WATER COMMITTEE MEETING

AGENDA

5 FEBRUARY 2014

Your attendance is required at a meeting of the Water Committee to be held in the Council Chambers, 232 Bolsover Street, Rockhampton on 5 February 2014 commencing at 9:00 am for transaction of the enclosed business.

CHIEF EXECUTIVE OFFICER
29 January 2014

Next Meeting Date: 05.03.14

Please note:

In accordance with the *Local Government Regulation 2012*, please be advised that all discussion held during the meeting is recorded for the purpose of verifying the minutes. This will include any discussion involving a Councillor, staff member or a member of the public.

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2 PRESENT

Members Present:

Councillor G A Belz (Chairperson)
The Mayor, Councillor M F Strelow
Councillor C R Rutherford
Councillor A P Williams
Councillor N K Fisher

In Attendance:

Mr E Pardon – Chief Executive Officer
Mr R Holmes – General Manager Regional Services

3 APOLOGIES AND LEAVE OF ABSENCE

4 CONFIRMATION OF MINUTES

Minutes of the Water Committee held 20 November 2013

5 DECLARATIONS OF INTEREST IN MATTERS ON THE AGENDA

6 BUSINESS OUTSTANDING

6.1 BUSINESS OUTSTANDING TABLE FOR WATER COMMITTEE

File No:	**10097**
Attachments:	**1. Business Outstanding Table for Water Committee**
Responsible Officer:	**Evan Pardon - Chief Executive Officer**
Author:	**Evan Pardon - Chief Executive Officer**

SUMMARY

The Business Outstanding table is used as a tool to monitor outstanding items resolved at previous Council or Committee Meetings. The current Business Outstanding table for the Water Committee is presented for Councillors information.

OFFICER'S RECOMMENDATION

THAT the Business Outstanding Table for the Water Committee be received.

BUSINESS OUTSTANDING TABLE FOR WATER COMMITTEE

Business Outstanding Table for Water Committee

Meeting Date: 5 February 2014

Attachment No: 1

Date	Report Title	Resolution	Responsible Officer	Due Date	Notes
20 November 2013	Management of Dee River Bores Impacted by Acidic Water	THAT due to the prevailing poor water quality in areas of the Dee River impacted by acid mine drainage, all bores identified as belonging to Council be capped, and Council make contact with owners of any known privately-owned bores in or adjacent to the Dee River to advise them of the potentially hazardous bore water so that property owners can investigate this matter and determine any necessary course of action.	Jason Plumb	04/12/2013	A letter to property owners along the Dee River is currently in draft form and will be finalised and mailed out to advise property owners by COB 24 January 2014.
20 November 2013	Fish Ladder at Fitzroy River Barrage	THAT a report be presented to a Full Council meeting outlining options for the fish ladder at the Barrage.	Robert Holmes	11/12/2013	

7 PUBLIC FORUMS/DEPUTATIONS

Nil

8 OFFICERS' REPORTS

8.1 FUTURE UPGRADING OF ROCKHAMPTON AND GRACEMERE SEWAGE TREATMENT PLANTS

File No:	**6031**
Attachments:	**1. Sewage Treatment Plants Strategy Planning Study** **2. South Rockhampton STP Interim Upgrade**
Responsible Officer:	**Robert Holmes - General Manager Regional Services**
Author:	**Jason Plumb - Manager Treatment and Supply**

SUMMARY

The four sewage treatment plants (STPs) that service the communities of Rockhampton and Gracemere are to varying degrees approaching the end of their design life and need to be upgraded and augmented to ensure they can continue to meet the future needs of the community. Fitzroy River Water (FRW) has recently completed some strategic planning to provide a more detailed understanding of the future requirements for each of the four STPs and also the timing and quantum of capital investment required in the coming years. This report provides some summary detail on the outcomes of this strategic planning and outlines the upgrade and augmentation works that are required in the short, medium and long term.

OFFICER'S RECOMMENDATION

THAT Council adopt the proposed upgrade and augmentation strategy for Rockhampton and Gracemere sewage treatment plants and approve the re-allocation of capital funding in the current capital budget as outlined in this report to enable commencement of the interim upgrade of the South Rockhampton sewage treatment plant and the completion of further design work for the augmentation of the Gracemere sewage treatment plant in the 2014-15 financial year.

BACKGROUND

Sewage treatment for the Rockhampton and Gracemere areas is provided by four STPs. Table 1 provides summary information about each STP. Each STP differs in age, size, design and treatment capability, and are all approaching the end of their design life. In addition, the standard of treatment possible in the original design of some of these STPs is no longer appropriate given the more stringent environmental licence conditions that are now used to design present day STPs. For example, the North Rockhampton and Gracemere STP were designed to achieve removal of total nitrogen whereas the South Rockhampton and West Rockhampton STPs were not. The original design capacity of each STP in Table 1 is therefore slightly misleading as it refers to the final effluent standard required in the year of construction rather than the final effluent standard that is defined by the current environmental discharge limits.

In mid-2012, FRW identified the need to develop a comprehensive long term strategy for the STPs that service the Rockhampton and Gracemere communities. This decision was made based on, the age of the STP infrastructure, the relatively high recent population growth in Gracemere and a decline in the performance of the South Rockhampton and Gracemere STPs. The environmental licence for the Rockhampton STPs has two separate weekly discharge limits for total nitrogen. One is a maximum limit and the other is a long term 50%ile limit which is used to monitor long term trends in STP performance and allows some flexibility to account for extreme events or occasional varied performance. The maximum limit for total nitrogen has not been exceeded, however, the reduced performance of the South Rockhampton STP has led to the 50%ile limit not being met consistently.

In mid-2013 minor upgrade works were completed on the Gracemere STP and it is now consistently meeting its discharge limits for total nitrogen.

Table 1 Summary Information for the Rockhampton and Gracemere STPs

	North Rockhampton STP	South Rockhampton STP	West Rockhampton STP	Gracemere STP
Year Built	1986	1983	1962	1984, 2004
Design	Extended Aeration	Activated Sludge	Trickling Biofilter	Extended Aeration
Contaminants Removed[a]	SS, BOC, N, Bacterial Pathogens	SS, BOC, Bacterial Pathogens	SS, BOC, Bacterial Pathogens	SS, BOC, N, Bacterial Pathogens
Original Capacity (Equiv. Persons)	50,000	34,000 (no Nitrogen removal)	11,000 (no Nitrogen removal)	8,100
Current Utilisation (Equiv. Persons)	46,000	19,120	6,172	8,000

[a]SS = suspended solids, BOC = biodegradable organic carbon, N = total N, Bacterial Pathogens includes indicators of faecal contamination such as *E. coli*.

In December 2012 an external consultant was engaged to help undertake a comprehensive strategic planning study for the future of sewage treatment in Rockhampton and Gracemere. The scope of the strategic planning study included an analysis of current population projection data, a high level review of the existing STP infrastructure and its performance, and an assessment of the numerous upgrade and augmentation options that could be considered to help determine, the timing and extent of future capital investment and indeed which STP infrastructure should be retained and which should be decommissioned. This assessment included a multi-criteria analysis of factors such as environmental, regulatory, cost and community issues.

A short-list was prepared of preferred options required to meet the sewage treatment needs up to the year 2027 and then to the year 2042. Cost estimates of each of the upgrade and augmentation projects required for each option were also generated. The Mount Morgan STP was not included in this strategic planning study as it is being considered as part of the planning for future expansion of the Mount Morgan sewerage scheme.

Two smaller reports were also commissioned to develop a concept design for the interim upgrading of the South Rockhampton STP and the Gracemere STP respectively, with the latter report to provide an analysis of the use of a constructed wetland to augment the treatment capacity of the Gracemere STP. This report is being prepared by a consultancy with specialist skills and a strong track record in developing low cost constructed wetlands for sewage treatment applications. The full strategic planning study and the smaller report on the interim upgrade for South Rockhampton STP are included as attachments in this agenda. The report on the possible use of constructed wetlands for the Gracemere STP is nearing completion and will be presented to Council as part of the decision on the choice of the upgrade options for the Gracemere STP.

UPGRADING AND AUGMENTATION OF STP INFRASTRUCTURE

Strategic planning for the future of the Rockhampton and Gracemere STPs has identified a staged approach to the upgrading, augmentation and where appropriate the decommissioning of existing STP infrastructure. The information provided in Table 2 provides some detail of the extent, timing and cost of capital works that have been identified as being required to ensure the ongoing compliant operation of the STPs to meet the future needs of the community up to the year 2027. Table 3 provides further detail for the specific projects required over the next three years to meet the short term sewage treatment needs in Rockhampton and Gracemere.

South Rockhampton STP Interim Upgrade

As indicated above, the performance of the South Rockhampton STP has declined over recent years due largely to its inability to consistently remove nitrogen from the final effluent. The proposed interim upgrade involves converting the existing conventional activated sludge design into a design that is capable of consistently removing total nitrogen from the final effluent to consistently meet environmental discharge limits. This interim upgrade can be achieved at a relatively low cost (and is expected to provide sufficient treatment capacity (up to ~28,000 EP) for the next 8 to 10 years before the completion of further upgrade works would be required.

Table 2 Capital Works for Rockhampton and Gracemere STPs 2014 to 2025

Project	2014-2016	2017-2019	2020-2022	2023-2025
SRSTP Interim Upgrade	$0.9M			
GSTP Augmentation	$4.7M			
WRSTP Diversion to SRSTP	$1.5M	$2.5M		
WRSTP Decommissioning		$0.8M		
NRSTP Augmentation	$0.5M	$20.0M	$30.0M	
SRSTP Augmentation			$20.0M	$26.0M
Recycled Water Schemes	$1.2M	$1.5M		
Total	**$8.8M**	**$25.3M**	**$50.0M**	**$26.0M**

Gracemere STP Augmentation

The existing Gracemere STP needs to be augmented to ensure it has sufficient treatment capacity to cater for the continued population growth that is expected in the Gracemere area. Key components of this capital investment include the construction of a new STP inlet structure to handle the increases in the rates of inflow and the addition of further treatment capacity (up to ~16,000EP) through either the duplication of the existing process technology or the installation of a constructed wetland to increase treatment capacity. The preferred augmentation option will be determined in the coming months. This level of augmentation would provide sufficient treatment capacity until at least 2025.

West Rockhampton STP Diversion to South Rockhampton STP

This project involves the construction of a new sewer rising main to divert the raw sewage inflows from the West Rockhampton STP to the South Rockhampton STP. The upgrading of the Jardine Park Sewerage Pump Station would also be required to pump the sewage the additional distance to the South Rockhampton STP. Design of the rising main is to be completed in 2015 with construction work to commence in 2016 with completion in 2017.

West Rockhampton STP Decommissioning

Once the sewage inflows to West Rockhampton STP are diverted to the South Rockhampton STP, the West Rockhampton STP will be decommissioned and the site reinstated appropriately. The work would include demolition of the existing tank structures and associated site works to return the site to a suitable standard.

North Rockhampton STP Augmentation

The North Rockhampton STP will require augmentation within the next 10 years to ensure it has sufficient treatment capacity to cater for population growth in North Rockhampton. The exact timing for this augmentation will be influenced by the rate of population growth that occurs in the coming 3 to 5 years. This augmentation project will be a major capital investment to increase the treatment capacity to ensure it can meet the future needs of the community. This augmentation would require the construction of new tank structures and other on-site facilities to house new equipment required for increase in treatment capacity.

The majority of the future population growth in Rockhampton is expected to occur in North Rockhampton, with a number of residential developments currently under construction, (e.g. Edenbrook, Crestwood and Northridge to name a few) or in the final stages of planning and approval (e.g. Ellida).

By the year 2021, the increase in residential population served by the North Rockhampton Sewerage Scheme is estimated to be almost 8000 people. It is therefore critical that STP infrastructure with sufficient capacity exists to meet this forecast population growth.

South Rockhampton STP Augmentation

Following the diversion of the West Rockhampton STP sewage inflows to the South Rockhampton STP, and with the expected population growth over the coming years, the South Rockhampton STP is likely to need augmentation between the years of 2020 and 2025 when the population being served by this STP is expected to exceed 27,000 EP. This augmentation project will be a significant upgrade project that is likely to cost in excess of $40 million and would deliver an increase in capacity to cater for growth in population up to the year 2042.

Recycled Water Schemes

The Gracemere STP already has an established recycled water scheme with virtually 100% of the treated effluent currently disposed to land via irrigation. No recycled water schemes have yet been established for any of the Rockhampton STPs. This is in part has been due to the lack of sufficient demand for recycled water in Rockhampton. For the three Rockhampton STPs compliance with environmental discharge limits are based primarily on the volume of treated effluent that is discharged to the Fitzroy River. Recycled water use has the potential to provide an effective long term, low cost means of reducing the volume of treated effluent discharged to the Fitzroy River. This reduction in the need to discharge to the Fitzroy River can provide the ability to defer the high cost augmentation and process upgrades of the STPs that would be required in order ensure environmental discharge limits are met for the larger volumes of sewage being treated.

Table 3 Capital Works – Rockhampton and Gracemere STPs 2014 to 2016

Capital Cost	**2013-14**	**2014-15**	**2015-16**
SRSTP Interim Upgrade			
Detailed Design	$30,000		
New Blowers, Building, Pipework	$200,000		
Aeration Grids and Diffusers	$200,000		
A-Recycle Pumps, Pipework	$40,000	$60,000	
Dividing Wall – Anoxic Tank	$50,000		
Electrical Works - Commissioning		$160,000	
Overhead Cost and Contingency	$80,000	$80,000	
Sub-total	**$600,000**	**$300,000**	
GSTP Augmentation			
Detailed Design	$200,000		
Inlet Works		$1,000,000	
Treatment Capacity Augmentation (Wetland or Conventional Design)		$3,500,000	
Sub-total	**$200,000**	**$4,500,000**	
WRSTP Diversion to SRSTP			
Detailed Design		$200,000	
Construction of Rising Main			$1,300,000
Sub-total		**$200,000**	**$1,300,000**
Recycled Water Schemes			
Rising main from Gracemere to South Rockhampton	$260,000	$120,000	$820,000
Sub-total	**$260,000**	**$120,000**	**$820,000**
NRSTP Augmentation			
Detailed Design			$500,000
Sub-total			**$500,000**
Total	**$1,060,000**	**$5,120,000**	**$2,620,000**

Three clear opportunities exist to expand existing (Gracemere STP), or create new recycled water schemes (each of North Rockhampton and South Rockhampton STPs) to avoid or reduce the need to discharge effluent to receiving waters respectively. An accompanying report in this agenda provides detail on a cost-effective (approx. $1.0M) option to construct a recycled water main to enable pumping of recycled water from Gracemere STP to recycled water users in South Rockhampton (e.g. Rockhampton Golf Club). The creation of a recycled water scheme at each of the North Rockhampton and South Rockhampton STP has the potential to make use of the sporting fields in North Rockhampton (e.g. Callaghan Park Racecourse, Cyril Connell and Norbridge Parks) and adjacent grazing lands in South Rockhampton. Construction of the infrastructure to establish these schemes is estimated to cost between $1.0M and $1.5M in total. Further detailed planning and negotiation with potential customers is required before a commitment is made to commence these two new schemes.

LEGISLATIVE IMPLICATIONS

The four STP are operated under two separate Environmental Authorities (environmental licences). The three Rockhampton STPs share a consolidated load-based environmental licence which was introduced in 2007 to enable the individual effluent streams from each STP to be regulated as a combined discharge to the Fitzroy River estuary. Currently 100% of the effluent produced by the three Rockhampton STPs is discharged to the Fitzroy River estuary. In comparison to other licence limits for disposal to receiving waters, the discharge limits for the Rockhampton STP are less stringent due to the relatively high background levels of nutrients and suspended solids in the Fitzroy estuary. These less stringent licence limits are generally achievable using lower cost treatment technologies (capital and operating costs) and therefore retaining the existing environmental licence for the Rockhampton STPs is of significant financial benefit to Council.

Recently, FRW has worked closely with the Department of Environment and Heritage Protection in recent months and in December 2013 received confirmation that the existing environmental licence for the Rockhampton STPs can be retained for the foreseeable future. It is conceivable that this environmental licence can be retained indefinitely through well-considered and timely future initiatives (e.g. recycled water scheme development) that limit the volumes of treated effluent that need to be discharged to the Fitzroy River estuary.

The Gracemere STP has a separate environmental licence and currently consistently meets all licence discharge limits with all flows disposed of to land. The discharge limits for the Gracemere STP are relative lenient due to the complete land disposal of the treated effluent. Augmentation of the Gracemere STP is likely to trigger a material change of use due to the increased capacity that will be achieved following the completion of the augmentation works. There is good potential to continue to increase the use of recycled water produced by this STP in the coming years, through local use around Gracemere and possibly also via the supply of recycled water to key potential end-users in South Rockhampton via a recycled water pipeline. This along with the potential for improved effluent quality following the installation of a constructed wetland, should enable the current environmental discharge limits to be retained. This will be confirmed with the regulator once the augmentation option is confirmed in the coming months.

Completion of upgrade works to the Rockhampton and Gracemere STPs may lead to short durations of non-compliance whilst key construction activities are undertaken on existing treatment infrastructure. In mid-2013 FRW submitted a voluntary Transitional Environmental Program (TEP) to the regulator to cover brief periods of non-compliances while minor upgrades were being completed to the Rockhampton and Gracemere STPs. FRW is currently seeking to extent this TEP to cover the period required for future works that have the potential to lead to periods of non-compliant STP operation.

BUDGET IMPLICATIONS

As indicated in Table 3, a total of $800,000 is required within the 2013-14 financial years for the completion of the proposed upgrade works to the SRSTP and the design of the augmentation works for the Gracemere STP. Funds to cover this expenditure can be made available by re-allocating capital funding from two other projects. These projects were originally proposed prior to the completion of the strategic planning study which has led to re-prioritisation or change in sequence of these projects. It is therefore proposed that the $800,000 be obtained by re-allocating funding from the following projects with the remaining funds to be deferred to help fund projects next financial year.

- C0959212 R-S GSTP Augmentation ($793,233)
- C0640283 R-STP Rton South Pipeline from WRSTP ($667,745)

Upon adoption of this proposed upgrade and augmentation strategy for the Rockhampton and Gracemere STPs, the necessary planning for the budget allocations required for the 2014-15 and 2015-16 financial years and beyond will be undertaken accordingly.

CONCLUSION

Future upgrading and augmentation of the Rockhampton and Gracemere STPs is required to ensure they continue to meet the needs of our growing community. Strategic planning has been completed to define the timing and quantum of the capital investment that will be required to deliver these upgrades in a timely manner.

FUTURE UPGRADING OF ROCKHAMPTON AND GRACEMERE SEWAGE TREATMENT PLANTS

Sewage Treatment Plants Strategy Planning Study

Meeting Date: 5 February 2014

Attachment No: 1

Rockhampton Regional Council / Fitzroy River Water

SEWAGE TREATMENT PLANTS STRATEGY PLANNING STUDY

Final | August 2013

SINCLAIR KNIGHT MERZ

SKM

Rockhampton sewage treatment plants strategy planning study

SINCLAIR KNIGHT MERZ
SKM

Document title:	Rockhampton sewage treatment plants strategy planning study
Version:	Final
Date:	August 2013
Prepared by:	Lex Appelgren (PM), Warwick Shillito, Niall Carey (Odour), Damien Sharland (Process), Graeme Lewis (Review)
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Contents

Executive summary

Fitzroy River Water (FRW) is a business unit of Rockhampton Regional Council (RRC). FRW is responsible for, among other things, the operation and maintenance of sewage treatment plants. This study examines the status of the existing Gracemere (GSTP), South Rockhampton (SRSTP), West Rockhampton (WRSTP) and North Rockhampton (NRSTP) sewage treatment plants (STPs) – it also presents long and short term strategies for the future development of these STPs.

The strategies include optimisation of existing treatment infrastructure, construction of new treatment infrastructure and diversions of load between the existing and new STP sites.

STP load projections

Council has developed 2011 and future equivalent population (EP) loads for the STPs using its Planning Assumptions Model (PAM). A flow based sanity check has been undertaken for the EP loads. The combined Gracemere and Rockhampton projected loads have been compared with the historical long term (30 year) population growth. There are some minor inconsistencies in the EP loads but this reflects the difficulties inherent in determining and projecting STP loads.

The projected STP loads are as follows.

STP	2011	2016	2027	2042
Gracemere STP	8,200 EP	9,506 EP	13,158 EP	20,501 EP
West Rockhampton STP	6,160 EP	6,191 EP	6,259 EP	6,354 EP
South Rockhampton STP	18,700 EP	19,751 EP	22,277 EP	26,250 EP
North Rockhampton STP	50,430 EP	53,804 EP	62,017 EP	75,276 EP
Total Rockhampton STPs	75,200 EP	79,746 EP	90,553 EP	107,880 EP
Gracemere + Rockhampton STPs	83,400 EP	89,252 EP	103,711 EP	128,381 EP

The load projections are considered suitable for this level of investigation but should be re-visited when the results of the raw sewage characterisation program are available and prior to detailed design.

Existing STP Capacities

The existing STPs are all fully loaded. The 2011 loads and current STP capacities are compared below.

STP	2011 load	Current capacity
Gracemere STP	8,200 EP	6,500 EP
West Rockhampton STP	6,160 EP	Nil
South Rockhampton STP	18,700 EP	18,000 EP
North Rockhampton STP	50,430 EP	48,000 EP

The current Gracemere STP capacity has been determined for its ability to achieve the current licence requirements of 20BOD / 30SS / 20TN / 8TP.

The current West, South and North Rockhampton STP capacities have been determined for their ability to individually meet a mass load licence requirement of 20BOD / 30SS / 7TN / 5TP.

Raw sewage volumes

A comparison of 2011 Average Dry Weather Flows (ADWF) and EP loads for each treatment plant was undertaken. For the purposes of this study it was decided to adopt 220L/EP/d for GSTP, WRSTP and NRSTP.

For SRSTP, 250L/EP/d was adopted but additional work needs to be undertaken to confirm this prior to detailed design. Persistent high inflows or high trade waste flows seem to be influencing the ADWF / EP contribution and a higher value than 250L/EP/d may be considered more appropriate after further investigation.

Raw sewage characteristics

FRW has nominated typical Australian domestic raw sewage characteristics for use in this study.

A raw sewage characterisation program needs to be undertaken for more detailed investigations and design.

Treated water quality

FRW has nominated two treated effluent standards for releases to the Fitzroy River.

Treated water quality A is 20BOD / 30SS / 7TN / 5TP (median) and assumes the existing mass load licence is retained until 2042.

Treated water quality B is 5BOD / 5SS / 0.5NH3 / 5TN / 1TP (median) and assumes a higher standard is negotiated with regulators.

GSTP effluent is presently all disposed of to land and has a lower licence requirement 20BOD / 30SS (median) / 20TN / 8TP (80 percentile).

Existing mass load licence compliance

The existing mass load licence allows 1,380kgTN/week and 1,000kgTP/week (50%ile) as combined releases from WRSTP, SRSTP and NRSTP. There are also maximum weekly release requirements.

FRW reports performance on a financial year basis and advises it was able to achieve TN compliance up to the end of the 2011/12 year.

The analysis presented below is on a calendar year basis and that analysis shows that, in recent times FRW has not been able to consistently meet the 50%ile TN requirement.

TP compliance has been maintained.

Calendar year	NRSTP		SRSTP		WRSTP		Combined	
	TN	TP	TN	TP	TN	TP	TN	TP
2010								
Data points (weeks)	50	50	50	50	51	51	50	50
50%ile (kg/wk)	272	305	500	180	152	38	974	513
Wks >50%ile target	0	1	0	1	0	0	6 (12%)	2 (4%)
2011								
Data points (weeks)	50	51	50	51	50	51	50	51
50%ile (kg/wk)	326	343	310	172	153	44	925	512
Wks >50%ile target	0	2	0	0	0	0	10 (20%)	3 (6%)

Calendar year	NRSTP		SRSTP		WRSTP		Combined	
	TN	TP	TN	TP	TN	TP	TN	TP
2012								
Data points (weeks)	50	50	50	50	51	51	50	50
50%ile (kg/wk)	721	317	1,024	165	162	43	1,897	538
Wks >50%ile target	7	2	1	0	0	0	35 (70%)	3 (6%)
2013 (January – March)								
Data points (weeks)	8	8	8	8	8	8	8	8
50%ile (kg/wk)	409	216	872	113	157	41	1,459	506
Wks >50%ile target	0	0	0	0	0	0	5 (62%)	0

Part of the problem was acceptance of trade waste loads during 2011 and 2012 but that ceased in August 2012.

The 2013 performance identifies SRSTP as the major source TN exports (even-though SRSTP has a much lower load than NRSTP).

Reducing the SRSTP TN exports should be an early priority for FRW.

Receiving water quality

The Fitzroy River estuary is 60km long below the Barrage to Keppel Bay. Published data on water quality in the estuary indicates that ammonia, nitrogen and phosphorus concentrations exceed the Queensland water quality objectives in various locations and at various times. The upper reach that receives discharges from WRSTP, SRSTP and NRSTP has the highest nutrient concentrations.

The 2013 report card (for 2011/11 data) issued by the Fitzroy Partnership for River Health rated the ecological health of the estuary as “C” (fair) and the marine area adjacent to the Fitzroy basin as poor.

The estuary drains to a World Heritage area, the Great Barrier Reef Marine Park, the Great Barrier Reef Coast Marine Park and designated fish habitats. The river delta area contains “regulatory listed” ecosystems and individual species. Migratory species also visit the delta area.

There are a number of issues with the potential (for a development application for STP augmentation) to trigger a re-assessment of STP discharge requirements. FRW might argue that the STPs are 50-60km from the protected areas or that the STP nutrient discharges are much smaller than the natural nutrient exports from floods. Such assessments are beyond the scope of this investigation but FRW needs to be aware that a higher (than current) treatment standard could be imposed.

Assessment of existing Gracemere STP

GSTP is a continuous flow oxidation ditch plant. It has some structural issues with concrete slab movement and sealing but it is a valuable asset for at least the short term. It is not consistently meeting its nutrient licence targets but this is not considered to be a major problem while all of the effluent is disposed of to land.

GSTP capacity could be optimised with relatively minor works to achieve 8,000EP capacity if no nutrient removal was required. The capacity is significantly reduced where nutrients need to be removed.

Treated water quality	STP capacity (EP)
20BOD / 30SS (no N / P removal)	8,000EP
20BOD / 30SS / 20TN / 8TP (existing licence for irrigation)	6,500EP
20BOD / 30SS / 7TN / 5TP (mass load treated water quality A)	5,100EP

Treated water quality	STP capacity (EP)
5BOD / 5SS / 5TN / 0.5NH3 / 1TP (treated water quality B)	3,600EP

Effluent reuse at Gracemere

The existing effluent irrigation areas at Gracemere (golf course, sports club and RRC leased irrigation area A) have a sustainable capacity of less than 3,000EP.

It is recommended that FRW undertakes an irrigation sustainability assessment to explore the possibility of reducing the licence standard for the Gracemere STP to remove nitrogen and phosphorus requirements.

It is recommended that FRW expands (sustainable) effluent reuse capability at Gracemere to 8,000EP.

It is recommended that FRW appoints a "Gracemere Reuse Champion" with responsibility to identify and develop additional effluent reuses for Gracemere effluent.

It is recognised that this has been difficult in the past at Gracemere but there are significant cost advantages that flow from deferring a pipeline to SRSTP which, in turn triggers augmentation of SRSTP.

Irrigation of the Rockhampton golf course (near the airport) with treated effluent is worth investigating as an interim option that may require pipeline construction but does not force a SRSTP augmentation.

Assessment of existing West Rockhampton STP

Council has decided to close WRSTP and divert the load to SRSTP. The inability of the WRSTP process to removed nutrients, the age of the plant and the condition of electrical equipment all confirm this decision.

The timing of the closure is dependent on having sufficient capacity at SRSTP to treat the diverted load and the construction of a pipeline to divert flow to SRSTP.

Assessment of existing South Rockhampton STP

SRSTP was not designed to remove nutrients. The plant is affected by high frequency floods (typically as low as 5 year ARI events). Mechanical equipment and some structures have been corroded by H_2S attack.

However, the plant is a valuable asset and the existing infrastructure could be optimised, as follows, to achieve the nominated treatment standards. Clarifier and membrane (MBR) options have been examined.

Treated water quality / Optimisation scenarios	STP Capacity (EP)
Clarifiers	
Mass load effluent standard A (20BOD / 30SS / 7TN / 5TP)	18,000EP
Effluent standard B (5BOD / 5SS / 5TN / 0.5NH3 / 1TP)	12,000EP
MBR	
Mass load effluent standard A (20BOD / 30SS / 7TN / 5TP)	35,000EP
Effluent standard B (5BOD / 5SS / 5TN / 0.5NH3 / 1TP)	19,000EP

The MBR options provide the largest capacity potential for the existing infrastructure and are discussed further in the report.

Assessment of existing North Rockhampton STP

NRSTP was designed to remove nitrogen (but not phosphorus). The plant is affected by floods but can protect its biomass up to 100 year ARI events and can be brought back on-line quite quickly after a flood. NRSTP structures are in relatively good condition. Mechanical equipment is starting to require overhaul / replacement.

NRSTP has the highest potential to cause odour nuisance. Odour control and abandoning the existing sludge lagoons should be considered in any augmentation.

Generally the plant is in good condition and is suitable for optimisation works to maximise the value of the existing infrastructure. Clarifier and MBR based optimisation options have been examined viz.

Treated water quality / Optimisation scenarios	STP Capacity (EP)
Clarifiers	
20BOD / 30SS / 7TN / 5TP (mass load effluent standard A)	48,000EP
5BOD / 5SS / 0.5NH3 / 5TN /1TP (treated effluent standard B)	42,500EP
MBR	
20BOD / 30SS / 7TN / 5TP (mass load effluent standard A)	80,000EP
5BOD / 5SS / 0.5NH3 / 5TN /1TP (treated effluent standard B)	70,000EP

The MBR options provide the largest capacity potential for the existing infrastructure and are discussed further in the report.

Sludge dewatering

FRW has purchased a skid mounted centrifuge. It has been assumed that this unit will be re-located (as required) to dewater existing sludge lagoons at NRSTP, SRSTP and GSTP. As loads increase over time, this approach will probably need to be re-visited. There are potential odour issues associated with the sludge lagoons that may require a change to permanent dewatering installations at the STPs. The STP process capacity assessments describe permanent dewatering installations which will be of future use to FRW. The cost estimates do not include provision for permanent dewatering installations.

Long term strategies for Rockhampton's sewage treatment infrastructure

Seven long term strategies have been examined for the development of sewage treatment capacity to 2042.

- LT1 – Single new "flood-proof" STP north of the Fitzroy River (includes closure of all existing STPs and diversion of loads to new STP)
- LT2 – Locate all treatment capacity at South Rockhampton STP (includes closure of GSTP, WRSTP and NRSTP and diversion of load to SRSTP)
- LT3 – Locate all treatment capacity at North Rockhampton STP (includes closure of GSTP, WRSTP and SRSTP and diversion of load to NRSTP)
- LT4 – Optimise existing North Rockhampton STP + Optimise / Upgrade South Rockhampton STP (includes closure of GSTP and WRSTP and diversion of load to SRSTP)
- LT5 – Optimise existing South Rockhampton STP + Optimise / Upgrade North Rockhampton STP (includes closure of GSTP and WRSTP and diversion to load to SRSTP; also includes diversion of excess load from SRSTP to NRSTP)
- LT6 – Optimise Gracemere STP / Reuse + Optimise SRSTP + Optimise / Upgrade NRSTP (includes closure of WRSTP and diversion of load to SRSTP)
- LT7 – Optimise Gracemere STP / Reuse + Optimise NRSTP + Optimise / Upgrade SRSTP (includes closure of WRSTP and diversion of load to SRSTP)

For these strategies "Optimise" means modification of the existing infrastructure while "Upgrade" refers to new construction beyond the capacity of the optimised infrastructure.

Two options (i.e. for treated water qualities A and B) have been considered for each of the long term strategies – making fourteen options. It is noted that a decision about which treated water quality is required will probably be determined in negotiations between the regulator and Council.

A multi-criteria analysis (MCA) was undertaken to compare the seven long term strategies. The MCA examined Environmental, Community, Cost and Regulatory issues. An MCA spreadsheet was developed to compare the strategies and various weightings and sensitivities for the issues were tested at a workshop held with Council staff.

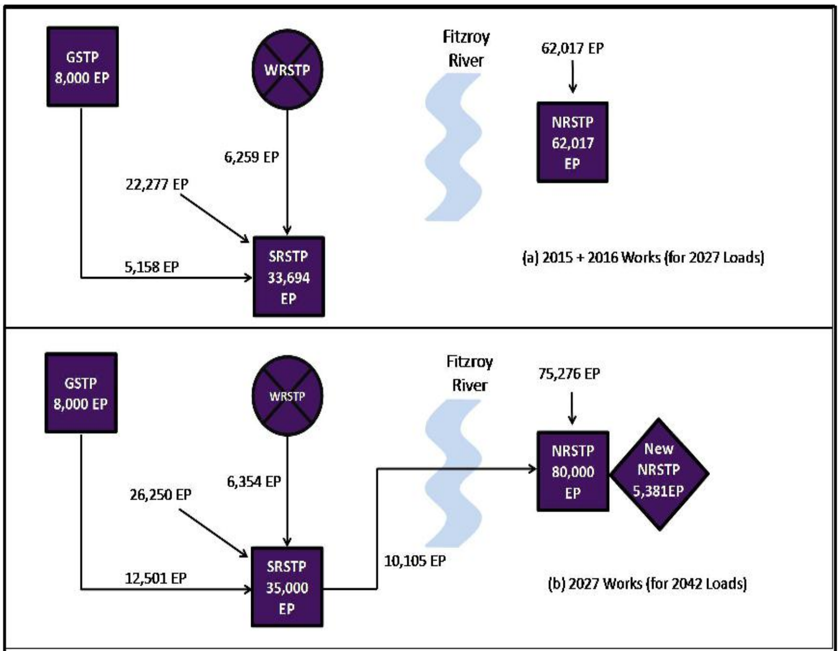
The workshop concluded that LT6 and LT7 were the preferred long term strategies.

The costs developed for LT6A, LT7A and LT7B were:

	LT6A	LT7A	LT7B
2015 & 2016 Works (for 2027 loads)			
Direct capital costs ($2013)			
Pipelines	$10.9M	$10.9M	$10.9M
Treatment plants	$84.6M	$84.6M	$107.5M
Indirect costs & contingency	$44.2M	$44.2M	$54.7M
Total capital	$139.7M	$139.7M	$173.0M
Annual operating cost (2027[1])	$4.2M	$4.2M	$4.2M
2027 Works (for 2042 loads)			
Direct capital costs ($2013)			
Pipelines	$11.4M	$6.1M	$6.1M
Treatment plants	$25.6M	$25.5M	$35.6M
Indirect costs & contingency	$17.0M	$14.6M	$19.2M
Total capital	$54.0M	$46.2M	$60.8M
Annual operating cost (2042[2])	$5.5M	$5.3M	$5.4M
Total capital ($2013)	$207.0M	$185.9M	$233.8M
NPV	$331M	$325M	$367M

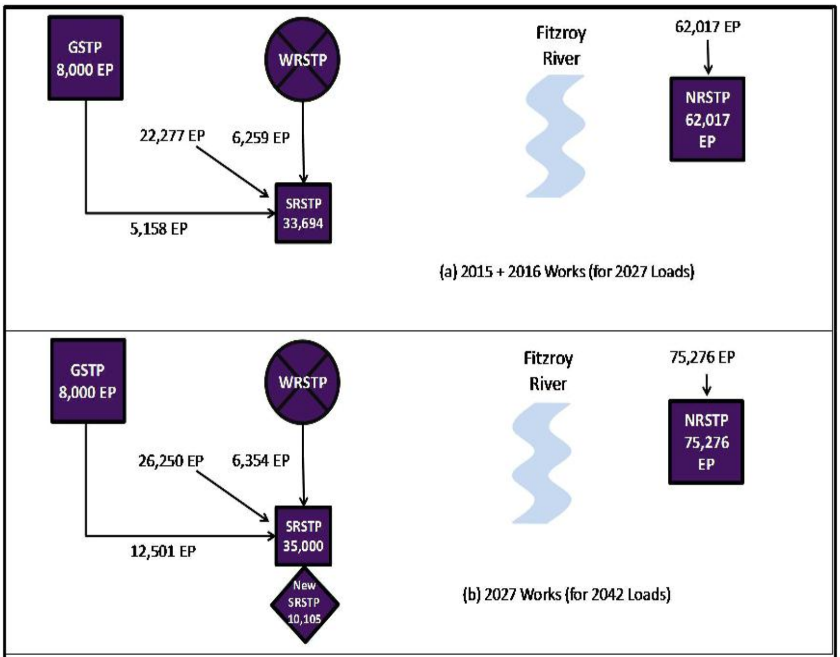
Notes: 1. Annual operating cost (power, chemicals & labour) for 2027 load in $2013. 2. Annual operating cost for 2042 load in $2013.

A schematic for Option LT6A is provided below.



Option LT6A - Optimise Existing GSTP, SRSTP and NRSTP and Construct New NRSTP

A schematic for Option LT7A is provided below.



Option LT7A - Optimise Existing GSTP, NRSTP and SRSTP and Construct New SRSTP

Review of FRW priorities

Subsequent to the workshop FRW personnel met and developed the following proposals for the next five years.

Action / project	Justification / driver / objective	Implementation
SRSTP		
Aeration upgrade	Regulatory; To consistently meet TN limit; Precursor for further augmentation	2013/14
Augment to achieve capacity for transfer of WRSTP (MLE conversion)	Regulatory; To allow decommissioning of WRSTP	2014/15, 2015/16
Augment for growth in SR and WR catchments to 2027 (MBR conversion)	Regulatory; To match growth	2016/17, 2017/18
NRSTP		
Aeration upgrade	Regulatory, To consistently meet TN limit	2014/15
Augment for growth in catchment to 2027	Regulatory; To match growth	2015/16 to 2017/18
WRSTP		
Electrical "band aid" works	Safety; Reliability; To operate to mid-2015	2013/14
Design & construct rising main to SRSTP	Safety, Reliability; Regulatory; Decommission WRSTP	2014/15, 2015/16
Upgrade Jardine Park SPS	Safety, Reliability; Regulatory; Decommission WRSTP	2015/16
Decommission & demolish WRSTP	Safety, Reliability; Regulatory; Decommission WRSTP	2015/16
GSTP		
Aeration upgrade for current load	Regulatory	2013/14
Augment for growth in catchment	Regulatory; match growth for 10 years; Avoid change to combined mass load licence	2013/14 to 2015/16

These proposals are broadly in line with the LT6 / TL7 long term strategy.

Short term strategy for South Rockhampton STP

TN exports from SRSTP are the immediate problem for FRW. A short term strategy has been developed for SRSTP to reduce TN exports.

The proposal is to convert the existing plant to a nitrogen removal process known as Modified Ludzak Ettinger (MLE).

It is considered that this can be done while the plant is on-line, although there would need to be some night time cut-overs and possibly inflow interruption to provide time to accomplish the cut-overs. The short term works would comprise:

- Retention of existing Primary Sedimentation Tank 1 (PST 1) as a PST
- Conversion of PST 2 to an Anoxic Tank (and adding submersible mixers)
- Modifying pipework to direct Anoxic Tank effluent to the existing aeration tanks
- Conversion of the aeration tanks to operate in series with over-the-wall submersible / propeller pumps and upgrading of the aeration system with fine bubble diffused air blowers, pipework and diffuser grids. The upstream section of the series aeration tank would be anoxic with submersible mixers
- Provision of an A-Recycle to pump from a de-aeration zone at the end of the series aeration tank to the Anoxic Tank

- Modification of the series aeration tank effluent pipework to allow flow to be directed to either or both of the existing Secondary Sedimentation Tanks (SST 1 & 2)
- Modification of the Return Activated Sludge (RAS) pumping system to direct RAS to the Anoxic Tank
- Retention of the existing liquid stream downstream of the SSTs
- Retention of the existing PST 1 sludge wasting system pumping to Anaerobic Digesters 1 & 2
- Retention of the existing Waste Activated Sludge (WAS) system pumping to Anaerobic Digesters 1 & 2
- Retention of the existing sludge storage lagoons and supernatant return system

It is anticipated that the existing Sludge Transfer Pump Station switch room could be used for the compressed air system. A new building would be required to accommodate the aeration blowers. These will require some careful design and construction.

Significant electrical and control works would be required and it is anticipated these can be accommodated in existing structures and the new blower building.

A Biowin process model has been prepared to test this short term strategy. Using currently available information the model predicts that these works could provide a capacity of 25,000EP (at 250L/EP/d) and deliver 5mgTN/L and 5mgTP/L (median) effluent quality.

This would reduce the current SRSTP TN exports from 870kg/week to about 220kg/week.

The estimated cost of these short term works at SRSTP is approximately $10 million.

Raw sewage characterisation, diurnal flow patterns, load peaking factors and a detailed concept design need to be undertaken to confirm this short term approach.

The short term works at SRSTP would allow WRSTP to be diverted. SRSTP would then be loaded to its 25,000EP capacity. After that there would be a gradual deterioration in performance at SRSTP as the load increased. Further works might be deferred several years by skilful operation of SRSTP and NRSTP to maximise the flexibility provided by the mass load licence.

If this approach can be successfully implemented it would provide time for FRW to plan the funding for the selected long term treatment strategy.

Conclusions / Recommendations

This study has determined that:

1. Council's decision to close WRSTP is supported. WRSTP is at the end of its life with equipment (especially electrical) in poor condition. A significant expenditure would be required to make the electrics code compliant – this expenditure could not be recovered. There is a latent odour risk at WRSTP. WRSTP cannot be converted to achieve nitrogen removal and this is the primary driver for compliance with the mass load discharge licence.
2. The most optimal long term strategy is either LT6 or LT7. Choosing between these two could only be done with more detailed costing
3. Immediate works are required at SRSTP and GSTP. It is recommended FRW proceeds with these works as a matter of high priority

1. Introduction

1.1 Background

This study concerns the existing Gracemere STP and three Rockhampton STPs (South, West and North).

The Gracemere STP has an environmental authority for ERA 15(d) that allows treatment of 4,000 – 10,000EP but requires discharge to land (EPA 2006).

The three Rockhampton STPs have a single environmental authority for ERA 15(e) that allows treatment of 10,000 – 50,000EP (per STP) and release to the tidal zone of the Fitzroy River downstream of the Fitzroy Barrage. The environmental authority includes combined load limits for total nitrogen and total phosphorus (EPA 2007).

The West Rockhampton STP is a trickling filter plant that was constructed in 1962. It is technologically incapable of any significant nitrogen or phosphorus removal and is approaching the end of its asset life. FRW has decided to decommission it and divert its load to South Rockhampton STP.

The Gracemere, South and North Rockhampton STPs are activated sludge plants that were constructed in 1984, 1983 and 1986 respectively. GSTP and SRSTP were not specifically designed for nitrogen or phosphorus removal. NRSTP was not specifically designed for phosphorus removal. The plants do achieve some (unintended) nitrogen and phosphorus removal (which has assisted FRW to meet the mass load licence requirements) but they are approaching the limits of their ability and will require augmentation for capacity and treatment technology in the near future.

1.2 Scope of investigation

The objective of this investigation is to develop a master sewage treatment plant planning strategy to the year 2042 considering the following:

- The optimal number and location of STPs to meet the growth in sewage inflows in Rockhampton and Gracemere without risk of disruption due to natural events such as floods;
- Maximising the economies of scale for STP infrastructure whilst maintaining sufficient safety and reliability of performance;
- Satisfying development approval and environmental licence requirements and carbon emission based operational constraints to minimise environmental impacts in a cost effective manner;
- Meeting customer and stakeholder expectations for standard of service with respect to odour and product quality including future demand for recycled water;
- Maximising the value of existing sewage treatment infrastructure;
- Staging of major capital upgrades in a manner that meets operational service needs whilst minimising the impact of the “cost to serve”;
- Maximising any opportunity to attract external funding and minimise the cost burden of the future capital investment in STP infrastructure on the region’s ratepayers;
- A brief discussion of the advantages and disadvantages of the various forms of project delivery with a recommendation and supporting reasons;
- A cost estimate to within +/- 40% accuracy and commentary of how forms of project delivery could impact the cost estimate

Three broad development phases are to be considered i.e. Phase 1 – 2016, Phase 2 – 2027, Phase 3 - 2042

1.3 Scope exclusions

The investigation is not required to undertake:

- Master planning of sewerage reticulation network upgrades;
- Integration of this sewage treatment strategy with the sewerage reticulation strategy developed by Council;
- Strategizing and costing for the raw sewage diversion between West and South STPs;
- Investigation of potential additional recycled water customers – the demand increases nominated in the brief are to be adopted;
- Detailed audits of STP structures / mechanical / electrical infrastructure – high level audits only are required at this stage of the project; and
- Communication with stakeholders outside of Council and FRW

1.4 Tentative augmentation schedule

FRW has identified a number of imperatives for the scheduling of treatment plant augmentations viz.

