
	110	297	$ 1,485	
	150	405	$ 2,025	$370,000
2015	300	810	$4,050	$1,109,000
2016	500	1350	$6,750	$1,907,100

The growth profile for the SUCE leads to a very high tankering cost over the first few years. If tankering is to be used for initial flows within the SUCE, it is only likely to be cost effective within the first few months before flushing becomes more cost effective.

4.2 Small Diameter Rising Mains

Analysis indicates that a nominal 80mm dia. main would service less than 360EP and would need a loading of 187EP to avoid tankering or flushing. The capacity of an 80mm dia. main would therefore be exceeded in less than a year, and the marginal cost of installing a slightly larger main are comparatively small. An 80mm main (or smaller) would lead to only limited savings in tankering and flushing and this option has not been considered further.

From the analysis it can be concluded that an early works rising main would need to be at least a 150mm dia. main. This would be laid in a common trench with the proposed 250mm dia. main and would require a 25kW pump prior to upgrading pumps to 89kW to service the 250mm rising main.

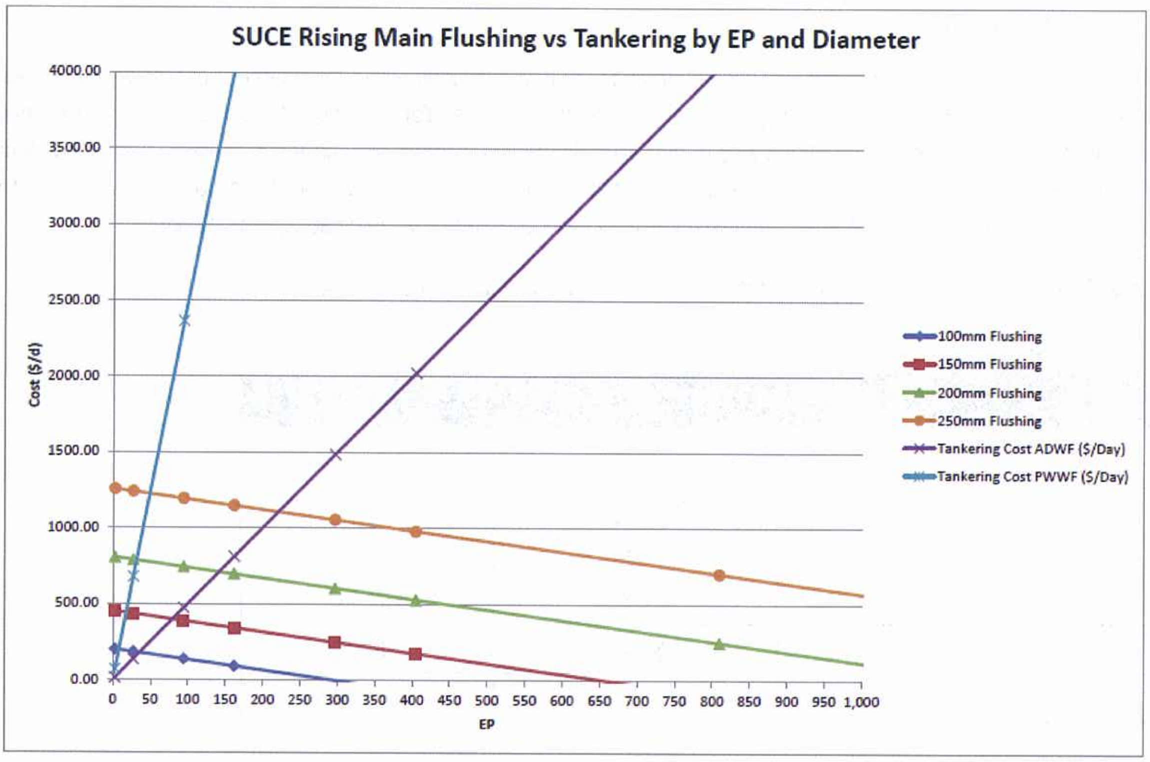
The cost of a 150mm rising main if constructed in its own trench would be approximately $720,000. If constructed in dual trench with the 250mm rising main this cost will be approximately $360,000. There would be additional costs at the pump station site to suit the twin mains, and initial set of pumps, at approximately $70,000.

4.3 Flushing

Assuming a cost of $3/kL the summary graph below indicates that the cost of flushing a 150mm dia rising main would be a maximum of $500/day, falling to $400/day at approximately 80EP and continuing to steadily decline to zero at 650EP/day i.e. at 1-2 years. The cost to provide flushing flows to maintain less than 6 hours retention at ADWF in the 150mm rising main is approximately $75,000.