- Due to rapid residential growth, rapid expansion of the adjacent industrial precinct and a significant pipeline of already approved residential developments, Gracemere STP must have a major augmentation or diversion of excess inflows by December 2016
- Due to significant deterioration of some aspects of its infrastructure, South Rockhampton STP may require some form of augmentation by 2016
- Council has resolved to decommission West Rockhampton STP and divert its raw sewage to the South Rockhampton STP catchment. The completion of these works has been put on hold pending the outcomes of this investigation.

FRW has nominated a tentative project delivery process comprising strategy study (this investigation), concept design and securing development approvals. FRW's objective is to complete these activities by late 2014. Design and construction works would need to commence in 2015.

1.5 Augmentation options

FRW has nominated the following augmentation options:

Gracemere STP

- Augment as standalone
- Retain and divert additional flows to SRSTP plus expand recycling to cater for an additional 10% Class A recycled water
- Decommission and provide potable water as a replacement for the existing recycled water plus 10% of current demand
- Other

South Rockhampton STP

- Augment as standalone
- Augment plus WRSTP diversion with different timing considerations
- Augment as above with partial diversion of NRSTP flows
- Other

North Rockhampton STP

Rockhampton sewage treatment plants planning strategy

SKM

- Augment as standalone
- Augment as above with partial diversion of SRSTP flows
- Other

2. STP load projections

FRW has presented projections for the individual STP loads and requested a “sanity” check of these projections using current dry weather flow contributions.

2.1 RRC planning assumptions model

RRC’s Planning Assumptions Model (PAM) develops an EP estimate from the catchment land parcels, zonings etc. The EP estimate includes resident population, non-residents (visitors) and allowances for industrial, commercial, retail and community infrastructure (typically based on gross floor area estimates).

RRC considers that the PAM projections are “closer to, although slightly above, the 2011 revision of the PIFU 2011 Medium Series”.

For this study it is assumed the PAM projections align with the PIFU (now OESR) 2011 medium series projections.

2.2 STP load projections

The following STP load projections (from PAM) for the Gracemere STP were presented.

Table 2-1 Gracemere STP EP projection

	2011	2016	2027	2042
Gracemere STP	8,200 EP[1]	9,506 EP[1]	13,158 EP[2]	20,501 EP[1]

Note: 1 – Value from PAM v2. 2. - Interpolated value

The 2011 load for Gracemere is the same as the ABS census count of 8,156 and implies very little non-domestic load. The PAM projection essentially adopts the 2011 census count and an annual growth rate of 3%pa.

The following STP load projections (from PAM) for the West, South and North Rockhampton STPs were presented.

Table 2-2 Rockhampton STPs EP projections

STP	2011	2016	2027	2042
West Rockhampton STP	6,160 EP[1]	6,191 EP[1]	6,259 EP[2]	6,354 EP[1]
South Rockhampton STP	18,700 EP[1]	19,751 EP[1]	22,277 EP[2]	26,250 EP[1]
North Rockhampton STP	50,430 EP[1]	53,804 EP[1]	62,017 EP[2]	75,276 EP[1]
Total Rockhampton STPs	75,200 EP	79,746 EP	90,553 EP	107,880 EP

Note: 1. – Value from PAM v2. 2. - Interpolated value

Council advised that the 2011 West Rockhampton STP load is almost exclusively residential; that the 2011 South Rockhampton STP catchment includes a significant non-residential load (approximately 40%) and that the 2011 North Rockhampton STP catchment load is predominantly (approximately 90%) residential.

These projections indicate very little growth in the WRSTP catchment. The SRSTP catchment load increases by about 7,500 EP and 6,000 EP of this is residential. Most of the growth, i.e. 32,500 EP is projected to occur in the NRSTP catchment.

2.3 OESR population projections

Queensland Treasury's Office of Economic and Statistical Research (OESR) has presented resident population projections for Gracemere and Rockhampton. The OESR resident population projections are for medium series growth for the 2011 to 2031 period.

The OESR resident population projections have been extrapolated to 2042 for this study. An interpolated value for 2027 has also been determined to align with the Phase 2 planning horizon.

Table 2-3 OESR medium series population projections

	2011	2016	2027[1]	2031	2042[2]
Gracemere	8,387	10,132	14,612	16,248	21,318
Rockhampton	65,421	68,366	75,308	78,113	86,203
Total	73,808	78,498	89,920	94,361	107,521

Note: 1. Interpolated value. 2. Extrapolated value

2.4 Non-domestic STP load

The total non-domestic EP load for the Gracemere and Rockhampton STP catchments can be obtained by subtraction of the OESR resident populations from the PAM EPs viz.

Table 2-4 Non-domestic EP load projections

	2011	2016	2027[1]	2031	2042[2]
Gracemere & Rockhampton EP	83,400 EP	89,252 EP	103,711 EP	109,710 EP	128,381 EP
Gracemere & Rockhampton population	73,808	78,498	89,920	94,361	107,521
Non-domestic EP	8,592 EP	10,754 EP	13,791 EP	15,349 EP	20,860 EP

Note: 1. Interpolated value. 2. Extrapolated value

The non-domestic EP load developed using the PAM model increases from about 10% of the total load in 2011 to 16% in 2042. This is considered to be reasonably realistic for a developed urban community like Rockhampton although it should be noted that a single new large trade waste generator could significantly alter the situation (and have a significant impact particularly in the smaller catchments).

2.5 ADWF sanity check

Average dry weather flow (ADWF) volumes for the Gracemere and Rockhampton STPs have been developed using 2011 data and are presented in the chapters for the existing STPs later in this report.

The ADWFs for the treatment plants are presented below.

Table 2-5 Gracemere and Rockhampton STPs ADWF flows

STP	2011 ADWF
Gracemere STP	1.22 ML/d
West Rockhampton STP	1.05 ML/d
South Rockhampton STP	5.11 ML/d
North Rockhampton STP	9.44 ML/d

STP	2011 ADWF
Total	16.82 ML/d

These data can be used to determine ADWF per EP volumes viz.

Table 2-6 Gracemere and Rockhampton STPs ADWF volumes per EP

	2011 ADWF	2011 EP	2011 ADWF / EP
Gracemere & Rockhampton STPs	16.82 ML/d	83,400 EP	202 L/EP/d
Gracemere STP	1.22 ML/d	8,200 EP	149 L/EP/d
West Rockhampton STP	1.05 ML/d	6,160 EP	170 L/EP/d
South Rockhampton STP	5.11 ML/d	18,700 EP	273 L/EP/d
North Rockhampton STP	9.44 ML/d	50,430 EP	187 L/EP/d

These data present a significant range of ADWF / EP values but, they are all possible.

In recent projects in SE Queensland ADWF / EP values as low as 160L/EP/d have been encountered. ADWF / EP values as high as 300L/EP/d are also quite common. However, these are usually calculated from Average Daily Flows (ADF) and include a sizeable “leakage” component due to groundwater infiltration.

While it may be theoretically “correct” to consider ADWF as sanitary flow only, the reality is that inflow / infiltration (I/I) in leaky catchments is often persistent, even after long dry periods. I/I is usually expensive and difficult to eliminate. The “real” flows that treatment plants receive often include an infiltration component that is captured by the ADWF calculation methodology.

FRW has proposed values of 220 and 250L/EP/d for this study. These values were developed for the preparation of Council’s Strategic Asset Management Plan (SAMP).

It is considered that 220L/EP/d is appropriate for GSTP, WRSTP and NRSTP.

SRSTP seems to be much more affected by I/I and 250L/EP/d is considered more appropriate at this level of investigation.

Another useful comparison is to determine the EP from the ADWF and the adopted per capita flows viz.

Table 2-7 Gracemere and Rockhampton STPs EP loads

	2011 ADWF	RRC 2011 EP	EP at 220L/EP/d	EP at 250L/EP/d
Gracemere & Rockhampton STPs	16.82 ML/d	83,400	76,456	67,280
Gracemere STP	1.22 ML/d	8,200	5,546	4,880
West Rockhampton STP	1.05 ML/d	6,160	4,773	4,200
South Rockhampton STP	5.11 ML/d	18,700	23,227	20,440
North Rockhampton STP	9.44 ML/d	50,430	42,909	37,760

This comparison suggests that 220L/EP/d is a conservative allowance for GSTP, WRSTP and NRSTP but much more appropriate than 250L/EP/d.

For SRSTP, 250L/EP/d "under estimates" the load but is considered a more appropriate allowance than 220L/EP/d. It would be unusual to adopt a higher value that 250L/EP/d but this may need to weighed against the cost of I/I reduction.

More detailed examination of ADWF / EP and EP loads is required prior to detailed design.

2.6 Ammonia, TKN and TP sanity checks

Similarly to ADWF, checks can be done for per EP contribution of ammonia, TKN and TP in raw sewage.

It is recommended that such checks are undertaken when raw sewage characterisation has been completed. FRW advises that raw sewage characterisation will be undertaken prior to design for significant augmentation works.

2.7 Sensitivity of STP load projections

Projecting future populations (or EP loads) is a very inexact science and projections can be strongly influenced by short term perceptions and external factors.

To add perspective to the STP load projections for this project, low and high growth projections have been developed to compare with the medium scenario developed from PAM.

OESR has not developed low and high series projections at the statistical local area (SLA) level so we have scaled these from the OESR projections for the Rockhampton Regional Council area data. OESR's projected growth rates for Rockhampton City are much lower than for the RRC local authority area and our projections reflect this.

The low, medium (RRC) and high EP projections are presented below.

The EP projections are also compared with historical (1971 – 2011) EP estimates. The historical EP estimates have been developed by applying the 2011 non-domestic to residential EP ratio to the historical census counts and presenting this as a "line of best fit".

If the historical EPs estimate trend-line was to continue into the future the PAM EP projections would be optimistic. However, Council expects that Gracemere / Rockhampton's future growth will be stronger than in the past and the projections reflect this.

The low and high growth plots provide an indication of the time sensitivity of the projections e.g.

- the Phase 1 - 2016 medium projection load could occur over a 3 year period from 2015 to 2017
- the Phase 2 - 2027 medium projection load could occur over a 6 year period from 2025 to 2031, and
- the Phase 3 – 2042 medium projection load could occur over a 10 year period between 2038 and 2048.

The low and high growth plots also provide an indication of the load sensitivity of the projections e.g.

- the Phase 1 – 2016 medium projection load of 89,252EP could vary over a -1.3% to +1.1% range from 88,059EP (low projection) to 90,266EP (high projection)
- the Phase 2 – 2027 medium projection load of 103,711EP could vary over a -4.2% to +3.6% range from 99,382EP (low projection) to 107,452EP (high projection)
- the Phase 3 – 2042 medium projection load of 128,381EP could vary over a -7.2% to +7.5% range from 119,200EP (low projection) to 137,958EP (high projection)

This sensitivity assessment does not detract from the value of the medium growth projection but it provides some perspective on the uncertainty of when the projected loads might be achieved.

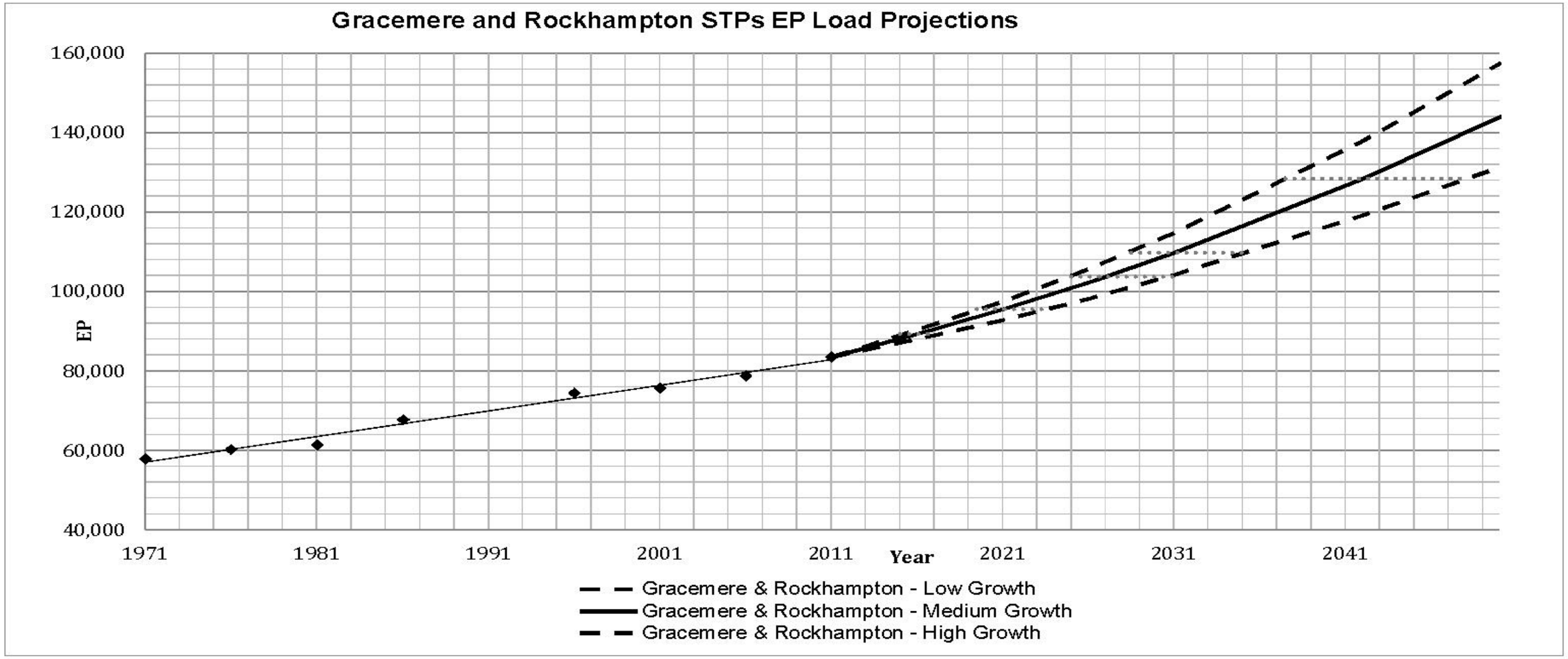


Figure 2-1 Gracemere + Rockhampton STPs EP load projections sensitivity

3. Raw sewage characteristics

3.1 ADWF

As discussed above, it is proposed to adopt the following ADWF (per EP) values for the STPs:

- Gracemere, West and North Rockhampton STPs 220L/EP/d
- South Rockhampton STP 250L/EP/d

The above values are based on an assessment of 2011 / 2012 inflows and it is recommended that a longer data series be examined prior to detailed design.

3.2 Other constituents

The (per EP) raw sewage characteristics nominated by FRW for this study are as follows. These are considered typical for Australian conditions.

Table 3-1 Raw sewage characteristics

Parameter	Characteristics
CODt[1]	125 g/EP/d
BOD[1]	58 g/EP/d
TN[1]	13 g/EP/d
Ammonia – N[1]	9 g/EP/d
TP[1]	2.3 g/EP/d
Nus[1]	2.0% TN
VSS[1]	85% TSS
Alkalinity as $CaCO_3$[1]	250 mg/L

Source: 1 – RRC 2012a

3.3 Raw sewage characterisation program

It is recognised that the above values may need to be re-assessed after the proposed raw sewage characterisation program. This should be undertaken prior to detailed design.

A raw sewage characterisation program will identify STP catchments with abnormal characteristics. Abnormal characteristics (both high and low) can be indicative of significant trade waste contributions. These can then be investigated further to confirm whether these loads need to be assessed individually during detailed design.

3.4 Trade waste

FRW has a Trade Waste Environmental Management Plan (RRC 2010) and a trade waste management team.

The categories of trade wastes are summarised as follows:

Table 3-2 Trade waste categories

Parameter	Category 1 Low strength / low volume	Category 2 Low strength / high volume	Category 3 High strength / any volume
BOD (mg/L)	<300	<300	<300

Parameter	Category 1 Low strength / low volume	Category 2 Low strength / high volume	Category 3 High strength / any volume
COD (mg/L)	<600	<600	>600
SS (mg/L)	<300	<300	>300
TKN (mg/L)	<80	<80	>80
TP (mg/L)	<15	<15	>15
Volume (kL/year)	<250	>250	Any volume
Trade waste approval	permit	permit	agreement
Charge	Annual charge	Quantity based charge Minimum charge	Quantity / quality charge on annual load Minimum charge

Council's Trade Waste Management Plan includes general sewer admission limits viz.

Table 3-3 General sewer admission limits

General sewer admission limits
Temperature 45°C, pH 6 to 10, BOD 600mg/L, COD 1,500mg/L, TOC 1,200mg/L, TSS 600mg/L, TDS 10,000mg/L, Oil & grease 200mg/L, Chlorine 10mg/L, Sulphate 1,500mg/L, Sulphite 15mg/L, Surfactants 500mg/L, Aluminium 100mg/L, Iron 100mg/L, NH_3/NH_4 100mg/L, TKN 150mg/L, Phosphorus 50mg/L.

Council's Trade Waste Management Plan includes specific sewer admission limits for a range of nominated inorganic compounds, metals and organic compounds.

Council's Trade Waste Management Plan excludes sewer admission of various nominated prohibited discharges and other wastes (of concern to Council).

3.4.1 SRSTP catchment

The largest Category 3 trade waste discharge is from Parmalat in the SRSTP catchment. FRW advises that Parmalat is permitted to discharge 300kL/d at the COD limit of 1,500mg/L.

FRW monitors Parmalat flows and BOD approximately quarterly. The BOD appears to have increased substantially since 2010. All of the more recent BOD samples exceed the 300mg/L sewer acceptance limit. The quality of Parmalat discharges continues to be discussed between FRW and Parmalat with a view to improving compliance with sewer admission limits.

Table 3-4 Parmalat trade waste monitoring data

Period	September 2005 – May 2010	August 2010 – May 2013
Flows		
Data points	17 (average sample period 94 days)	8
Minimum (kL/d)	136	162
Average (kL/d)	195	183
Median (kL/d)	196	182
Maximum (kL/d)	302	205
No. greater than 300kL/d	1	0
BOD		

Period	September 2005 – May 2010	August 2010 – May 2013
Data points	18	8 (average sample period 137 days)
Minimum (mg/L)	250	630
Average (mg/L)	440	923
Median (mg/L)	450	905
Maximum (mg/L)	577	1,200
No. greater than 300mg/L	17	8

The 200 to 300kL/d load implies an equivalent hydraulic load of 800 to 1,200EP at 250L/EP/d. The equivalent organic load for 450mg/L BOD and 200kL/d is approximately 1,500EP at 58gBOD/EP/d.

FRW has undertaken additional sampling and analysis of the Parmalat trade waste since December 2012 with the following results.

Table 3-5 Parmalat trade waste monitoring results

Date	BOD (mg/L)	COD (mg/L)	pH	SS (mg/L)	TDS (mg/L)	PO4-P (mg/L)	TKN (mg/L)
5 Dec 2012	440	-	6.9	130	1,600	-	-
10 Jan 2013	660	1,100	6.2	210	1,200	11	55
18 Feb 2013	1,500	-	7.3	240	1,000	-	-
26 Feb 2013	1,200	-	4.6	430	1,500	-	-
12 Mar 2013	1,100	-	8.6	240	1,800	-	-
2 Apr 2013	890	1,500	5.1	170	1,400	7.3	36

These data confirm that Parmalat releases a significant load to sewer and that the organic load is higher than previously thought.

3.4.2 NRSTP catchment

Recent investigations have identified approximately six fast food premises in the NRSTP catchment that exceed the 300mg/L BOD limit for Category 3. These establishments each discharge between 5 and 10kL/d. It has been assumed that trade waste is included in the above raw sewage characteristics.

FRW accepted a trade waste discharge from Murgon Leather until August 2012. This waste stream was 13kL/d and had characteristics of 320,000mg/L TDS; 10,000mg/L BOD; 10,000mg/L SS; 2,000mg/L TN; 200mg/L TP and 2,000mg/L total oil & grease. The analysis of NRSTP performance over this period clearly showed impaired TN removal.

3.5 Septage

FRW accepts septage from its non-sewered areas. All septage is delivered to North Rockhampton STP.

FRW estimates that the normal volume of septage is 20 – 50kL/d but there is no available information about septage volume, strength or characteristics.

For this study it has been assumed that the septage has some toxicity that affects the growth rate of nitrifiers. A reduced nitrifier growth rate has been adopted for the NRSTP process assessment.

More detailed information about septage characteristics will need to be obtained prior to detailed design.

4. Treated water quality

4.1 Existing environmental licences

4.1.1 Gracemere STP

The environmental authority treated effluent limits for Gracemere STP are summarised below.

These limits apply for release to land and not to aquatic ecosystems.

Table 4-1 Gracemere STP release to land limits (EPA 2006)

	Minimum	80%ile	Median	Maximum	Sample Frequency
Residual Cl2				0.7 mg/L	Daily
TDS				1,000 mg/L	Monthly
BOD				20 mg/L	Monthly
SS				30 mg/L	Monthly
pH	6.5			8.5	Weekly
TN		20 mg/L			Monthly
TP		8 mg/L			Monthly
E. coli		150 cfu/100mL	100 cfu/100mL		Fortnightly

4.1.2 Re-assessment of Gracemere STP licence for discharge to land

The 20TN and 8TP licence conditions are somewhat arbitrary and this is reflected in their 80%ile compliance requirement.

The nitrogen and phosphorus limits for land disposal should be set for sustainable irrigation practice. The crop type, soils, irrigation application, groundwater etc. determine the sustainability of effluent irrigation.

An irrigation sustainability study may well determine that there is an advantage to FRW from relaxing the existing licence requirements.

FRW should undertake a detailed sustainability assessment of Gracemere effluent irrigation (with a view to relaxing the current licence conditions and maximising the effluent irrigation reuse).

4.1.3 South, West and North Rockhampton STPs

The environmental authority treated effluent limits for South, West and North Rockhampton STPs are summarised below.

These limits are for the combined discharge to the Fitzroy River estuary downstream of the barrage.

Table 4-2 South, West and North Rockhampton STPs release to Fitzroy River limits (EPA 2007)

	Minimum	80%ile	Median	Long term 50%ile	Maximum	Sample Frequency
Residual Cl2					0.7 mg/L	Daily
BOD					20 mg/L	Monthly

	Minimum	80%ile	Median	Long term 50%ile	Maximum	Sample Frequency
Dissolved oxygen	6 mg/L					Monthly
SS					30 mg/L	Monthly
pH	6.5				8.5	Weekly
TN (combined)				1,380 kg/wk	4,140 kg/wk	Weekly
TP (combined)				1,000 kg/wk	3,000 kg/wk	Weekly
E. coli		<4,000 cfu/100mL	1,000 cfu/100mL			Weekly

The interesting features here are the TN and TP mass loads. The implications of retaining the nutrient mass load requirements into the future are discussed below.

The existing licence includes a requirement to prepare a Water Quality Release Improvement Plan (WQRIP) with the objective of achieving 5mg/L TN and 1mg/L TP (50%ile) effluent quality in the long term.

Interestingly, the 5mg/L TN long term 50%ile objective (1,380kgTN/wk and 220L/EP/d ADWF) implies a load of 180,000EP while the 1mg/L TP objective (1,000kgTP/wk and 220L/EP/d) implies a load of 650,000EP.

The existing licence also includes a requirement to implement a Receiving Environment Monitoring Program (REMP) or to participate in regional monitoring studies.

RRC / FRW is a member of the Fitzroy Basin Partnership for River Health. This is an initiative to prepare a report card describing the health of the various reaches of the Fitzroy River and its tributaries. The first report card (for 2010/11 data) was released in May 2013. It rated the Fitzroy River estuary as “C” i.e. fair condition. The main conclusions were:

- Good results for oxygen, total nitrogen, dissolved phosphorus and chlorophyll
- Fair results for turbidity, total phosphorus and dissolved nitrogen
- Poor recruitment of barramundi, potentially due to unseasonal early post-winter flows

The report card rated the marine area adjacent to the Fitzroy basin as “poor” with water quality, sea grass and coral all in poor condition. The deterioration from the previous year was attributed to the cumulative effect of several years of extreme weather with flood borne large sediment and nutrient loads.

4.2 Compliance with mass load licence

FRW monitors the SRSTP, WRSTP and NRSTP performance against the mass load targets for TN and TP. FRW calculates weekly nutrient loads from weekly grab sample data and the “most recent” ADWF flow. The “most recent” ADWF is calculated as the average inflow over periods of at least seven days when there has been less than 0.25mm of rain.

The loads calculated by FRW have been analysed for the calendar years 2010, 2011, 2012 and for the first three months of 2013.

Table 4-3 Analysis of weekly nutrient mass loads

	NRSTP		SRSTP		WRSTP		Combined	
	TN	TP	TN	TP	TN	TP	TN	TP

	NRSTP		SRSTP		WRSTP		Combined	
	TN	TP	TN	TP	TN	TP	TN	TP
2010								
Data points	50	50	50	50	51	51	50	50
Minimum (kg/wk)	7	7	101	44	34	13	397	165
50%ile (kg/wk)	272	305	500	180	152	38	974	513
Maximum (kg/wk)	1,060	1,189	1,265	1,062	297	87	2,179	1,729
Wks >50%ile target	0	1	0	1	0	0	6	2
2011								
Data points	50	51	50	51	50	51	50	51
Minimum (kg/wk)	78	1	57	1	39	0	421	2
50%ile (kg/wk)	326	343	310	172	153	44	925	512
Maximum (kg/wk)	1,238	1,173	1,353	307	324	104	2,009	1,517
Wks >50%ile target	0	2	0	0	0	0	10	3
2012								
Data points	50	50	50	50	51	51	50	50
Minimum (kg/wk)	95	49	439	46	21	17	943	239
50%ile (kg/wk)	721	317	1,024	165	162	43	1,897	538
Maximum (kg/wk)	2,151	1,693	1,417	458	221	85	3,549	1,944
Wks >50%ile target	7	2	1	0	0	0	35	3
2013 (January – March)								
Data points	8	8	8	8	8	8	8	8
Minimum (kg/wk)	191	100	235	38	48	7	796	166
50%ile (kg/wk)	409	216	872	113	157	41	1,459	506
Maximum (kg/wk)	642	489	1,235	415	199	50	1,959	662
Wks >50%ile target	0	0	0	0	0	0	5	0

FRW considered 2010 to be a normal operating year. The 50%iles of the combined weekly TN and TP loads were less than the 50%ile long term targets. There were 6 weeks (12% of the 50 weeks of available data) when the combined TN load exceeded the 50% long term target. There were 2 weeks (4% of the 50 weeks of available data) when the combined TP load exceeded the 50%ile long term target. There were no weeks when the combined maximum weekly TN or TP targets were exceeded.

The 2011 performance was affected by the January 2011 floods. The 2011 performance was generally similar to 2010. The combined weekly 50%ile target exceedances increased to 10 (20%) for TN and 3 (6%) for TP. This was probably due to the time required for process recovery after the floods. The maximum combined weekly TN and TP targets were not breached.

The 2012 performance was significantly worse. The 50%ile of the combined weekly TN loads exceeded the 50%ile long term target. The 50%ile combined weekly TN target was breached on 35 weeks (70% of the 50 weeks of available data). The 50%ile combined weekly TP target was exceeded in 3 weeks (6%). The 50%ile TN export loads for SRSTP and NRSTP were more than double the 2011 loads. Weekly TN exports from NRSTP alone exceeded the total licence target in 7 weeks. Weekly TN exports from SRSTP exceeded the total licence target in one week. The maximum combined weekly TN and TP loads were significantly higher than 2011 but did not breach the maximum target.

FRW advises that the lower 2012 performance was largely due to increased trade waste loads. FRW allowed Parmalat to discharge a high BOD / TKN waste stream to SRSTP and allowed Murgon Leather to deliver a high salt / high BOD / high TKN waste to NRSTP. This occurred between July 2011 and August 2012. The effect of these additional loads was not particularly noticeable in 2011. But the effect was pronounced in 2012. The additional load was taken for about 25 weeks but the breaches occurred for 35 weeks – this implies a significant recovery period. The difference in performance between 2011 and 2012 suggests that the load volume or concentrations increased in 2012. FRW has no monitoring data to confirm this.

The 2013 data is only to early March (8 data weeks) but the 50%ile performance has not returned to 2010 levels. The 50%ile combined weekly TN load is 50% higher than 2010 and 2011 loads but is still just less than the combined licence 50%ile weekly target. The combined weekly TN target has been exceeded in 5 weeks (60% of the 8 weeks of available data). No combined weekly TP loads breached the 50%ile target. No combined weekly TN or TP loads have exceeded the maximum weekly targets. The TN exports from SRSTP are significantly higher than from NRSTP even though NRSTP has the higher hydraulic load.

FRW considers that the NRSTP performance has been impaired by its reduced aeration capacity. One of the horizontal surface aerators has been offline since the latter part of 2011 – it is expected to be replaced in the near future.

It is expected that the NRSTP performance will improve when the aerator is replaced. However, SRSTP's TN exports are more than double those from NRSTP and improvements from the new aerator may be insufficient to prevent ongoing regular breaches of the combined 50%ile weekly target. There seems to be little danger of breaching the maximum weekly targets but it could become increasingly difficult to meet the combined 50%ile weekly TN target (especially if it is analysed as a 52 week rolling average or similar).

It is noted that FRW reports performance to the regulator on a water year (June to June) basis and that its evaluation will be numerically different to the above. However, the general conclusions will still be valid.

4.3 Discharge water quality A (mass load)

FRW has nominated retaining the existing mass load licence as the first option for discharge water quality for this investigation.

The table below presents the "allowable" combined TN and TP treated effluent concentrations for the existing mass load licence as the load increases. The table also assumes that the Gracemere and Rockhampton STPs loads are combined. This may not occur but it provides an indication of the "worst case" concentrations.

Table 4-4 Allowable TN and TP effluent concentrations

	2011	2016	2027	2042
Gracemere EP	8,200 EP	9,506 EP	13,158 EP	20,501 EP
Rockhampton STPs EP	75,299 EP	79,746 EP	90,553 EP	107,880 EP
Gracemere + Rockhampton STPs EP		89,252 EP	103,711 EP	128,381 EP
Gracemere + Rockhampton TN	11.9 mg/L[2]	10.0 mg/L	8.6 mg/L	7.0 mg/L
Gracemere + Rockhampton TP	8.6 mg/L[2]	7.3 mg/L	6.3 mg/L	5.1 mg/L

Notes: 1 - TN and TP concentrations calculated for 1,380kgTN/wk, 1,000kgTP/wk, 7d/wk and 220L/EP/d. 2 – Rockhampton STPs only

These (median) TN and TP concentrations are readily achievable with a nitrifying / denitrifying process and chemical precipitation. At first glance, a more sophisticated treatment process e.g. Enhanced Biological Phosphorus Removal (EPBR) process would not be necessary. However, at larger loads (say above 10,000EP) the economics favour the adoption of EPBR.

FRW notes that nomination as a "controlled action" under the federal *Environment Protection & Biodiversity Conservation (EPBC) Act* might allow regulators to require more stringent effluent standards e.g. to protect ecosystems etc. downstream of Rockhampton. This study is not required to consider EPBC implications but briefly examines downstream water quality later in this report.

The other concern in this regard is development approval for augmenting the STPs. The Gracemere STP load is projected to exceed the existing licence limit of 10,000 EP between 2016 and 2027. The combined Rockhampton and Gracemere STPs load is not projected to exceed the 150,000 EP implied in the existing licence before 2042. If this approach is adopted (and Gracemere STP is decommissioned or limited in capacity) there may be no need for a new development approval.

On the other hand, STP augmentations with greater than 10% change in design capacity may be considered a Material Change of Use (MCU) requiring new approvals (EPA, 2005). There is a risk that regulators could use the MCU trigger to require more stringent effluent quality and even EPBC compliance.

FRW should seek expert town planning advice on this matter.

4.4 Discharge water quality B (5BOD / 5SS / 5TN / 0.5NH3 / 1TP)

FRW has nominated the following discharge water quality as an alternate to discharge water quality A.

Table 4-5 Discharge water quality B

Parameter	Long term median	Maximum
BOD	5 mg/L	15 mg/L
TSS	5 mg/L	15 mg/L
TN	5 mg/L	15 mg/L
Ammonia – N	0.5 mg/L	3 mg/L
TP	1 mg/L	3 mg/L
pH	6.5 – 8.5	
E. coli	150 cfu/100mL	600 cfu/100mL
Enterococci	40 / 100mL	N/A

The 5SS value proposed above may be excessive for release to the Fitzroy River estuary. Because the estuary is very long the turbidity and suspended solids concentration are naturally high. Consistently removing suspended solids to 5mg/L requires filtration and this expense could not be justified solely on the basis of receiving water quality.

4.5 Receiving waters

The Fitzroy is the largest estuary and drains the largest catchment on the east coast of Australia.

The Fitzroy Basin Association commissioned a review of development issues for the area (Eberhard 2012) and the main characteristics of the Fitzroy River delta area (as described by Eberhard) are summarised below.

The Fitzroy River estuary extends 60km below the Barrage. When the Barrage was constructed in 1970 it approximately halved the tidal reach. For much of its length the estuary is more than 100m wide and 4m dep at mid tide. The Spring tidal range is about 4.4m and the estuary experiences strong tidal currents. Tidal velocities are greatest in the lower reaches and progressively decrease upstream towards the Barrage and STP outfalls (DERM 2012).

The estuary drains to a delta of islands and channels containing various wetland communities including salt flats, salt marshes and mangroves. The main outlet is to Keppel Bay. Keppel Bay supports a significant scallop, prawn and fishing industry.

Keppel Bay includes the Great Barrier Reef Marine Park (GBRMPA) that was established by the federal government in 1975. It also includes the Great Barrier Reef Coast Marine Park that was established by the Queensland government in 2004. Keppel Bay includes several small island National Parks and resorts. All of these are overlain by a World Heritage area.

The Fitzroy River delta is listed in the National Directory of Important Wetlands.

A number of "nationally listed" threatened species and ecological communities occur in the area.

A number of migratory birds, mammals and marine reptiles visit the area.

A number of "state listed" endangered, near endangered and vulnerable species occur in the area.

Parts of the Fitzroy River delta are included in a Queensland Fish Habitat Area.

4.6 Queensland water quality guidelines

The Queensland Water Quality Guidelines (DERM 2009) nominate the following criteria for the protection of aquatic ecosystems in Central Coast waterways.

These are median values for the water body i.e. outside any mixing zone from a sewage treatment plant outfall.

The values provide an indication of the water quality improvements that are desired as the water flows from the upper estuary (where the Rockhampton STPs discharge) to the lower estuary and open coastal areas.

Table 4-6 Queensland Central Coast water quality guideline values for aquatic ecosystems

Water type	Amm N (mg/L)	Oxid N (mg/L)	Org N (mg/L)	Total N (mg/L)	FiltR P (mg/L)	Total P (mg/L)	SS (mg/L)	pH	
Upper estuary	0.03	0.015	0.40	0.45	0.010	0.040	25	7.0	8.4
Mid-estuary	0.10	0.10	0.26	0.30	0.008	0.025	20	7.0	8.4
Enclosed coastal / lower estuary	0.008	0.003	0.18	0.20	0.006	0.020	15	8.0	8.4
Open coastal	0.004	0.003	-	0.14	0.006	0.020	2	8.1	8.4

The Fitzroy River sub-basin environmental values and water quality objectives (DERM 2011) nominate the same values for the upper, mid and lower estuary reaches – except for suspended solids. The Fitzroy River sub-basin water quality objectives do not include values for suspended solids because the estuary has naturally occurring high suspended solids levels.

These water quality objectives are targets that regulators are endeavouring to achieve in the Fitzroy River. They provide guidance for regulators when they set licence conditions for sewage treatment plants and other release to the river.

The above water quality objectives for nutrients cannot be achieved by conventional sewage treatment plants.

This is recognised in the Rockhampton STPs licence where mass loads have been set as follows:

- Weekly long term 50 percentile 1,380kg TN and 1,000kg TP
- Weekly maximum 4,140kg TN and 3,000kg TP

Over a year the long term 50 percentile loads equate to 72 tonnes TN and 52 tonnes TP.

4.7 Water quality in the Fitzroy River estuary

4.7.1 2000 to 2002

The CRC for Coastal Zone Estuary and Waterway Management (CRC 2003) prepared a statistical analysis of water quality in the Fitzroy River estuary. The analysis considered monthly data from January 2000 to July 2002 for samples collected at 13 sites between the Barrage (Adopted Mean Thread Distance AMTD 60km) and the river mouth (AMTD 0km).

SRSTP, NRSTP and WRSTP are located as AMTD 55km, 56.5km and 59.6km respectively.

The CRC noted various deficiencies with the data and recommended some changes for ongoing monitoring.

Ammonia

The CRC analysis for ammonia was as follows:

- The median values of monthly NH_4 ranged from about 0.04mg/L in March to about 0.3mg/L in August
- The median values for the sampling sites ranged from about 0.003mg/L at AMTD 2.5km to about 0.02mg/L at AMTD 52.6km

The median ammonia concentration for monthly samples exceeded the water quality objective from June through to October.

The median ammonia concentrations in the upper estuary (above AMTD 45km) were the highest in the estuary and were about 0.2mg/L - this compares with the water quality objective of 0.03mg/L.

TN and TP

The CRC analyses for TN and TP were as follows viz.

- The median values of monthly TN samples ranged between about 0.4mg/L in December to about 0.7mg/L in January
- The median values of monthly TP samples ranged between about 0.08mg/L in July to about 0.2mg/L in January
- The median TN values for the sampling sites ranged from about 0.2mg/L at AMTD 2.5km to about 0.9mg/L at AMTD 55.1km
- The median TP values for the sampling sites ranged from about 0.06mg/L at AMTD 2.5km to about 0.3mg/L at AMTD 55.1km

All of the monthly median TN concentrations (except December) exceeded the water quality objective. All of the monthly median TP concentrations exceeded the water quality objective.

The median TN concentrations upstream from about AMTD 33.8km exceeded the water quality objective. The median TP concentrations upstream from AMTD 2.5km exceeded the water quality objective.

The TN concentrations upstream from about AMTD 45.2km were the highest in the estuary and were reasonably consistent at about 0.8 to 0.9 mg/L. The TP concentrations upstream from about AMTD 50.2km were the highest in the estuary and were reasonably consistent at about 0.2 to 0.3mg/L.

This analysis indicates that nutrient concentrations in the Fitzroy River estuary (and particularly in the upper estuary where the STPs are located) exceeded the water quality objectives.

4.7.2 2003 to 2006

DERM (2012) presented the results of water quality monitoring in the Fitzroy River estuary. Nitrate, total phosphorus, turbidity and chlorophyll-a data for three water years were presented as annual medians as shown below.

Table 4-7 Fitzroy River annual median water quality

	Year	AMTD 57.3	AMTD 20.0
Nitrate N (mg/L)	2003 – 2004	0.300	0.170
	2004 - 2005	0.290	0.135
	2005 - 2006	0.370	0.170
Total phosphorus (mg/L)	2003 – 2004	0.280	0.110
	2004 - 2005	0.200	0.079
	2005 - 2006	0.230	0.082
Turbidity (NTU)	2003 – 2004	31	136
	2004 - 2005	20	87
	2005 - 2006	25	76
Chlorophyll a (ug/L)	2003 – 2004	9.7	2.2
	2004 - 2005	10.8	2.3
	2005 - 2006	4.8	1.4

All of the nutrient values exceed the water quality objectives. As with the earlier sources the nutrient concentrations are higher in the upper estuary (near the STPs) than in the lower reaches of the estuary.

The 2002/03 and 2003/04 chlorophyll-a values exceed the water quality objectives.

DERM (2012) considers that the STP discharges have “caused significant nutrient enrichment of the estuary. This has resulted in increased algal growth but this is mainly confined to the less turbid upper reaches of the estuary”

4.7.3 Long term trend

DERM (2012) undertook a statistical analysis of dissolved oxygen (day time), turbidity, oxidised nitrogen, total phosphorus and chlorophyll-a data for the 13 years of the 1993 to 2006 period and concluded that there was “no statistically significant trends in any indicators for the Fitzroy.”

The STP nutrient exports over this period will have increased with increasing population and it is noteworthy that there has not been a deteriorating water quality trend over this period.

4.7.4 Mass load licence for Rockhampton STPs

FRW advises that on 31 August 2007, the then EPA, granted a development approval for the ERA 15(e) activities at the Rockhampton STPs. FRW considers that the development approval was made after the monitoring program described above (DERM 2012) and that the agreed mass load licence presumably was determined with regard to the monitoring data obtained.

4.8 Nutrient exports from floods

The nutrient analyses presented in the above sources are indicative of non-flood conditions i.e. they do not include significant inputs from urban, agricultural or grazing area runoff. However, the impacts of these diffuse sources can be very substantial (as shown below) and the poor mixing in the Fitzroy River upper estuary may be retaining some of these inputs (and influencing the above assessments).

4.8.1 Agricultural lands are hot-spots for annual runoff polluting the southern GBR lagoon

Packett et al (2009) have determined nutrient exports from the Fitzroy River basin for flood events over the 12 years of 1994-98 and 2002-08 periods.

Packett et al considered that small volume floods dominated the flow regime for the study period with only the 2008 event being considered a medium to large flood. Packett et al considered that annual discharges for the study period were fairly representative for the Fitzroy River Basin in a long-term sense.

Interestingly over this 12 year period there were 10 flood events and only 1995 and 2005 did not experience a flood event.

Table 4-8 Fitzroy River Basin flood nutrient exports

Flood event	Flood volume (ML)	TN (tonnes)	TP (tonnes)
1994, March	2,099,719	3,256	7,114
1996, January	2,331,612	2,074	6,887
1997, March	1,843,102	1,387	2,358
1998, September	2,115,549	1,439	3,480
2002, January	341,472	223	421
2003, February	1,644,591	2,283	5,514
2004, January	945,587	493	1,409
2006, April	258,656	122	341
2007, February	738,506	465	1,205
2008, January - February	11,097,700	5,496	12,772

This analysis shows that the Rockhampton STPs annual combined 50%ile TN and TP export limits ranged from 1% to 60% and 0.4% to 15% respectively of the flood exports.

4.8.2 The fate of contaminants from the Fitzroy River

Packett (2007) reported on the transport of sediments and dissolved nutrients between the Barrage and the outer parts of Keppel Bay during a moderate flood event in February 2003.

Packett considered that suspended sediments were being deposited near the Fitzroy River mouth but dissolved nutrients were being carried out into Keppel Bay in the flood plume. Satellite imagery and salinity measurements indicated the flood plume extended approximately 15km from the river mouth into Keppel Bay.

Total dissolved nitrogen concentrations declined from about 0.8mg/L in the river proper to about 0.2mg/L at the end of the flood plume. Maximum total reactive phosphorus concentrations in the river were about 0.05mg/L but they declined to near zero quite quickly.

These nutrient concentrations in the river significantly exceed the water quality objectives.

4.9 Regulatory regime

4.9.1 Sustainable Planning Act

Augmentation of the existing STPs might be deemed an MCU and trigger the Integrated Development Assessment System (IDAS) process under the *Sustainable Planning Act*. A new STP would certainly be classified as an MCU. An increase of 10% to the current capacity or to the site coverage might also be classified as an MCU.

FRW should seek expert town planning advice in this regard.

DEHP would likely be the assessment manager for the IDAS process if it was triggered. Under these circumstances, DEHP may refer the project for assessment under the federal EPBC Act.

4.9.2 Environmental Protection and Biodiversity Conservation Act

The EPBC Act is currently administered by the Department of Sustainability, Environment, Water, Population and Communities (SEWPaC).

The EPBC Act is concerned with matters of national environmental significance and specifically:

- World Heritage properties
- Wetlands of international importance
- Listed threatened species and communities, and
- Listed migratory species

The work of Eberhard (2012) suggests there are potentially a number of triggers for a “Controlled Action” classification and therefore a need for federal government approval.

On the other hand, it might be argued that the existing or any new Rockhampton STP would be 60km upstream of the World Heritage and main wetland areas and that there is sufficient separation so to avoid EPBC referral.

Also, the effects of flood exports substantially exceed the inputs from the STPs and it might be accepted by DEHP that environmental impacts from STP releases are minimal and do not justify EPBC referral.

Again, FRW should seek expert advice on this matter.

5. Assessment of existing Gracemere sewage treatment plant

5.1 Plant overview

Raw sewage is pumped to Gracemere STP from SPS 1 (Armstrong Street) at 110 L/s (duty capacity), from SPS 6 (Rahima Court) at 45L/s (duty capacity) and from SPS10 (Viney Street) at 14 L/s (duty capacity). These pump stations discharge into a common rising main system with the largest rising main diameter being 200mm. The pump stations each have two pumps that alternate duty after each operation. They have soft starters but are not fitted with VSDs. In wet weather the pumps can operate in duty / assist mode.

The combined maximum instantaneous dry weather flow rate (duty pumps only) is 169 L/s which equates to 12ADWF. The combined maximum instantaneous wet weather flow rate (duty and standby pumps) is 338 L/s which equates to 24ADWF.

FRW advises that the highest dry weather instantaneous flow observed, since SCADA was installed in 2013, is 75L/s (5.4ADWF). A common rising main system with multiple pump stations has the potential to produce a wide range of flow conditions.

One of the challenges in designing STP inlet works is to understand the historical and potential pumping behaviour. These matters need to be examined closely prior to detailed design.

The 2011 ADWF determination is presented below.

The Gracemere STP commenced operation in 1984 as an intermittent Pasveer channel plant. It was upgraded to continuous flow with a clarifier in 2004. The plant comprises:

- An inlet works with spiral screen and two gravity grit settling channels,
- An extended aeration 1.2ML x 1.56m maximum depth Pasveer channel with three x 2m+2m TNO horizontal surface aerators on floats (15kgO_2/hr SOTR each), two floating 7.5kW surface aerators (11kgO_2/hr SOTR each) and an adjustable weir overflow,
- A 16m diameter (assumed) x 3m SWD (assumed) secondary clarifier with full bridge sludge scraper,
- Duty / assist RAS /WAS pumps and duty / standby clarifier scum pumps;
- Duty / standby lift pumps to the chlorine contact tank,
- A 28m^3 x 1m deep (assumed) chlorine contact tank for NaOCl disinfection,
- 53 ML of treated effluent storages (Hood 2005),
- Duty / standby 30L/s irrigation pumps (Hood 2005),
- 3 sludge lagoons (one fitted with a pontoon mixer), and
- 2 / 20m x 20m sludge drying pans.

Dried sludge cake is taken to landfill.

The switchboards are external. The control room is of Hardiplank construction with a steel roof. The steel roof is extended to cover a prefabricated demountable ablutions building.

5.2 Effluent reuse

5.2.1 Current irrigation reuse

All of the Gracemere STP effluent is currently reused. The total raw sewage volume (and therefore reuse volume) for 2012 was 427.9ML. The raw sewage volume for 2011 from 12 April to 30 December was 351.6ML – if this is scaled up for the full year (allowing for the 3 days of missing data) the annual volume is 495.5ML.

Treated effluent from Gracemere STP is presently reused on Effluent Irrigation Area A and the golf course. FRW advises that only small volumes are used by the Sports club. A new supply has been provided to the Nu-Grow soil composting site but no usage volume data is yet available.

FRW has nominated that irrigation of sports fields (Gracemere sports club) is to be regarded as a Community Service Obligation (CSO) and is to be retained or replaced with potable water (paid for by FRW). FRW nominates an increase to the current sports field irrigation volume of 10% by 2016. If GSTP is decommissioned in the future no consideration is to be given to supplying the other reuse water customers.

Table 5-1 Gracemere STP current effluent irrigation

Site	Land holder	Irrigation area	STP storage	Annual reuse (ML)		Irrigation application rate (ML/ha/yr)		Storage period (mths)	
				2011	2012	2011	2012	2011	2012
Effluent Irrigation area A	RRC	18.7ha							
Gracemere golf course	Golf club	24ha							
Total		42.7ha	53ML	496ML	428ML	11.6	10.0	1.3	1.5

Effluent irrigation application rates of 10 – 12ML/ha/year are excessive. Hood (2005) nominated an application rate of 7.5ML/ha/year for kikuyu pasture. Even this rate is at the higher end of the acceptable range. Council considers that 6ML/ha/year may be a more typical application rate for Central Queensland.

A storage period of 1.3 – 1.5 months is inadequate. It is considered that a minimum period of 3 months is required to provide storage through wet periods when crop demand is satisfied by rainfall. The golf course and Effluent Irrigation Area A are located on or adjacent to drainage paths and it may take longer than 3 months for soil moisture to reduce to suitable levels for irrigation without runoff or sub-surface seepage.

The high application rate and short storage period indicate that the existing effluent irrigation scheme is overloaded. Aerial photography suggests that the area downstream of the golf course to Padgole Lagoon is well irrigated (possibly by sub-surface seepage).

Hood (2005) advised that the golf course irrigation area needed to be reduced to 9.2ha in the future because part of the area contains soils that are unsuitable for sustainable long term irrigation.

At 7.5ML/ha/year application rate an irrigation area of 27.9ha could support a load of 2,350EP (after allowing 10% for wet weather inflows).

The existing 53ML effluent storage could provide 3 months storage for 2,380EP (after allowing 10% for wet weather inflows). The 10% annual wet weather volume allowance is nominal but compares reasonably well with the 2011 and 2012 volumes.

5.2.2 Current irrigation infrastructure

FRW delivers treated effluent to storages (water hazards) on the golf course. The golf club has installed its own irrigation system to water greens and fairways. Visual inspection and aerial photography suggests that the golf course may be over-irrigated contributing to sub-surface seepage to Padgole Lagoon.

FRW leases Effluent Irrigation Area A. The irrigation area has travelling irrigators and fixed sprays. However, it appears that effluent is released from the end of the delivery pipe at least some of the time. The irrigation infrastructure requires maintenance. The system also needs to be operated efficiently to maximise effluent reuse from Gracemere STP.

5.2.3 Future irrigation opportunities

Hood (2005) identified the following effluent irrigation opportunities and capacities.

Table 5-2 Gracemere STP potential effluent irrigation

Site	Land holder	Irrigation area	Annual reuse (ML)		Irrigation application rate (ML/ha/yr)	
			2011	2012	2011	2012
Effluent irrigation area A	RRC	18.7ha				
Effluent irrigation area B	Private	23.8ha				
Gracemere golf course	Golf club	9.2ha				
GSTP	RRC	2ha				
GSTP	Private	2ha				
Gracemere sports club	Sports club	4ha				
Touch of Paradise	Private	10ha (approx.)				
Total		69.7ha (approx.)	496ML	428ML	7.1	6.1

If all of the identified irrigation land is developed for effluent reuse the application rates (for current loads) reduce to acceptable levels.

If the 7.5ML/ha/year application rate for kikuyu is adopted the reuse volume could increase to 523ML/year. At 220L/EP/d this equates to only 5,860EP (after allowing 10% for additional wet weather inflows).

Additional effluent storage of 78ML would be required to provide 3 months storage for a 523ML/year load.

5.2.4 Third party reuse agreements

FRW has provided a copy of the effluent reuse agreement for the Gracemere sports club. Under this agreement, supply is to cease in 2014. The contracted water quality is called "Class A" at 10 *E.coli*/100mL, 20 mg/L BOD, 30 mg/L SS, 1 mg/L residual chlorine, 2mg/L dissolved oxygen and 16,000 uS/cm (i.e. approx. 1,000 mg/L TDS).

FRW has not been able to provide copies of other effluent reuse agreements.

FRW advises that new recycled water agreements are being prepared for the Gracemere Lakes Golf Club, Nu-Grow and the leased Effluent Irrigation Area A.

5.2.5 Third pipe reuse

Reuse at Gracemere could be expanded by implementing a third pipe reuse scheme to provide recycled water to the community. Class A+ recycled water has been used for toilet flushing and uses outside the house in other communities.

However, the production of Class A+ recycled water would require a significant investment and the regulatory regime is very onerous.

Introducing a third pipe recycled water scheme at Gracemere is not recommended.

5.2.6 Recycled water quality for existing customers

Recycled water schemes in Queensland are regulated under the *Water Supply (Safety and Reliability) Act 2008* and the *Public Health Regulation 2005*.

The *Public Health Regulation 2005* requirement for Class A recycled water is 95 percentile compliance of <10cfu/100mL *E.coli* as an annual value over a 52 week rolling analysis period.

The Queensland legislation is silent on recycled water quality for irrigation (other than minimally processed crops) but Class A is generally accepted for pasture / golf course irrigation.

FRW has also requested a high level risk assessment using the Australian Guidelines for Recycled Water 2006 (Phase 1) to assign log credits for treatment and reuse site security. The assessment is to consider the suitability of NaOCl disinfection (as is currently practised) and recommend additional treatment e.g. filtration and disinfection e.g. UV if considered necessary.

A number of guidelines have been issued to define the Queensland regulatory requirements under the *Water Supply (Safety and Reliability) Act 2008* and the *Public Health Regulation 2005.* These include recycled water management plan preparation, validation, auditing, reporting etc. There is no requirement to comply with the Australian Guidelines for Recycled Water.

A properly designed and operated NaOCl disinfection system achieving 15mg.min/L will readily achieve <10cfu/100mL *E.coli*.

FRW advises that it is upgrading the existing Gracemere NaOCl disinfection system to include flow paced dosing and online monitoring.

5.3 Raw sewage inflows

5.3.1 2011 / 2012

FRW has presented daily inflow data for the period from July 2011 to July 2012.

Inflows for July 2011 to December 2011 are of interest because this period does not contain significant wet weather events. There are significant wet weather influences from January 2012.

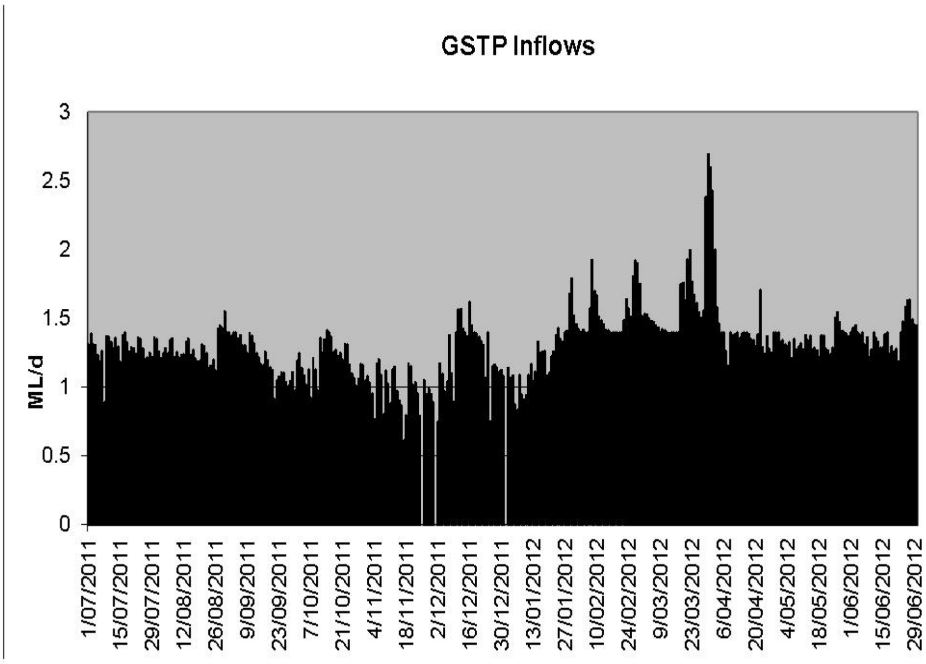


Figure 5-1 Gracemere STP raw sewage inflows July 2011 – July 2012

The median inflow for the July to December 2011 period can reasonably be adopted as ADWF.

Interestingly, the data provided suggests that the Gracemere catchment does not have a particularly strong wet weather response.

Table 5-3 Analysis of Gracemere STP ADWF and peak inflows

Period	Daily flows
July – December 2011	
Median daily flow (ADWF)	1.22 ML/d (14.1 L/s)
January – July 2012	
Number of daily flows greater than 2ADWF	2
Number of daily flows greater than 3ADWF	0
Maximum daily flow	2.69 ML/d (31.1 L/s)

The ADWF above compares with 1.49ML/d nominated by FRW for August 2012 (RRC 2012a) and 1.6ML/d for July 2013.

The nominated design flow for this project is 3ADWF as an instantaneous flow. DNRM (2005) nominates full treatment up to 3ADWF; screening and grit removal for 3 to 5ADWF and coarse screening for >5ADWF.

The data presented above suggest 3ADWF (as a daily flow event) is rare at Gracemere STP. Instantaneous flows are higher than daily flows especially for short term wet weather flow events. A longer dataset, including instantaneous flows, would need to be examined prior to detailed design.

5.3.2 Comparison with projected load

At an ADWF of 220L/EP/d the 1.22ML/d inflow implies a contributing load of 5,550EP. This is significantly less than the 2011 projection of 8,200EP.

FRW advises that the July 2013 ADWF was 1.6ML/d which implies a load of 7,273 EP. This is still less than the 2011 projection but the increase might be indicative of the population growth Council has anticipated.

5.4 Treated water quality

FRW provided weekly effluent grab sample data for 2012 that has been compared with the current licence requirements viz.

Table 5-4 Analysis of 2012 Gracemere STP effluent data

	BOD	TSS	pH	TDS	Cl	TN	TP	E. coli
Licence	20mg/L[1]	30mg/L[1]	6.5-8.5	1,000mg/L[1]	0.7mg/L[1]	20mg/L[2]	8mg/L[2]	100[3]/150[2]cfu/100mL
Minimum	1.0	1.0	7.3		0.0	1.3	0.5	
Median	6.1	7.0	7.8		0.4	5.0	5.2	126
80%ile	9.9	12.0	8.1		0.8	13.6	6.9	968
95%ile	13.7	23.5	8.2		2.2	36.3	10.4	
Maximum	25.0	35.0	8.3		2.2	37.6	12.0	>2,400
Data points	49	50	50	0	50	50	50	50
"Failures"	1	1	0		12	>20 - 7	>8 - 5	>100-5; >150-16
Mass load						>7 – 15	>5 – 26	
5/1 licence						>5 – 26	>1 - 49	

Notes: 1 – maximum. 2 – 80 percentile. 3 - median

The 2012 data indicate that the Gracemere plant failed to achieve the BOD and TSS maximum targets – but it does achieve better than 95%ile compliance. This demonstrates the extreme difficulty in meeting maximum targets. This is a common problem across the industry and the regulator should be encouraged to set a more realistic target, say 95%ile.

100%ile compliance was achieved for the pH range.

Residual chlorine values exceeded the maximum target but failed to achieve median or 80%ile *E.coli* targets. FRW advises that flow paced chlorine dosing control is being provided and that this should improve residual clhorine and *E.coli* performance.

In nutrient removal terms the plant achieved the 80%ile compliance targets for TN and TP.

If the Gracemere effluent was included in the mass load licence (for the combined Rockhampton STPs) TN would have "failed" 30% of the "time" (15 samples out of 50) and TP would have "failed" 50% of the "time" (26 samples at 2042 (7/5) targets.

If the Gracemere effluent was subject to a 5/1 BNR type licence TN would have "failed" 50% of the "time" (26 samples out of 50) and TP would have "failed" 95% of the time (49 samples out of 50).

FRW considers that two aerator failures during 2012 have contributed to the TN performance.

It needs to be noted that these are grab sample data and composite sample data would probably produce a very different statistical analysis outcome. The process assessment raises questions about whether the effluent grab samples are representative of performance over the entire day. FRW advises that the regulator considers grab sampling is satisfactory. Composite sampling will be required for the raw sewage characterisation program and for detailed design.

5.4.1 Salinity

No TDS data are collected at Gracemere STP. The 1,000mg/L TDS licence requirement is for assessing the sustainability of irrigating soils with the effluent.

While no data are available the TDS concentration can be inferred from the drinking water and published information.

FRW advises that the Glenmore WTP final water TDS was in the 76 – 188 mg/L range for the 2009 to 2010 period and that this is typical. Metcalf & Eddy (1991) nominates a typical increase in TDS of 150 – 380mg/L from drinking water to sewage.

This implies a maximum TDS of 580 mg/L in Gracemere sewage which is significantly less than the 1,000 mg/L target.

5.5 A new treated effluent standard for Gracemere STP?

An irrigation sustainability assessment might well be able to demonstrate that a lower effluent standard than the existing is suitable for irrigation at Gracemere.

Nitrogen and phosphorus are taken up by the irrigated crops and soils and it is often the case that sewage effluent cannot provide the complete crop needs. Where this is the case there is no justification for removing any nitrogen or phosphorus. Similarly, it is very difficult to provide excess carbon to soils and it is likely that a case can be made for a quite low effluent quality – say 50BOD / 50SS.

All of these matters would need to be examined in a sustainable irrigation investigation but the financial benefits for FRW would be considerable.

5.6 Odour assessment

5.6.1 Complaints

FRW records odour complaints for the Gracemere sewerage network. Over the 12 months to December 2012 there were only four odour complaints in the Gracemere network. FRW considered that none of these were associated with the Gracemere STP.

5.6.2 Odour assessment

An odour modelling assessment has been undertaken to compare the odour nuisance potential with the guideline requitements administered by DEHP. Details of the methodology are presented in **Appendix D**.

The preliminary odour modelling shows the critical 2.5OU contour extends to the north and west beyond the Gracemere STP site boundaries. The modelling suggests there is a potential to cause odour nuisance to three existing receptors.

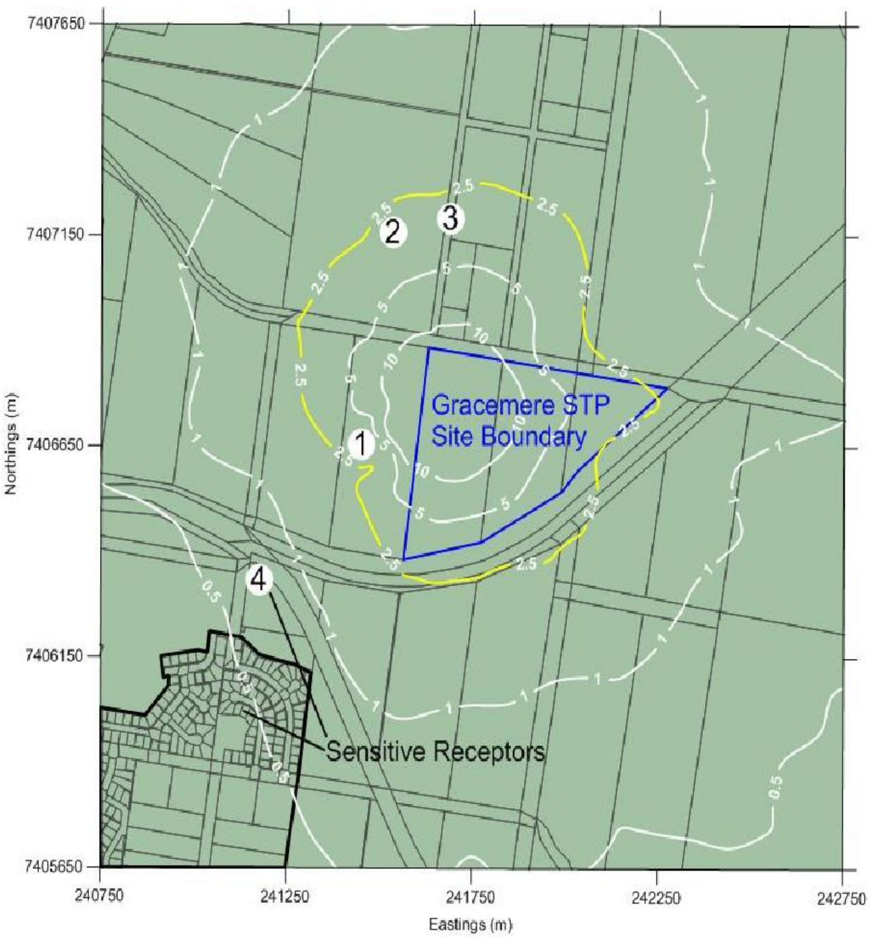


Figure 5-2 Predicted 99.5th percentile odour contours for Gracemere STP

The modelling outcomes are strongly influenced by the emission rate for the two sludge drying pans (that together comprise 88% of the total emissions). Emissions from sludge drying beds are usually worst when the beds are initially filled and are progressively less offensive as drying proceeds. An average (rather than a 90%ile) emission rate was selected for the drying beds but the modelling probably still presents an overly conservative outcome.

If odour complaints were to become an issue FRW should consider a different approach for sludge handling.

5.7 Noise assessment

There are no records of noise complaints. Noise nuisance is not considered to be an issue at Gracemere STP.

5.8 Strategic review of STP assets

5.8.1 Overall condition assessment

The Gracemere STP oxidation ditch is in poor condition due to movement of the sloping wall slabs and subsequent displacement of the joints.

The key mechanical components are only in fair condition and significant maintenance will be required in the near future.

Significant works are required to bring the electrics, controls and instrumentation up to a satisfactory standard.

5.8.2 Structural

The following assessment criteria were used to evaluate the condition of the major structural and mechanical equipment items at the Gracemere and Rockhampton STPs.

New - full life remaining

Good - long life remaining

Fair - needs maintenance, significant remaining life

Poor - needs major maintenance, approaching the end of useful life

Very poor - needs replacement, not repairable

A general overview of the condition of the existing structures is provided below. This is based on visual inspection (where possible e.g. above water level) and comment from FRW personnel.

Table 5-5 Gracemere STP structures condition assessment

Item	Condition	Comment
Inlet works	Fair, obsolete technology	Constructed 1984, some exposed aggregate
Pasveer channel	Poor	Constructed 1984, slab movement, joint repair
Clarifier	Good	Constructed 2004
RAS / WAS pump station	Good	Constructed 2004
Scum pump station	Good	Constructed 2004
Chlorine contact tank	Good	Constructed 2004
Irrigation pump station	Fair	Constructed 1984

5.8.3 Mechanical equipment

The mechanical equipment at GSTP was installed in 1984 and 2004 and is now 29 and 9 years old respectively. The general condition assessment is fair to good.

The horizontal surface aerators have had insufficient oxygen transfer capacity for the increasing load and have been supplemented by two floating surface aerators.

Table 5-6 Gracemere STP mechanical equipment condition assessment

Mechanical Equipment	Condition	Comment
Inlet works manual bar screen (1)	Fair, obsolete technology	Installed 1984
Inlet works rotating brush screen (1)	Fair	Relocated from other STP, 2013
Horizontal surface aerators (3)	Fair	Installed 1984
Floating surface aerators (2)	Fair	Installed after horizontal aerators

Mechanical Equipment	Condition	Comment
Secondary sedimentation tank scraper (1)	Good	Installed 2004
Secondary sedimentation tank weir (1)	Good	Installed 2004
RAS / WAS pumps (2)	Good	Installed 2004
Scum pumps (2)	Good	Installed 2004
NaOCl storage tank	Good	Installed 2004
NaOCl dosing pumps (4)	Fair	Diaphragm (2) and peristaltic (2) pumps require periodic attention
Chlorine contact tank lift pump (1)	Fair	Installed 2004
Irrigation pumps (2)	Fair	Installed 1984
Sludge drying bed supernatant pumps (2)	Good	Installed 2004

5.8.4 Power supply, electrics and controls

GSTP is supplied from a 300kVA Ergon transformer.

The majority of the switchboards, cabling etc. was installed in 1984. The switchboards are located outdoors. The control system is located in the control room.

The EIC equipment requires refurbishment. The SCADA system has been upgraded to being part of the Honeywell Experion HMI that can be visualised remotely and at the site.

An outdoor switchboard for the clarifier / RAS / scum pumps was installed in 2004. This switchboard included an Allen Bradley PLC.

The irrigation switchboard is currently receiving a $0.2M upgrade.

Instrumentation at GSTP comprises flow meters, level sensors and dissolved oxygen probes.

FRW maintenance personnel estimate the refurbishment, equipment standardisation and telemetry upgrade works at $0.5M.

5.8.5 Electrical power consumption / demand

FRW advises that GSTP's current power demands are as follows:

- Annual consumption 432,000 kWh
- Peak daily demand 80 kW

5.9 Flooding implications

FRW has nominated the following flood protection provisions for this project:

- MCC and major switchboards 100 year ARI flood level + 500mm
- Building slabs 100 year ARI flood level + 300mm

The Gracemere STP site is located in the Fitzroy River flood plain and is subject to periodic flooding.

Because Gracemere STP is upstream of the Fitzroy River flood gauge the flood level values are higher. The gauge levels and flood levels for the various frequency floods are compared below.

FRW has been unable to provide plans for the clarifier, RAS / WAS pump station, scum pump station, chlorine contact tank, chlorine contact tank lift station, spray irrigation pump station, large effluent storage and new sludge drying pans. Therefore some of the flooding conclusions for these structures are inferred.

FRW maintenance personnel advise that some switchboards were raised / removed as a precautionary measure for the January 2013 floods.

Table 5-7 Gracemere STP flooding

Flood ARI	Fitzroy River gauge level	Flood level at / near Gracemere STP[1]	Effect on structures	Effect on treatment
2 year	4.2m AHD	N/A		
5 years	5.96m	N/A		
10 years	6.65m	N/A		
20 years	7.23m	7.8m AHD	Potential loss of access from Rockhampton, Backup into effluent storage ponds (TWL 7.50m) may occur	
50 years	7.59m	8.3m	Effluent storage ponds overtopped (embankment RL 8.20m), MH6 (top 8.20m) overtopped	Hydraulic capacity of STP outfall impaired Effluent storage flooded
100 years	7.93m	8.8m	Potential loss of access from Gracemere, New clarifier (TWL <8.86m) may be overtopped Oxidation ditch (TWL 8.86m, embankment RL 9.20m) above flood level, Old sludge lagoons (TWL 10.00m and embankment 10.30m) above flood level	Treatment capability probably lost with flooding of clarifier

Notes: 1. Flood levels interpreted from Aurecon (2011)

Access to the GSTP from Rockhampton is lost at 20 year ARI flood levels.

Effluent storage integrity is lost at about 50 year ARI flood level. GSTP outfall hydraulic capacity is also impaired at about this level.

Treatment capability may be lost at 100 year ARI flood levels. Access from Gracemere may also be lost at about this level.

5.10 High level capacity assessment for current plant

5.10.1 Biological capacity / configuration pinch points

The existing Gracemere STP capacity has been determined / optimised for four treated effluent standards viz

Table 5-8 Gracemere STP optimised capacity

Treated water quality	Optimised STP capacity
20BOD / 30SS (no N / P removal)	8,000EP
20BOD / 30SS / 20TN / 8TP (existing licence for irrigation)	6,500EP
20BOD / 30SS / 7TN / 5TP (mass load treated water quality A)	5,100EP
5BOD / 5SS / 5TN / 0.5NH3 / 1TP (treated water quality B)	3,600EP

Details of the assessments are provided in **Appendix C**.

The inlet works needs a >3ADWF bypass to protect the biological process.

A capacity of 8,000EP can be achieved for the 20BOD / 30SS standard if the aeration capacity is increased (for peak conditions) and the RAS and WAS pumps have adequate capacity (or are replaced). The effluent disinfection system will also need upgrading.

A capacity of 6,500EP can be achieved for the 20BOD / 30SS / 20TN / 8TP standard if the aeration system is upgraded and (if necessary) configured to provide sufficient anoxic volume in the ditch; the RAS and WAS pumps have (or are replaced to provide) adequate capacity; alum dosing is added to trim phosphorus and caustic dosing is added to correct alkalinity (following alum dosing). It is expected that minimal chemical dosing would be required to achieve the 8mg/L TP target.

A capacity of 5,100EP can be achieved for the 20BOD / 30SS / 7TN / 5TP standard if the aeration system is upgraded and (if necessary) configured to provide sufficient anoxic volume in the ditch; the RAS and WAS pumps have (or are replaced to provide) adequate capacity; alum dosing is added to trim phosphorus and caustic dosing is added to correct alkalinity (following alum dosing).). It is expected that regular chemical dosing would be required to achieve the 5mg/L TP target.

A capacity of 3,600EP can be achieved for the 5BOD / 5SS / 5TN / 0.5NH3 / 1TP standard if the aeration system is upgraded and (if necessary) configured to provide sufficient anoxic volume in the ditch; the RAS and WAS pumps have (or are replaced to provide) adequate capacity; alum dosing is added to trim phosphorus and caustic dosing is added to correct alkalinity (following alum dosing). It is expected that significant chemical dosing would be required to achieve the 1mg/L TP target. Filters would also be required to achieve 5mg/L SS consistently.

It is expected that the above optimisation works could be implemented while maintaining plant operation. This assumption would need careful consideration during detailed design and may require Transitional Environmental Program (TEP) approval from DEHP during construction. This should not be a concern while the effluent is used for irrigation.

5.10.2 Hydraulic pinch points

There is insufficient available information e.g. for the clarifier and RAS / WAS pump stations and associated pipework to be able to undertake a hydraulic capacity assessment of the existing Gracemere STP.

The plant already operated with a 5,500EP hydraulic load and has a nominal design capacity of 8,000EP - it is considered unlikely that internal plant hydraulics would be a significant constraint for operating the GSTP. The exception to this is the inlet works where a >3ADWF bypass needs to be provided.

5.11 Geotechnical conditions

FRW has not been able to provide any geotechnical information for the Gracemere STP site.

Design drawings are available for the oxidation ditch. The design is for lightly reinforced sloping concrete slabs. The joints for these slabs have been repaired and it seems likely that there has been more soil movement than originally expected.

FRW has not been able to provide drawings for other structures at GSTP.

5.12 Potential for retention or augmentation

GSTP is a valuable asset and there has been a significant recent investment in the clarifier and associated works.

On the other hand, the oxidation ditch civil and mechanical assets have deteriorated and there is potentially a significant repair cost required if these assets are retained for an extended period.

The ditch aeration system needs to be upgraded but this would not be a high cost.

The infrastructure for FRW's leased Effluent Irrigation Area A needs maintenance and the area needs to be operated effectively. The existing effluent reuse capacity is limited. This should be expanded to postpone the need for excess load to be exported to SRSTP.

If the projected high growth does not occur or takes longer to occur the existing (optimised) plant could be retained for some time (deferring the cost of a pipeline to SRSTP).

The plant is not particularly badly affected by flooding and treatment capacity is not lost until 50 year ARI flood levels are reached.

5.13 Maximising effluent reuse

Deferring major treatment / transport investment at Gracemere depends on the ability to reuse the effluent locally.

It is recommended that FRW undertakes the following to maximise effluent reuse:

- Appoint a FRW officer as "Effluent Reuse Champion" with responsibility to maximise effluent reuse
- Undertake an effluent irrigation sustainability investigation for existing and potential irrigation areas (comprising soil profiling, soil chemistry analysis, effluent water chemistry, water balance analysis, nutrient and salt budgets, irrigation scheduling, groundwater impact etc.) The effluent irrigation sustainability investigation should be able to provide the basis for justifying a lowering of the STP effluent standard to 20BOD / 30SS or possibly an even lower standard e.g. 50BOD / 50SS.
- Change the supply of existing irrigated areas from potable water to treated effluent
- Identify new irrigation areas
- Identify and investigate innovative environmental reuse opportunities e.g. supplementation of wetlands, groundwater resources etc.
- Identify and investigate innovative industrial reuse opportunities e.g. land rehabilitation, dust suppression, "fit for purpose" water uses
- Encourage reuse of existing and new irrigation areas e.g. by FRW meeting power costs, FRW undertaking environmental monitoring etc.
- Undertake environmental monitoring (e.g. effluent quality, soils, groundwater etc.) to demonstrate sustainable operations

5.13.1 Rockhampton golf course

Another possibility that should be examined is pumping treated effluent to the Rockhampton golf course near the southern end of the airport. There are other small public areas in the vicinity that could also be irrigated.

This would require a significant investment in a new pipeline but part of the new pipeline could be aligned to suit future extension to SRSTP.

The Rockhampton golf course is said to be already irrigated which would make a change to recycled water relatively simple.

This approach could prolong the life of SRSTP.

FRW has examined the construction of a recycled water main from Gracemere back to Athelstane Range and the Rockhampton golf course (in conjunction with another pipeline project). FRW considers this would be a more economical way to construct the recycled water main.

5.14 Future strategy options

In the short term the Gracemere STP could be retained largely in its existing configuration. This also requires the retention and expansion of the effluent irrigation scheme.

FRW has obligations to provide recycled water to existing customers. It is unlikely that these obligations will "expire" which leaves FRW with the options of using potable water or retaining some STP capability at Gracemere.

The existing Gracemere STP could be retained although the oxidation ditch is in poor structural condition and may need a significant investment to maintain. The ditch may need to be abandoned entirely in the future.

The 2011 flow load was about 5,500EP. FRW advise that the July 2013 load was 7,200EP. The projected load for 2011 is 8,200EP. The irrigation scheme is currently handling more than its estimated 2,600EP capacity but it may not perform satisfactorily in a series of wet years. There are a number of inconsistencies here which make future planning difficult.

It seems that the best strategy is to retain the existing GSTP and maximise the effluent irrigation scheme in the short term and to construct a pipeline when necessary to transfer excess raw sewage to SRSTP.

Strategies involving the timing and sizing of the pipeline are considered later in the report.

6. Assessment of existing South Rockhampton sewage treatment plant

6.1 Plant overview

Raw sewage is pumped to the South Rockhampton STP from Arthur Street SPS. Arthur Street SPS has three 110 L/s (duty capacity) pumps in a dry well and a 202 L/s (duty capacity) submersible pump in a wet well. The dry well pumps alternate duty after each operation and have soft starters. The submersible pump is a manual standby. All are fixed speed pumps. In wet weather the pumps can operate in duty / assist / assist mode + manual standby.

There are 2 / 600 mm diameter rising mains between Arthur Street SPS and the South Rockhampton STP.

The maximum instantaneous dry weather capacity of the Arthur Street SPS is 110L/s which equates to 1.9ADWF. The maximum instantaneous wet weather capacity of the Arthur Street SPS is 532L/s (3/110L/s pumps + 202L/s manual standby) which equates to 9ADWF.

FRW advises that the highest dry weather instantaneous flow observed is 185L/s (3.2ADWF) and that dry weather flow is normally at least 138L/s (2.4ADWF). A system comprising multiple pumps and pipeline can deliver a wide range of flows.

One of the challenges in designing STP inlet works is to understand the historical and potential pumping behaviour. These matters need to be examined closely prior to detailed design.

The 2011 ADWF determination is presented below.

The SRSTP commenced operation in 1983. It is a conventional activated sludge plant i.e. it was not designed to remove nitrogen or phosphorus. The plant comprises:

- An inlet works with a 10mm step screen, a manual bypass screen, two grit settling channels controlled by proportional weirs and a wet weather bypass to the plant outfall;
- two 22m diameter x 2.15m SWD primary sedimentation tanks with half bridge sludge scrapers and actuated valve sludge withdrawal;
- two 1.02ML x 3.4m deep activated sludge aeration tanks each with three 15kW submersible jet aerators (27kgO_2/hr SOTR each) with overflow bypass to the plant outfall;
- two 22m diameter x 3.0m SWD secondary sedimentation tanks with half bridge suction lift scrapers and telescopic valve sludge withdrawal;
- a wet well / dry well type sludge transfer pump station with two duty / assist RAS pumps (45L/s one pump, 135L/s two pumps), two duty / assist primary sludge pumps (25L/s one pump, 40L/s two pumps) and sludge supernatant liquor pumps. Part of the RAS is returned to the inlet works.
- an 0.32ML twin train chlorine contact tank with chlorine gas disinfection;
- 600 mm diameter outfall to the Fitzroy River;
- A dissolved air flotation WAS thickener;
- two fixed cover (unheated) 1.2ML anaerobic digesters with biogas compressors and sparger mixing combined with mechanical mixing;
- four x 4.8ML x 3m deep sludge lagoons with supernatant return to the sludge transfer pump station

Stabilised sludge is periodically excavated from the sludge lagoons and taken to landfill.

Treated effluent is discharged to the Fitzroy River downstream of the Barrage near the mouth of Gavial Creek.

The Amenities Block is a two storey cavity brick building with office, laboratory, lunch room and wash rooms on the first floor. The toilet is suitable for male and female use. The ground floor is a storage area.

The Main Switch Room is an elevated pre-fabricated structure.

The Sludge Transfer Pump station comprises a below ground wet well / dry well caisson with three sets of pumps. The pumps are driven by line shafts from motors at about ground level that are flood protected by a concrete shaft structure. Access to the pumps and motors is from a higher level cavity brick and concrete roof building.

The Chlorinator House is an elevated cavity brick structure with concrete roof. It includes a store for 2/920kg chlorine drums and a chlorinator room.

The DAF thickener tank has an adjacent plant room constructed from blockwork with a steel roof. The DAF plant was added in 1994 but it is currently off-line.

6.2 Effluent reuse

There is no current effluent reuse from SRSTP and FRW has not required an assessment of reuse potential for SRSTP.

6.3 Raw sewage inflows

FRW has provided daily flow data for SRSTP for the July 2011 to July 2012 period.

Inflows for July 2011 to December 2011 are of interest because this period does not contain significant wet weather events. There are significant wet weather influences from January 2012.

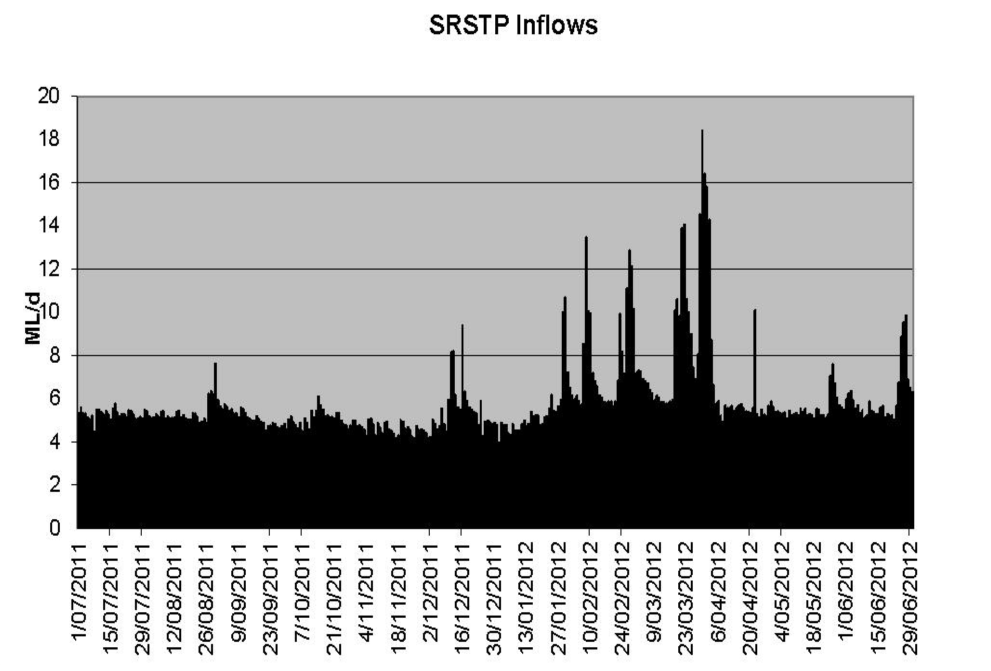


Figure 6-1 South Rockhampton STP raw sewage inflows July 2011 – July 2012

The median inflow for the July to December 2011 period can reasonably be adopted as ADWF.

Table 6-1 Analysis of South Rockhampton STP ADWF and peak inflows

Period	Daily flows
July – December 2011	
Median daily flow (ADWF)	5.11 ML/d (59.1 L/s)
January – July 2012	
Number of daily flows greater than 2ADWF	11
Number of daily flows greater than 3ADWF	3
Number of daily flows greater than 4ADWF	0
Maximum daily flow	18.43 ML/d (213.3 L/s)

The above ADWF compares with 5.1ML/d nominated by FRW for August 2012 (RRC 2012a).

The nominated design flow for this project is 3ADWF as an instantaneous flow. DNRM (2005) nominates full treatment up to 3ADWF; screening and grit removal for 3 to 5ADWF and coarse screening for >5ADWF.

The data presented above suggest that daily flows up to 4ADWF are possible but higher flows are unlikely. Instantaneous flows are higher than daily flows, especially for relatively short term wet weather flow events. This would need to be confirmed with a longer dataset, including instantaneous flows, prior to detailed design. The wet weather operation of Arthur Street SPS and flooding of the sewer network also needs to be better understood prior to detailed design.

6.4 Current performance

6.4.1 Discharge water quality compliance

FRW provided weekly effluent grab sample data for 2012 that has been analysed as follows:

Table 6-2 Analysis of South Rockhampton STP effluent data

	BOD	TSS	pH	Dissolved Oxygen	Cl	TN	TP	Faecal coliforms (cfu/100mL)
Licence	20mg/L[1]	30mg/L[1]	6.5-8.5	6mg/L[4]	0.7mg/L[1]	12mg/L[3,5]	9mg/L[3,5]	1,000[3]/4,000[2]
Minimum	2.3	1.0	6.9	3.2	0.0	11.8	0.6	
Median	9.7	10.5	7.3	7.2	0.3	29.2	4.6	
80%ile	14.0	12.9	7.5	7.2	0.5	33.2	6.6	
95%ile	20.2	18.6	7.9	7.2	0.7	37.0	8.0	
Maximum	24.0	59	8.0	8.7	1.1	40.5	13.1	>24,000
Data points	49	49	49	49	49	49	49	98
"Failures"	2	1	0	3	1	>12 - 48	>9 - 1	>1,000-2, >4,000-1
Mass load						>7 - 49	>5 - 19	
5/1 licence						>5 - 49	>1 - 47	

Notes: 1 – maximum. 2 – 80 percentile. 3 – median. 4 – minimum. 5 – calculated mass load concentration across all R'ton STPs

The 2012 data indicate that SRSTP failed to achieve the maximum BOD and TSS targets. There were two BOD samples above 20mg/L and one TSS sample above 30mg/L – TSS compliance was better than 95%ile compliance. This demonstrates the extreme difficulty in meeting maximum targets. This is a common problem across the industry and the regulator should be encouraged to set a more realistic target, say 95%ile.

The pH target range was achieved for all samples.

The DO minimum target was not achieved in three samples.

The maximum residual chlorine target was exceeded in one sample but the faecal coliforms exceeded 1,000 in only 2 samples one of which exceeded 4,000 cfu/100mL.

In nutrient removal terms the plant failed to meet the "2011 mass load" TN target of 12mg/L in 97% of samples (i.e. 48 samples from 49).

The plant did meet the "2011 mass load" TP target of 9mg/L in 98% of samples (i.e. 48 samples out of 49).

If the "future" 7TN / 5TP mass load licence applied TN would have failed in 100% of the samples and TP would have failed in 40% of the samples. If a 5TN / 1TP licence applied TN would have failed in 100% of samples and TP would have failed in 95% of samples.

It needs to be noted that these are grab sample data and composite sample data may well produce a very different statistical analysis outcome.

6.5 Odour assessment

6.5.1 Complaints

FRW keeps records of odour complaints for the Rockhampton STP catchments. For the period Dec 2011 – Dec 2012 there were 30 odour complaints in the combined Rockhampton sewerage catchment area. Most of these were pump station and network related.

SRSTP has had several odour complaints (from Council staff at SRSTP and at the adjoining animal pound) over this period and the corroded condition of concrete at the plant confirms the presence of high hydrogen sulphide concentrations and odours.

6.5.2 Odour assessment

An odour modelling assessment has been undertaken to compare the odour nuisance potential with the guideline requitements administered by DEHP. Details of the methodology are presented in **Appendix D**.

The preliminary odour modelling shows the critical 2.5OU contour 200m to 400m beyond the South Rockhampton STP boundary in all directions.

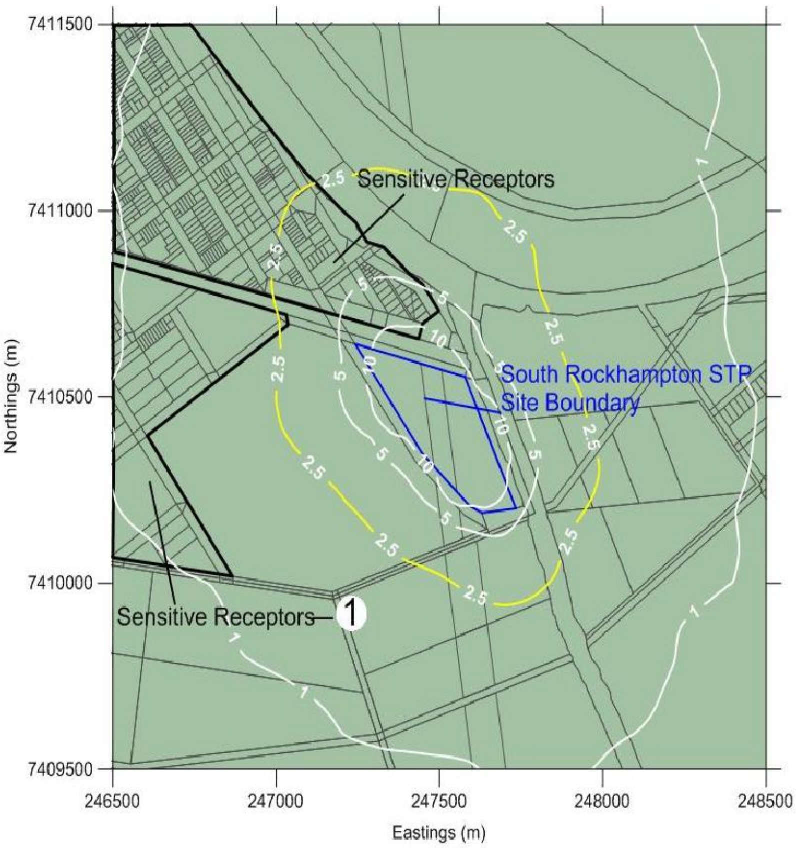


Figure 6-2 Predicted 99.5th percentile odour contours for South Rockhampton STP

The largest odour sources are the inlet works (8% of the total) and the two primary sedimentation tanks (12% each).