This correlates with tankering costs for ADWF flows being at $400/day at 80EP. These escalate to $3,000/day at 650EP. In effect, the 80EP threshold is where tankering costs exceed flushing costs, beyond which the daily costs rapidly diverge.

The cost to provide flushing flows to maintain less than 6 hours retention at ADWF in the 250mm rising main is approximately $200,000.



4.4 Storage Volume

SEQ Water and Sewerage Planning Guidelines require that for new pump stations an emergency storage volume based on 3 hours at PDWF is provided. This storage volume includes for flows above the start level of the pump station, up to the overflow weir, and can be made up of pump station volume, gravity pipeline and manholes, and a dedicated storage tank. Subject to detailed design, the volume of pump station, gravity pipelines and manholes is approximately 56 kL.

The table below confirms that a storage tank will be required from 2015/2016 onwards. The volume of tank required is approximately 366 kL at pump station design capacity 2021/2022. The cost of this tank is approximately $1.08M to $1.25M, depending on whether it is storage pipe or insitu tank.

Year	ET	EP	Total Volume Required (kL)	Storage Tank Requirement (kL)
2014	150	405	31	Included in SPS and Network
2015	300	810	56	Included in SPS and Network
2016	500	1350	84	18
2017	800	2160	124	68
2018	1200	3240	174	118
2019	1750	4725	242	186
2020	2350	6345	312	256
2021	3050	8235	391	335
Design capacity of 250mm RM	3337	9011	422	366
2022	3850	10395	476	420

4.5 Emergency Generator

As an alternative to the storage tank, it is proposed a generator is considered in lieu of all or at least a significant portion of the storage. This would reduce the cost by up to 70% of the storage tank estimate. The generator will also cost less to decommission than a 422 kL storage tank and has re-use potential after decommissioning.

4.6 Recommended Short Term Servicing Strategy

The primary drivers for the recommended short term servicing strategy is that the tankering costs are highest by a significant margin, and the additional cost of providing a 150mm rising main and additional pumps at $500,000 is nearly twice that of the $275,000 required for providing initial tankering and flushing flows for the 250mm rising main.

Based on the analysis above, the following short term servicing strategy is proposed:

- Install the full size pumps, with 250mm rising main and provide flushing flows to minimise retention within the rising mains.
- Install a permanent generator in lieu of all or most of the storage tank volume.
- Defer construction of the generator and/or additional storage until 2015/2016 or until such time as the critical population of approximately 810 is reached, or average dry weather flows of 1.7 l/sec (146 kL/day).
- Odour treatment may be required, and it is recommended that allowance is made to connect this at some future time if odours do become an issue.

5 Summary Recommendations

The proposed strategy for servicing the SUCE in the short and medium term is outlined below:

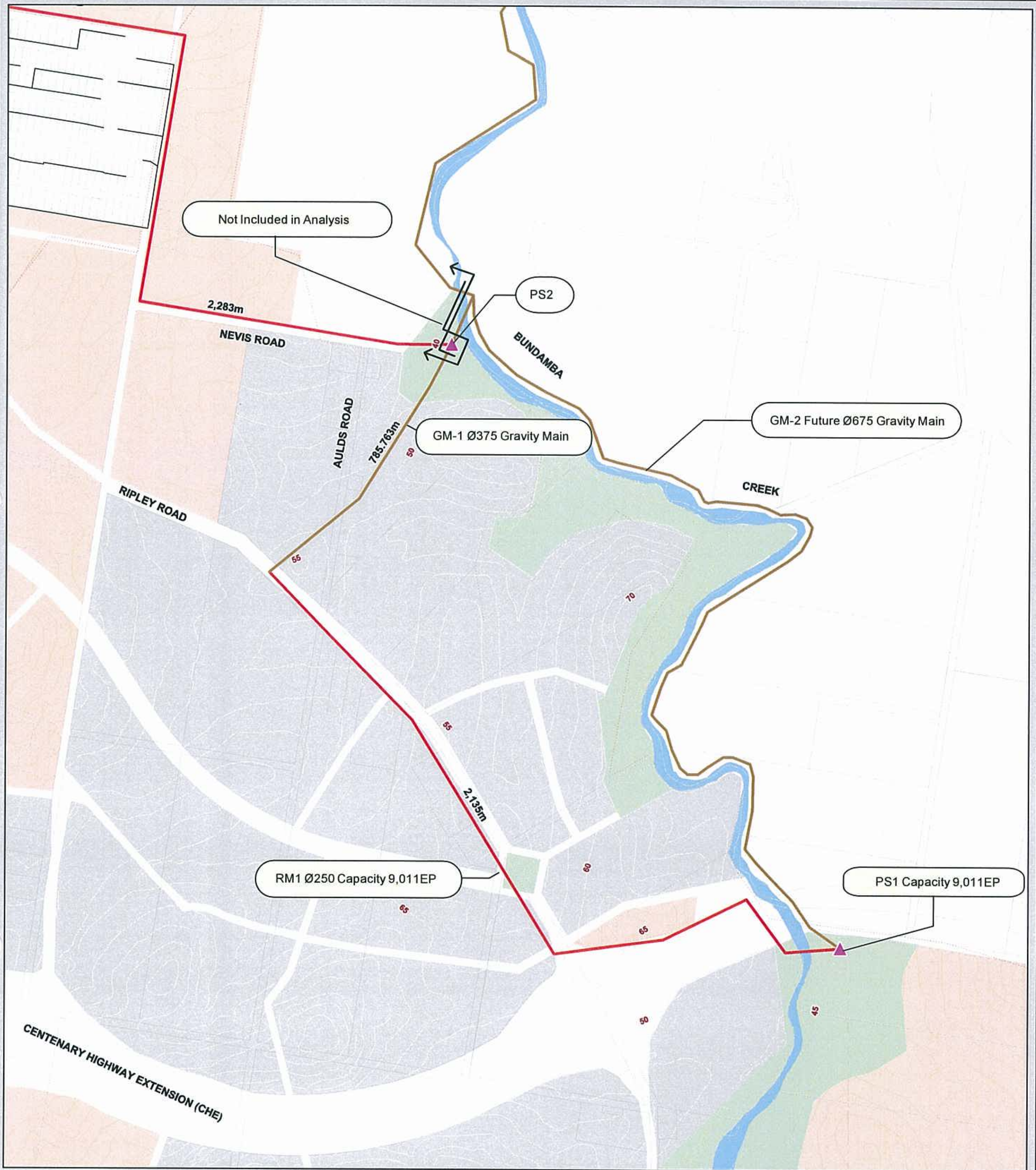
- Install pump station (85kW) and 250mm dia. rising main in 2013/14 to service up to 9,011EP (2021/2022). Make provision for odour control to be added if there is an odour problem in the system.
- Provide flushing flows as required to the pump station or upstream network to mitigate septicity in the rising main.
- Install generator or additional storage at 810 EP (2015/16).
- Beyond 2021/2022 the 675mm diameter gravity sewer would be required to bypass the pump station and rising main. Further investigation will be required at that time to determine the optimum gravity main size.

Timing	Infrastructure required	EP service capacity	Cost (not NPV)
2013	Tankering (6 months at av. $400/day – not including QUU disposal charges)	0 – 80 EP	$75,000
2013	Rising main to Aulds Rd (2135m x 250mm dia)	9,011 EP (2013 – 2021/2022)	$1,500,000
2013	Stage 1 Pump Station - 85kW pumps	9,011 EP (2013 – 2021/2022)	$725,000
2013 - 2018	Flushing of mains required to mitigate septicity (5 years)	3,240 EP (2013 - 2018)	$200,000 (variable annual revenue cost)
		SUB TOTAL	**$2,500,000**
2015 2015	Additional storage, or Generator & minor storage	9,011 EP (2015-2021/2022)	$1,080,000 to $1,250,000 $370,000
		TOTAL	**$2,870,000 to $3,750,000**

2013	Gravity main GM-1 (785m x 375mm dia) – by others	17,542EP (2013 – ultimate)	$900,000
2021	Gravity main Stage 1 GM-2A Bundamba Creek trunk sewer (2,700m x 675mm dia)	24,800EP (2021 – 2028)	$11,650,000

Notes:

1. Planning cost estimates are at todays' construction prices (not NPV), and are exclusive of GST.
2. Estimates are based on typical industry rates and recently tendered project costs (including RM construction on 'live' road) and an additional contingency of 10%.
3. There is a 50% contingency allowance for soft rock excavation for the 375mm gravity main and 675mm gravity main.
4. It is assumed that trenchless pipe installation will not be required for any of the pipes.



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SHEET	A3
Project No:	7901-47
Date:	08/11/2012
Revision Number:	B
Designed by:	J.L.
Client Name:	Ripley Valley

LEGEND

- Proposed SPS
- Proposed Gravity Main
- Proposed Rising Main
- Existing Sewer Main
- Contour (5m Interval)

N W E S

Figure 1 - Rev B

Ripley Valley

Interim SUCE Sewer Strategy

Scale: 1:10,000

100 0 100 200 300
Metres