The modelling assessment is strongly influenced by the emission rate adopted for the four sludge lagoons (that together comprise 36% of the total emissions).

Currently odours do not appear to be a significant issue at SRSTP. If this was to change FRW should give consideration to changing the sludge handling approach.

6.6 Noise assessment

Noise complaints at the SRSTP are rare and usually related to a mechanical breakdown. There has been a recent complaint about a temporary aeration blower that malfunctioned.

6.7 Strategic review of SRSTP assets

6.7.1 Structural assets condition

A general overview of the condition of the existing structures is provided below. This is based on visual inspection (where possible) and comment from FRW personnel.

FRW advises that the aeration tanks were cleaned out 5-10 years ago and were considered to be in reasonable structural condition below the water line.

SRSTP was constructed in 1983 and is now 30 years old. The plant has experienced significant sulphide attack and there is visible concrete and metalwork corrosion to varying degrees throughout the plant.

Table 6-3 South STP structures condition assessment

Item	Condition	Comment
Inlet works	Poor, obsolete technology	
Primary sedimentation tanks (2)	Poor	Extensive corrosion in sludge withdrawal chambers; below water condition unknown
Activated sludge tanks (2)	Fair	Below water condition unknown
Secondary sedimentation tanks (2)	Fair	Below water condition unknown
Chlorine contact tank	Fair	Constructed prior to 1983
Sludge transfer pump station	Fair	
DAF WAS thickener	Fair	Constructed 1988, currently off-line
Primary digester tanks (2)	Fair	Internal condition unknown
Secondary digester tank	Very poor	Abandoned, constructed prior to 1983
Amenities block	Fair	
Switchroom / control building	Good	Prefabricated structure recently installed
DAF plant room	Fair	
Chlorinator house	Fair	

Below ground pipework could not be inspected but it is mostly concrete and significant corrosion would be expected.

Some of the concrete structures could be retained or reused but, it should be anticipated that they would need repair work. The buildings could be retained but would need refurbishment.

The process pipework condition is unknown but it unlikely to be in good condition and some replacement would be necessary if the plant was retained as part of the long term strategy.

6.7.2 Mechanical equipment condition

A general overview of the condition of the existing mechanical equipment is provided below. This is based on visual inspection (where possible) and comment from FRW personnel.

Much of the mechanical equipment at SRSTP is original and is now 30 years old.

SRSTP has been a highly corrosive environment (as evidenced by the extensive concrete deterioration) and this reflects in the generally poor condition of the mechanical equipment.

Table 6-4 South Rockhampton STP mechanical equipment condition

Mechanical Equipment	Condition	Comment
Inlet works step screen (1)	Fair	Installed 1999
Screenings conveyor	Fair	Installed 1999
Inlet works grit channel weirs	Non-functional	Badly corroded

Mechanical Equipment	Condition	Comment
Primary sedimentation tank scrapers (2)	Poor	Installed 1983, require periodic attention to splash zone items and slip rings
Primary sedimentation tank weirs (2)	Fair	Installed 1983
Primary sludge telescopic valves (2)	Non-functional	Abandoned, replaced with timer actuated valves
Activated sludge tank penstocks (8)	Non-functional	Badly corroded
Aerators (6)	Good	Submersible jet aerators installed 2011, one being repaired
Secondary sedimentation tank scrapers (2)	Poor	Installed 1983, require periodic attention to splash zone items and slip rings; have been fully refurbished in the past
Secondary sedimentation tank weirs (2)	Fair	Installed 1983
Secondary sed tank telescopic valves (2)	Poor	Installed 1983
Primary sludge pumps (2)	Poor	Installed 1983
RAS pumps (2)	Poor	Installed 1983
Digester supernatant pumps (2)	Poor	Installed 1983
Gas chlorinator	New	Recent replacement
DAF thickener equipment	Fair	Installed 1994, taken out of service
Digester gas compressor & spargers	Poor	Installed 1983
Digester mixers	Poor	Installed 1983
Sludge lagoon supernatant pumps (2)	Poor	Installed 1983
Platforms and walkways	Fair	Some aluminium grating replacement
Handrails	Very poor	Badly corroded

6.7.3 Power supply, electrics and controls condition

SRSTP is supplied from a 500kVA Ergon transformer.

SRSTP received a $2.4M EIC upgrade in 2009. This involved a new elevated pre-fabricated switch room, switchboards, cabling and controls. Field equipment like actuators was not replaced / upgraded because a process / capacity upgrade for the whole plant was anticipated.

Site control is by PLC with a radio telemetry link to a main server at the Glenmore water treatment plant. Data archiving, manipulation, trending etc. is done at Glenmore with a Remote Server link (via Telstra) to SRSTP.

The Operators at SRSTP have virtual SCADA capability through the Remote Server link.

Instrumentation at SRSTP comprises flow meters, level sensors, dissolved oxygen probes, pH analysers, chlorine residual controller and chlorine gas alarming.

6.8 Flooding implications

The South Rockhampton STP site is located at the confluence of Gavin Creek and Fitzroy River and is subject to periodic flooding.

South Rockhampton STP is a short distance downstream of the Fitzroy River flood gauge and the SRSTP flood levels are a little lower than the gauge level. The gauge / STP flood levels for the various frequency floods are compared below.

FRW advises that the SRSTP sewer network is essentially "compromised" at flood levels above about 7m on the Rockhampton River gauge and this leads to significant impairment / process failure.

Table 6-5 South Rockhampton STP flooding

Flood ARI	Fitzroy River Gauge level	Flood level at SRSTP[1]	SRSTP structures	Effect on treatment process
2 year	4.2m AHD	4.0m ADH	Outfall capacity impaired from about 3.2m	Outfall capacity impaired
5 years	5.96m	5.8m	Chlorine contact tank outlet IL 4.47m, emergency overflow IL 4.57m, various MH tops (with bolt down covers) from 4.87m, sludge transfer pump station wet well needs to be isolated, general site surface levels 4.87m to 4.97m	Disinfection lost. Sludge transfer pump station wet well needs to be isolated. RAS system inoperable. Activated sludge needs to be shut down to preserve biomass. Inlet works, PSTs, aeration tanks and SSTs "operational" but discharging into flood waters across the site
10 years	6.65m	6.4m	Potential loss of access from Rockhampton, chlorine contact tank overtopped (TWL 6.14m)	
20 years	7.23m	7.0m	Site fully flooded (highest earthworks platform around primary sedimentation tanks at 6.87m)	
50 years	7.59m	7.4m		
100 years	7.93m	7.7m	Sludge lagoon embankment overtopped (7.47m) SSTs overtopped (TWL 7.62m), Aeration tank (TWL 8.07m), Inlet works (WL 9.12m)	

Notes: 1. Flood levels interpreted from Aurecon (2011)

Essentially SRSTP loses treatment capability at the 5 year ARI flood. The inlet works, PSTS, aeration tanks and SSTs may be above the flood waters but without RAS capability the biomass will be washed out of the system and treatment capability will be lost.

6.9 High level capacity assessment for current plant loads

6.9.1 Process capacity

The optimised capacity of the existing infrastructure has been assessed against two effluent standards and using clarifiers and MBR separation technologies.

The optimised capacities of the SRSTP infrastructure are presented below.

Table 6-6 Optimised capacity of SRSTP infrastructure

Optimisation scenarios	Capacity (EP)
Clarifiers	
Mass load effluent standard A (20BOD / 30SS / 7TN / 5TP)	18,000EP
Effluent standard B (5BOD / 5SS / 5TN / 0.5NH3 / 1TP)	12,000EP
MBR	
Mass load effluent standard A (20BOD / 30SS / 7TN / 5TP)	35,000EP
Effluent standard B (5BOD / 5SS / 5TN / 0.5NH3 / 1TP)	19,000EP

Details of these assessments are presented in **Appendix C**.

A capacity of 18,000EP could be achieved for the clarifier / 20BOD / 30SS / 7TN / 5TP scenario by converting the process to MLE + chemical phosphorus trimming. This could be done if one of the primary sedimentation tanks was taken off-line and, the aeration system was upgraded with fine bubble diffused aeration (FBDA). Alum and caustic dosing systems would also be required.

A capacity of 12,000EP could be achieved for the clarifier / 5BOD / 5SS / 5TN / 0.5NH3 / 1TP standard by conversion to an EBPR process i.e. if the two primary sedimentation tanks were converted to anaerobic / anoxic zones, the aeration system was upgraded with fine bubble diffused aeration and sufficient WAS pumping capacity is provided. This would be a significant plant upgrade and it is considered mechanical dewatering and UV disinfection would also need to be considered. Filters would be necessary to achieve 5SS consistently but the need for this could be argued with the regulator.

A capacity of 35,000EP could be achieved for the MBR / 20BOD / 30SS / 7TN / 5TP standard by converting the process to EBPR. This would involve construction of a new inlet works with 2mm punched hole screens, converting the existing PSTS to anaerobic / anoxic zones, upgrading the aeration system to FBDA. A new bioreactor would be needed so that the existing bioreactors could be taken off-line for repairs and modification. One of the existing bioreactors could then be converted to accept the membrane cassettes. The existing secondary sedimentation tanks would be retained for emergency bypass treatment. Mechanical dewatering may prove to be advantageous over sludge lagoon desludging at this scale.

A site layout for the 35,000EP MBR optimisation scenario is presented in **Appendix B**.

A capacity of 19,000EP could be achieved for the MBR / 5BOD / 5SS / 5TN / 0.5NH3 / 1TP standard by a similar approach. The capacity is lower because the 1TP effluent standard requires a greater percentage of the bioreactor to be used in anaerobic and anoxic zones.

An MBR approach provides the greater opportunity to maximise the capacity of the existing SRSTP infrastructure.

The above discussion compares with the original 34,000EP design capacity for 20BOD / 30SS standard with no ammonia oxidation or nutrient removal capability (RRC 2012a).

6.9.2 Electrical power consumption / demand

FRW advises that SRSTP's current power demands are as follows:

- Annual consumption 937,092 kWh
- Peak daily demand 134kW

6.9.3 Hydraulic pinch points

The existing SRSTP was designed for 34,000EP hydraulic load. The retained hydraulic elements should have sufficient capacity for the options mentioned above but significant new hydraulics works would be required for the new elements of the optimised plant.

6.9.4 Optimised plant odour behaviour

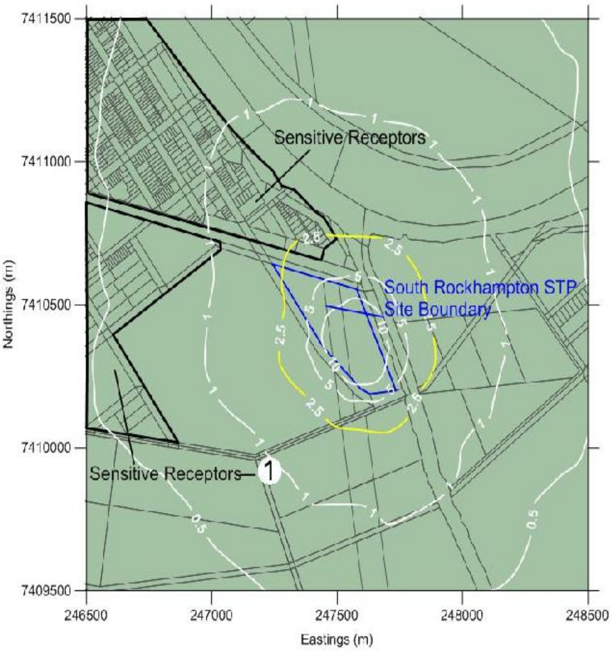
An odour assessment has been undertaken for the SRSTP EBPR/MBR 35,000EP treated water quality A case.

The odour assessment is presented in **Appendix D**.

The assessment assumed that a covered inlet works with air treatment would be provided. The assessment also examined two sludge handling scenarios. The first assumed the existing sludge lagoons would be retained and the second replaced the lagoons with a mechanical dewatering building and out-loading silo.

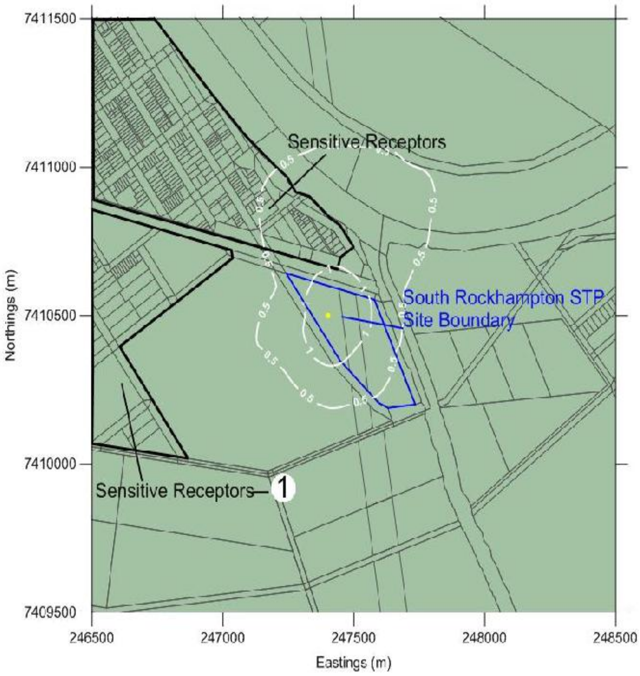
The odour modelling results for the "with sludge lagoons" case are presented below.

Figure 6-3 Odour contours for optimised SRSTP EBPR / MBR 35,000EP treated water quality A with sludge lagoons



The odour modelling results for the "without sludge lagoons" case are presented below.

Figure 6-4 Odour contours for optimised SRSTP EBPR / MBR 35,000EP treated water quality A without sludge lagoons



The modelling shows that the odour footprint extends beyond the SRSTP boundary when the sludge lagoons are retained. This may be acceptable if there are no impacted receptors.

Replacement of the sludge lagoons with mechanical dewatering eliminates the odour nuisance risk.

6.10 Geotechnical conditions

The 1981 design drawings reproduce logs for 6 bore holes and three penetrometer probings.

The bore holes were taken down about 12m to about -7.5m AHD. The profiles generally included 1 – 2m of fill or silt, about 5m of stiff clay, and sand or gravel to the base. Some of the clay was soft and the sand / gravel ranged from loose to very dense.

The penetrometer probes were taken down about 3m in sand.

The profiles are considered typical for an alluvial flood plain.

No special foundations were used in the construction of the SRSTP and there has not been extensive settlement. The inlet works was constructed on pad footings founded about 2m below natural surface. The sedimentation tanks have perimeter footings and 130 / 150mm thick floor slabs over an under-drainage system. The aeration tanks were founded about 1m below natural surface and have 360mm thick floors over an underdrainage system. The primary digesters were founded 1.5m below natural surface and have 800mm thick floors. The sludge transfer pump station is a caisson construction with 450mm thick walls and 1200mm thick plug. The Amenities Block is founded at ground level with perimeter beam and 150mm thick floor slab. There are numerous platform and stair sets that are supported on pads at natural surface.

6.11 Potential for retention or augmentation

SRSTP is a valuable asset and FRW has made a significant recent investment in electrics, instrumentation and controls.

The civil and mechanical assets have deteriorated and there will be a significant repair cost required for these assets.

The plant is flood affected by low return events and treatment capacity is probably lost at the 5 year ARI level.

Evenso, there is considerable value in the existing infrastructure and consideration needs to be given to optimisation and augmentation at this site.

MBR technology will maximise the capacity of the existing assets.

A short term upgrading option for SRSTP that requires less funding but also delivers less capacity is examined later in this report.

7. Assessment of existing West Rockhampton sewage treatment plant

7.1 Plant overview

The West Rockhampton STP receives raw sewage from Jardine Park SPS. The Jardine Park SPS has 2 / 110L/s L/s pumps that alternate duty after each operation. The pumps have VSDs. In wet weather the pumps can operate in duty / assist mode.

The instantaneous dry weather capacity of Jardine Park SPS is 110L/s which equates to 9ADWF. The instantaneous wet weather capacity of Jardine Park SPS is 220L/s which equates to 18ADWF. The 2011 ADWF determination is presented below.

The plant access is from Harman Street.

The current WRSTP commenced operation in 1962. It comprises:

- an inlet works with a step screen, a manually raked bar screen and two grit channels with proportional weirs and bypass to the plant outfall;
- two 13.5m diameter x 2.5m SWD primary sedimentation tanks with half bridge sludge scrapers;
- duty / standby primary sludge pumps
- two 34m diameter x 1.5m deep rock trickling filters;
- two 12m diameter x 2m SWD secondary sedimentation tanks with half bridge sludge scrapers,
- sludge pump station with duty / standby primary sludge pumps and duty / standby humus recirculation pumps;
- a 51m^3 x 1.4m deep single train contact tank with chlorine gas disinfection;
- 450mm diameter outfall to the Fitzroy River;
- An 0.85ML open digester (Clarigester) with bottom sludge scraper, and
- eight x 81m2 sludge sand drying beds.

Treated effluent is discharged to the Fitzroy River downstream of the Barrage.

Dried sludge is taken to landfill.

The Office is a cavity brick building with tiled roof. It contains an office / lunch room, laboratory, wash room (male only) and store room.

The Chlorinator House sits over the chlorine contact tank. It is a cavity brick building with concrete roof and contains a chlorine cylinder room and a chlorinator room.

The original design criteria for WRSTP are unknown.

7.2 Effluent reuse

There is no current effluent reuse from WRSTP and FRW has not required an assessment of reuse potential for WRSTP.

7.3 Raw sewage inflows

FRW has provided daily flow data for WRSTP for the July 2011 to July 2012 period.

Inflows for July 2011 to December 2011 are of interest because this period does not contain significant wet weather events. There are significant wet weather influences from January 2012.

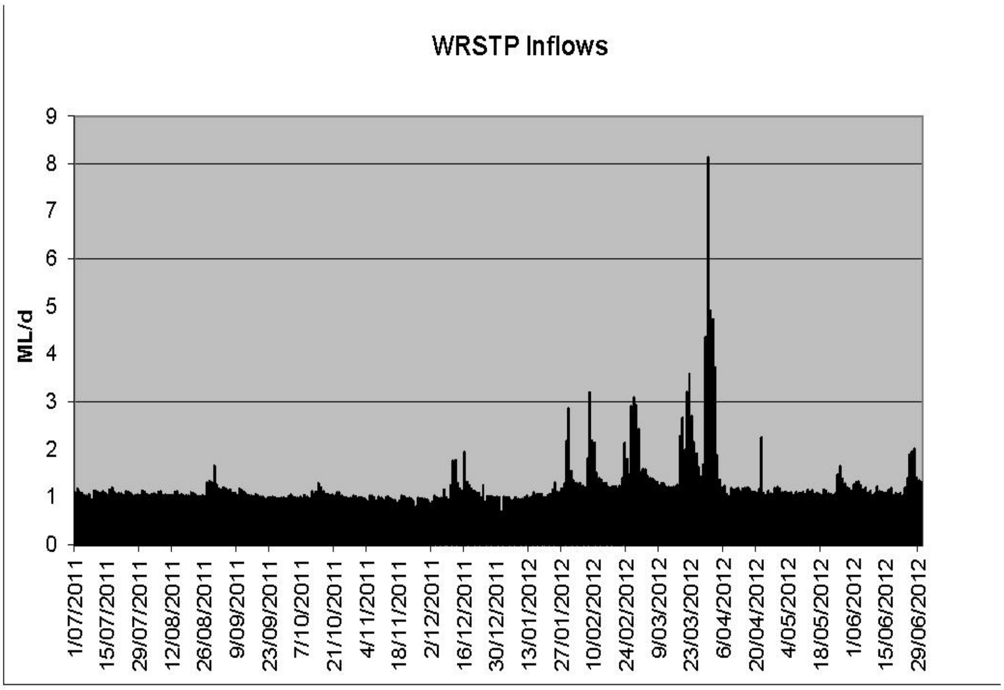


Figure 7-1 West Rockhampton raw sewage inflows July 2011 to July 2012

The median inflow for the July to December 2011 period can reasonably be adopted as ADWF.

Table 7-1 Analysis of West Rockhampton STP ADWF and peak inflows

Period	Daily flows
July – December 2011	
Median daily flow (ADWF)	1.05 ML/d (12.2 L/s)
January – July 2012	
Number of daily flows greater than 2ADWF	14
Number of daily flows greater than 3ADWF	4
Number of daily flows greater than 4ADWF	3
Number of daily flows greater than 5ADWF	1
Number of daily flows greater than 6ADWF	1
Number of daily flows greater than 7ADWF	1
Number of daily flows greater than 8ADWF	0
Maximum daily flow	8.14 ML/d (94.2 L/s)

The above ADWF compares with 1.1ML/d for August 2012 nominated by FRW (RRC 2012a).

The nominated design flow for this project is 3ADWF as an instantaneous flow. DNRM (2005) nominates full treatment up to 3ADWF; screening and grit removal for 3 to 5ADWF and coarse screening for >5ADWF.

The data presented above suggest that daily flows up to 8ADWF are possible. . Instantaneous flows are higher than daily flows especially for short term wet weather flow events. A longer dataset, including instantaneous flows, would need to be examined prior to detailed design.

7.4 Current performance

7.4.1 Discharge water quality compliance

FRW provided weekly effluent grab sample data for 2012 that has been analysed as follows:

Table 7-2 Analysis of West Rockhampton STP 2012 effluent data

	BOD	TSS	pH	Dissolved Oxygen	Cl	TN	TP	Faecal coliforms (cfu/100mL)
Licence	20mg/L[1]	30mg/L[1]	6.5-8.5	6mg/L[4]	0.7mg/L[1]	12mg/L[3,5]	9mg/L[3,5]	1,000[3]/4,000[2]
Minimum	1.0	1.0	5.8	4.3	0.1	3.3	2.4	
Median	8.4	11.0	6.8	5.6	0.1	23.7	6.3	
80%ile	11.7	15.0	7.2	6.7	0.2	27.7	7.1	
95%ile	19.4	26.4	7.5	6.9	0.5	30.6	8.9	
Maximum	25.0	35.0	7.8	7.1	2.2	31.5	11.7	>10
Data points	50	50	50	50	50	50	50	100
"Failures"	1	1	10	31	2	>12 – 45	>9 – 2	0
Mass load						>7 – 46	>5 – 36	
5/1 licence						>5 - 48	>1 - 50	

Notes: 1 – maximum. 2 – 80 percentile. 3 – median. 4 – minimum. 5 – calculated mass load concentration across all R'ton STPs

The 2012 data show WRSTP failed to comply with the licence for maximum BOD and maximum TSS – but 95%ile compliance was achieved. This demonstrates the extreme difficulty in meeting maximum targets. This is a common problem across the industry and the regulator should be encouraged to set a more realistic target, say 95%ile.

WRSTP failed to achieve the minimum pH target in 40% of samples (i.e. 10 samples out of 50). This would be due to the incoming sewage pH – WRSTP does not have any chemical dosing facilities to adjust pH.

WRSTP failed to achieve the minimum dissolved oxygen target in 60% of samples (i.e. 31 samples out of 50) – WRSTP's design does not provide sufficient capability (hydraulic or mechanical) to sufficiently aerate the effluent.

WRSTP complied with the maximum residual chlorine target in 95% of samples (i.e. 48 samples out of 50) and achieved 100% compliance with the faecal coliforms target.

WRSTP failed to meet the "2011 mass load" TN target (12 mg/L, median) in 90% of samples (i.e. 45 samples out of 50).

WRSTP achieved the "2011 mass load" TP target (9 mg/L, median) in 100% of samples.

The 2042 mass load TN target for all Rockhampton (and Gracemere) STPs is 7 mg/L (median). WRSTP would have failed to achieve this in 90% of samples (i.e. 46 samples of the 50 samples). The 2042 TP target is 5mg/L (median) and WRSTP would have failed to achieve this in 70% of samples (i.e. 36 samples out of 50).

If the West Rockhampton effluent was subject to a 5/1 BNR type licence TN would have failed in 95% of samples (i.e. 48 samples out of 50) and TP would have failed in 100% of samples.

These are not surprising outcomes because trickling filter technology has no ability to remove nutrient other than some small endogenous biomass uptake.

It needs to be noted that these are grab sample data and composite sample data (that is required for detailed design) may produce a very different statistical analysis outcome.

7.5 Odour assessment

7.5.1 Complaints

FRW keeps records of odour complaints for the Rockhampton STP catchments. For the period Dec 2011 – Dec 2012 there were 30 odour complaints in the combined Rockhampton sewerage catchment area. Most of these are pump station and network related.

FRW advises there have been no reported odour complaints related to WRSTP.

7.5.2 Odour assessment

An odour modelling assessment has been undertaken to compare the odour nuisance potential with the guideline requitements administered by DEHP. Details of the methodology are presented in **Appendix D**.

The preliminary odour modelling shows the critical 2.5OU contour 400m to 500m beyond the West Rockhampton STP boundary in all directions.

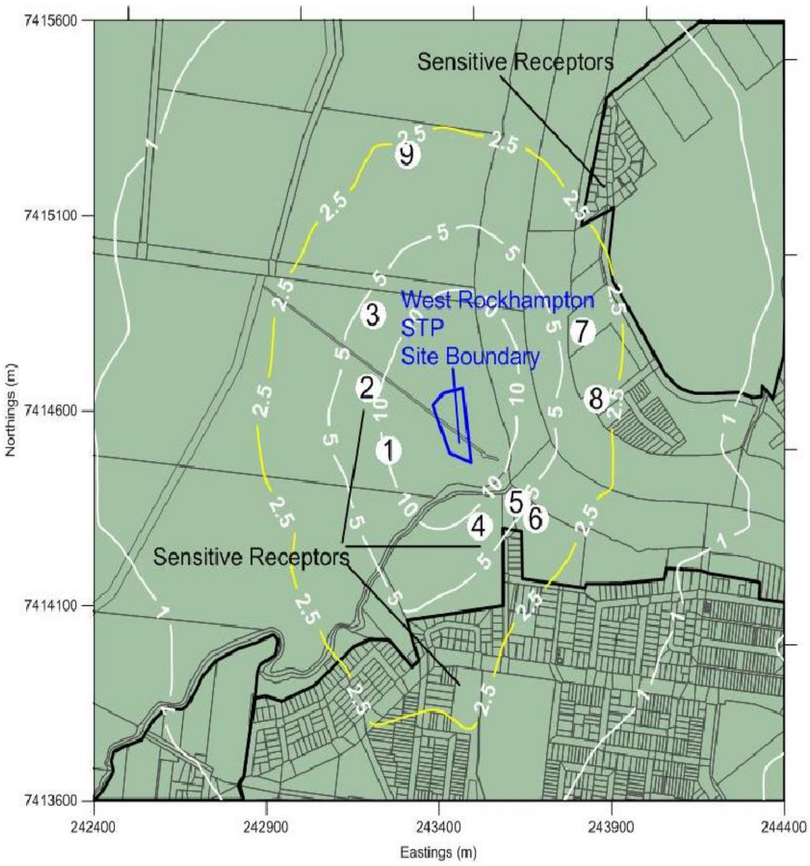


Figure 7-2 Predicted 99.5th percentile odour contours for West Rockhampton STP

The modelling assessment is strongly influenced by the emission rate adopted for the sludge drying beds (that together comprise 46% of the total emissions).

If WRSTP is abandoned (as presently proposed) the odour nuisance risk will be eliminated.

7.6 Noise assessment

WSTP has no history of noise complaints.

7.7 Strategic review of WRSTP assets

7.7.1 Structural

A general overview of the condition of the existing structures is provided below. This is based on visual inspection (where possible) and comment from FRW personnel.

WRSTP was constructed in 1962. Some structures were constructed in an earlier stage.

Table 7-3 West STP structures condition assessment

Item	Condition	Comment

Item	Condition	Comment
Inlet works	Fair	Obsolete technology
Primary sedimentation tanks (2)	Fair	
Primary sludge pump station	Fair	
Trickling filters (2)	Fair	Obsolete technology
Secondary sedimentation tanks (2)	Fair	
Sludge pump station	Fair	
Chlorine contact tank	Fair	
Primary sludge digester	Poor	Constructed prior to 1962, obsolete technology
Sludge drying beds	Fair	

While the WRSTP structures are in fair condition most of them utilise an obsolete technology and they have little value for Rockhampton's future sewage treatment requirements.

7.7.2 Mechanical equipment

The mechanical equipment at WRSTP was installed in 1962; it is now more than 50 years old and is approaching the end of its life. The sludge digester "Claridigester" equipment is even older. Some equipment e.g. manual bar screens have been replaced and upgraded with more modern equipment like step screens.

A general overview of the condition of the existing mechanical equipment is provided below. This is based on visual inspection (where possible) and comment from FRW personnel.

The general equipment rating is poor. The decision to close WRSTP is consistent with its mechanical condition.

Table 7-4 West Rockhampton STP mechanical asset condition

Mechanical Equipment	Condition	Comment
Inlet works step screen (1)	Good	Installed to replace manual screen
Screenings conveyor	Fair	Installed with step screen
Primary sedimentation tank scrapers (2)	Poor	Installed 1962, requires periodic attention to splash zone items and slip rings
Primary sedimentation tank weirs (2)	Fair	Installed 1962
Trickling filter rotary distributors (2)	Poor	Installed 1962, media replaced 1979
Secondary sedimentation tank scrapers (2)	Poor	Installed 1962, requires periodic attention to splash zone items and slip rings
Secondary sedimentation tanks weirs (2)	Fair	Installed 1962
Primary sludge pumps (2)	Poor	Installed 1962
Humus recirculation pumps (2)	Poor	Installed 1962
Scum pumps (2)	Poor	Installed 1962
Gas chlorinator	New	Recent replacement
"Claridigester" scraper	Very poor	Installed prior to 1962
"Claridigester" weir	Poor	Installed prior to 1962

Mechanical Equipment	Condition	Comment
Platforms and walkways	Fair	Generally replaced 1979, inlet works replaced 1998

7.7.3 Power supply, electrics and control

WRSTP is supplied from a small (<150kVA) Ergon transformer.

A switchboard and cabling upgrade was undertaken in 1985. Pump level control is relay based. A Honeywell PLC controls chlorine dosing and monitors the remainder of the plant.

There is a radio telemetry link to the Glenmore water treatment plant server but no HMI at WRSTP.

Instrumentation at WRSTP comprises flow meters, level sensors, chlorine residual controller and chlorine gas alarming.

An upgrade of the WRSTP EIC systems to address concerns about the condition of the equipment (estimated by FRW maintenance personnel to be worth $1M) has been abandoned since the decision was taken to close WRSTP. Indeed, the cost of this work and the generally outdated technology of WRSTP were major reasons for this decision.

7.8 Flooding implications

The West Rockhampton STP site is located near the confluence of Lion Creek and the Fitzroy River and is subject to periodic flooding.

West Rockhampton STP is upstream of the Fitzroy River flood gauge and the WRSTP flood levels are generally higher than the gauge level. The gauge / flood levels for the various frequency floods are compared below.

Table 7-5 West Rockhampton STP flooding

Flood ARI	Fitzroy River Gauge level	Flood level at WRSTP[1]	WRSTP structures	Effect on treatment process
2 year	4.2m AHD	4.0m AHD		
5 years	5.96m	7.2m	Loss of access?	
10 years	6.65m	8.4m	Backup to chlorine contact tank (outlet IL8.5m)	
20 years	7.23m	9.4m		Inlet works, PSTs, trickling filters and SSTs operational. Disinfection lost.
50 years	7.59m	9.8m	Overtop secondary sedimentation tank (TWL 9.72m)	Treatment capability lost.
100 years	7.93m	10.1m	Overtop secondary sedimentation tank coping (RL 10.0m)	

Notes: 1. Flood levels interpreted from Aurecon (2011)

Site access is lost at about the 10 year ARI flood level due to inundation of the Harman Street bridge.

Disinfection is lost between the 10 and 20 year ARI flood levels.

Treatment capability is lost just before the 50 year ARI flood level.

7.9 High level capacity assessment for current plant loads

7.9.1 Biological capacity

FRW has nominated an original design capacity of 11,000EP for 20BOD / 30SS standard with no ammonia oxidation and no nutrient removal (RRC 2012a).

FRW / RRC propose to decommission WRSTP and divert the raw sewage to SRSTP. This approach is endorsed.

7.9.2 Hydraulic pinch points

Because it is proposed to abandon WRSTP no analysis of the existing plant hydraulics has been undertaken.

7.10 Geotechnical conditions

For the design in 1962, 42 test holes were excavated on the WRSTP site. The deepest test hole was 3m deep. The descriptions for the test holes identified loose fill, glass and rubbish in many of the holes. Other test holes comprised a “top soil” layer over sandy loam. A few test holes encountered clays.

It appears that WRSTP was constructed over a former rubbish dump.

No special foundations were used for the structures. The elevated inlet works had pad footings and piers down about 3m. About 1.5m of unreinforced concrete (enveloping the pipework) was provided under the sedimentation tanks. The trickling filters were founded on compacted fill. The office building had a concrete floor over compacted fill and surrounded by a concrete ring beam.

7.11 Potential for retention or augmentation

The plant is not particularly flood affected and treatment capacity is probably not lost until 50 year ARI flood levels are reached.

However, WRSTP is a technologically out-dated plant that is not capable of nutrient removal.

It would require a significant investment in mechanical equipment, electrics, instrumentation and controls if it was to be retained for any significant period.

7.12 Future strategy

RRC / FRW has taken the decision to close the plant. The timing of this action may be examined in this strategy study but WRSTP needs to be closed in the relatively near future.

For the purposes of this investigation it is assumed WRSTP is closed by 2016. WRSTP should be closed as soon as there is capacity at SRSTP to accept the load.

8. Assessment of existing North Rockhampton sewage treatment plant

8.1 Plant overview

The North Rockhampton STP receives raw sewage from SPS No. 1 and SPS No. 2. SPS No. 1 and SPS No. 2 are adjacent to NRSTP. Each pump station contains 2 / 185 L/s dry well pumps. SPS No. 1 and SPS No. 2 pump to NRSTP via two separate 500mm dia rising mains. The pumps in each pump station alternate duty after each operation. They are all fixed speed pumps but have soft starters. In wet weather the pumps can operate in duty / assist mode.

SPS No. 1 and SPS No. 2 have a combined instantaneous dry weather capacity of 370L/s which equates to 3.4ADWF. SPS No. 1 and SPS No. 2 have a combined instantaneous wet weather capacity of 740L/s which equates to 6.8ADWF.The 2011 ADWF determination is presented below.

The maximum day inflow over the July 2011 to July 2012 period was 572.2 L/s which indicates a significant period of duty / assist operation for the pumps.

Septage is delivered to an open tank near SPS 2. The tank drains slowly to SPS No. 2.

NRSTP was commissioned in 1986 and comprises (RCC 1986):

- Inlet structure and venturi flume (with 10mm duty / standby step screens, screening conveyors, screenings bin). There is a bypass with adjustable weir but this is blanked-off.
- Two aerated spiral flow grit chambers (with duty / standby 7.5kW blowers, air diffusers, four air lift pumps, one Onga water pressure pump, Passavant shovel type grit screw / classifier, grit bin);
- Odour control (covered inlet structure, fan (4kW, 1,260m^3/hr), ducting, demister / heater (4 / 8kW, two banks), Norit activated carbon unit (2.5m3), exhaust stack)
- Two 5.5ML x 3.6m maximum depth, vertical wall oxidation ditches (each with three Passavant Mammoth horizontal surface aerators (1m dia x 9m long x 300mm maximum immersion, 72rpm, 45kW motors, helical gear speed reducers, 444kgO_2/hr SOTR each at 300mm immersion); adjustable overflow weir (5m long x 300mm vertical travel, motorised), duty helical rotor positive displacement WAS pumps (5L/s each)
- Two 32m dia x 4m side wall depth secondary clarifiers (with half-bridge log spiral sludge scraper, single submersible cutter type scum waste pump (3.8L/s) for the two clarifiers);
- RAS pumps (two duty up to 2ADWF (150L/s each), three duty for >2.7ADWF (133L/s each);
- Effluent chlorination (with dosing to overflow manhole with chlorine contact in 880ID outfall, duty / standby 920 chlorine drums, 240kg/d gas chlorinator with manual change-over, monorail crane scale for drum weighing, manually initiated ventilation fan for chlorine store);
- 880ID RC gravity outfall to the Fitzroy River (910m long); and
- Five 15ML sludge lagoons (3.6m deep, 1m surface water layer, duty / assist submersible pumps (10L/s each) returning supernatant to the oxidation ditches).

Sludge is periodically excavated from the lagoons and taken to landfill.

A centrifuge has been purchased and is to be installed to improve dewatering.

Treated effluent is discharged to the Fitzroy River downstream of the Barrage.

The Administration Building is of blockwork construction elevated to avoid flooding. It includes the main switch room, laboratory, lunch room, office and wash room (male only).

The Chlorination Building is of blockwork construction with a concrete roof and elevated to avoid flooding. It includes a gas chlorinator and 2/920kg chlorine drums.

8.2 Effluent reuse

There is no current effluent reuse from NRSTP and FRW has not required an assessment of reuse potential for NRSTP.

FRW is continuing to negotiate with the adjacent racecourse to supply effluent for irrigation of the racetrack and surrounding areas.

8.3 Raw sewage inflows

FRW has provided daily flow data for SRSTP for the July 2011 to July 2012 period.

Inflows for July 2011 to December 2011 are of interest because this period does not contain significant wet weather events. There are significant wet weather influences from January 2012.

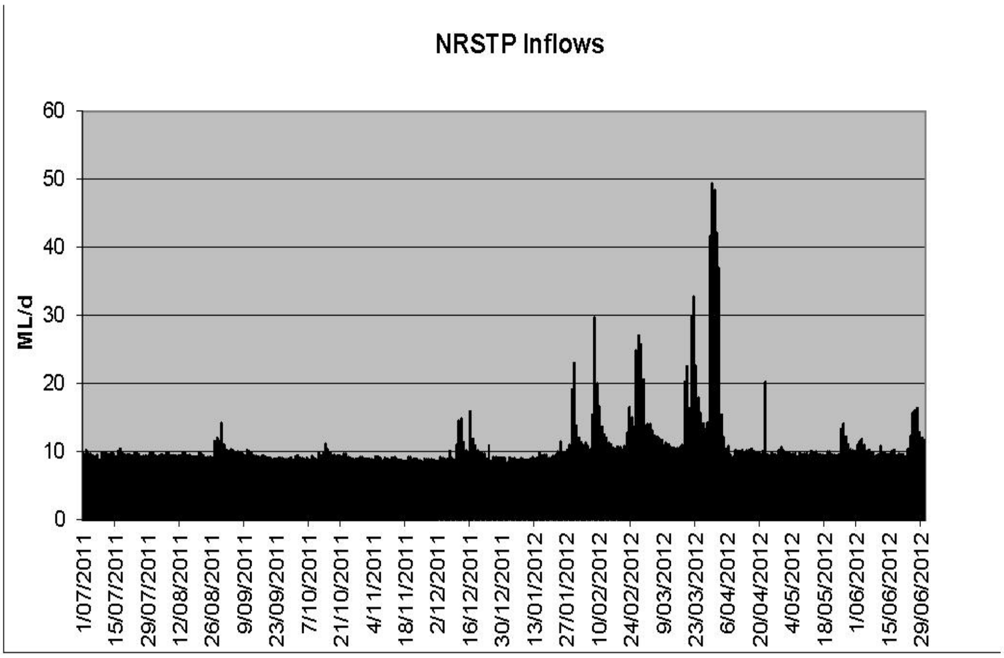


Figure 8-1 North Rockhampton STP raw sewage inflows July 2011 – July 2012

The data shows that raw sewage inflows over the period 1 July 2011 to 30 December 2011 were very uniform and largely unaffected by wet weather. It is considered that the median inflow for the July to December 2011 period can reasonably be adopted as ADWF.

Table 8-1 Analysis of North Rockhampton STP ADWF and peak inflows

Period	Daily flows
July – December 2011	
Median daily flow (ADWF)	9.44 ML/d (109.3 L/s)
January – July 2012	
Number of daily flows greater than 2ADWF	11

Period	Daily flows
Number of daily flows greater than 3ADWF	4
Number of daily flows greater than 4ADWF	2
Number of daily flows greater than 5ADWF	2
Number of daily flows greater than 6ADWF	0
Maximum daily flow	49.44 ML/d (572.2 L/s)

The above ADWF compares with 10.3ML/d for August 2012 nominated by FRW (RRC 2012a).

The nominated design flow for this project is 3ADWF as an instantaneous flow. DNRM (2005) nominates full treatment up to 3ADWF; screening and grit removal for 3 to 5ADWF and coarse screening for >5ADWF.

The data presented above suggest that daily flows up to 6ADWF are possible. Instantaneous flows are higher than daily flows especially for short term wet weather flow events. A longer dataset, including instantaneous flows, would need to be examined prior to detailed design.

8.4 Septage

Septage from waste transport contractors is delivered to NRSTP. FRW advises that this is predominantly septic tank and domestic liquid waste with occasional trade waste deliveries by exception. The average daily volume is estimated to be 20 – 50kL.

FRW has not provided any specific data for the volume or characteristics for septage for NRSTP. An allowance has been made for septage in the assessment of STP capacity by adopting a lower than normal nitrifier growth rate. This approach will need to be confirmed following raw sewage characterisation and prior to detailed design.

8.5 Current performance

8.5.1 Discharge water quality compliance

FRW provided weekly effluent grab sample data for 2012 that has been analysed as follows:

Table 8-2 Analysis of North Rockhampton STP 2012 effluent data

	BOD	TSS	pH	Dissolved Oxygen	Cl	TN	TP	Faecal coliforms (cfu/100mL)
Licence	20mg/L[1]	30mg/L[1]	6.5-8.5	6mg/L[4]	0.7mg/L[1]	12mg/L[3,5]	9mg/L[3,5]	1,000[3]/4,000[2]
Minimum	0.3	1.0	7.1	5.0	0.0	1.5	0.8	
Median	5.8	10.0	7.4	8.1	0.2	11.4	4.8	
80%ile	10.9	22.0	7.6	9.2	0.3	19.3	7.6	
95%ile	17.1	35.4	7.8	10.8	0.5	29.1	18.1	
Maximum	25.0	41.0	8.1	11.2	1.2	32.2	26.7	>42,000
Data points	50	50	50	50	50	49	49	100
"Failures"	1	4	0	1	3	>12 - 23	>9 – 8	>1,000-3, >4,000-2
Mass load						>7 – 36	>5 – 21	

	BOD	TSS	pH	Dissolved Oxygen	Cl	TN	TP	Faecal coliforms (cfu/100mL)
5/1 licence						>5 - 42	>1 - 48	

Notes: 1 – maximum. 2 – 80 percentile. 3 – median. 4 – minimum. 5 – calculated 2011 mass load concentration across all R'ton STPs

In 2012 NRSTP failed to comply with the maximum targets for BOD and TSS. There was one exceedance for BOD and four for TSS. 95%ile compliance was achieved for BOD but not for TSS. This demonstrates the extreme difficulty in meeting maximum (and minimum) targets. This is a common problem across the industry and the regulator should be encouraged to set a more realistic target, say 95%ile.

NRSTP achieved 100% compliance with the pH target range.

NRSTP failed to comply with the minimum DO target in one sample out of 50.

NRSTP failed to comply with the maximum residual chloride target in 3 samples out of 50. The effluent indicator organisms seems to be measured as *E.coli* against a faecal coliforms standard – in three samples from the 100 the 1,000cfu/100mL target was exceeded and in two of these the 4,000cfu/100mL target was exceeded. Because *E.coli* is a sub-set of faecal coliforms the performance may be worse than indicated.

The 2011 mass load median TN (12 mg/L) and TP (9mg/L) targets were achieved.

While the plant achieves the median TN target (12 mg/L) the individual weekly results are important because each of them is used to calculate the total weekly mass load. 45% of the samples exceeded the TN target which indicates there is not a lot of TN "freeboard". On the other hand, the 2011 mass load TP target (9 mg/L, median) is achieved in 85% of the samples and there seems to be significant TP "freeboard". These TN and TP targets include all Rockhampton STPs and Gracemere STP loads.

FRW reports that NRSTP achieved 9mg/L TP more than 90% of the time in calendar 2012 and, 100% of the time in 2013 to June.

The 2042 mass load TN target (7mg/L) would not be achieved in 75% of the samples and the 2042 TP target (5mg/L) would not achieved in 40% of the samples. These TN and TP targets again include all Rockhampton STPs and Gracemere STP loads.

If the North Rockhampton STP effluent was subject to a 5/1 BNR type licence the TN target (5 mg/L, median) would not be achieved in 85% of the samples and the TP target (1 mg/L, median) would not be achieved in 95% of the samples.

It needs to be noted that these are grab sample data and composite sample data (that would be required for detailed design) may produce a very different statistical analysis outcome.

I also should be noted that managing a mass load licence (when there is little freeboard) requires constant statistical vigilance and week to week results may obscure the situation.

8.6 Odour

8.6.1 Complaints

FRW keeps records of odour complaints for the Rockhampton STP catchments. For the period Dec 2011 – Dec 2012 there were 30 odour complaints in the combined Rockhampton sewerage catchment area. Most of these are pump station and network related.

A small number of complaints were received during the period when additional trade waste deliveries from Parmalat and Murgon Leather were received. Otherwise there have been no odour complaints about NRSTP.

8.6.2 Odour assessment

An odour modelling assessment has been undertaken to compare the odour nuisance potential with the guideline requitements administered by DEHP. Details of the methodology are presented in **Appendix D**.

The preliminary odour modelling shows the critical 2.5OU contour 400m to 500m beyond the North Rockhampton STP boundary in all directions including across residential areas to the north.

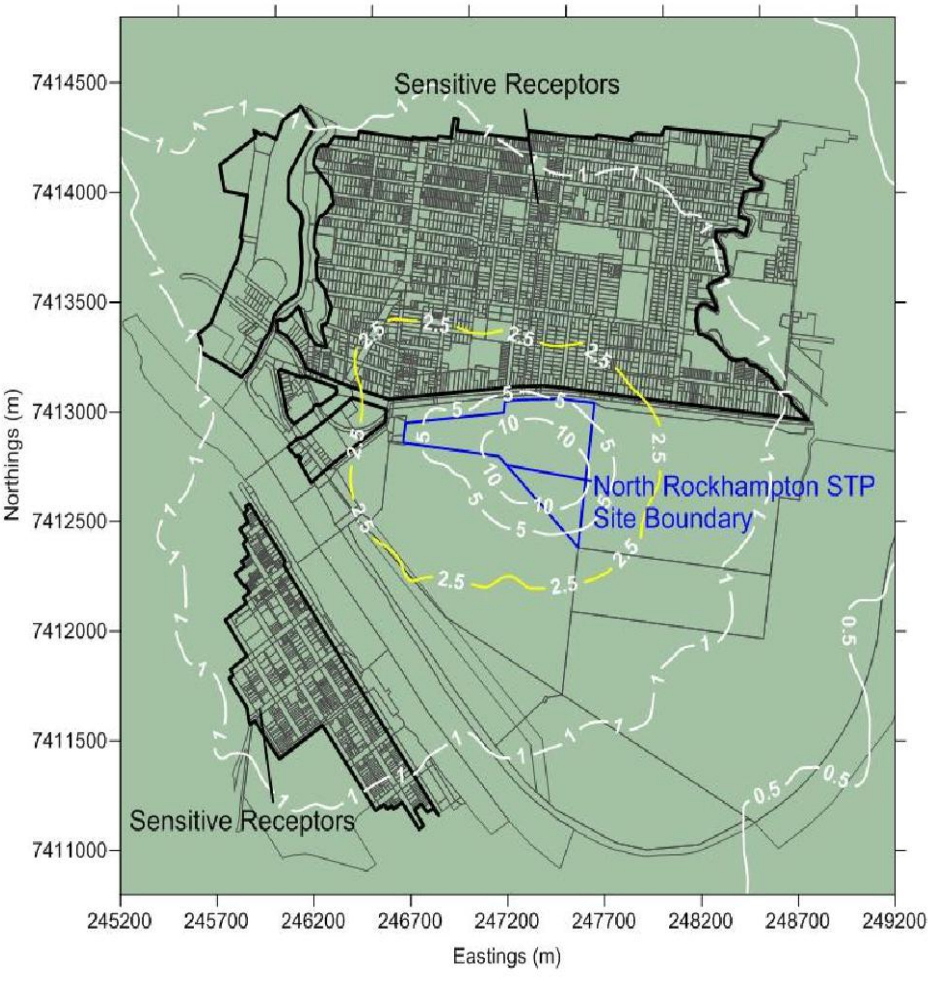


Figure 8-2 Predicted 99.5th percentile odour contours for North Rockhampton STP

Emissions from SPS No. 1, SPS no. 2, the septage receival tank, the sludge supernatant pump station and fugitive emissions from th covered inlet works are more than 40% (of total emissions).

The modelling assessment is strongly influenced by the emission rate adopted for the five sludge lagoons (that together comprise 50% of the total emissions). The adopted lagoons emission rate is considered conservative and would need to be confirmed with site measurement prior to a detailed design response.

FRW is presently installing a centrifuge to do WAS dewatering. FRW's intention is to use the skid mounted centrifuge to dewater sludge from lagoons at GSTP, SRSTP and NRSTP.

Future augmentation of NRSTP (or an unacceptable increase in odour complaints) may lead FRW to consider mechanical dewatering (and abandon the sludge lagoons) because that would change sludge odour emissions substantially.

The pump stations and septage odour sources will also need to be considered as part of any future NRSTP augmentation.

8.7 Noise

FRW reports that NRSTP has not experienced any noise complaints.

8.8 Strategic review of STP assets

8.8.1 Structural

A general overview of the condition of the existing structures is provided below. This is based on visual inspection (where possible) and comment from FRW personnel.

The plant is now nearly 30 years old and some "wear and tear" is to be expected.

Table 8-3 North STP structures condition assessment

Item	Condition	Comment
Inlet works	Fair	Potential for sulphide corrosion
Aerated grit chambers (2)	Fair	Potential for sulphide corrosion
Oxidation ditches (2)	Fair	Undermining and movement at expansion joint
Secondary sedimentation tanks (2)	Fair	
Overflow MH / chlorine contact tank	Fair	
Administration building	Good	Will need refurbishment
Chlorinator building	Good	Will need refurbishment

FRW personnel have noted that the oxidation ditch structure had been undermined by flood waters at the south-west corner and may need re-instatement or possibly under-pinning. Movement of the central expansion joint in the oxidation ditch structure has also been noted.

8.8.2 Mechanical equipment

A general overview of the condition of the existing mechanical equipment is provided below. This is based on visual inspection (where possible) and comment from FRW personnel.

The original mechanical equipment at NRSTP was installed in 1986. It is now 27 years old and is approaching the end of its life. Some equipment e.g. mechanical bar screens have been replaced and upgraded with more modern equipment like step screens. Other equipment items like the horizontal surface aerators are becoming an increasing maintenance issue and need replacement / upgrading.

The equipment ratings range from new to poor.

Table 8-4 North Rockhampton STP mechanical equipment condition assessment

Mechanical Equipment	Condition	Comment
Inlet works step screens (2)	Good	One recent, one new installation
Screenings conveyor	Good	Installed with step screens
Grit blowers, diffusers, air lifts & sparge pump	Poor	Installed 1986
Odour control fan, heater & carbon unit	Poor	Installed 1986
Horizontal surface aerators (6)	Poor	One being replaced, one being rebuilt
Overflow weirs / decanters (2?)	Fair	Installed 1986, motors removed
Secondary sed tank scrapers (2)	Poor	Installed 1986, requires periodic attention to splash zone items and slip rings
Secondary sed tank weirs (2)	Fair	Installed 1986
RAS pumps (3)	Poor	Installed 1986, regular attention required
WAS pump (1)	Poor	Installed 1986, being replaced with installation of centrifuge
Gas chlorinator	New	Recent replacement
Sludge lagoon supernatant pumps (2)	Fair	Originals have been replaced
Centrifuge (1)	New	Being installed
Platforms and walkways	Fair	Installed 1986

8.8.3 Power supply, electrics and control

NRSTP is supplied from a 315KVA Ergon transformer that is fully loaded.

The 1986 relay based control system was partially replaced in 1994 with PLC based control. There are a number of issues with the existing EIC system and a major upgrade is required - FRW maintenance personnel estimate this to be cost $2M. The issues include vermin attacks on existing cabling, deterioration of cable ladder systems, switchboard upgrades and standardisation of key equipment items like Allen Bradley PLCs.

The SCADA / telemetry system operates similarly to SRSTP with a radio telemetry link to the server at Glenmore water treatment plant and a Remote Server link (via Telstra) for the NRSTP operators.

Instrumentation at NRSTP comprises flow meters, level sensors, DO probes, pH analysers, chlorine residual control and chlorine gas alarming.

8.9 Flooding implications

The North Rockhampton STP site is located in the Common on the north side of the Fitzroy River and is subject to periodic flooding.

North Rockhampton STP is a short distance downstream of the Fitzroy River flood gauge and the NRSTP flood levels are a little lower than the gauge level. The gauge / flood levels for the various frequency floods are compared below.

FRW advises that the NRSTP sewer network is essentially “compromised” at flood levels above about 7m on the Rockhampton River gauge and this leads to significant impairment / process failure.

Table 8-5 North Rockhampton STP flooding

Flood ARI	Fitzroy River Gauge level	Flood level at NRSTP[1]	NRSTP structures	Effect on treatment process
2 year	4.2m AHD	4.0m AHD		Nil
5 years	5.96m	5.8m	Potential loss of access to site Site flooded (surface levels approx. 4.3m to 5.1m) RAS (dry mounted submersible) and supernatant pumps overtopped (SL 5.1m)	RAS system needs to be isolated to protect biomass
10 years	6.65m	6.4m		
20 years	7.23m	7.0m	Overflow MH overtops (WL6.67m) Backup into sludge lagoons (TWL 6.72m)	Outfall capacity reduced / lost
50 years	7.59m	7.4m	Backup into sedimentation tank launder (7.25m)	
100 years	7.93m	7.8m	Sedimentation tank (TWL 7.98m)	Inlet structure, oxidation ditch and sedimentation tank operational

Notes: 1. Flood levels interpreted from Aurecon (2011)

The plant was designed to continue to operate up to the 100 year ARI flood level i.e. 7.93m AHD.

Site access is lost at about the 5 year ARI flood level and disinfection is lost at about the 20 year ARI level i.e. 7.0m AHD.

8.10 High level capacity assessment for current plant loads

8.10.1 Biological capacity / configuration pinch points

The existing North Rockhampton STP capacity has been assessed / optimised for two treated effluent standards and clarifier / MBR separation technologies.

Table 8-6 Optimised NRSTP capacity

Treated water quality	Optimised STP capacity
Clarifiers	
20BOD / 30SS / 7TN / 5TP (mass load effluent standard A)	48,000EP
5BOD / 5SS / 0.5NH3 / 5TN /1TP (treated effluent standard B)	42,500EP
MBR	
20BOD / 30SS / 7TN / 5TP (mass load effluent standard A)	80,000EP
5BOD / 5SS / 0.5NH3 / 5TN /1TP (treated effluent standard B)	70,000EP

The existing NRSTP cannot achieve either of standards A or B in its existing configuration.

Capacity assessments for the following options are presented in **Appendix C**.

A capacity of 48,000EP can be achieved for the clarifier / 20BOD / 30SS / 7TN / 5TP standard by a "soft" conversion to EBPR. This could be accomplished if (1) a new inlet works is provided, (2) a new anaerobic zone

/ RAS de-aeration zone is provided, (3) alum and caustic dosing for TP trimming is provided, (4) fine bubble diffused aeration is provided, (5) RAS pumping is upgraded to 500L/s capacity, and (6) WAS pumping capacity of 20L/s is confirmed. This would require be a significant plant re-configuration and UV disinfection. Mechanical dewatering has been briefly considered but it is noted FRW has decided to dewater from WAS or the existing sludge lagoons.

A capacity of 42,500EP could be achieved for the clarifier / 5BOD / 5SS / 5TN / 0.5NH3 / 1TP standard by conversion to EBPR. This would involve (1) a new inlet works, (2) a new anaerobic zone / RAS de-aeration zone, (3) alum and caustic dosing for TP trimming (4) fine bubble diffused aeration, (5) RAS pumping upgrade to 500L/s capacity, and (6) WAS pumping capacity of 15L/s. This would be a significant plant re-configuration and UV disinfection and mechanical dewatering should also be considered. Filters would probably be required to achieve 5SS consistently (but there may be a case for arguing for a relaxation of this requirement).

A capacity of 80,000EP can be achieved for the MBR / 20BOD / 30SS / 7TN / 5TP scenario by a "soft" conversion to EBPR. This would require a new inlet works with 2mm punched hole screens, a new anaerobic / de-aeration reactor, an aeration upgrade with FBDA and a new membrane tank and permeate pumping system. The 80,000EP hydraulic capacity requires some significant upgrading of existing pipework.

A site layout for the 80,000EP MBR option is presented in **Appendix B**.

The 70,000EP / MBR / 5BOD / 5SS / 5TN / 0.5NH3 /1TP capacity can be achieved by a similar approach to the above. The reduced capacity occurs because more of the existing bioreactor is used for anoxic volume to achieve the 1TP target.

The above discussion compares with the original design capacity of 47,000EP for 20BOD / 30SS standard with no ammonia oxidation or nutrient removal (RCC 1986). Being an oxidation ditch, NRSTP has inherent anoxic zones and a nitrogen removal capability, even-though this was not a stated design objective.

8.10.2 Electrical power consumption / demand

FRW advises that NRSTP's current power demands are as follows:

- Annual consumption 1,391,868 kWh
- Peak daily demand 239kW

8.10.3 Hydraulic pinch points

NRSTP was designed for 47,000EP (270L/EP/d ADWF) so the main retained hydraulic components should be satisfactory for the 42,500EP and 48,000EP capacity options.

Significant new pipework will be required for the 70,000 and 80,000EP MBR options.

The >3ADWF bypass at the existing inlet works was blocked off. FRW has now installed a manually actuated slide on the bypass. Bypass capability needs to be automated for times when the plant is not manned.

8.10.4 Optimised plant odour behaviour

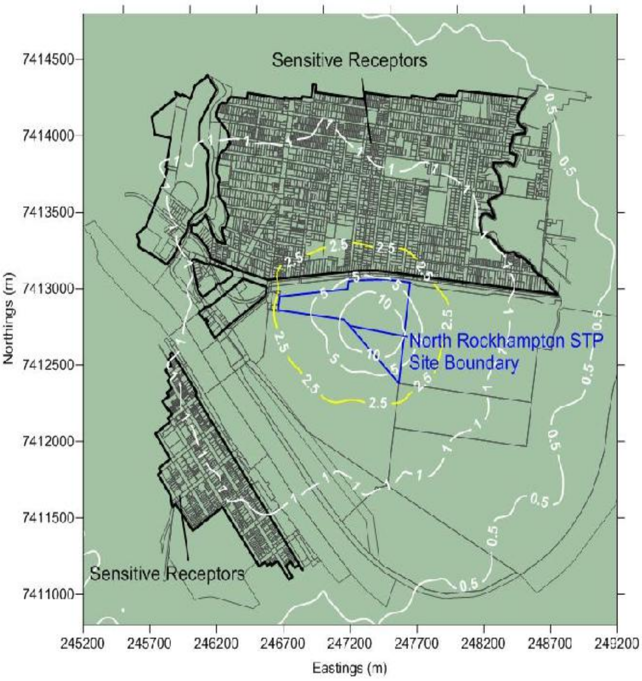
An odour assessment has been undertaken for the NRSTP EBPR/MBR 80,000EP treated water quality A case.

The odour assessment is presented in **Appendix D**.

The assessment assumed that a covered inlet works with air treatment would be provided. The assessment also examined two sludge handling scenarios. The first assumed the existing sludge lagoons would be retained and the second replaced the lagoons with a mechanical dewatering building and out-loading silo.

The odour modelling results for the "with sludge lagoons" case are presented below.

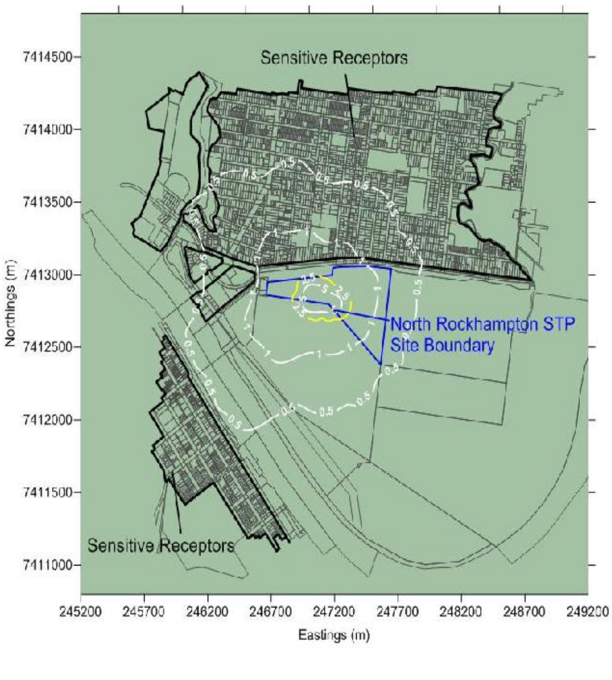
Figure 8-3 Odour contours for optimised NRSTP EBPR / MBR 80,000EP treated water quality A with sludge lagoons



These results indicate considerable potential for odour nuisance.

The odour modelling results for the "without sludge lagoons" case are presented below.

Figure 8-4 Odour contours for optimised NRSTP EBPR / MBR 80,000EP treated water quality A without sludge lagoons



The modelling shows that replacing the sludge lagoons with mechanical dewatering reduces the odour footprint considerably but there remains a potential for nuisance to the south in the racecourse.

8.11 Geotechnical conditions

FRW has not been able to provide any geotechnical information for North Rockhampton STP.

The design drawings show that surcharging was used to improve the foundation capacity of the existing soils. The surcharged area provided foundations for the ditch structure, sedimentation tanks and administration building. Vertical wick drains were installed at 2m centres across the surcharge area. The natural surface was stripped to about 300mm depth to stiff clay. Four metres of compacted decomposed granite was placed over the ditch structure area. The surcharge over the administration building and chlorinator building area was 3.5m. A different surcharge material was used over the sedimentation tank area with a depth of 3.25m. Settlement measuring points were installed at 11 locations across the surcharge area.

The surcharge material was taken down to about 1m above original natural surface for the ditch structure. The ditch structure did not include any special foundation design features and consisted of a simple cantilever perimeter wall / footing with 140mm thick floor slabs. Internal non-hydraulic walls were blockwork.

The surcharge material was largely removed from beneath the sedimentation tanks and the tanks were founded about 1m below original natural surface. Again no special foundation design features were provided. The sedimentation tanks have a ring wall and 150mm thick floor slabs. Groundwater pressure relief valves were provided.

The chlorinator building was elevated (above flood level) and supported on piers with pad footings on 150mm of compacted decomposed granite. The decomposed granite layer base was about 1m below the original natural surface.

8.12 Potential for retention or augmentation

NRSTP is a very valuable asset. It services Rockhampton's largest growth area.

The structures are in fair condition (although some remedial work may be required for the ditch structure).

The mechanical equipment is nearing the end of its life but its replacement may allow more modern technologies to be employed.

The plant loses site access at the 5 year ARI level; disinfection at the 20 year ARI level but it was designed to retain its biomass up to the 100 year ARI level.

An MBR upgrade maximises the value of the existing infrastructure. If the mass load effluent standard A is retained all growth to 2042 on the northern side of the Fitzroy River can be handled with the optimised MBR option.

8.13 Future strategy

Because of its age and condition, relative flood immunity, technology and location in the fastest growing, largest catchment it is difficult to see the NRSTP not being part of the long term strategy for Rockhampton's sewage treatment.

9. Sewage treatment strategies

Seven potential long term strategies have been identified viz.

- Option LT1 – New "flood-proof" STP north of the Fitzroy River
- Option LT2 – Locate all treatment capability at South Rockhampton STP
- Option LT3 – Locate all treatment capability at North Rockhampton STP
- Option LT4 – Optimise existing North Rockhampton STP + South Rockhampton STP Upgrade
- Option LT5 – Optimise existing South Rockhampton STP + North Rockhampton STP Upgrade
- Option LT6 – Optimise Gracemere STP / Reuse + Optimise South Rockhampton STP + North Rockhampton STP Upgrade
- Option LT7 – Optimise Gracemere STP / Reuse + Optimise North Rockhampton STP + South Rockhampton STP Upgrade

These options have been developed to accommodate 2016, 2027 and 2042 loads.

Where these options adopt treated water quality A they are termed LT"X"A. All of the options use MBR technology (where possible).

Option LT7B has also been developed for treated water quality B (with MBR technology) for comparison.

Fitzroy River Crossing

Most of the long term strategies involve crossing the Fitzroy River at some time.

The options considered for crossing the river included an under-river crossing and attachment to existing structures.

An under-river crossing for a pipe of less than 1m diameter capacity would usually be constructed by directional drilling or bored pipe jacking. There are other construction methods but they are more economical for larger capacities. Directional drilling is favoured for smaller pipes and it is common to install duplicate directional drilled crossings to reduce the risk.

All under-river pipeline construction methods require extensive geotechnical information to reduce the risks and to provide confidence to the specialist contractors that the project is feasible. Even with extensive geotechnical information there are failures.

FRW has not been able to provide any geotechnical information for a river crossing. In the absence of detailed geotechnical any cost estimate for a river crossing is a guess and no defendable level of accuracy could be attached to the estimate.

FRW has provided plans for the old Fitzroy Street Bridge that shows provision was made for a future 600mm dia meter main to be slung under the bridge. This would still be an expensive exercise and would probably involve traffic disruptions but this is a far more common approach and can be costed with more confidence than an under-river crossing. This approach has been adopted for this investigation.

9.1 Option LT1A – New "flood-proof" STP north of the Fitzroy River

The Option LT1A – New "flood-proof" STP north of the Fitzroy River strategy is to:

- Close WRSTP, transfer raw sewage to SRSTP
- Close GSTP, transfer raw sewage to SRSTP
- Close SRSTP, transfer raw sewage to NRSTP (Arthur St SPS to NRSTP SPS 1 / 2)
- Close NRSTP, transfer raw sewage to new STP
- Construct new STP at 'flood-proof' site

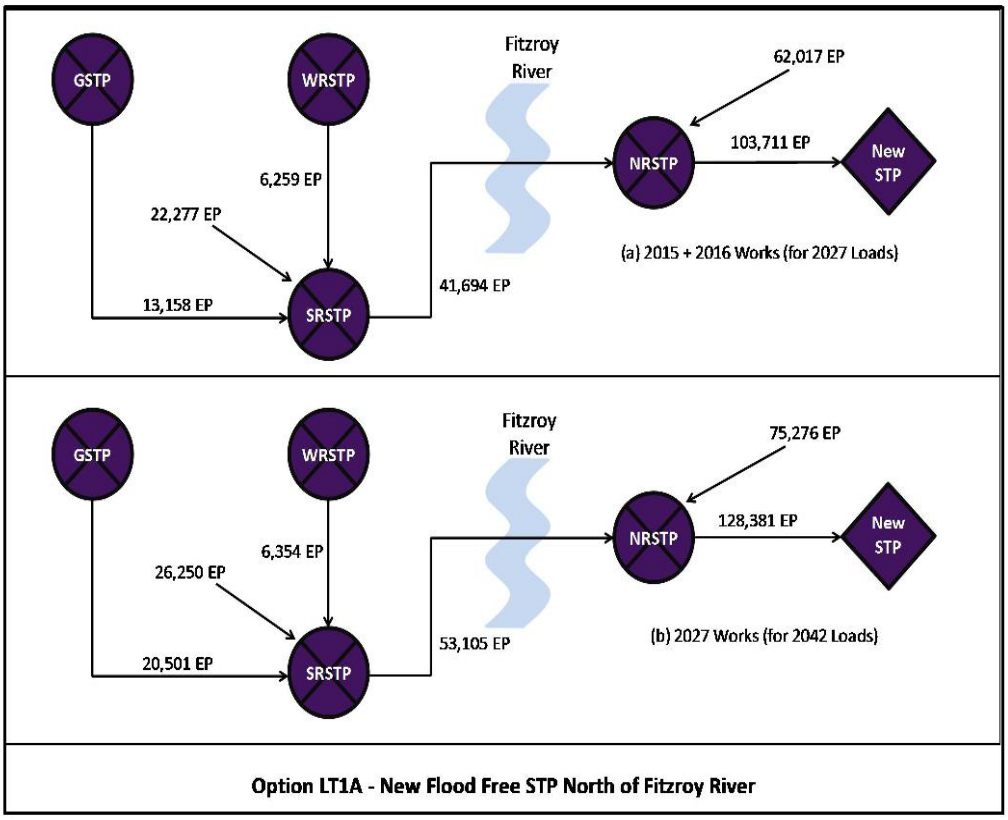


Figure 9-1 Option LT1A – New flood free STP north of Fitzroy River

Inspection of the 100 year ARI flood mapping (Aurecon 2011) suggests that it would be very difficult to secure a viable new "flood-free" STP site close to SRSTP or NRSTP. The closest land above the 100 year ARI inundation area (on the southern side of the Fitzroy River) is about 5km from SRSTP and from GSTP. The closest 'dry land" to NRSTP on the northern side of the Fitzroy River is about 6km distant at Lakes Creek.

Because most of the future growth is projected to occur north of a Fitzroy River the alternative to LT1 i.e. a new "flood-proof" STP south of the Fitzroy River will be more expensive than LT1 and has not been investigated.

9.2 Option LT2A – South Rockhampton STP only

The Option LT2A – South Rockhampton STP only strategy is to:

- Close WRSTP, transfer raw sewage to SRSTP
- Close GSTP, transfer raw sewage to SRSTP
- Close NRSTP, transfer raw sewage to SRSTP (NRSTP SPS 1 / 2 to SRSTP)
- Optimise existing SRSTP
- Construct New SRSTP for balance load

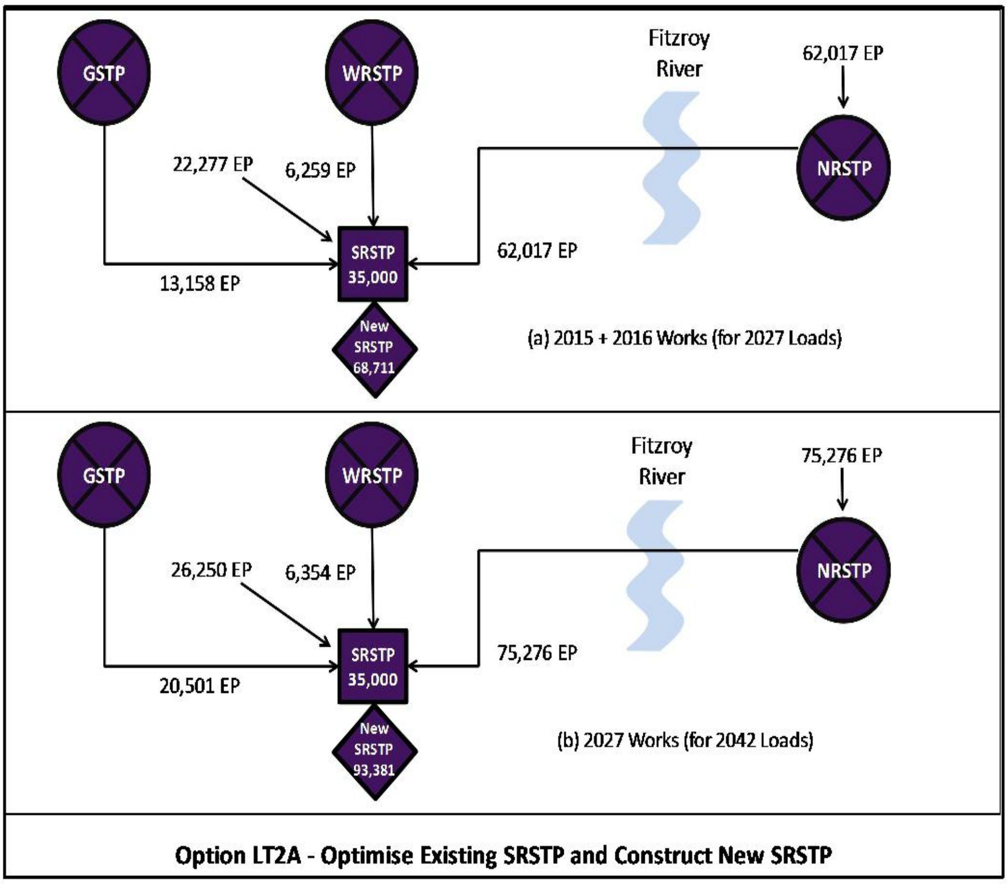


Figure 9-2 Option LT2A Construct all STP capacity at SRSTP

9.3 Option LT3A – North Rockhampton STP only

The Option LT3A – North Rockhampton STP only strategy is to:

- Close WRSTP, transfer raw sewage to SRSTP
- Close GSTP, transfer raw sewage to SRSTP
- Close SRSTP, transfer raw sewage to NRSTP (Arthur St SPS to NRSTP SPS 1 / 2)
- Optimise existing NRSTP
- Construct New NRSTP for the balance load

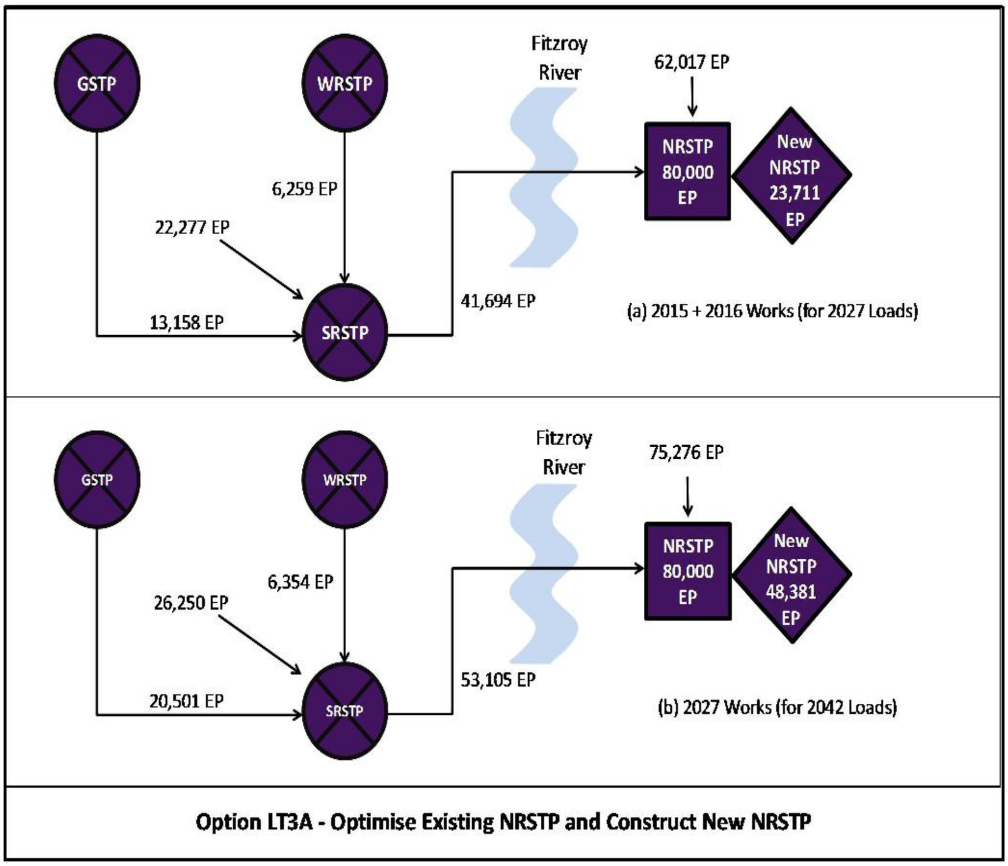


Figure 9-3 Option LT3A Construct all STP capacity at NRSTP

Options LT2 and LT3 ignore the value of much of the existing infrastructure. There is potential to reuse concrete structures at South and North Rockhampton STPs and that approach produces two refinement options (as outlined below). Reusing the existing concrete structures would allow the capacity of the existing STPs to be "Optimised".

9.4 Option LT4A – Optimise NRSTP + Optimise / Upgrade SRSTP

The Option LT4A – Optimise existing North Rockhampton STP + South Rockhampton STP Upgrade strategy is to:

- Close WRSTP, transfer raw sewage to SRSTP
- Close GSTP, transfer raw sewage to SRSTP
- Optimise existing NRSTP, transfer excess raw sewage to SRSTP
- Optimise existing SRSTP
- Construct new SRSTP for the balance load

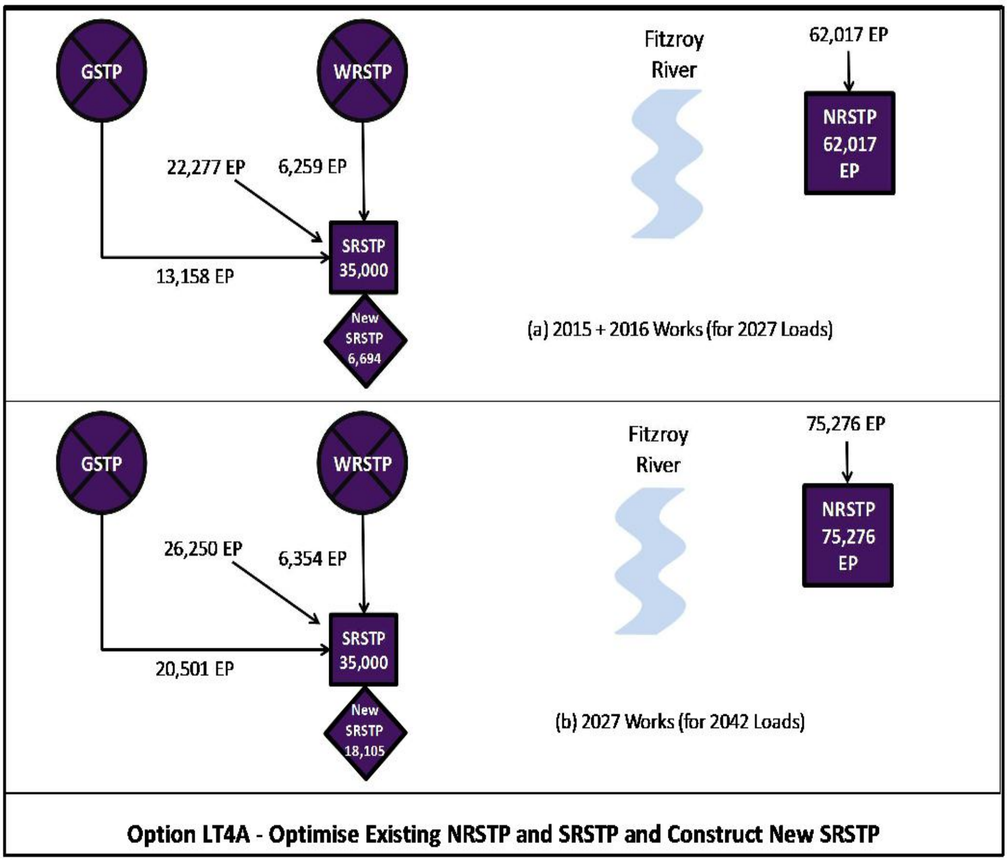


Figure 9-4 Option LT4A Optimise SRSTP & NRSTP and Construct new capacity at SRSTP

9.5 Option LT5A – Optimise existing SRSTP + Optimise / Upgrade NRSTP

The Option LT5A – Optimise existing South Rockhampton STP + North Rockhampton STP Upgrade strategy is to:

- Close WRSTP, transfer raw sewage to SRSTP
- Close GSTP, transfer raw sewage to SRSTP
- Optimise existing SRSTP, transfer excess raw sewage to NRSTP (Arthur St SPS to NRSTP SPS 1 / 2)
- Optimise existing NRSTP
- Construct new NRSTP for the balance load

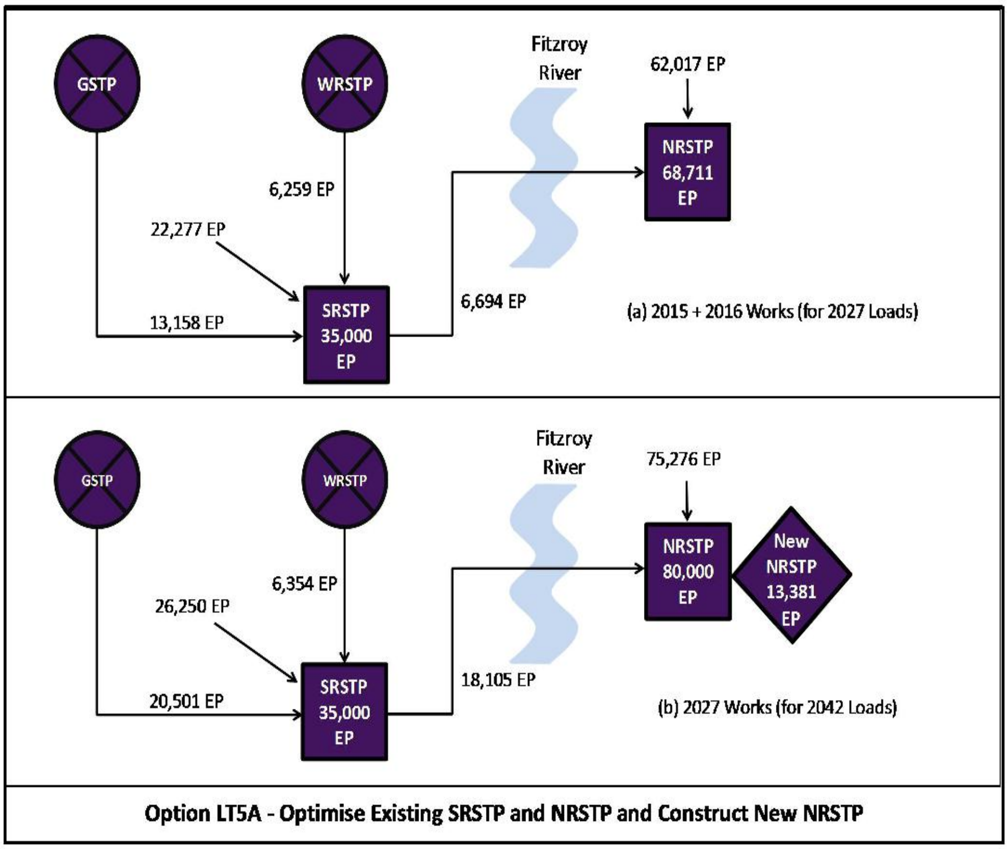


Figure 9-5 Option LT5A Optimise SRSTP & NRSTP and construct new capacity at NRSTP

Options LT4 and LT5 are likely to be less expensive than LT1, LT2 and LT3.

Further capital cost savings can be achieved by optimising the STP / reuse at Gracemere.

9.6 Option LT6A – Optimise Gracemere STP / Reuse + Optimise SRSTP + Optimise / Upgrade NRSTP

The Option LT6A – Optimise Gracemere STP / Reuse + Optimise South Rockhampton STP + North Rockhampton STP Upgrade strategy is to:

- Close WRSTP, transfer raw sewage to SRSTP
- Optimise Gracemere STP / reuse, transfer excess raw sewage to SRSTP
- Optimise SRSTP, transfer excess raw sewage to NRSTP (Arthur St SPS to NRSTP SPS 1 / 2)
- Optimise existing NRSTP
- Construct new NRSTP for the balance load

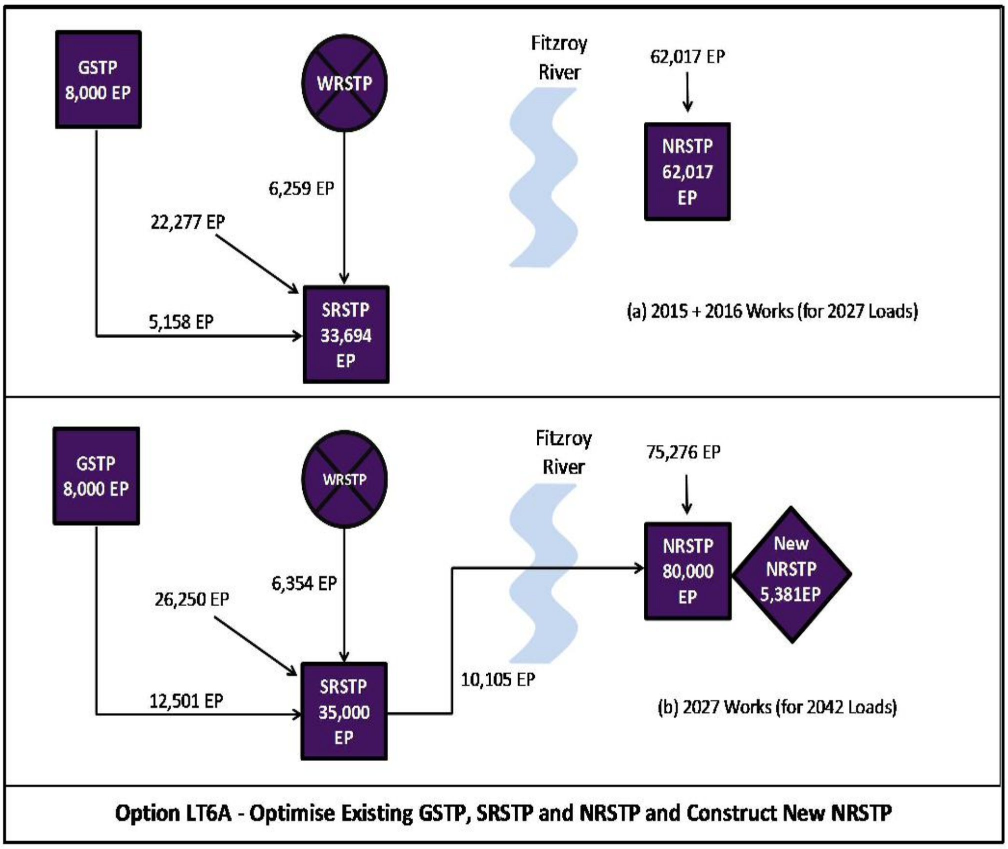


Figure 9-6 Option LT6A Optimise GSTP, SRSTP & NRSTP and construct new capacity at NRSTP

9.7 Option LT7A – Optimise Gracemere STP / Reuse + Optimise NRSTP + Optimise / Upgrade SRSTP

The Option LT7A – Optimise Gracemere STP / Reuse + Optimise North Rockhampton STP + South Rockhampton STP Upgrade strategy is to:

- Close WRSTP, transfer raw sewage to SRSTP
- Optimise Gracemere STP / reuse, transfer excess raw sewage to SRSTP
- Optimise existing NRSTP
- Optimise existing SRSTP
- Construct new SRSTP for the balance load

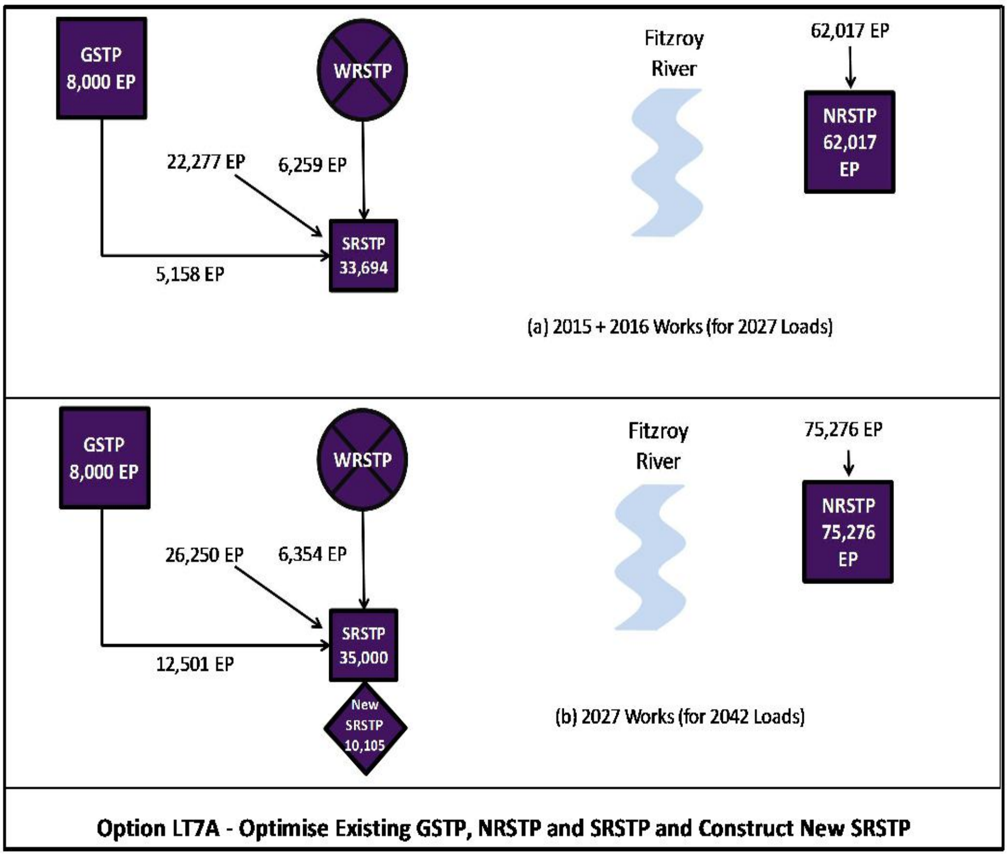


Figure 9-7 Option LT7A Optimise GSTP, SRSTP & NRSTP and construct new capacity at SRSTP

Option LT7 will have a capital cost advantage over LT6 (after 2027) because there is no Fitzroy River crossing.

Option LT7B has also been developed for treated water quality B (with MBR technology) for comparison.

9.8 Option LT7B - Optimise Gracemere STP / Reuse + Optimise NRSTP + Optimise / Upgrade SRSTP

Option LT7B is the same as LT7A except that it adopts treated water quality B.

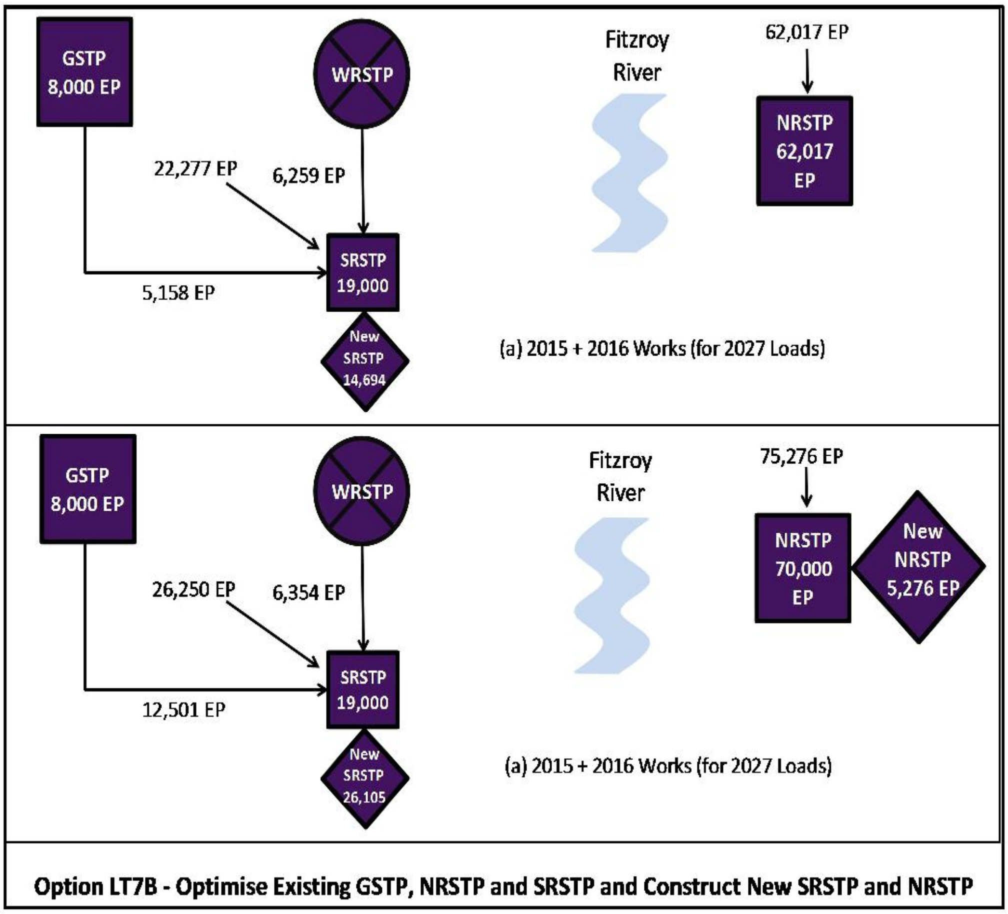


Figure 9-8 Option LT7B Optimise GSTP, SRSTP & NRSTP and construct new capacity at SRSTP and NRSTP

9.9 Staging Capacities

The 2016, 2017 and 2042 staging capacities for the above strategies are presented below.

Table 9-1 Staging capacities of long term STP strategies

Long term STP strategies	Year	Load (EP) Years 2016 / 2027 / 2042					Exist STP optimised capacity (EP)			New capacity required (EP) Years 2016 / 2027 / 2042					
		GSTP	WRSTP	SRSTP	NRSTP	Total	GSTP	SRSTP	NRSTP	Pipeline WRSTP to SRSTP	Pipeline GSTP to SRSTP	Fitzroy River crossing	New SRSTP	New NRSTP	New STP Site / Pipeline from NRSTP
Treated water quality A (20BOD / 30SS / 7TN / 5TP)	2016 2027 2042	9,506 13,158 20,501	6,191 6,259 6,354	19,751 22,277 26,250	53,804 62,017 75,276	89,252 103,711 128,381	8,000(No N/P)	35,000(MBR/A)	80,000(MBR/A)						
Option LT1A – New "flood-free" STP north of Fitzroy River Close GSTP, WRSTP, SRSTP, NRSTP, transfer raw sewage to new STP; Construct new STP at "flood-proof" site	2016 2027 2042	Close Close Close	Close Close Close				Close Close Close	Close Close Close	Close Close Close	6,191 6,259 6,354	9,506 13,158 20,501	35,448(StoN) 41,694(StoN) 53,105(StoN)	Close Close Close	Close Close Close	89,252(MBR/A) 103,711(MBR/A) 128,381(MBR/A)
Option LT2A – South Rockhampton STP only Close WRSTP, transfer to SRSTP; Close GSTP, transfer to SRSTP; Close NRSTP, transfer to SRSTP; Optimise exist SRSTP; Construct new SRSTP	2016 2027 2042	Close Close Close	Close Close Close				Close Close Close	35,000(MBR/A) 35,000(MBR/A) 35,000(MBR/A)	Close Close Close	6,191 6,259 6,354	9,506 13,158 20,501	53,804(NtoS) 62,017(NtoS) 75,276(NtoS)	54,252(MBR/A) 68,711(MBR/A) 93,381(MBR/A)	Close Close Close	N/A N/A N/A
Option LT3A – North Rockhampton STP only Close WRSTP, transfer to SRSTP; Close GSTP, transfer to SRSTP; Close SRSTP, transfer to NRSTP; Optimise exist NRSTP; Construct NRSTP	2016 2027 2042	Close Close Close	Close Close Close				Close Close Close	Close Close Close	80,000(MBR/A) 80,000(MBR/A) 80,000(MBR/A)	6,191 6,259 6,354	9,506 13,158 20,501	35,448(StoN) 41,694(StoN) 53,105(StoN)	Close Close Close	9,252(MBR/A) 23,711(MBR/A) 48,381(MBR/A)	N/A N/A N/A
Option LT4A – Optimised North STP + South STP Upgrade Close WRSTP, transfer to SRSTP; Close GSTP, transfer to SRSTP; Optimise exist NRSTP, transfer excess to SRSTP; Optimise exist SRSTP; Construct new SRSTP	2016 2027 2042	Close Close Close	Close Close Close				Close Close Close	35,448(MBR/A) 35,000(MBR/A) 35,000(MBR/A)	53,804(MBR/A) 62,017(MBR/A) 75,276(MBR/A)	6,191 6,259 6,354	9,506 13,158 20,501	Nil Nil Nil	Nil 6,694(MBR/A) 18,105(MBR/A)	N/A N/A N/A	N/A N/A N/A
Option LT5A – Optimised South STP + North STP Upgrade Close WRSTP, transfer to SRSTP; Close GSTP, transfer to SRSTP; Optimise exist SRSTP, transfer excess to NRSTP; Optimise exist NRSTP; Construct new NRSTP	2016 2027 2042	Close Close Close	Close Close Close				Close Close Close	35,448(MBR/A) 35,000(MBR/A) 35,000(MBR/A)	53,804(MBR/A) 68,711(MBR/A) 80,000(MBR/A)	6,191 6,259 6,354	9,506 13,158 20,501	Nil 6,694(StoN) 18,105(StoN)	N/A N/A N/A	N/A N/A 13,381(MBR/A)	N/A N/A N/A
Option LT6A – Optimised Gracemere STP / Reuse + Optimised South STP + North STP Upgrade Close WRSTP, transfer to SRSTP; Optimise GSTP / reuse, transfer excess to SRSTP; Optimise exist SRSTP, transfer excess to NRSTP; Optimise exist NRSTP; Construct new NRSTP	2016 2027 2042		Close Close Close				8,000(No N/P) 8,000(No N/P) 8,000(No N/P)	27,448(MBR/A) 33,694(MBR/A) 35,000(MBR/A)	53,804(MBR/A) 62,017(MBR/A) 80,000(MBR/A)	6,191 6,259 6,354	1,506 5,158 12,501	Nil Nil 10,105(StoN)	N/A N/A N/A	N/A N/A 5,381(MBR/A)	N/A N/A N/A
Option LT7A – Optimised Gracemere STP / Reuse + Optimised North STP + South STP Upgrade Close WRSTP, transfer to SRSTP; Optimise GSTP / reuse, transfer excess to SRSTP; Optimise exist NRSTP; Optimise exist SRSTP, Construct new SRSTP	2016 2027 2042		Close Close Close				8,000(No N/P) 8,000(No N/P) 8,000(No N/P)	27,448(MBR/A) 33,694(MBR/A) 35,000(MBR/A)	53,804(MBR/A) 62,017(MBR/A) 75,276(MBR/A)	6,191 6,259 6,354	1,506 5,158 12,501	Nil Nil Nil	Nil Nil 10,105(MBR/A)	N/A N/A N/A	N/A N/A N/A
Treated water quality B (20BOD / 30SS / 5TN / 0.5NH3 / 1TP)	2016 2027 2042	9,506 13,158 20,501	6,191 6,259 6,354	19,751 22,277 26,250	53,804 62,017 75,276	89,252 103,711 128,381	8,000(No N/P)	19,000(MBR/B)	70,000(MBR/B)						
Option LT7B – Optimised Gracemere STP / Reuse + Optimised North STP + South STP Upgrade Close WRSTP, transfer to SRSTP; Optimise GSTP / reuse, transfer excess to SRSTP; Optimise exist NRSTP; Optimise exist SRSTP, Construct new SRSTP	2016 2027 2042		Close Close Close				8,000(No N/P) 8,000(No N/P) 8,000(No N/P)	19,000(MBR/B) 19,000(MBR/B) 19,000(MBR/B)	53,804(MBR/B) 62,017(MBR/B) 70,000(MBR/B)	6,191 6,259 6,354	1,506 5,158 12,501	Nil Nil Nil	8,448(MBR/B) 14,694(MBR/B) 26,105(MBR/B)	Nil Nil 5,276(MBR/B)	N/A N/A N/A

9.10 Cost comparison

Capital and operating costs for long term strategies LT1A, LT6A, LT7A and LT7B have been prepared (in 2013 cost terms) and are presented in **Appendix E**.

The 2013 cost estimates have been escalated at a rate of 4%pa for capital works and at the rates nominated by FRW for power, chemicals and labour.

The capital and annual operating costs have been extended to 2042.

It has been assumed that the earliest date for major works is 2015 and that the first tranche of works (constructed in 2015 and 2016) provides capacity for 2027 projected loads. It was also assumed that works to provide capacity for the projected 2042 loads are constructed in 2027.

NPVs have been calculated for the 2015 to 2042 period using the long term cost of money value nominated by FRW.

The cost comparison for these options is summarised below.

This cost comparison includes the "book ends" and allows ready interpretation of the options within the range.

The cost comparison shows:

- New flood-free treatment sites have the most expensive capital cost and NPV
- Options that maximise the reuse of existing infrastructure (by optimisation) have the lowest capital costs and NPVs
- Treatment standard B has substantially higher capital and NPV costs that treatment standard A

Table 9-2 Capital, operating and NPV cost comparison

	Treated water quality A (20BOD / 30SS / 7TN / 5TP)			Treated water quality B (5BOD / 5SS / 5TN / 0.5NH3 / 1TP)
	Option LT1A	Option LT6A	Option LT7A	Option LT7B
2015 & 2016 Works				
Direct capital costs ($2013)				
Pipelines	$71.1M	$10.9M	$10.9M	$10.9M
Treatment plants	$100.6M	$84.6M	$84.6M	$107.5M
Indirect costs & contingency	$82.6M	$44.2M	$44.2M	$54.7M
Total capital	$254.3M	$139.7M	$139.7M	$173.0M
Annual operating cost (2027[1])	$3.6M	$4.2M	$4.2M	$4.2M
2027 Works				
Direct capital costs ($2013)				
Pipelines	$28.1M	$11.4M	$6.1M	$6.1M
Treatment plants	$42.5M	$25.6M	$25.5M	$35.6M
Indirect costs & contingency	$32.0M	$17.0M	$14.6M	$19.2M
Total capital	$102.5M	$54.0M	$46.2M	$60.8M
Annual operating cost (2042[2])	$5.0M	$5.5M	$5.3M	$5.4M
Total capital ($2013)	$356.8M	$207.0M	$185.9M	$233.8M
NPV	$456M	$331M	$325M	$367M

Notes: 1. Annual operating cost (power, chemicals & labour) for 2027 load in $2013. 2. Annual operating cost for 2042 load in $2013.

9.11 Multi-criteria assessment of long term strategies

A multi-criteria analysis (MCA) of the strategic long term options has been undertaken by the comparing environmental, community, cost, regulatory and operations attributes of the strategies.

The following features were selected as important and able to differentiate the various strategies.

Environment

- Tonnes per week of TN and TP released to the Fitzroy River in 2042
- Percentage of flow released (i.e. less reuse) to the Fitzroy River in 2042
- Tonnes per year of e-CO_2 generated in 2042
- Flood immunity of the STP sites

Community

- Potential for odour nuisance (number of potential sensitive receptors within the 2.5OU footprint)
- Potential for new STP noise nuisance (yes / No test)
- Potential for new STP aesthetic impact (Yes / No test)
- Potential for new STP community impact (Yes / No test)
- Potential for river crossing construction to cause community disruption (Yes / No test)
- Potential for business disruption in city area (length of pipeline to be constructed)
- Potential for resident disruption in developed areas (length of pipeline to be constructed)
- Potential for private landholder impact (length of pipeline constructed across privately owned land)
- Potential for odour / aesthetic nuisance from sludge cartage from STP to landfill (Yes / No test)
- Potential for community
- Potential for community traffic disruption in city area (length of pipeline to be constructed)
- Potential for community traffic disruption in developed areas (length of pipeline to be constructed)

Cost

- Total capital cost (for 2042 loads)
- Cashflow (capital cost to 2016 for 2027 loads)
- Annual operating cost (power, chemicals and labour in 2042)
- NPV (of capital and annual operating costs to 2042)

Regulatory

- Need to obtain approval for a new STP site (Yes / No test)
- Suitability of the treated water quality for higher (EPBC) regulatory requirements (yes / No test)

Operations

- Complexity of biological process operations (number of EBPR STP sites)
- Complexity of mechanical process operations (number of MBR STP sites)
- Complexity / safety of chemical operations (number of chemicals in use)
- Potential for chemical misadventure (tonnes of chemical used per year in 2042)

9.12 Short listed long term strategies

Various weightings for environment, community, cost, regulatory and operations were tested. Various weightings for the individual features were tested.

It was concluded that strategies LT6 and TL7 were the preferred long term strategies for the development of sewage treatment capacity for Gracemere and Rockhampton.

It was agreed that differentiating between treated water qualities A and B was a regulatory matter that would be decided by others. It was noted that treated water quality B carried a substantial additional cost burden for FRW.

9.13 Long term sewage treatment strategy for Gracemere and Rockhampton

Both LT6 and LT7 are suitable long term sewage treatment strategies for Gracemere and Rockhampton.

FRW's major concern is a viable and cost effective short term strategy that is consistent with LT6 and LT7 and will deliver relief from the difficulties of meeting the current licence.

A suitable short term compliance strategy is presented below.

9.14 FRW review of objectives

Subsequent to the above workshop, FRW personnel met and produced the following proposals that summarise FRW's objectives.

These proposals concentrate on activities for the next 5 years and are broadly consistent with LT6 / LT7.

Table 9-3 FRW strategy proposals

Action required / Project	Justification / driver / objective	Implementation
SRSTP		
Aeration upgrade	Regulatory; To consistently meet TN limit; Precursor for further augmentation	2013/14
Augment to achieve capacity for transfer of WRSTP (MLE conversion)	Regulatory; To allow decommissioning of WRSTP	2014/15, 2015/16
Augment for growth in SR and WR catchments to 2027 (MBR conversion)	Regulatory; To match growth	2016/17, 2017/18
NRSTP		
Aeration upgrade	Regulatory, To consistently meet TN limit	2014/15
Augment for growth in catchment to 2027	Regulatory; To match growth	2015/16 to 2017/18
WRSTP		
Electrical "band aid" works	Safety; Reliability; To operate to mid 2015	2013/14
Design & construct rising main to SRSTP	Safety, Reliability; Regulatory; Decommission WRSTP	2014/15, 2015/16
Upgrade Jardine Park SPS	Safety, Reliability; Regulatory; Decommission WRSTP	2015/16

Action required / Project	Justification / driver / objective	Implementation
Decommission & demolish WRSTP	Safety, Reliability; Regulatory; Decommission WRSTP	2015/16
GSTP		
Aeration upgrade for current load	Regulatory	2013/14
Augment for growth in catchment	Regulatory; match growth for 10 years; Avoid change to combined mass load licence	2013/14 to 2015/16

It needs to be noted that the proposed aeration upgrades at SRSTP and NRSTP will only produce marginal improvements in TN removal. These works could be valuable in the short term by allowing major upgrades to be deferred for a couple of years – this would require skilful operation of SRSTP and NRSTP to maximise overall mass load performance.

SRSTP does not have a designated anoxic zone and increasing the aeration will decrease the existing “unintended” anoxic volume. There is a tipping point at which the current “bonus” TN removal will cease.

The NRSTP oxidation ditches were designed to have anoxic zones. Increasing the aeration (with new horizontal aerators) will produce improved TN removal performance. However, this improvement will be marginal and will be limited by the aerated / anoxic volume trade-off and other process constraints such as clarifier size.

While these upgrades are worthwhile they will only provide a short time delay until more substantial works will be required.

The delay that can be achieved will depend on a combination of factors. Some of these, FRW can control e.g. maximising the flexibility afforded by the existing mass load licence by skilful operation of SRSTP and NRSTP. Other factors e.g. load growth are largely outside FRW’s control.

10. Short term licence compliance strategy

10.1 The problem

From the analysis of weekly TN and TP exports from SRSTP, NRSTP and WRSTP it is apparent that FRW will have difficulty meeting the combined 50%ile TN target in the short term. The 50%ile TP target seems to be achievable.

The analysis indicated that WRSTP discharges relatively little TN (as kg/week). FRW would gain little from reducing the WRSTP TN export.

The analysis indicated that NRSTP exports a significant TN load (as kg/wk) but NRSTP is also receiving the majority of the raw sewage load and is performing reasonably satisfactorily, especially when compared to SRSTP.

STSTP exports twice as much TN as NRSTP (from about half the raw sewage load). It is clear that the major short term TN compliance problem is at SRSTP.

It is also clear that implementation of the long term sewage treatment strategy would involve a large capital investment that FRW / RRC would have considerable difficulty funding.

10.2 The objective

The objective of a short term TN strategy is to reduce TN exports from SRSTP (at a relatively low capital cost) and thereby to improve TN licence compliance.

10.3 A suggested approach

The least expensive way to reduce TN exports is to convert the existing SRSTP plant to an MLE process.

The following works are proposed:

- Retain the existing inlet works (with modifications to the overflow and "blocking-off" the PST 2 feed)
- Feed settled effluent from PST 1 to PST 2 (with modifications to the pipework system)
- Convert PST 2 to an anoxic tank (provided with new mixers)
- Pump anoxic tank effluent to the aeration tanks
- Upgrade the aeration tanks with fine bubble diffused air (FBDA)
- Provide new aeration blowers, pipework and diffusers for the FBDA system
- Pump an A-Recycle stream from the aeration tanks to the anoxic tank
- Retain existing SST 1 and 2
- Retain the existing pumped RAS stream (from the SSTs to the anoxic tank)
- Retain the existing CCT and outfall to the Fitzroy
- Retain the existing WAS pumped stream from the Sludge Transfer Pump station to the anaerobic digesters
- Retain the existing sludge lagoons for storing digested sludge
- Retain the existing sludge lagoons supernatant return to the Sludge Transfer pump station

This approach requires construction of some works under live sewage conditions but it is considered that these works can be managed so that the cut-overs can be undertaken over a few hours scheduled at low flow periods (and probably with Arthur Street SPS closed down).

Some works e.g. placing diffuser grids in the aeration tanks will need to be undertaken "live" and will require particular design elements.

A layout plan for the above works is presented in **Appendix B**.

10.4 Potential performance

A Biowin model has been prepared for the above short term works at SRSTP. This model indicates that 5TN performance can be performed at a load of 25,000EP. The Biowin model schematic is presented below.

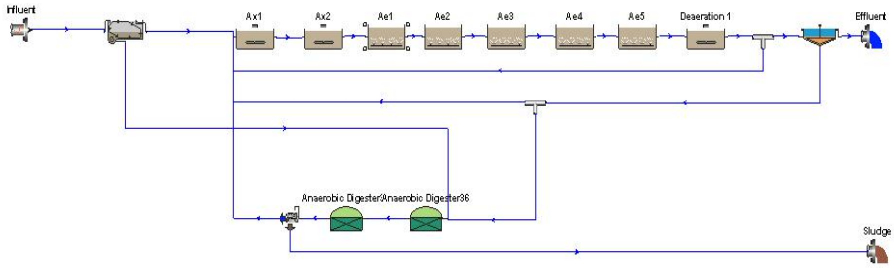


Figure 10-1 Biowin model schematic for SRSTP short termworks

A detailed process summary for the Biowin analysis is presented in **Appendix C**.

The Biowin analysis suggests the following TN and TP effluent performance.

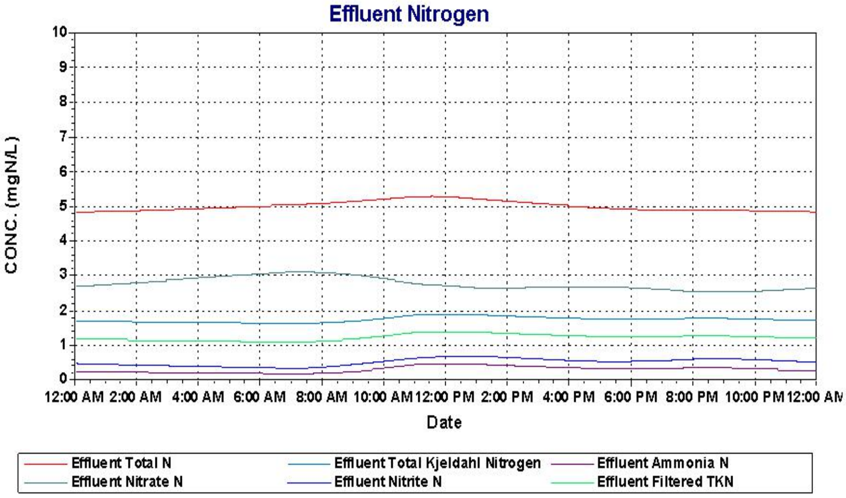


Figure 10-2 Biowin effluent nitrogen performance for SRSTP short termworks

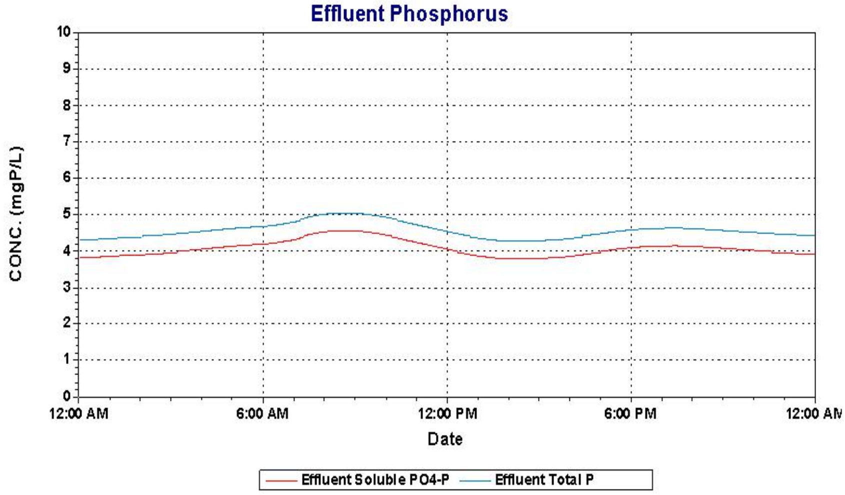


Figure 10-3 Biowin effluent phosphorus performance for SRSTP short termworks

This implies a discharge of 220kgTN/wk which is a 75% reduction from the 50%ile (870kgTN/wk) performance achieved over the early months of calendar 2013.

Interestingly the analysis also implies a discharge of 220kgTP/wk which is double the 113kgTP/wk achieved over the early months of calendar 2013. This could be explained as a lower TP inflow than assumed in the modelling.

The different TN and TP results reinforce the need for more detailed assessment e.g. after the raw sewage characterisation but it indicates a strong potential to significantly reduce TN exports and possibly to defer major augmentation works.

10.5 Cost estimate

The estimated cost for the above works is approximately $10 million. As presented in **Appendix E**.

10.6 Next steps

Should FRW agree to the above approach the next step would be to develop a concept design.

The concept design should be developed to a level that provides greater confidence by examining raw sewage characteristics, hydraulic issues, process refinements, equipment sizing, cut-over issues (electrical, control and hydraulic) and more detailed costing.

11. Project delivery

FRW objectives and constraints have been discussed throughout this report and that information provides background for considering the most appropriate method for the Rockhampton STPs project.

11.1 Pre-feasibility (concept) / Feasibility (preliminary) design phases

A significant amount of work needs to be done in the short term to select the preferred STP strategy and to secure development approvals to implement that strategy.

Concept designs (and possibly preliminary designs and additional investigations) will be required to support the development applications.

These works can be “bundled” into an Alliance type package where the constructor / designer team develops the strategy and secures the approvals. There are advantages (e.g. fewer FRW resources are required) and disadvantages (e.g. FRW’s influence and control is reduced) to this approach.

It is considered that FRW / RRC should retain control of the project through the concept and preliminary design phases. FRW should engage skills from consultants, specialist suppliers etc. to supplement its in-house expertise during these phases.

11.2 Early / critical works

FRW is in danger of breaching its current discharge licence in the near term. FRW advises that it has an approved Temporary Environmental Program from DEHP that will be in force until 31 January 2014.

It is likely that FRW will have to undertake works, as soon as possible, to avoid / reduce the risk of environmental harm.

The existing TEP may need to be modified or extended to include early / short term works adopted by FRW.

FRW will wish to undertake works that provide maximum value for money i.e. that provide the greatest capacity increase for the lowest expenditure.

This can only be achieved by maximising the value of the existing assets. This will be complex work requiring careful interaction with existing operations. FRW needs to have a strong involvement in this work and again should engage consultants, specialist suppliers etc. to supplement its in-house expertise.

Traditional “design and build” is considered the most appropriate delivery method for this work.

11.3 Major augmentation work

Following the early / critical works there will be less urgency and FRW will be able to explore other delivery methods.

These other delivery methods would include the following and have the following advantages and disadvantages:

Table 11-1 Comparison of project delivery methods

Delivery method	Advantages	Disadvantages
Design & build (traditional)	High level of FRW involvement required FRW can get what it wants Competitive bidding provides value for money	Requires significant FRW resources Requires selection of skilled advisors by FRW Constructability can be neglected by designers Tendency to select constructor predominantly on price

Delivery method	Advantages	Disadvantages
Design & construct	Encourages innovation Usually quicker than Design & build Competitive bidding provides value for money	Requires careful technical assessment of offers by FRW Requires careful financial assessment of offers by FRW Risk of non-preferred equipment selection Design driven by cost rather than ease of operations Tendency to select contractor predominantly on price Quality can be a problem, especially if specification is weak and FRW reviewers are unskilled in this work Can generate confrontational behaviour
Early contractor involvement	Brings additional resources to the project Brings additional expertise to the project Encourages innovation	Cost of ECI involvement Reduced competition
Alliances	Brings additional resources to the project Brings additional expertise to the project Encourages innovation Suitable where delivery is urgent but scope is not well defined and approvals are required Encourages co-operative culture to the project	Only some forms provide competitive tension

Traditional delivery provides FRW with the most control over the project but it also requires the highest resourcing. The current, competitive market conditions favour D&C and ECI delivery. Alliances are out of favour, especially with the funding agencies.

Key points to consider are:

- The amount of involvement that FRW wants to have or can resource
- The work is brownfield and parts of it are very intricate i.e. it needs high quality design and construction
- FRW needs to carefully define the required functionality

A form of ECI that is based on a detailed concept design may be best for this project. It would “lock in” the process, hydraulics, site layout and key equipment items but allow the contractor to be innovative in construction, procurement and other project delivery areas.

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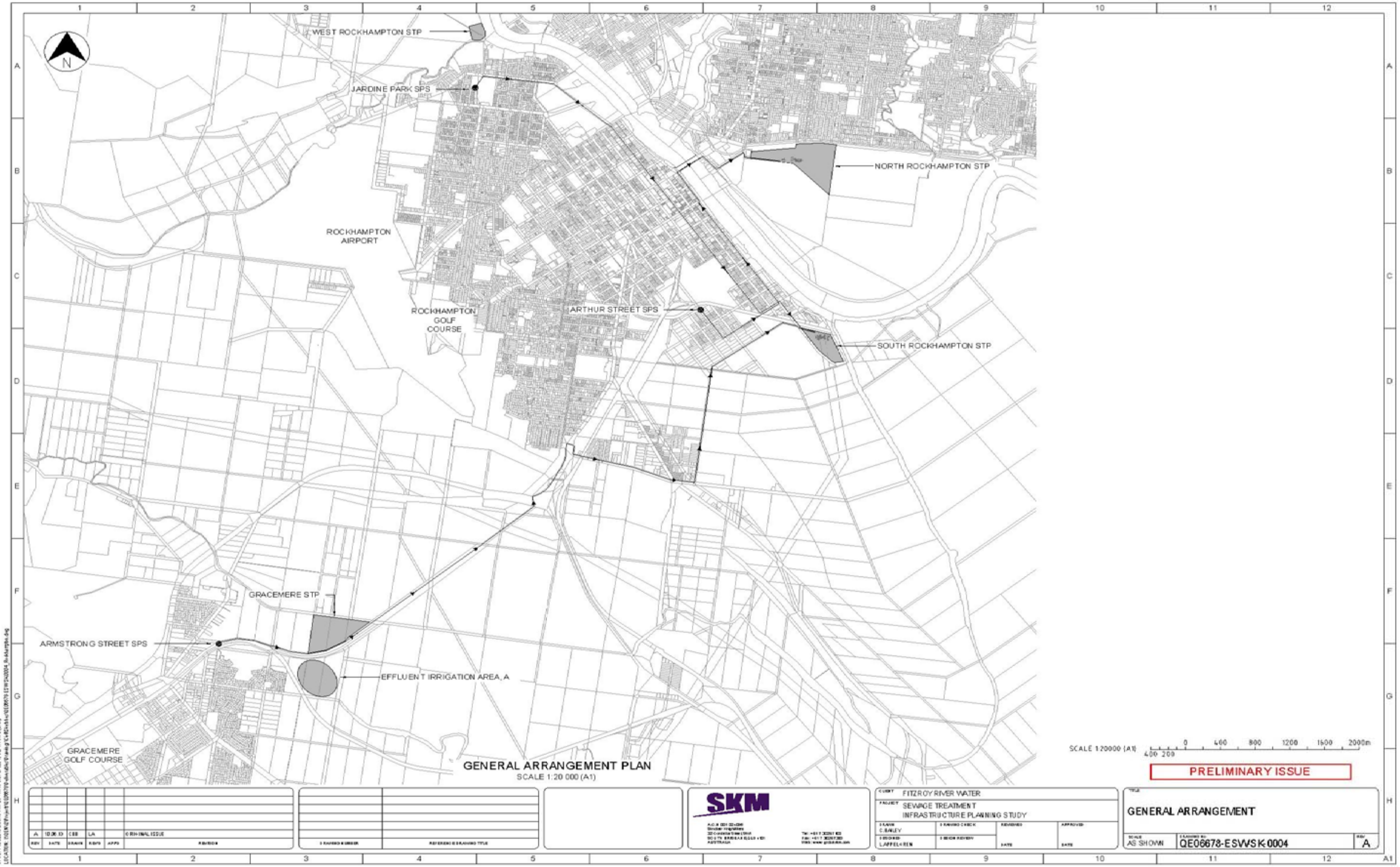
Appendix A. Gracemere & Rockhampton STPs and pipelines



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JARDINE PARK SPS
NORTH ROCKHAMPTON STP
ROCKHAMPTON AIRPORT
ROCKHAMPTON GOLF COURSE
ARTHUR STREET SPS
SOUTH ROCKHAMPTON STP
GRACEMERE STP
ARMSTRONG STREET SPS
EFFLUENT IRRIGATION AREA, A
GRACEMERE GOLF COURSE
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SEWAGE TREATMENT INFRASTRUCTURE PLANNING STUDY
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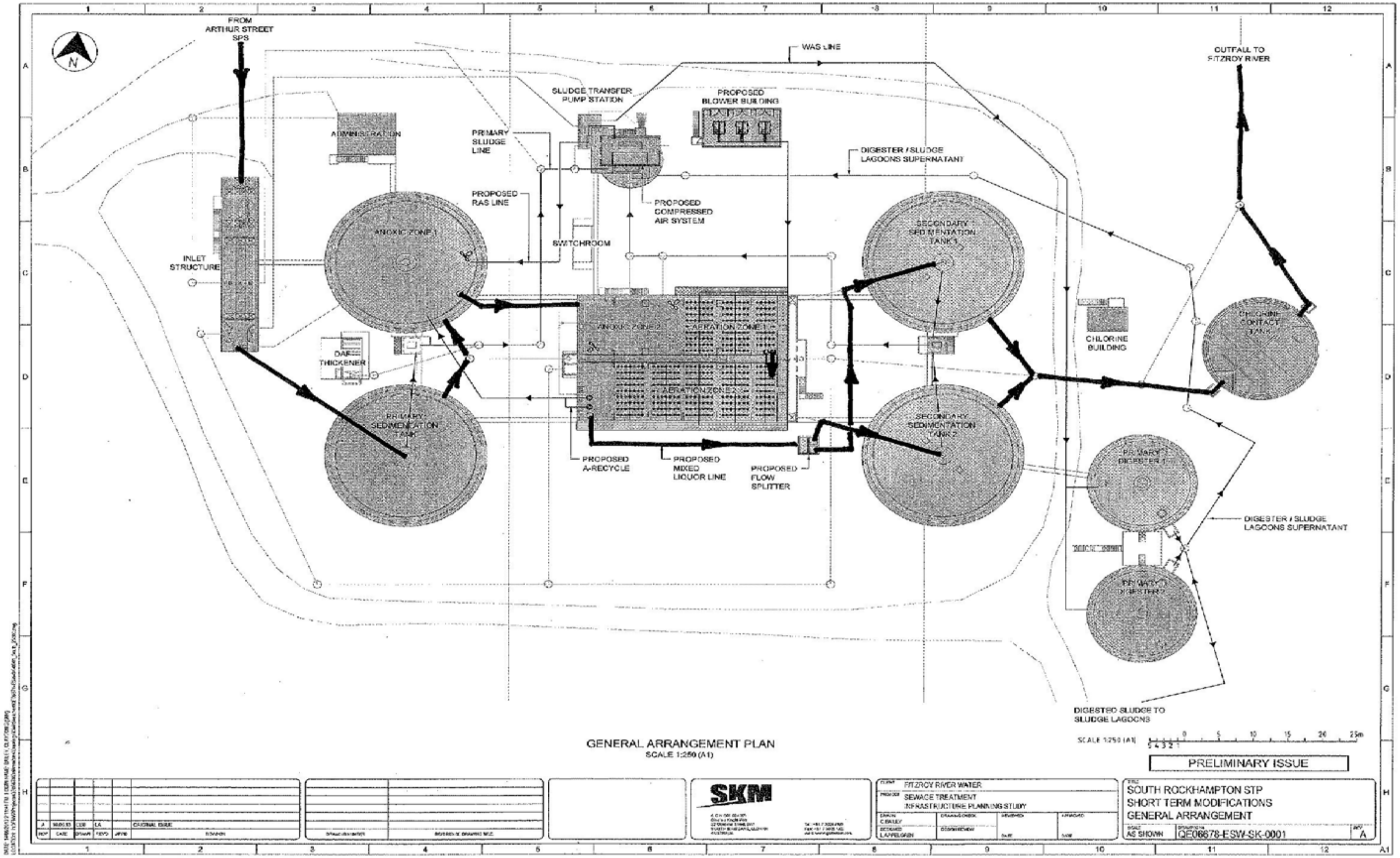
Appendix B. STP augmentation general arrangements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DIGESTER / SLUDGE LAGOONS SUPERNATANT
PROPOSED RAS LINE
PROPOSED COMPRESSED AIR SYSTEM
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SECONDARY SEDIMENTATION TANK 1
INLET STRUCTURE
ANOXIC ZONE 2
AERATION ZONE 1
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CHLORINE BUILDING
DAF THICKENER
AERATION ZONE 2
PRIMARY SEDIMENTATION TANK
SECONDARY SEDIMENTATION TANK 2
PROPOSED A-RECYCLE
PROPOSED MIXED LIQUOR LINE
PROPOSED FLOW SPLITTER
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PRIMARY DIGESTER 2
DIGESTED SLUDGE TO SLUDGE LAGOONS
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SHORT TERM MODIFICATIONS
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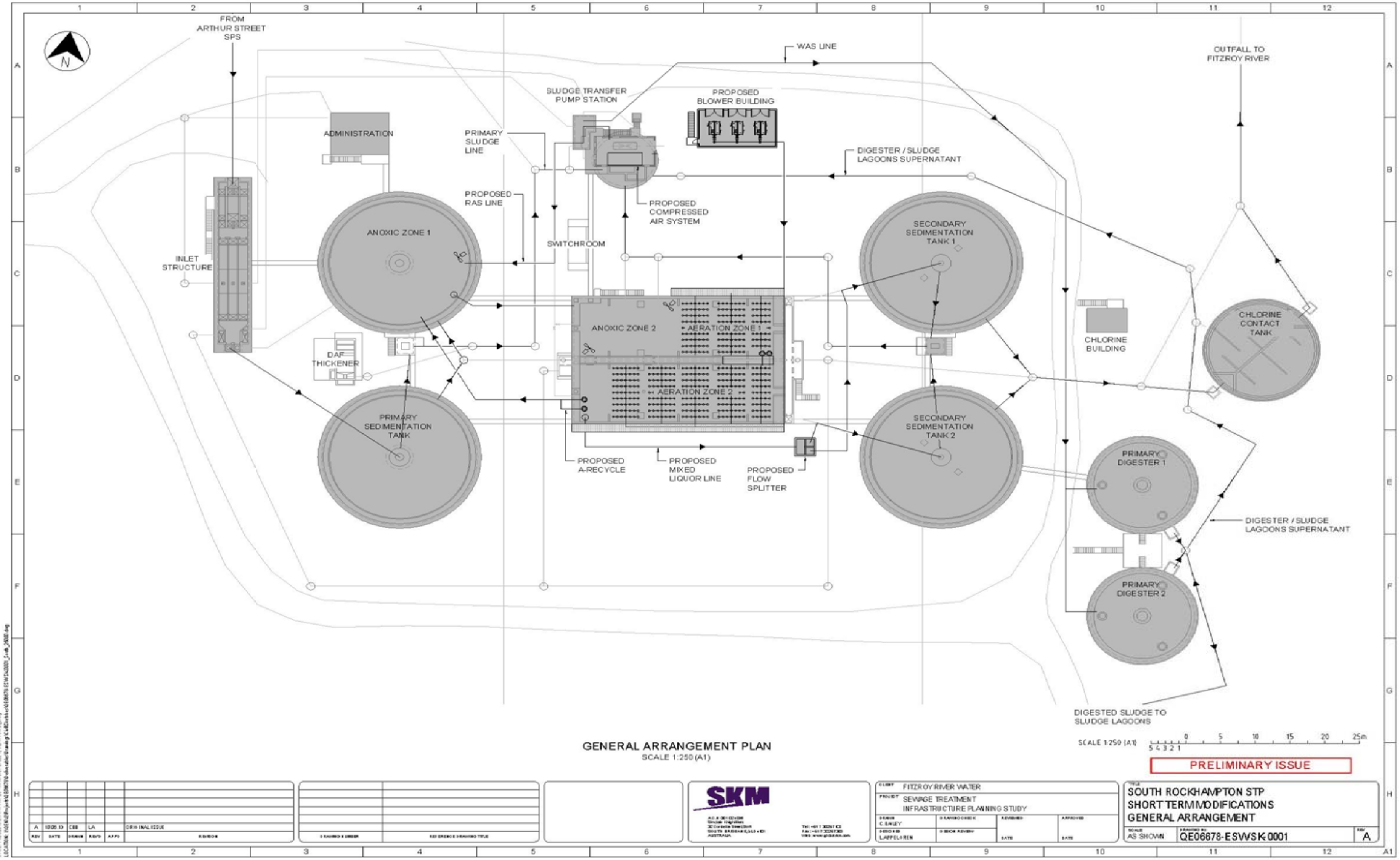
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DIGESTER / SLUDGE LAGOONS SUPERNATANT
PROPOSED RAS LINE
PROPOSED COMPRESSED AIR SYSTEM
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INLET STRUCTURE
ANOXIC ZONE 2
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AERATION ZONE 2
CHLORINE BUILDING
CHLORINE CONTACT TANK
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PROPOSED MIXED LIQUOR LINE
PROPOSED FLOW SPLITTER
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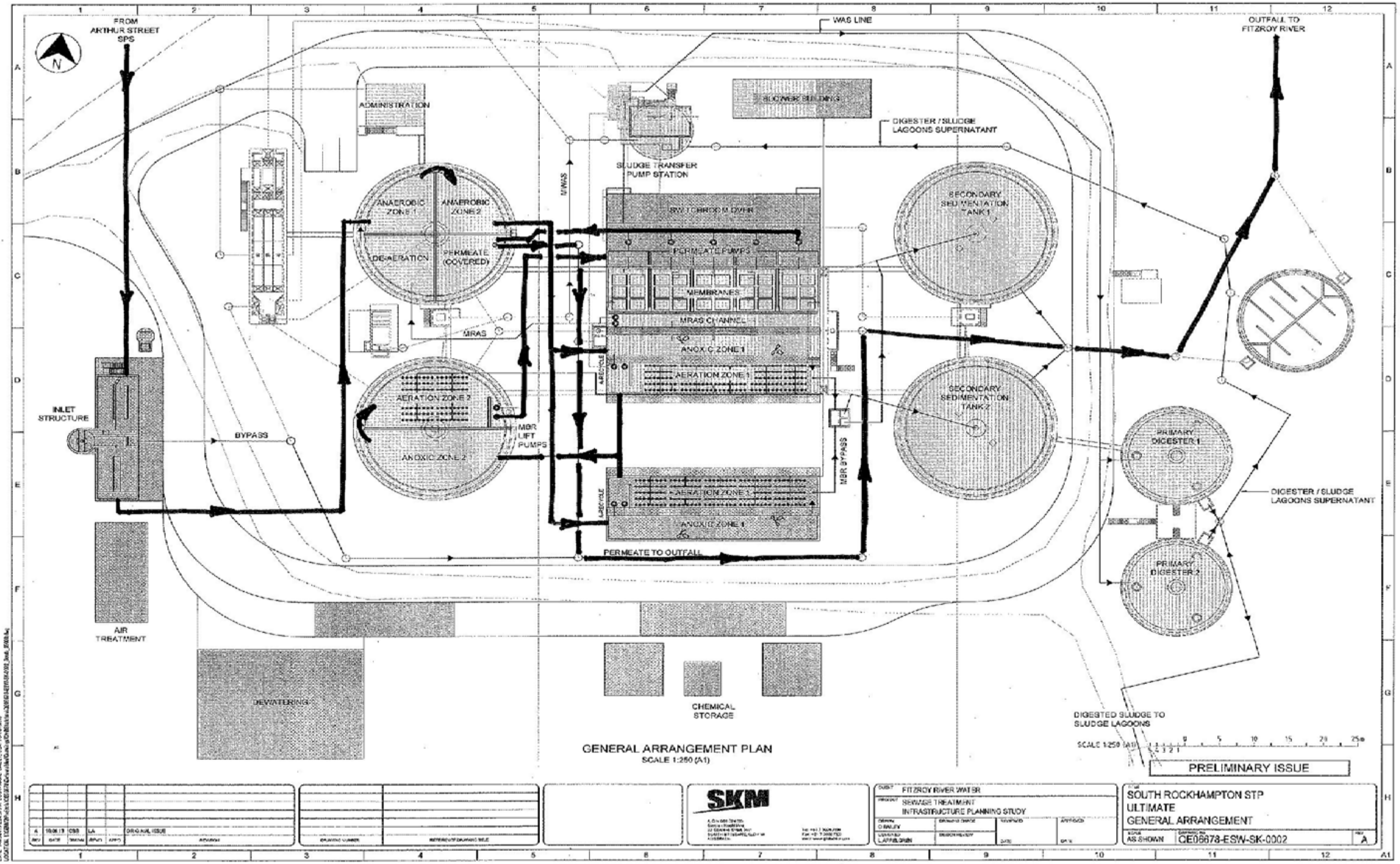
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ANAEROBIC ZONE 2
DE-AERATION
PERMEATE (COVERED)
PERMEATE PUMPS
MEMBRANES
MRAS CHANNEL
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AERATION ZONE 1
SECONDARY SEDIMENTATION TANK 1
SECONDARY SEDIMENTATION TANK 2
MRAS
AERATION ZONE 2
ANOXIC ZONE 2
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INLET STRUCTURE
BYPASS
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PRIMARY DIGESTER 2
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AIR TREATMENT
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CHEMICAL STORAGE
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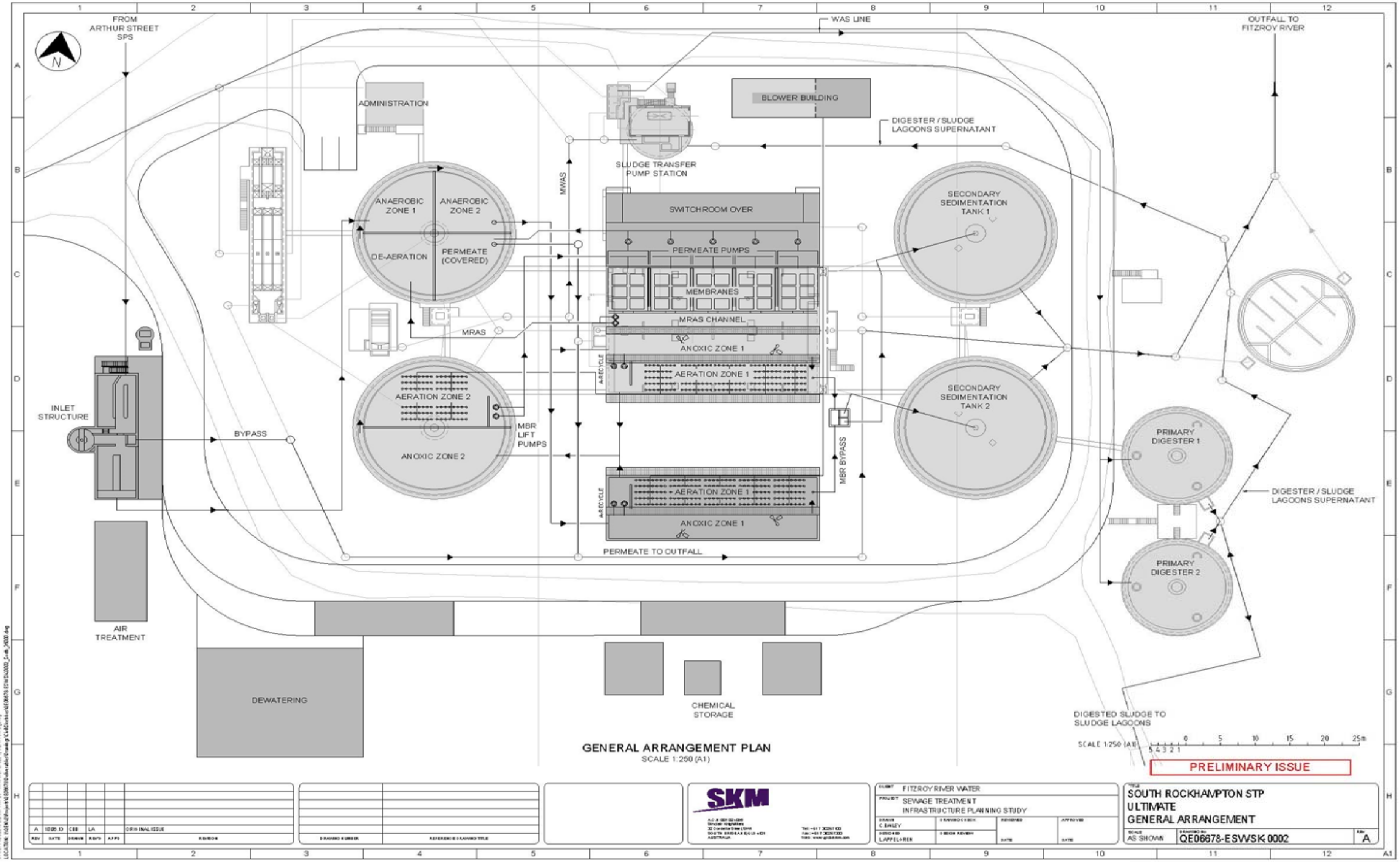
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ANOXIC ZONE 2
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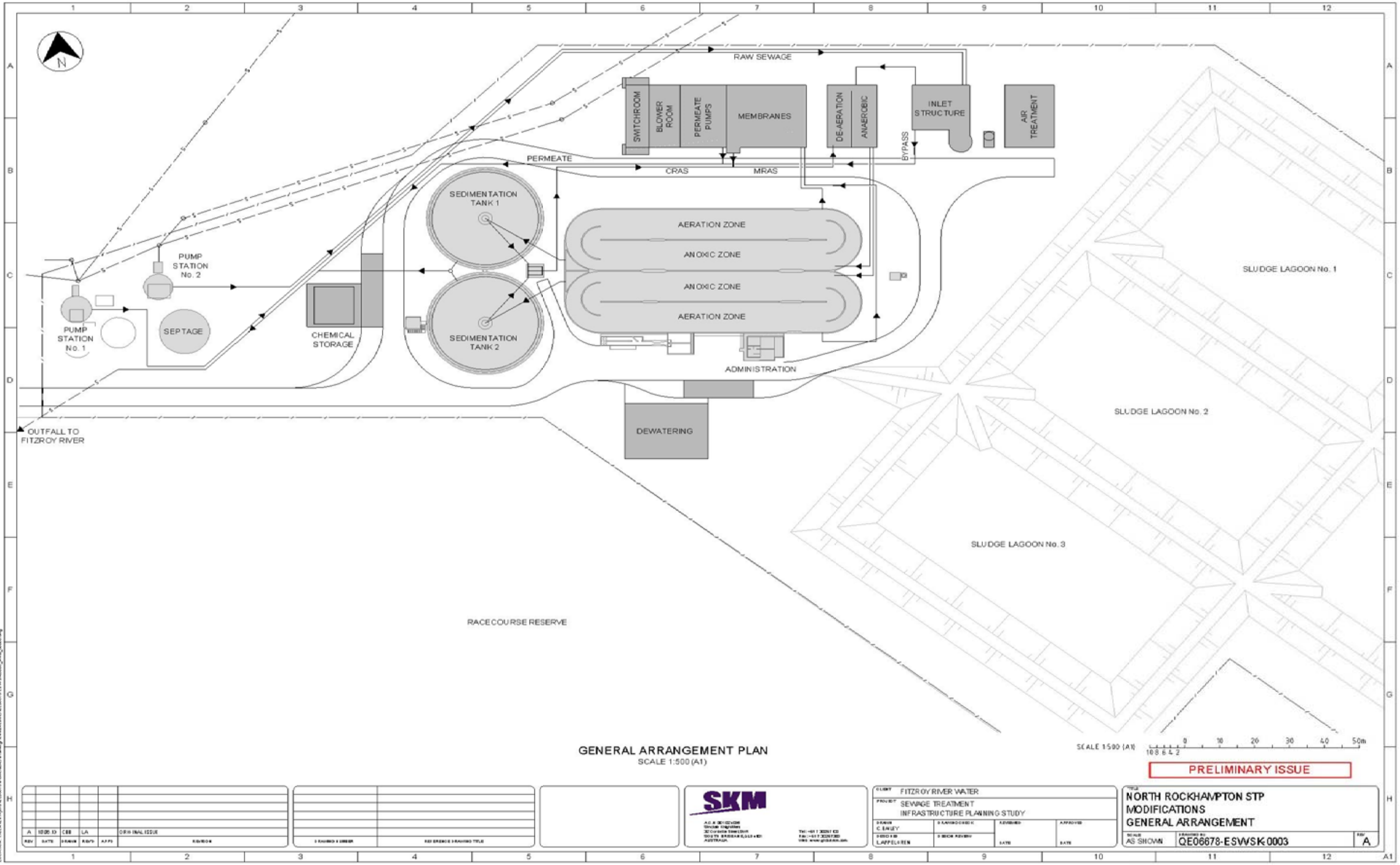
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MEMBRANES
DE-AERATION
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INLET STRUCTURE
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CRAS
MRAS
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SEDIMENTATION TANK 2
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ANOXIC ZONE
AERATION ZONE
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PUMP STATION No. 1
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ADMINISTRATION
DEWATERING
OUTFALL TO FITZROY RIVER
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Appendix C. STP process capacity assessments

Rockhampton sewage treatment plants planning strategy
Existing STPs capacity / optimisation assessments

SKM

Contents

1. Gracemere STP

Over the 2012 calendar year Gracemere STP achieved 7BOD / 7SS / 5TN / 6TP median performance with a hydraulic load of 5,500EP. GRSTP was not designed to remove nitrogen or phosphorus.

Four options for "optimising" the capacity of the existing Gracemere STP infrastructure have been considered and the results are summarised below.

The first option assumes a relaxed licence condition will apply with no nitrogen or phosphorus criteria and that the effluent will be reused locally for irrigation.

The second option assumes the existing licence conditions will be retained, again with the effluent reused locally for irrigation.

The third and fourth options are for mass load effluent standard A and effluent standard B.

Table 1-1 Gracemere STP existing plant optimisation scenarios

Optimisation scenarios	Capacity (EP)
No nutrient criteria effluent standard (20BOD / 30SS)	8,000EP
Current effluent standard (20BOD / 30SS / 20TN / 8TP)	6,500EP
Mass load effluent standard A (20BOD / 30SS / 7TN / 5TP)	5,100EP
Effluent standard B (5BOD / 5SS / 5TN / 0.5NH3 / 1 TP)	3,600EP

The process scenarios are summarised below.

1.1 No nutrient criteria effluent standard (20BOD / 30SS)

The no nutrient criteria effluent standard is assumed to be suitable for local irrigation but, it is noted, this needs to be confirmed by an irrigation sustainability investigation.

The following assumptions have been made in the process capacity assessments.

- ADWF of 220L/EP/d
- PDWF / ADWF ratio of 2.0
- Full treatment up to 3ADWF and bypassing of >3ADWF
- Raw sewage of 125gCODt/EP/d; 58gBOD/EP/d; 13gTN/EP/d; 9gNH3N/EP/d; 2.3gTP/EP/d; Nus 2%TN
- Peak loading factor of 1.7 for the raw sewage parameters
- Sewage temperatures – minimum 20oC, average 25oC, maximum 30oC
- Design targets 0.5mg/L below the nominated effluent parameters
- Aeration alpha factor of 0.7 – 0.8; clean water SOTE of 1.5kgO2/hr for surface aerators and motor wire power 85% of motor rating
- Alum dosing – provided for chemical phosphorus trimming (where applicable)
- Caustic dosing – provided to correct alkalinity loss from alum dosing and maintain minimum effluent alkalinity of 50mg/L (CaCO3)
- Sludge SSVI of 150mL/g – considered typical where there are no selector or anaerobic zones

The constraints to the existing plant capacity (to achieve this effluent standard) are the ditch / final settling tank sizes and the configuration of the aerators that limits the anoxic volume. The aeration system also has insufficient standby capacity.

The process assessment is presented below and indicates a potential capacity of 8,000EP (for 20BOD / 30SS effluent standard) with the following modifications:

- The inlet works is modified to provide bypassing of >3ADWF flows
- The aeration system is re-configured to optimise the performance of the aerobic pass and the anoxic pass
- Pre-treated sewage is directed to the anoxic volume of the ditch
- New aeration standby capacity is provided
- New RAS pumps are installed (if the existing pumps have inadequate capacity)
- New WAS pumps are installed (if the existing pumps have inadequate capacity)
- New caustic dosing is provided for alkalinity correction of the effluent

Consideration should also be given to constructing a new inlet works to provide automatic screening, vortex grit collection and grit classification. Efficient screening and grit removal will prevent loss of active volume in the ditch over time. A >3ADWF bypass should also be provided to prevent biomass being washed out in high flow conditions.

FRW has purchased a skid mounted centrifuge for dewatering sludge lagoons across its operational area. The existing Gracemere sludge lagoons and drying beds are likely to limit the ability to remove WAS from the plant and the centrifuge could improve this capability. The process requirements for a normal fixed mechanical sludge dewatering system are provided to give guidance for the operation of the centrifuge.

1.2 Existing effluent standard (20BOD / 30SS / 20TN / 8TP)

The existing Gracemere STP effluent standard is suitable only for continued land irrigation.

The constraints to the existing plant capacity (to achieve this effluent standard) are the ditch / final settling tank sizes and the configuration of the aerators that limits the anoxic volume. The aeration system also has insufficient standby capacity.

Because Gracemere STP is a small plant chemical precipitation of phosphorus has been adopted. For effluent TP targets of 8TP and 5TP phosphorus trimming using alum has been adopted. For the 1TP effluent target the description “phosphorus removal” (also using alum) has been used.

The process assessment is presented below and indicates a potential capacity of 6,500EP (for 20BOD / 30SS / 20TN / 8TP effluent standard) with the following modifications:

- The inlet works is modified to provide bypassing of >3ADWF flows
- The aeration system is re-configured to optimise the performance of the aerobic pass and the anoxic pass
- Pre-treated sewage is directed to the anoxic volume of the ditch
- New aeration standby capacity is provided
- New RAS pumps are installed (if the existing pumps have inadequate capacity)
- New WAS pumps are installed (if the existing pumps have inadequate capacity)
- New alum dosing is provided for phosphorus trimming
- New caustic dosing is provided for alkalinity correction of the effluent

1.3 Mass load effluent standard A (20BOD / 30SS / 7TN / 5TP)

The assumptions listed above generally apply for this case also.

The current performance indicates that the anoxic fraction is approximately 30% at average load. While the aeration configuration is sub-optimal some nitrogen removal is being achieved due to the simultaneous nitrification de-nitrification characteristics of oxidation ditches.

To achieve the desired effluent quality an anoxic volume of up to 40% is recommended. The aeration system needs to be re-configured or replaced so that sufficient anoxic volume is created.

Due to the shallow depth and type of aeration equipment it may not be possible to re-configure the existing aerators to achieve the required anoxic volume and also provide sufficient aeration capacity to meet aeration demands. Larger horizontal surface aerators may drive the ditch contents at too high a velocity to achieve sufficient anoxic volume. Vertical or aspirating surface aeration equipment may not be able to deliver sufficient oxygen in a sufficiently compact area. Fine bubble diffused air systems will not be able to operate efficiently in the shallow ditch. Meeting the aeration / anoxic volume requirements may not be achievable. More detailed examination is required but, for this assessment, it is assumed that this problem can be solved.

The process assessment is presented below and indicates a potential capacity of 5,100EP (for 20BOD / 30SS / 7TN / 5TP effluent standard) with the following modifications:

- The inlet works is modified to provide bypassing of >3ADWF flows
- The current aeration system is re-configured / replaced and is assumed to provide sufficient anoxic volume
- Pre-treated sewage is directed to the anoxic volume of the reactor
- New RAS pumps are installed (if the existing pumps have inadequate capacity)
- New WAS pumps are installed (if the existing pumps have inadequate capacity)
- New alum dosing is provided for phosphorus removal
- New caustic dosing is provided for alkalinity correction of the effluent (but would only be required during peak alum dosing periods)

1.4 Effluent standard B (5BOD / 5SS / 5TN / 0.5NH3 / 1TP)

The same comments as for the above cases generally apply.

An anoxic fraction of 45% is required.

Filters will probably be required to consistently achieve 5SS.

The process assessment is presented below and indicates a potential capacity of 3,600EP (for 5BOD / 5SS / 5TN / 0.5HN3 / 1TP effluent standard) with similar modifications.

1.5 Constructability

A number of the optimisation works considered above could be undertaken without taking the plant offline e.g. redirecting RAS to the anoxic zone, RAS pumps, WAS pumps, alum dosing and caustic dosing. There may be some issues with electrical cut-overs but these should be readily overcome.

It is assumed that re-configuring the aeration system (to create the necessary anoxic volume) could be done (with the plant online) using surface aerators but this would require detailed examination prior to implementation.

Adding a >3ADWF bypass to the inlet works is potentially more difficult in that a new flow splitter structure may be required to provide sufficient weir length. This constructability problem might be overcome by bypassing the inlet works during construction / cutover but screenings and grit would be pumped directly into the ditch.

The best solution is probably to construct a new inlet works and that is provided in the cost estimate for optimisation works.

Table 1-2 Gracemere STP process capacity assessment for 8,000EP load and 20BOD / 30SS / no nutrient criteria effluent

Process / Unit Operation	Existing	Evaluation criteria	Requirement for 8,000EP Capacity	Constraint / Comment
Inlet works			Bypass for >3ADWF flows	
Bioreactor	Pasveer ditch 1,200kL volume			Existing ditch / FST limits capacity
Clarification	Final settling tank 16m dia x 3m depth	Multiple units for peak load are desirable		Existing FST has no redundancy
Aeration	Surface aerators – 6x2m horiz + 2 vertical SOTR (6x2x3.7 + 2x11) 66.4kgO2/hr Power (6x2x1.6 + 2x7.5) 34.2kW			
	5 horizontal + 2 vertical SOTR 59kgO2/hr Power 31kW	One horizontal aerator (2m) standby		Existing aeration has insufficient standby capacity for peak demand
RAS	Duty / standby pumps (capacity unknown)	Duty / standby pumps		Existing RAS pumping capacity is unknown
WAS	Duty / standby pumps (capacity unknown)	WAS over 12hr/d x 5d/wk		Existing WAS pumping capacity is unknown
Caustic dosing	Nil	Duty / standby pumps 30 days storage		Caustic dosing may be required to correct effluent alkalinity for irrigation
Solids handling	Sludge lagoons (3) drying beds (2) Skid mounted centrifuge purchased	Mechanical dewatering over 6hrs/d x 5d/wk		Existing lagoons and drying beds are likely to be capacity limiting.

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Table 1-3 Gracemere STP process capacity assessment for 6,500EP load and 20BOD / 30SS / 20TN / 8TP effluent

Process / Unit Operation	Existing	Evaluation criteria	Requirement for 6,500EP Capacity	Constraint / Comment
Inlet works			Bypass for >3ADWF flows	
Bioreactor	Pasveer ditch 1,200kL volume		6day SRT + 1,800mg/L MLSS	Existing ditch / FST limits capacity
Clarification	Final settling tank 16m dia x 3m depth	Multiple units for peak load are desirable	Hydraulic flux – 0.89m/hr at 3ADWF Solids flux – 3.93kg/m2/hr at 3ADWF	Existing FST has no redundancy
Aeration	Surface aerators – 6x2m horiz + 2 vertical SOTR (6x2x3.7 + 2x11) 66.4kgO2/hr Power (6x2x1.6 + 2x7.5) 34.2kW			Existing aerator configuration limits anoxic volume in ditch
	5 horizontal + 2 vertical SOTR 59kgO2/hr Power 31kW	One horizontal aerator (2m) standby	SOTR peak 87kgO2/hr; average 53kgO2/hr Power peak 68kW; average 42kW	Existing aeration has insufficient standby capacity for peak demand Existing aerators may not be able to be re-configured to achieve anoxic volume
RAS	Duty / standby pumps (capacity unknown)	Duty / standby pumps	Flow rate peak 26L/s; average 12L/s	Existing RAS pumping capacity is unknown
WAS	Duty / standby pumps (capacity unknown)	WAS over 12hr/d x 5d/wk	97kL/d WAS volume Flow rate peak 7.5L/s; average – 3 L/s	Existing WAS pumping capacity is unknown
Alum dosing	Nil	Duty / standby pumps 30 days storage	Flow rate peak 342 L/d; average 98L/d 4,000L storage	Alum dosing is required to trim effluent TP
Caustic dosing	Nil	Duty / standby pumps 30 days storage	Flow rate peak 114L/d; average 24L/d 1,000L storage	Caustic dosing is required to correct effluent alkalinity
Solids handling	Sludge lagoons (3) drying beds (2) Skid mounted centrifuge purchased	Mechanical dewatering over 6hrs/d x 5d/wk	Load rate hydraulic 28kL/hr; solids 62kgSS/hr Cake output 17.2t/wk at 14% DS	Existing lagoons and drying beds are likely to be capacity limiting.

Table 1-4 Gracemere STP process capacity assessment for 5,100EP load and 20BOD / 30SS / 7TN / 5TP effluent

Process / Unit Operation	Existing	Evaluation criteria	Requirement for 5,100EP Capacity	Constraint / Comment
Inlet works			Bypass for >3ADWF flows	
Bioreactor	Pasveer ditch 1,200kL volume		10 day SRT + 2,300mg/L MLSS	Existing ditch / FST limits capacity
Clarification	Final settling tank 16m dia x 3m depth	Multiple units for peak load are desirable	Hydraulic flux 0.7m/hr at 3ADWF Solids flux 3.9kg/m2/hr at 3ADWF	Existing FST has no redundancy
Aeration	Surface aerators – 6x2m horiz + 2 vertical SOTR (6x2x3.7 + 2x11) 66.4kgO2/hr Power (6x2x1.6 + 2x7.5) 34.2kW			Existing aerator configuration limits anoxic volume in the ditch
	5 horizontal + 2 vertical SOTR 59kgO2/hr Power 31kW	One horizontal aerator (2m) standby	SOTR peak 59kgO2/hr; average 37kgO2/hr Power peak 47kW; average 29kW	Existing aerators may not be able to be re-configured to achieve 40% anoxic volume
RAS	Duty / standby pumps (capacity unknown)	Duty / standby pumps	Flow rate peak 27L/s	Existing RAS pumping capacity is unknown
WAS	Duty / standby pumps (capacity unknown)	Duty / standby pumps to deliver WAS volume over 12hr/d x 5d/wk	Flow rate minimum 1.5L/s	Existing WAS pumping capacity is unknown
Alum dosing	Nil	Duty / standby pumps 30 days storage	Flow rate peak 336 L/d; average 150L/d 4,500L storage	Alum dosing is required to trim effluent TP
Caustic dosing	Nil	Duty / standby pumps 30 days storage	Flow rate peak 86L/d; average 13L/d 400L storage	Caustic dosing is required to correct effluent alkalinity
Solids handling	Sludge lagoons (3) drying beds (2) Skid mounted centrifuge purchased			Existing lagoons and drying beds may be capacity limiting.

Table 1-5 Gracemere STP process capacity assessment for 3,600EP load and 5BOD / 5SS / 5TN / 0.5NH3 / 1TP effluent

Process / Unit Operation	Existing	Evaluation criteria	Requirement for 3,600EP Capacity	Constraint / Comment
Inlet works			Bypass for >3ADWF flows	
Bioreactor	Pasveer ditch 1,200kL volume		14 day SRT + 2,500mg/L MLSS	Existing ditch / FST limits capacity
Clarification	Final settling tank 16m dia x 3m depth		Flux hyd 0.5m/hr; solids 3.9kg/m2/hr at 3ADWF	Existing FST has no redundancy
Aeration	Surface aerators – 6x2m horiz + 2 vertical SOTR (6x2x3.7 + 2x11) 66.4kgO2/hr Power (6x2x1.6 + 2x7.5) 34.2kW			Existing aeration system configuration limits the anoxic volume
	5 horizontal + 2 vertical SOTR 59kgO2/hr Power 31kW	One horizontal aerator (2m) standby	SOTR peak 43kgO2/hr; average 30kgO2/hr Power peak 34kW; average 23kW	Existing aerators may not be able to be re-configured to achieve 45% anoxic volume
RAS	Duty / standby pumps (capacity unknown)	Duty / standby pumps	Flow rate peak 24L/s	Existing RAS pumping capacity is unknown
WAS	Duty / standby pumps (capacity unknown)	Deliver WAS volume over 12hr/d x 5d/wk	Flow rate minimum 1.7L/s	Existing WAS pumping capacity is unknown
Alum dosing	Nil	Duty / standby pumps 30 days storage	Flow rate peak 446 L/d; average 260L/d 7,800L storage	Alum dosing is required to remove TP
Caustic dosing	Nil	Duty / standby pumps 30 days storage	Flow rate peak 79L/d; average 23L/d 700L storage	Caustic dosing is required to correct effluent alkalinity
Solids handling	Sludge lagoons (3) drying beds (2) Skid mounted centrifuge purchased			Existing lagoons and drying beds may be capacity limiting.

2. South Rockhampton STP

Over the 2012 calendar year South Rockhampton STP achieved a median performance of 10BOD / 11SS / 30TN / 5TP with a hydraulic load of 20,000EP. SRSTP was not designed to remove nitrogen or phosphorus.

Four options for "optimising" the capacity of the existing South Rockhampton STP infrastructure have been considered and the results are summarised below.

The first two options assume the existing clarifiers are retained as the separation technology. The second two options adopt MBR as the separation technology.

For the 5TP effluent target, chemical phosphorus trimming using alum has been adopted for the smaller capacity clarifier option. For the larger capacity MBR option EBPR has been adopted as the primary phosphorus removal technology.

For the 1TP effluent target, EBPR biological phosphorus removal (supplemented with alum trimming) has been adopted.

Anaerobic sludge digestion has been adopted but it is noted that aerobic digestion is more effective for WAS. This matter should be re-visited during concept design.

Table 2-1 South Rockhampton STP existing plant optimisation scenarios

Optimisation scenarios	Capacity (EP)
Clarifiers	
Mass load effluent standard A (20BOD / 30SS / 7TN / 5TP)	18,000EP
Effluent standard B (5BOD / 5SS / 5TN / 0.5NH3 / 1 TP)	12,000EP
MBR	
Mass load effluent standard A (20BOD / 30 SS / 7TN / 5TP)	35,000EP
Effluent standard B (5BOD / 5SS / 5TN / 0.5NH3 / 1TP)	19,000EP

The process scenarios are summarised below.

2.1 Mass load effluent standard A (20BOD / 30SS / 7TN / 5TP)

The following assumptions have been made in the process capacity assessments.

- ADWF of 250L/EP/d
- PDWF / ADWF ratio of 2.0
- Full treatment up to 3ADWF and bypassing of >3ADWF
- Raw sewage of 125gCODt/EP/d; 58gBOD/EP/d; 13gTN/EP/d; 9gNH3N/EP/d; 2.3gTP/EP/d; Nus 2%TN
- Peak loading factor of 1.7 for the above characteristics
- Sewage temperatures – minimum 20oC, average 25oC, maximum 30oC
- Design targets 0.5mg/L below the nominated effluent parameters
- Aeration alpha factor of 0.7 – 0.8; clean water vendor SOTE of 1.8kgO2/hr for jet surface aerators and motor wire power 85% of motor rating. It is considered that the vendor SOTE for jet aerators is high.
- OTE of 5.5%/m, alpha 0.6 – 0.7 and 65% blower efficiency for fine bubble diffused aeration
- Alum dosing is provided for chemical phosphorus trimming
- Caustic dosing is provided to correct effluent alkalinity to 50mg/L (CaCO3)

- RAS rate of 1.5 ADWF
- Sludge SSVI of 120mL/g at PDWF and 150mL/g at 3ADWF
- Effective volume of the anaerobic digesters is 70%

The key constraint in the existing plant to achieving this effluent standard is the lack of an anoxic zone for nitrogen removal. The size of the reactor, its arrangement as two parallel streams and the configuration of the existing jet aerators prevents the creation of a suitable anoxic zone.

The reactor / FST volume limits the overall capacity.

The process assessment is presented below and indicates a potential capacity of 18,000EP (for 20BOD / 30SS / 7TN / 5TP effluent standard) with the following modifications made to the existing plant:

- The inlet works is modified to provide bypassing of >3ADWF flows
- One Primary Sedimentation Tank (PST) is taken off-line to preserve COD / BOD for de-nitrification
- The bioreactors are modified to operate in series (rather than parallel) and provided with baffling for compartmentalisation of anoxic and aerobic zones
- A fine bubble diffused aeration system is provided
- An A-recycle system is provided
- New alum dosing is provided for chemical phosphorus trimming
- New caustic dosing is provided for alkalinity correction of the effluent (after alum dosing)

As noted above FRW has purchased a skid mounted centrifuge that will be used for dewatering digested sludge from the SRSTP sludge lagoons. The dewatering will be undertaken regularly and this should provide sufficient capacity to effectively remove solids from the plant.

2.2 Effluent standard B (5BOD / 5SS / 5TN / 0.5NH3 / 1TP)

For this case, where there is a low TP effluent target and plant has a significant capacity, chemical phosphorus is not considered economic.

The approach taken here is to establish an EBPR process viz:

- Convert the existing PSTs to anaerobic / RAS de-aeration volume
- Reconfigure the two parallel trains of bioreactors to operate in series and provide baffling for compartmentalisation of aerobic, anoxic and de-aeration zones
- A fine bubble diffused aeration system is provided
- An A-recycled system is provided
- Provide alum dosing for chemical phosphorus trimming (and backup if EBPR fails)
- Provide caustic dosing for alkalinity correction of the effluent (after alum dosing)

The assumptions described above for the 20BOD / 30SS / 7TN / 5TP case generally apply.

The process assessment is presented below and indicates a potential capacity of 12,000EP (for 5BOD / 5SS / 5TN / 0.5NH3 / 1TP effluent standard).

Filters may also need to be added to achieve 5SS consistently.

2.3 MBR mass load effluent standard A (20BOD / 30SS / 7TN / 5TP)

EBPR has been adopted as the primary phosphorus removal technology for this larger capacity MBR option.

The existing PSTs and bioreactors need to be re-configured in series with baffling to create the anaerobic, aerobic and anoxic zones that are required. FBDA is required for increased capacity and efficiency. An internal recycle is also required.

The reactor / PSTs volume limits the overall capacity. This constraint is reduced by the higher MLSS concentration provided by the MBR process and by the extra tankage provided by the MBR tank.

An issue with MBR systems is that they are not hydraulically "fail safe". To overcome this constraint the existing final settling tanks are retained to provide partial treatment of the MBR bypass.

The process assessment is presented below and indicates a potential capacity of 35,000EP (for 20BOD / 30SS / 7TN / 5TP effluent standard) with the following modifications made to the existing plant:

- A new inlet works is constructed to provide 2mm punched hole fine screening (a warranty requirement for MBR membranes)
- The Primary Sedimentation Tanks are converted to provide anaerobic / de-aeration volume for the EBPR process
- The bioreactors are modified to operate in series (rather than parallel) with baffling to provide appropriate anoxic and aerobic volumes
- A new fine bubble diffused aeration system is provided
- An A-recycle system is provided
- A new MBR system is provided
- The existing secondary settling tanks are retained for partial treatment of emergency MBR bypass flows
- New alum dosing is provided for chemical phosphorus trimming
- New caustic dosing is provided for alkalinity correction of the effluent (after alum dosing)

MBR provides adequate disinfection for release to aquatic environments but this may need to be reassessed for some reuse applications.

A process flow diagram for this option follows:

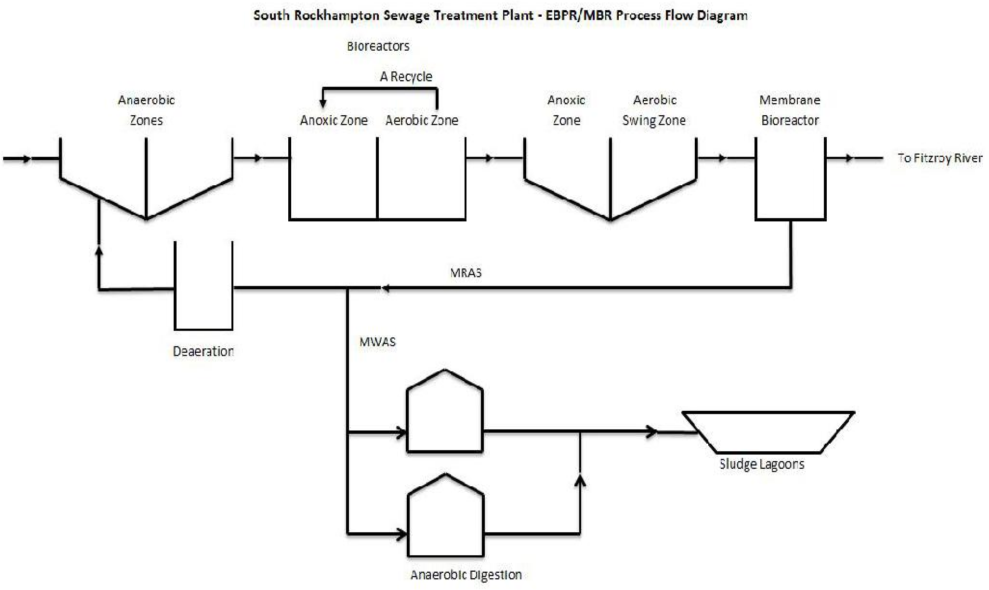


Figure 2-1 South Rockhampton STP EBPR / MBR Optmisation process flow diagram

2.4 MBR effluent standard B (5BOD / 5SS / 5TN / 0.5NH3 / 1TP)

This higher effluent standard requires that an EBPR process is implemented and that significant re-configuration of the plant is undertaken.

The process assessment is presented below and indicates a potential capacity of 19,000EP (for 5BOD / 5SS / 5TN / 0.5NH3 / 1TP effluent standard) with the following modifications to the existing plant:

- A new inlet works is constructed to provide 2mm punched hole fine screening (a warranty requirement for MBR membranes)
- The Primary Sedimentation Tanks are converted to anaerobic / de-aeration volume for the EBPR process
- The bioreactors are modified to operate in series (rather than parallel) with baffling to provide appropriate anoxic and aerobic volumes
- A new fine bubble diffused aeration system is provided
- An A-recycle system is provided
- A new MBR system is provided
- The existing secondary settling tanks are retained for partial treatment of emergency MBR bypass flows
- New alum dosing is provided for chemical phosphorus trimming (or for EBPR failure backup)
- New caustic dosing is provided for alkalinity correction of the effluent (after alum dosing)

2.5 Constructability

Some of the above optimisation works could be constructed without taking the plant offline e.g. filters for 5SS, new inlet works, MBR tank / system, alum dosing and caustic dosing.

However, many of the optimisation works described above would require the plant (or significant parts of it) to be taken offline during construction e.g. re-configuring the two parallel reactors to series operation and providing baffling to create anoxic volume, providing fine bubble diffused aeration in the reactors, converting the PSTs to anaerobic / RAS de-aeration volume, interconnecting pipework and electrics.

FRW has suggested that the plant could be taken offline during construction under a Temporary Environmental Program approval. This needs to be pursued by RFW.

In recent Queensland STP projects effluent quality has needed to be maintained during construction. If this is the case here a new reactor and associated aeration etc. would need to be constructed. The cost estimate for optimisation works provides for this.

Table 2-2 South Rockhampton STP process capacity assessment for 18,000EP load and 20BOD / 30SS / 7TN / 5TP effluent

Process / Unit Operation	Existing	Evaluation criteria	Requirement for 18,000EP Capacity	Constraint / Comment
Inlet works			>3ADWF bypass	
Primary Settling Tanks	PSTs 2x22m dia tanks x 2.15m deep		Hydraulic flux 1.4m/hr at 3ADWF	One PST only required (two PSTs remove COD / BOD that is required for TN removal)
Bioreactor	Bioreactors 2x1040kL		12 day SRT + 2,400mg/L MLSS	Re-configure in series and change aeration to provide anoxic volume. Provide A recycle of 15ADWF
Clarification	FSTs 2x22m dia x 3m deep	One FST for PDWF load Two FSTs for 3ADWF load	Hydraulic flux 0.87 at PDWF; 0.65m/hr at 3ADWF Solids flux 5.8 at PDWF; 3.9kg/m2/hr at 3ADWF	
Aeration	Jet aerators 6 duty no standby; SOTR (6x27)162kgO2/hr; Power (6x15) 90kW		SOTR - peak - 155kgO2/hr; average – 97kgO2/hr Power - peak – 101kW; average – 63kW	Configuration does not allow sufficient anoxic volume. Install new FBDA.
RAS	2 duty 90L/s; 2 duty + 1 assist 135L/s	Duty / standby pumps	Flow rate peak 140L/s; average 70L/s	Existing RAS pumping capacity sufficient
WAS	Capacity unknown	WAS over 12hr/d x 5d/wk	Flow rate minimum 4L/s	Existing WAS capacity unknown
Alum dosing	Nil	Duty / standby pumps 30 days storage	Flow rate peak 458 L/d; average 284L/d 9,000L storage	Alum dosing is required to remove TP
Caustic dosing	Nil	Duty / standby pumps 30 days storage	Flow rate peak 266L/d; average 33L/d 1,000L storage	Caustic dosing is required to correct effluent alkalinity
Anaerobic dig	2x1200kL cold digesters	Load 1.6 – 4.8 kg/m3/d	SRT – 50d; VSS load – 0.62kg/m3/d	Digestion is not process limiting.
Sludge lagoons	19.2ML total capacity		150d at 116kL/d WAS volume (0.45%DS)	
Solids handling	Skid mounted centrifuge purchased	Mechanical DWAS dewatering 6hr/d x 5d/wk	Hydraulic load 32kL/hr Solids load 127kgSS/hr Cake output 22.2t/wk at 14%DS	Mechanical dewatering data for permanent installation

Table 2-3 South Rockhampton STP process capacity assessment for 12,000EP load and 5BOD / 5SS / 5TN / 0.5NH3 / 1TP effluent

Process / Unit Operation	Existing	Evaluation criteria	Requirement for 12,000EP Capacity	Constraint / Comment
Inlet works			>3ADWF bypass	
Primary Settling	PSTs – 2x22m dia tanks x 2.15m deep		Convert both PSTs to anaerobic + RAS de-aeration volume. Combined 3,550kL including 190kL anaerobic and 70kL RAS de-aeration 16 day SRT + 2,500mg/L MLSS	Re-configure PSTs as part of EBPR process. Re-configure bioreactors in series and change aeration to provide anoxic volume. Provide A-Recycle.
Bioreactor	Bioreactors 2x1040kL			
Clarification	FSTs 2x22m dia x 3m deep	One FST for PDWF load Two FSTs for 3ADWF load	Hydraulic flux 0.58m/hr at PDWF; 0.43 at 3ADWF Solids flux 3.9kg/m2/hr at PDWF; 3.9 at 3ADWF	
Aeration	Jet aerators 6 duty no standby; SOTR (6x27) 162kgO2/hr; Power (6x15) 90kW		SOTR peak 150kgO2/hr; average 95kgO2/hr Power peak 99kW; average 62kW	Configuration does not allow sufficient anoxic volume. Install new FBDA.
RAS	2 duty 90L/s; 2 duty + 1 assist 135L/s	Duty / standby pumps	Flow rate peak 96L/s; average 48L/s	Existing RAS pumping capacity sufficient
WAS	Capacity unknown	WAS over 12hr/d x 5d/wk	Flow rate minimum 4L/s	Existing WAS capacity unknown
Alum dosing	Nil	Duty / standby pumps 30 days storage	Flow rate peak 1,038 L/d; average 133L/d 4,000L storage	Alum dosing is required to trim TP. Full chemical P removal peak 1,357L/d; average 860L/d
Caustic dosing	Nil	Duty / standby pumps 30 days storage	Flow rate peak 268L/d; average 24L/d 1,000L storage	Caustic is required to correct effluent alkalinity. Full chemical P removal peak 272L/d; average 82L/d
Anaerobic digest	2x1200kL cold digesters	Load 1.6 – 4.8 kg/m3/d	SRT 43d; VSS load 0.25kg/m3/d	Digestion is not process limiting.
Sludge lagoons	19.2ML total capacity		HRT 140d at 136kL/d WAS volume 0.45%DS	

Table 2-4 South Rockhampton STP MBR process capacity assessment for 35,000EP load and 20BOD / 30SS / 7TN / 5TP effluent

Process / Unit Operation	Existing	Evaluation criteria	Requirement for 35,000EP Capacity	Constraint / Comment
Primary Settling	PSTs 2x22m dia tanks x 2.15m deep		Hydraulic flux 2.0m/hr at PDWF; 3.1m/hr at 3ADWF	One PST only required.
Bioreactor	Bioreactors 2x1040kL		Combined EBPR 2,700kL including 300kL anaerobic, 150kL RAS; A Recycle de-aeration 150kL 17 day SRT + 4,500mg/L MLSS	Convert one PST to EBPR. Re-configure bioreactors in series and change aeration to provide anoxic volume. Provide A-Recycle.
Secondary Settling	FSTs 2x22m dia x 3m deep	Two FSTs for 3ADWF load	Hyd flux 1.4m/hr; Solids flux 10.35kg/m2/hr	80 SSVI assumed for MBR bypass at 3ADWF
MBR	Nil	Flux – average 32; 7day 39; 4day 46; 1hr 52L/m2/hr	750kL; 6 trains of membranes (5 duty , 1 standby) Cassettes - 30	New MBR tank
Aeration	Jet aerators 6 duty no standby; SOTR (6x27)162kgO2/hr; Power (6x15) 90kW		SOTR peak 375kgO2/hr; average 230kgO2/hr Power peak 145kW; average 23kW	Configuration does not allow sufficient anoxic volume. Install new FBDA.
	MBR Nil		Airflow peak 9,500Nm3/hr, average 2,400Nm3/hr Power peak 160kW, average 34kW	New MBR blowers (3 duty, 1 standby)
RAS	2 duty pumps 90L/s; 2 duty1 assist 135L/s	Duty / standby pumps	Flow rate min 60L/s, avg 205L/s, max 460L/s	Existing capacity insufficient
WAS	Capacity unknown	WAS over 12hr/d x 5d/wk	Flow rate minimum 4L/s, maximum 9L/s	Existing WAS capacity unknown
MBR permeate pumps	Nil	30d average flow to 1hr production rate	Flow rate peak 103L/s, maximum 515L/s	New MBR permeate pumps
Alum dosing	Nil	Duty / standby; 30d storage	Flow rate peak 800 L/d; median 0L/d; 5,000L store	Alum dosing is only required if EBPR fails
Caustic dosing	Nil	Duty / standby pumps 30 days storage	Flow rate peak 525L/d; average 26L/d 2,000L storage	Caustic dosing is required to correct effluent alkalinity during peak alum dosing
CIP dosing	Nil	Duty / standby pumps, 30 day storage	Citric acid 20kL/yr, NaOCl 11kL/yr; Citric storage 2,000L, NaOCl storage 1,000L	Based on GE LEAP system
Anaerobic digest	2x1,200kL cold digesters	Load 1.6 – 4.8 kg/m3/d	SRT 18d; VSS load 0.71kg/m3/d	Digestion is not process limiting.
Solids handling	Sludge lagoons 19.2ML Skid mounted centrifuge purchased	Mechanical DWAS dewatering	Hydraulic load 34kL/hr, solids load 540kg/hr Average cake production 71t/wk at 14%DS	Mechanical dewatering data provided for permanent installation

Table 2-5 South Rockhampton STP MBR process capacity assessment for 19,000EP load and 5BOD / 5SS / 5TN / 0.5NH3 / 1TP effluent

Process / Unit Operation	Existing	Evaluation criteria	Requirement for 19,000EP Capacity	Constraint / Comment
Inlet works			2mm punched hole fine screening	
Primary Settling	PSTs 2x22m dia tanks x 2.15m deep		Convert both PSTs to anaerobic / de-aeration volume. Combined EBPR volume 3,550kL including 240kL anaerobic, 100kL RAS; A Recycle de-aeration 100kL. 18 day SRT + 4,500mg/L MLSS	Re-configure both PSTs as part of EBPR process. Re-configure bioreactors in series and change aeration to provide anoxic volume.
Bioreactor	Bioreactors 2x1040kL			
Secondary Settling	FSTs 2x22m dia x 3m deep	Two FSTs for 3ADWF load	Hyd flux – 0.78m/hr; Solids flux – 10.35kg/m2/hr	80 SSVI assumed for MBR bypass at 3ADWF
MBR	Nil	Flux average 32; 7day 39; 4day 46; 1hr 52L/m2/hr	410kL; 5 trains of membranes (4 duty , 1 standby) Cassettes 16	New MBR tank
Aeration	Jet aerators 6 duty no standby; SOTR (6x27)162kgO2/hr; Power (6x15) 90kW		SOTR peak 269kgO2/hr; average 170kgO2/hr Power peak 105kW; average 55kW	Configuration does not allow sufficient anoxic volume. Install new FBDA.
	MBR Nil		Airflow peak 5,050Nm3/hr, average 1,900Nm3/hr Power peak 84kW, average 27kW	New MBR blowers (3 duty, 1 standby)
RAS	2 duty pumps 90L/s; 2 duty1 assist 135L/s	Duty / standby pumps	Flow rate min 45L/s, average 115L/, max 255L/s	Existing capacity is insufficient
WAS	Capacity unknown	WAS over 12hr/d x 5d/wk	Flow rate minimum 4.5L/s, maximum 11L/s	Existing capacity unknown
MBR permeate pumps	Nil	30d average flow to 1hr production rate	Flow rate average 57L/s, maximum 280L/s	
Alum dosing	Nil	Duty / standby; 30d storage	Flow rate peak 1,450 L/d; avg 295; 105,000L storage	Alum dosing is required for TP trimming
Caustic dosing	Nil	Duty / standby;30d storage	Flow rate peak 480L/d; avg 40L/d; 2,000L storage	Caustic dosing to correct effluent alkalinity
CIP dosing	Nil	Duty / standby pumps, 30 day storage	Citric acid 11kL/yr, NaOCl 6kL/yr; Citric storage 1,000L, NaOCl storage 1,000L	Based on GE LEAP system
Anaerobic digest	2x1,200kL cold digesters	Load 1.6 – 4.8 kg/m3/d	SRT 16d; VSS load 0.31kg/m3/d	Digestion is not process limiting.
Sludge handling	Sludge lagoons 19.2ML Skid mounted centrifuge purchased	Mechanical DWAS dewatering	Hydraulic load 38kL/hr, solids 194kg/hr Cake production 33t/wk at 14%DS	Mechanical dewatering data provided for permanent installation

3. North Rockhampton STP

Over the 2012 calendar year the North Rockhampton STP achieved a median performance of 6BOD / 10SS / 12TN / 5TP with a hydraulic load of 42,900EP. The plant was not designed for nitrogen or phosphorus removal. However, because it is an oxidation ditch it has inherent de-nitrification capability and has consistently achieved nitrogen removal. Phosphorus removal has also been observed but it is due to biomass assimilation rather than a specific phosphorus removal process or intent.

Four options for "optimising" the capacity of the existing North Rockhampton STP infrastructure have been considered and the results are summarised below.

The first two options assume the existing clarifiers will be retained as the separation technology.

The second two options adopt MBR as the separation technology.

All septage accepted by FRW is directed to NRSTP. The nominated volume of 20 – 50kL/d is insignificant but the potential toxicity is significant. An allowance has been made for this by reducing the nitrifier growth rate (by about 20% i.e. to 0.7/d down from 0.9/d). The decreased growth rate increases the sludge age / biomass. This will provide buffering in the system to account for any partial inhibition or toxicity caused by various unknown and transient components. The general rule is to increase sludge age as sewage toxicity increases. This matter needs to be re-visited during concept design.

For all of the effluent standards an EBPR solution with an upstream anaerobic / RAS de-aeration reactor has been adopted. Alum dosing is proposed for TP trimming.

Table 3-1 North Rockhampton STP existing plant optimisation scenarios

Optimisation scenarios	Capacity (EP)
Clarifiers	
Mass load effluent standard A (20BOD / 30SS / 7TN / 5TP)	48,000EP
Effluent standard B (5BOD / 5SS / 5TN / 0.5NH3 / 1 TP)	42,500EP
MBR	
Mass load effluent standard A (20BOD / 30 SS / 7TN / 5TP)	80,000EP
Effluent standard B (5BOD / 5SS / 5TN / 0.5NH3 / 1TP)	70,000EP

The process scenarios are summarised below.

3.1 Mass load effluent standard A (20BOD / 30 SS / 7TN / 5TP)

Because NRSTP is a relatively large plant and is expected to receive the majority of the future growth load chemical precipitation is not considered an appropriate primary phosphorus removal technology.

The existing air spiral grit chamber aerates the raw sewage and is incompatible with EBPR processes. It will need to be replaced with vortex grit removal.

The following assumptions have been made in the process capacity assessments.

- ADWF of 220L/EP/d
- PDWF / ADWF ratio of 2.0
- Full treatment up to 3ADWF and bypassing of >3ADWF

- Raw sewage of 125gCODt/EP/d; 58gBOD/EP/d; 13gTN/EP/d; 9gNH3N/EP/d; 2.3gTP/EP/d; Nus 2%TN
- Peak loading factor of 1.7 for the above characteristics
- Sewage temperatures – minimum 20oC, average 25oC, maximum 30oC
- Design targets 0.5mg/L below the nominated effluent parameters
- Aeration alpha factor of 0.7 – 0.8; clean water vendor SOTE of 1.8kgO2/hr for surface aerators and motor wire power 85% of motor rating.
- OTE of 5.5%/m, alpha 0.6 – 0.7 and blower efficiency of 65% for fine bubble diffused aeration
- Alum dosing is provided for chemical phosphorus trimming
- Caustic dosing is provided to correct effluent alkalinity to 50mg/L (CaCO3)
- RAS rate of 1.5 ADWF
- Sludge SSVI of 120mL/g

The reactor / FST sizes limit the overall capacity.

The location of the existing horizontal surface aerators constrains the optimisation of anoxic / aeration volumes in the ditch. The oxygen transfer capacity of the existing aeration system needs to be increased substantially to maximise the treatment capacity of the existing tankage. A fine bubble diffused air system will be needed to optimise the anoxic / aerobic volumes and to provide the necessary oxygen transfer to maximise the capacity of the existing tankage.

The process assessment is presented below and indicates a potential capacity of 48,000EP (for 20BOD / 30SS / 7TN / 5TP effluent standard) with the following modifications to the existing plant:

- A new inlet works to provide >3ADWF bypassing and vortex grit removal
- A new anaerobic / RAS de-aeration reactor upstream of the ditches
- A new fine bubble diffused air system for the ditches
- New RAS pumps
- New WAS pumps
- Alum dosing for phosphorus trimming
- Caustic dosing for alkalinity correction

As noted above FRW has purchased a skid mounted centrifuge that will be used for dewatering digested sludge from the NRSTP sludge lagoons. The dewatering will be undertaken regularly and this should provide sufficient capacity to effectively remove solids from the plant.

3.2 Effluent standard B (5BOD / 5SS / 5TN / 0.5NH3 / 1TP)

Generally the same assumptions as listed above apply.

A larger upstream anaerobic / RAS de-aeration reactor is required for this option. The same general aeration system constraints apply.

The process assessment is presented below and indicates a potential capacity of 42,500EP (for 5BOD / 5SS / 5TN / 0.5NH3 / 1TP effluent standard) with the following modifications to the existing plant:

- A new inlet works to provide >3ADWF bypassing and vortex grit removal

- A new anaerobic / RAS de-aeration reactor upstream of the ditches
- A new fine bubble diffused air system for the ditches
- New RAS pumps
- New WAS pumps
- Alum dosing for phosphorus trimming
- Caustic dosing for alkalinity correction

Filters may also need to be added to achieve 5SS consistently.

3.3 MBR mass load effluent standard A (20BOD / 30SS / 7TN / 5TP)

Generally the same assumptions as listed above apply.

The total ditch volume limits the overall capacity of the existing plant. This constraint is reduced by the higher MLSS concentration provided by the MBR process and the extra tankage provided by the MBR tank.

The anoxic / aerobic zones in the ditches need to be optimised to maximise the plant capacity and this will require fine bubble diffused aeration.

An issue with MBR systems is that they are not hydraulically "fail safe". To overcome this constraint the existing final settling tanks are retained to provide partial treatment of the MBR emergency bypass. Other options e.g. settling in the bioreactors, are possible and could be examined during concept design.

The process assessment is presented below and indicates a potential capacity of 80,000EP (for 20BOD / 30SS / 5TN / 7TP effluent standard) with the following modifications to the existing plant:

- A new inlet works to provide >3ADWF bypassing, vortex grit removal and 2mm punched hole fine screening (a warranty requirement for MBR membranes)
- A new anaerobic / RAS de-aeration reactor upstream of the ditches
- A new fine bubble diffused air system for the ditches
- A new MBR tank / system
- New RAS pumps
- New WAS pumps
- Alum dosing for phosphorus trimming
- Caustic dosing for alkalinity correction

MBR provides adequate disinfection for release to aquatic environments but this may need to be reassessed for some reuse applications.

A process flow diagram for this option follows:

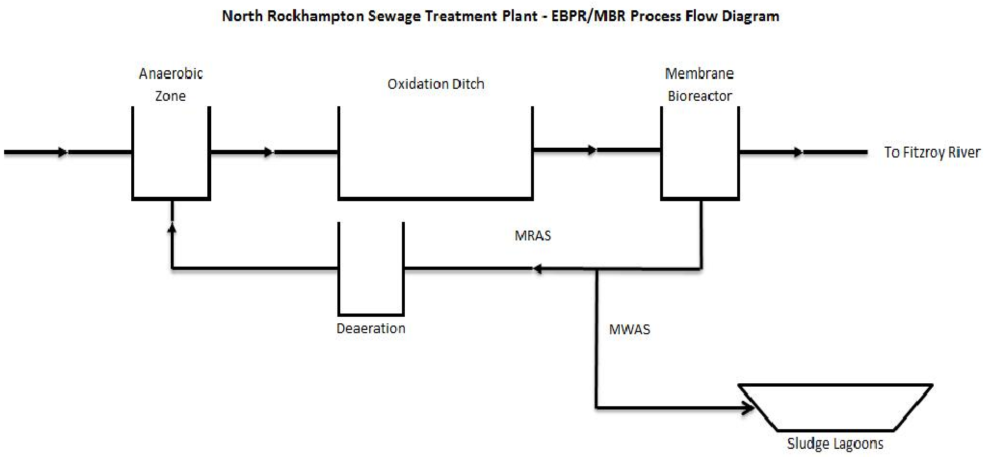


Figure 3-1 North Rockhampton STP EBPR / MBR Optimisation process flow diagram

3.4 MBR effluent standard B (5BOD / 5SS / 5TN / 0.5NH3 / 1TP)

For this effluent standard the anaerobic / RAS de-aeration reactor needs to be a little larger but generally the same comments as above apply.

The process assessment is presented below and indicates a potential capacity of 70,000EP (for 5BOD / 5SS / 5TN / 0.5NH3 / 1TP effluent standard) with the following modifications to the existing plant:

- A new inlet works to provide >3ADWF bypassing, vortex grit removal and 2mm punched hole fine screening (a warranty requirement for MBR membranes)
- A new anaerobic / RAS de-aeration reactor upstream of the ditches
- A new fine bubble diffused air system for the ditches
- A new MBR tank / system
- New RAS pumps
- New WAS pumps
- Alum dosing for phosphorus trimming
- Caustic dosing for alkalinity correction

3.5 Constructability

Many of the optimisation works proposed above could be constructed without taking the plant offline e.g. new inlet works, new anaerobic / RAS de-aeration reactor, MBR tank / systems, RAS pumps, WAS pumps, alum dosing and caustic dosing.

Some of the optimisation works would require one of the ditches or one of the clarifiers to be taken offline e.g. new FBDA systems for the ditches, inter-connecting pipework, and electrical cut-overs. This would probably result in a short term loss of effluent quality and may need TEP approval. This temporary effluent quality problem can probably be overcome for the MBR options.

Table 3-2 North Rockhampton STP process capacity assessment for 48,000EP load and 20BOD / 30SS / 7TN / 5TP effluent

Process / Unit Operation	Existing	Evaluation criteria	Requirement for 48,000EP Capacity	Constraint / Comment
Inlet works			>3ADWF bypass required	
Anaerobic	Nil		Combined EBPR volume 12,000kL including new anaerobic 750kL, 250kL RAS de-aeration volume 12 day SRT + 2,500mg/L MLSS	New tankage for anaerobic and RAS de-aeration required upstream of oxidation ditches for EBPR process.
Bioreactor	Oxidation ditches 2x5,500kL			
Clarification	FSTs – 2x32m dia x 3m depth	One FST for PDWF load Two FSTs for 3ADWF load	Hydraulic flux 1.1m/hr at PDWF Solids flux – 5.8kg/m2/hr at PDWF	
Aeration	Horizontal aerators 2x3 per ditch; SOTR (6x44) 264kgO2/hr; Power (6x14) 270kW One aerator is being replaced with Orbal	Standby capacity required	SOTR peak 592kgO2/hr; average 364kgO2/hr Power peak 387W; average 238kW	Existing aeration capacity insufficient and no standby capacity.
RAS	2 duty 300L/s; 3 duty 400L/s	Duty / standby pumps	Flow rate peak 500L/s; average 170L/s	Existing capacity insufficient for peaks
WAS	Existing capacity unknown	Duty / standby to deliver WAS over 12hr/d x 5d/wk	Flow rate minimum 20L/s	Existing capacity unknown
Alum dosing	Nil	Duty / standby; 7d storage at peak	Flow rate peak 955L/d; median 0L/d; 7,000L storage	Alum dosing is required for TP trimming
Caustic dosing	Nil	Duty / standby;30d storage	Flow rate peak 736L/d; average 51L/d 1,600L storage	Caustic dosing is normally not required but is provided for peak alum dosing
Sludge lagoons	15ML total capacity		HRT 28d at 523kL/d WAS volume	
Sludge dewatering	Skid mounted centrifuge purchased	Mechanical WAS dewatering (5d/wk, 12hr/d)	Hydraulic load 77kL/hr, soilds 305kg/hr Cake production 106t/wk at 14%DS	Mechanical dewatering data provided for permanent installation

Table 3-3 North Rockhampton STP process capacity assessment for 42,500EP load and 5BOD / 5SS / 5TN / 0.5NH3 / 1TP effluent

Process / Unit Operation	Existing	Evaluation criteria	Requirement for 42,500EP Capacity	Constraint / Comment
Inlet works			>3ADWF bypass required	
Anaerobic	Nil		Combined 12,150kL including new anaerobic 950kL + 200kL RAS de-aeration volume 16 day SRT + 2,700mg/L MLSS	New tankage for anaerobic and RAS de-aeration required upstream of oxidation ditches for EBPR process
Bioreactor	Oxidation ditches 2x5,500kL			
Clarification	FSTs 2x32m dia x 4m deep	One FST for PDWF load Two FSTs for 3ADWF load	Hydraulic flux 0.97m/hr at PDWF Solids flux 3.5kg/m2/hr at PDWF	Filters may be needed for reliable 5SS performance
Aeration	Horizontal aerators 2x3 per ditch; SOTR (6x44) 264kgO2/hr; Power (6x14) 270kW	Standby capacity required	SOTR peak 530kgO2/hr; average 336kgO2/hr Power peak 346W; average 219kW	Existing aeration capacity insufficient and no standby capacity. Anoxic / aerobic optimisation and FBDA required.
RAS	2 duty 300L/s; 3 duty 400L/s	Duty / standby pumps	Flow rate peak 500L/s; average 170L/s	Existing capacity insufficient for peaks
WAS	Existing capacity unknown	Duty / standby to deliver WAS over 12hr/d x 5d/wk	Flow rate minimum 15L/s	Existing capacity unknown
Alum dosing	Nil	Duty / standby;30d storage	Flow rate peak flow rate 3,494L/d; average 587L/d 18,000L storage	Alum dosing is required for TP trimming
Caustic dosing	Nil	Duty / standby;30d storage	Flow rate peak 903L/d; average 83L/d 2,500L storage	Caustic dosing is required for alkalinity correction
Sludge lagoons	15ML total capacity		HRT 33d at 451kL/d WAS volume	
Sludge handling	Skid mounted centrifuge purchased	Mechanical WAS dewatering (5d/wk 12hr/d)	Hydraulic load 63kL/hr, solids 284kg/hr Cake production 100t/wk at 14%DS	Mechanical dewatering data provided for permanent installation

Table 3-4 North Rockhampton STP process capacity assessment for MBR 80,000EP load and 20BOD / 30SS / 7TN / 5TP effluent

Process / Unit Operation	Existing	Evaluation criteria	Requirement for 80,000EP Capacity	Constraint / Comment
Inlet works			>3ADWF bypass; 2mm punched hole fine screening	
Anaerobic	Nil		Combined EBPR volume 12,400kL including new anaerobic 1,000kL and 400kL RAS de-aeration volume. 16 day SRT + 4,500mg/L MLSS	New anaerobic / RAS de-aeration tankage required upstream of oxidation ditches for EBPR process.
Bioreactor	Oxidation ditches 2x5,500kL			
MBR	Nil	Max MLSS 8,000mg/L; Avg flux 32L/m2/hr; 7d - 39; 4hr - 46; 1hr - 52	MBR volume 1,275kL; 6 trains membranes 5 duty, 1 standby; Cassettes 54	New MBR tank
Clarification	FSTs 2x32m dia x 3m depth	Two FSTs for 3ADWF load	Hyd flux 1.37m/hr; Solids flux 10.35kg/m2/hr	Clarifiers retained for MBR bypass treatment
Aeration	Horizontal aerators 2x3 per ditch; SOTR (6x44) 264kgO2/hr; Power (6x14) 270kW		SOTR peak 1,140kgO2/hr; average 685kgO2/hr Power peak 425W; average 215kW	Existing aeration capacity insufficient and no standby capacity. Anoxic / aerobic optimisation and FBDA required.
	MBR Nil		Airflow peak 17,000Nm3/hr; average 4,300Nm3/hr Power peak 280kW; average 60kW	Based on GE LEAP system. Provide 3 duty, 1 standby blowers.
MBR perm pumps	Nil		Flow rate peak 1,030L/s; average 210L/s	
RAS	2 duty 300L/s; 3 duty 400L/s	Duty / standby pumps	Flow rate peak 944L/s; average 420L/s; min 185L/s	Existing RAS pumping capacity sufficient
WAS	Existing capacity unknown	WAS over 12hr/d x 5d/wk	Flow rate average 42L/s; minimum 18L/s	
Alum dosing	Nil	Duty / standby;7d storage	Flow rate peak 1,560L/d; med 0L/d; 11,000L storage	Alum dosing is required only when EBPR fails
Caustic dosing	Nil	Duty / standby;7d storage	Flow rate peak 1,230L/d; avg 96L/d; 9,000L storage	Caustic dosing is required for alkalinity correction
MBR CIP	Nil	Duty / standby; 30d storage	Citric acid 35kL/yr, 3,000L storage; NaOCl 19kL/yr, 2,000L storage	Based on GE LEAP system
Sludge handling	Sludge lagoons Skid mounted centrifuge purchased	Mechanical WAS dewatering (5d/wk 12hr/d)	Hyd load 77kL/hr; solids load 519kg/hr; avg cake production 176t/wk at 14%DS	

Table 3-5 North Rockhampton STP process capacity assessment for MBR 70,000EP load and 5BOD / 5SS / 5TN / 0.5NH3 / 1TP effluent

Process / Unit Operation	Existing	Evaluation criteria	Requirement for 70,000EP Capacity	Constraint / Comment
Inlet works			>3ADWF bypass; 2mm punched hole fine screening	
Anaerobic	Nil		Combined 12,400 kL including anaerobic 850kL + 300kL RAS de-aeration volume 17 day SRT + 4,500mg/L MLSS	New anaerobic / RAS de-aeration tankage required upstream of oxidation ditches for EBPR process
Bioreactor	Oxidation ditches 2x5,500kL			
MBR	Nil	Max MLSS 8,000mg/L; Avg flux 32L/m2/hr; 7 39; 1hr 52	MBR volume 1,154kL; 6 trains membranes 5 duty, 1 standby; Cassettes 48	New MBR tank
Clarification	FSTs – 2x32m dia x 3m depth	Two FSTs for 3ADWF load	Hyd flux 1.2m/hr; solids flux 10.35kg/m2/hr	Clarifiers retained for MBR bypass treatment
Aeration	Horizontal aerators 2x3 per ditch; SOTR (6x44) 264kgO2/hr; Power (6x14) 270kW		SOTR peak 994kgO2/hr; average 620kgO2/hr Power peak 375W; average 193kW	Existing aeration capacity insufficient and no standby capacity. Anoxic / aerobic optimisation and FBDA required.
	MBR Nil	3 duty, 1 standby blowers	Airflow peak 15,000Nm3/hr; average 3,800Nm3/hr Power peak 250kW; average 55kW	Based on GE LEAP system
MBR permeate	Nil		Peak flow rate 900L/s; average 185L/s	
RAS	2 duty 300L/s; 3 duty 400L/s	Duty / standby pumps	Peak 830L/s; average 370L/s; min 170L/s	Existing RAS pumping capacity sufficient
WAS	Existing capacity unknown	WAS over 12hr/d x 5d/wk	Maximum flow rate 40L/s; minimum 17L/s	
Alum dosing	Nil	Duty / standby;30d storage	Peak flow rate 5,600L/d; avg 950L/d; 30,000L storag	Alum dosing is required for TP trimming
Caustic dosing	Nil	Duty / standby;30d storage	Peak flow rate 1,470L/d; avg 132L/d; 5,000L storage	Caustic dosing is required for alkalinity correction
MBR CIP	Nil	Duty / standby; 30d storage	Citric acid 31kL/yr, 3,000L storage; NaOCl 17kL/yr, 2,000L storage	Based on GE LEAP system
Sludge handling	Sludge lagoons Skid mounted centrifuge purchased	Mechanical dewatering (5d/wk 12hr/d)	Hyd load 73kL/hr; solids load 491kg/hr; avg cake production 167t/wk at 14%DS	

4. South Rockhampton STP short term works

4.1 The objective

FRW is exporting greater quantities on TN than desired and SRSTP is the major source.

The objective here is to reduce TN exports from SRSTP (at a relatively low capital cost) and thereby to improve TN licence compliance.

4.2 A suggested approach

The least expensive way to reduce TN exports is to convert the existing SRSTP plant to an MLE process.

The following works are proposed:

- Retain the existing inlet works (with modifications to the overflow and "blocking-off" the PST 2 feed)
- Feed settled effluent from PST 1 to PST 2 (with modifications to the pipework system)
- Convert PST 2 to an anoxic tank (provided with new mixers)
- Pump anoxic tank effluent to the aeration tanks
- Upgrade the aeration tanks with fine bubble diffused air (FBDA)
- Provide new aeration blowers, pipework and diffusers for the FBDA system
- Pump an A-Recycle stream from the aeration tanks to the anoxic tank
- Retain existing SST 1 and 2
- Retain the existing pumped RAS stream (from the SSTs to the anoxic tank)
- Retain the existing CCT and outfall to the Fitzroy
- Retain the existing WAS pumped stream from the Sludge Transfer Pump station to the anaerobic digesters
- Retain the existing sludge lagoons for storing digested sludge
- Retain the existing sludge lagoons supernatant return to the Sludge Transfer pump station

This approach requires construction of some works under live sewage conditions but it is considered that these works can be managed so that the cut-overs can be undertaken over a few hours scheduled at low flow periods (and probably with Arthur Street SPS closed down).

Some works e.g. placing diffuser grids in the aeration tanks will need to be undertaken "live" and will require particular design elements.

4.3 Potential performance

A Biowin model has been prepared for the above short term works at SRSTP. This model indicates that 5TN performance can be performed at a load of 25,000EP. The process summary for this approach is attached.

The following assumptions have been made for the Biowin modelling.

- Sewage temperature 25ºC,
- Flow per capita of 250L/EP/d.
- Loads per capita of 125gCOD/EP/d, 12.9gTKN/EP/d, 2.3gTP/EP/d,
- PST SS removal 55%,

- Maximum MLSS at 3,000mg/L,
- No back mixing between bioreactor cells,
- Anoxic zones mixed by a mechanical mixer,
- Clarifier flux limit of 5.8kg/m^2/h at 120SVI at 3xADWF,
- Effluent TSS expected to be 10 to 15mg/L as a time weighted composite concentration.
- Maximum RAS rate of 135L/s (as per existing facility drawings),
- Anaerobic Digester DWAS is directed to the sludge lagoons,
- Co-settled sludge (including WAS) is approx. 2.5%ds solids from the PSTs to the Anaerobic Digesters,
- Lagoons return supernatant solids concentration is approx.1,200mg/L,
- Lagoon sludge concentration is approx. 6%ds,

It is noted that the return liquors from the lagoons impose a significant nutrient load on the plant.

The BioWin model default settings have been used.

The wastewater fractions are default except as follows:

- Fbs - 0.2
- Fxsp - 0.82
- Fup - 0.21
- Fna - 0.69
- Fnus - 0.01 and
- FPO_4 - 0.6

These variations from default values are based on calibration experience in other Queensland plants.

4.4 Next Steps

Should FRW agree to this approach the next step would be to develop a concept design.

The concept design should be developed to a level that provides greater confidence by examining raw sewage characteristics, hydraulic issues, process refinements, equipment sizing, cut-over issues (electrical, control and hydraulic) and more detailed costing.

South Rockhampton STP
Process Summary - Short Term Works

Version 1 4/06/13

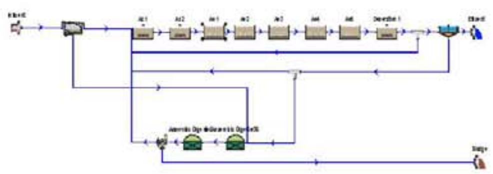
25000 EP

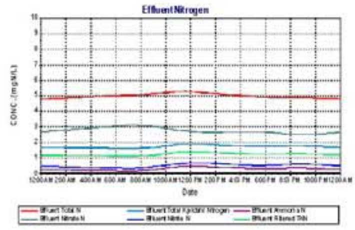
RAW SEWAGE CHARACTERISTICS		
ADWF - average dry weather flow(Q)	6.250	ML/d
PWWF - peak wet weather flow	31.25	ML/d
PIF - Peak instantaneous flow	398	L/s
COD - chemical oxygen demand	500	mg/L
BOD - biological oxygen demand	232	mg/L
TSS - total suspended solids	260	mg/L
VSS - volatile suspended solids	221	mg/L
ISS - inert non-volatile suspended solids	39	mg/L
Alkalinity as CaCO3	220	mg/L
TKN - Total Kjeldal Nitrogen	52	mg/L
NH3 - free & saline ammonia	36	mg/L
TP - Total Phosphorous	9.2	mg/L
OP - ortho-Phosphorous	5.5	mg/L
Maximum temperature	30	C
Average temperature	25	C
Minimum temperature	20	C
Key sewage fractions....		
Fus, Fraction of COD which is soluble, unbiodegradable	0.052	
Fup, Fraction of COD which is particulate, unbiodegradable	0.210	
Fbs, Fraction of biodegradable COD which is soluble	0.385	
Alt Fup, used for aeration design	0.170	
Alt Fbs, Fraction of total COD which is soluble, biodegradabl	0.340	
Fnus, Fraction of TKN which is soluble, unbiodegradable	0.023	
REACTOR & MEMBRANE TANK - KEY PROCESS PARAMETERS		
Sludge Age	10.0	days
Option		
MLE, 1PST, 1PST converted to Ax, FBDA Ae		
Anaerobic Digestion		
Overall volume....		
Anaerobic volume	0	m3
Primary Anoxic	1,279	m3
Primary Aerobic	1,413	m3
Secondary Anoxic volume	0	m3
Secondary Aerobic volume	0	m3
MBR Volume (ave duty vol and including cassette vol)	0	m3
MBR Volume (including cassette volume)	0	m3
RAS Deaeration volume	0	m3
A-Recycle Deaeration	135	m3
Total volume	2,826	m3
Volume fractions....		
Anaerobic Tank	0.0%	
Primary Anoxic Tank	45.2%	
Primary Aerobic Tank	50.0%	
Secondary Anoxic Tank	0.0%	
Secondary Aerobic Tank	0.0%	
MBR Tank (ave duty vol and excluding cassette vol)	0.0%	
RAS Deaeration Tank	0.0%	
A-Recycle Dearation Tank	4.8%	
Total	100.0%	
MLSS concentrations in zones......		
Anaerobic Tank	2,000	mg/L
Primary Anoxic Tank	2,000	mg/L
Primary Aerobic Tank	2,000	mg/L
Secondary Anoxic Tank	2,000	mg/L
Secondary Aerobic Tank	2,000	mg/L
MBR Tank	3,000	mg/L
RAS Deaeration Tank	3,000	mg/L
A-Recycle Deaeration Tank	2,000	mg/L
Inventory mass distribution....		
Mass in Anaerobic	0	kg
Mass in Primary anoxic Tank	2,557	kg
Mass in Primary aerobic Tank	2,826	kg
Mass in Secondary Anoxic	0	kg
Mass in Secondary Aerobic	0	kg
MBR Tank (including cassettes)	0	kg
Mass in RAS Deaeration	0	kg
Mass in A-Recycle Dearation	269	kg
Total mass	5,653	kg
Inventory mass fractions....		
Anaerobic mass fraction	0.0%	
Primary anoxic mass fraction	45.2%	
Primary aerobic mass fraction	50.0%	
Secondary Anoxic mass fraction	0.0%	
Secondary Aerobic mass fraction	0.0%	
MBR mass fraction	0.0%	
RAS Deaeration mass fraction	0.0%	
A-Recycle Deaeration mass fraction	4.8%	
Total mass fraction	100%	
Aerated fraction	50.0%	
Unaerated fraction	50.0%	

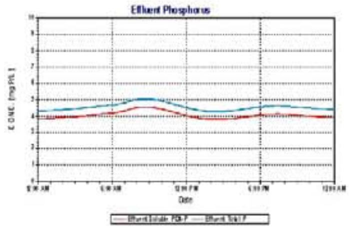
706m3 as PST converted to Ax

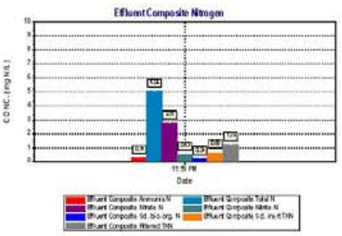
A RECYCLE	**Ave**	**Max**	**Min**	
Type	Submersible Pumps			
A-Recycle Flow	50,000	62,500	31,250	m3/d
A-Recycle Multiplier	8	10	5	xQ
PROCESS AERATION				
	Peak	**Average**	**Minimum**	
Bioreactor AOTR	117	70	21	kgO2/h
Bioreactor Aeration Depth	3.40	3.40	3.40	m
BIOREACTOR AERATION				
Fine Bubble Diffuser Aeration with Blowers	**Peak**	**Average**	**Minimum**	
AOTR	**117**	**70**	**21**	**kg/h**
Aeration assumptions - actual data to be supplied by aeration subcontractor				
	Peak	**Average**	**Minimum**	
a - alpha factor Zone 1	0.60	0.65	0.70	
b - beta factor	0.95	0.95	0.95	
P - atmospheric pressure at site	101.3	101.3	101.3	kPa
T - maximum water temperature at site	30.0	25.0	20.0	C
q - temperature correction constant	1.024	1.024	1.024	
Cs - sat O2 conc at site temp	7.54	8.24	9.07	mg/L
Diffuser diameter	230	230	230	mm
Number of diffusers	943	943	943	
Diffuser density	10.0%	10.0%	10.0%	
Depth for SOTE	3.100	3.100	3.100	
Assumed blower data - actual data to be provided by aeration subcontractor				
	Peak	**Average**	**Minimum**	
Discharge pressure	46.4	41.2	37.5	kPa
Air Inlet Temperature C	45.0	20.0	0.0	C
No of duty blowers	2	1	1	
Blower/motor efficiency	55%	55%	55%	
Air supply estimates - actual data to be provided by supplier				
Overall......	**Peak**	**Average**	**Minimum**	
OTE per m depth (vendor to specify)	5.5%	5.5%	5.5%	%/m
SOTE at actual depth (typical)	17.1%	17.1%	17.1%	%
DO	1.5	2.0	2.5	mg/L
SOTR	**248**	**150**	**45**	kgO/h
Air Flow (NTP = 20C, 1atm, Density 1.204 kg/m3	5,227	3,153	938	Nm3/hr
Air Flow (STP = 0C, 1atm, Density 1.204 kg/m3	**4,870**	**2,938**	**874**	Sm3/hr
Air supplied at discharge pressure	87	53	16	Nm3/min

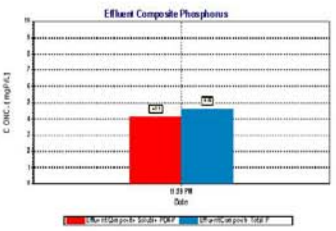
Sanitare Disc











South Rockhampton STP
Process Summary - Short Term Works

Airflow per diffuser per hour	5.6	3.4	1.0	Nm3/diff/hr		
Blower total power (at VSD Output)	95.4	47.7	12.2	**kW**		
Number of duty blowers	2.0	1.0	1.0			
Blower type	PD	PD	PD			
Blower efficiency	65%	65%	65%			
Blower Capacity Each	48	48	12	kW		
DIFFUSER REQUIREMENTS						
Bioreactor Aerated Floor Area	392	m2				
Diffuser diameter	230	mm	*Sanitaire*			
Diffuser Details (vendor to specify)...						
Short Term Peak Airflow per diff per hr (vendor to specify)	11.9	Nm3/hr				
Long Term Peak Airflow per diff per hr (vendor to specify)	6.8	Nm3/hr				
Min Airflow per diff per hr (vendor to specify)	0.86	Nm3/hr				
Min airflow for mixing	2.20	Nm3/hr/m2				
Bioreactor Diffuser Details....	**Peak**	**Average**	**Minimum**			
Total SOTR (process requirement)	248	150	45	Kg O2/hr		
Zone 1 SOTR	75	45	13	Kg O2/hr		
Zone 2 SOTR	62	37	11	Kg O2/hr		
Zone 3 SOTR	50	30	9	Kg O2/hr		
Zone 4 SOTR	37	22	7	Kg O2/hr		
Zone 5 SOTR	25	15	4	Kg O2/hr		
Zone 1 Number of Diffusers	188			No.		
Zone 2 Number of Diffusers	188			No.		
Zone 3 Number of Diffusers	188			No.		
Zone 4 Number of Diffusers	188			No.		
Zone 5 Number of Diffusers	188			No.		
Total number of diffusers	940			No.		
Total Air Flow (process requirment)	5227	3,153	938	Nm3/hr		
Zone 1 Air Flow	1568	946	281	Nm3/hr		
Zone 2 Air Flow	1307	788	234	Nm3/hr		
Zone 3 Air Flow	1045	631	188	Nm3/hr		
Zone 4 Air Flow	784	473	141	Nm3/hr		
Zone 5 Air Flow	523	315	94	Nm3/hr		
Zone 1 Diffuser density	10.0%					
Zone 2 Diffuser density	10.0%					
Zone 3 Diffuser density	10.0%					
Zone 4 Diffuser density	10.0%					
Zone 5 Diffuser density	10.0%					
Zone 1 Airflow per diff per hour	8.3	5.0	1.5	m3/diff/h		
Zone 2 Airflow per diff per hour	7.0	4.2	1.2	m3/diff/h		
Zone 3 Airflow per diff per hour	5.6	3.4	1.0	m3/diff/h		
Zone 4 Airflow per diff per hour	4.2	2.5	0.7	m3/diff/h		
Zone 5 Airflow per diff per hour	2.8	1.7	0.5	m3/diff/h		
DEWATERING & BIOSOLIDS SUMMARY						
Operating conditions............						
Days per week operation	5.0	d/wk	*Peak dewatering rate, or alternative scheduling possible*			
Hours per day operation	12.0	h/d	*Peak dewatering rate, or alternative scheduling possible*			
Overall Dewatering efficiency	90.3%	Overall	*Expect approx 90% overall with Centrifuge as thickener and dewatering unit*			
Solids Balance.......	**Peak**	**Average**	**Minimum**	**Abnormal**		*Abnormal case allows for full ChemP and 20% additional WAS flow*
Sludge produced by bioreactor (WAS gross yeild)	5,259	4,382	3593	5,259	kg SS/week	
Sludge produced by chemical addition	0	0	0	1,083	kg SS/week	
Sludge recycled as filtrate (Total)	658	425	257	712	kg SS/week	
Sludge returned as filtrate (from WAS thickening)	0	0	0	0	kg SS/week	
Sludge to digester (TWAS)	16,943	11,256	7030	7,063	kg SS/week	
Sludge leaving the digester (DWAS, allows for VSS destruct	13,156	8,503	5150	14,238	kg SS/week	
Sludge destroyed by Digester	3,788	2,753	1,881	-7,186	kg SS/week	
Sludge dewatered as cake	12,498	8,078	4,892	13,526	kg SS/week	1154 kgSS/d
Sludge returned as filtrate (from DWAS dewatering)	658	425	257	712	kg SS/week	
Expected dewatering hours per week	60.0	60.0	36.3	64.9	h/wk	
Dewatering feed conditions..........	**Peak**	**Average**	**Minimum**	**Abnormal**		
Mass of feed sludge feed per hour (of operation)	219	142	142	219	kg SS/h	
Flow of feed sludge feed per hour (of operation)	29.21	24.35	32.96	26.99	m3/h	
Feed sludge flowrate	8.1	6.8	6.8	7.5	L/s	
Feed sludge flowrate including polymer to GDD/BFP	8.6	7.1	7.1	8.6	L/s	
Dewatering discharge conditions..........	**Best Case**	**Average**	**Minimum**	**Worst Case**		*Typical production with dewatering performance variation only.*
Cake dry solids	16%	14%	14%	12%	%ds	*Best case allows ave mass rate AT ULTIMATE at best dewaterability*
Mass of dry cake solids discharged per hour	135	135	135	208	kg/h	*Min case allows ave mass AT STARTUP at ave dewaterability*
Mass of wet cake solids discharged per hour	841	962	962	1,736	kg/h	*Worst case allows for abnormal mass flows with full ChemP AT ULTIMATE at min dewaterability.*
Mass of wet cake per week	50.5	57.7	34.9	112.7	t/week	
Cake density	1.10	1.10	1.10	1.10	kg/m3	
Cake volume per hour	0.76	0.87	0.87	1.58	m3/h	
Cake volume per day	9.2	10.5	6.4	20.5	m3/d	*Based on 5 days/ wk dewatering*
Cake volume per week	45.9	52.5	31.8	102.5	m3/week	
Cake bin density	0.85	0.85	0.85	0.85	kg/m3	*Allows for pile voids and air entrainment in bin*
Cake bin volume per hour	0.90	1.03	1.03	1.86	m3/h	
Cake bin volume per day	10.80	12.34	7.47	24.11	m3/d	*Based on 5 days/ wk dewatering*
Cake bin volume per week	54.00	61.71	37.37	120.56	m3/week	
Centrifuge Polymer system..........	**Peak**	**Average**	**Minimum**			
Unit polymer consumption (assumed)	10.00	8.00	8.00	kg/dry ton		
Polymer make-up concentration	0.50%	0.50%	0.50%			
Polymer dosing concentration	0.10%	0.10%	0.10%			
Polymer pump rate at make-up concentration	0.09	0.06	0.06	L/s		
=	0.34	0.23	0.23	kL/h		
Daily volume of polymer at make-up concentration	4.08	2.72	2.72	kL/d		
Polymer pump rate at dosing concentration	0.47	0.31	0.31	L/s		
=	1.70	1.13	1.13	kL/h		
Daily volume of polymer at dosing concentration	20.41	13.60	13.60	kL/d		
Potable Water Consumption	4.08	2.72	2.72	kL/d		
Service Water Consumption	16.33	10.88	10.88	kL/d		
Mass of polymer per week	102.0	68.0	68.0	kg/week		
Dewatering Consumables......	**Peak**	**Average**	**Minimum**			
Total Potable Water Consumption	4.1	2.7	2.7	kL/d		
Total Potable Water Consumption	20.4	13.6	13.6	kL/wk		
Total Service Water Consumption	16.3	10.9	10.9	kL/d		
Total Service Water Consumption	82	54	54.4	kL/wk		
Total Polymer Consumption	20.4	13.6	13.6	kd/d		
Total Polymer Consumption	102.0	68.0	68.0	kg/wk		
To drain	**Peak**	**Average**	**Minimum**			
Wastewater (filtrate production etc) to drain	238	200	166	m3/d		
Wastewater (filtrate etc) to drain (instantaneous)	34.6	33.0	27.8	L/s		
Wastewater TSS (estimated)	396	303	221	mg/L		
PUMPS (MAJOR)						
A-Recycle Pumps						
No. of Total Pumps	2	No.				
No. of Duty Pumps Ave	2	No.				
No. of Duty Pumps Max	2	No.	*May be operated as Duty/Assist*			
No. of Duty Pumps Min	1	No.				
No. of Standby Pumps	0	No.				
Average A-Recycle Rate	8	X Q				
Peak A-Recycle Rate	10	X Q				
Min A-Recycle Rate	5	xQ				
Duty Flow (Average)	597	L/s				
Duty Flow (Peak)	747	L/s				
Duty Flow (Min)	373					
Pumping Head Ave	6.0	m				
Pumping Head Max	8.0	m				
Pumping Head Min	8	m				
Pump Efficiency	100%	%				
A Recycle Pumping Ave Power Consumption	35.1	kW	Total Power at Ave			
A Recycle Pump Ave Motor Power (each)	17.5	kW	Motor Power at Ave			
A Recycle Pumping Peak Power Consumption	58.5	kW	Total Power at Peak			
A Recycle Pump Peak Motor Power (each)	29.2	kW	Motor Power at Peak			
A Recycle Pumping Min Power Consumption	29.2	kW	Total Power at Min			
A Recycle Pump Min Motor Power (each)	29.2	kW	Motor Power at Min			
Required A-Recycle Pump Turndown	40%	%				
RAS Pumps						
No. of Total Pumps	2	No.	2 x Duty at 3xQras, 1 Duty for 1.5xQras			

South Rockhampton STP
Process Summary - Short Term Works

No of Duty Pumps	2	No.	
No of Duty Pumps at Ave flow	1	No.	
No of Standby Pumps	0	No.	
RAS Recycle Rate Ave	2.0	X Q	NBMin 1.5x
RAS Recycle Rate Peak	2.0	X Q	
Flow Duty (Average)	149	L/s	
Flow Duty (Peak)	224	L/s	
Flow Duty (Min)	75	L/s	
Pumping Head	10	m	
Pump Efficiency	0.60	%	Motor (91.6%) and Pump (65%) Efficiency
RAS Pumping Ave Power Consumption	24.6	kW	Total Power at Ave
RAS Pump Ave Motor Power (each)	24.6	kW	Motor Power at Ave
RAS Pumping Peak Power Consumption	36.8	kW	Total Power at Peak
RAS Pump Peak Motor Power (each)	18.4	kW	Motor Power at Peak
RAS Pumping Min Power Consumption	12.3	kW	Total Power at Min
RAS Pump Min Motor Power (each)	6.1	kW	Motor Power at Min
WAS System			*NB Duty/Standby*
Biomass Sludge yield	565	kg ds/d	*Based on 7 days per week wasting*
Solids Return Efficiency (allows for filtrate return)	90%	%	
Waste Peaking Factor	1.20	factor	
Equivalent worst case BFP Efficiency	89%	%	
Waste Min factor	0.82	factor	
Peak sludge volume	250	m3/d	*Waste as RAS. Based on 7 days per week wasting*
Average Sludge volume	209	m3/d	*Waste as RAS. Based on 7 days per week wasting*
Min sludge volume	171	m3/d	*Waste as RAS. Based on 7 days per week wasting*
Days per week for wasting	5	d	
Hours per Day for wasting (min)	6	h	
Hours per Day for wasting (max)	12	h	
Dewatering Filtrate Pumps			
Ave Filtrate flow from WAS Thickening		m3/d	
Ave Filtrate Flow DWAS Thickening	0	m3/d	
Ave Filtrate Flow Dewatering	200	m3/d	
Ave Total Filtrate Flow	200	m3/d	
Ave Filtrate Solids Returned	61	kg/d	
Overall Dewatering Efficiency	89%	%	
Ave Filtrate Solids Conc	303	mg/L	
Peak Filtrate Flow Flow DWAS Thickining	0	m3/d	
Peak Filtrate Flow Flow Dewatering	238	m3/d	
Peak Total Filtrate Flow	238	m3/d	
Peak Filtrate Solids Returned	94	kg/d	
Peak Filtrate Solids Conc	395	mg/L	
Hours per Day PS Operation	2	h	*Typical daily total duration*
Total Ave Filtrate Flow	27.8	L/s	
Total Peak Filtrate Flow	33.0	L/s	
Head at Ave	25	m	Typical
Head at Peak	30	m	Typical
Type	Centrifugal		End Suction with VSD
Pump Efficiency	56%	%	Motor (80%) and Pump (70%) Efficiency
Filtrate Pumping Total Ave Power Consumption	12.17	kW	Motor Drive Power
Filtrate Pumping Total Peak Power Consumption	17.31	kW	
Number of Duty Filtrate Pumps	1	Duty	1 Duty / 1 Standby
Peak flow per pump	33.0	L/s	
Number of Standby Filtrate Pumps	1	Standby	
MIXERS			
Mixing power density requirements	7.5	W/m3	*Submersible High Speed Impeller Mixers*
Efficiency	56%	%	
Anoxic Zone 1			
Anoxic 1 Zone No. of mixers	2.0	no.	
Anoxic 1 Zone Installed Mixer Power (each)	8.56	kW	
Anoxic 1 Zone Total Installed Mixer Power	17.12	kW	

Appendix D. Odour modelling

Rockhampton sewage treatment plants planning study
Odour modelling

Contents

1. Legislative requirements

1.1 Odour nuisance

The environmental nuisance impacts of odour are considered a form of environmental harm under the *Environmental Protection Act 1994.*

The Department of Environment and Heritage Protection (DEHP) is responsible for administering the *Environmental Protection Act 1994.* The objective of the legislation is to ensure odours from new or upgraded developments do not cause environmental nuisance impacts at sensitive receptors.

There are currently no legislated odour limits in the *Environmental Protection Act 1994* or the *Environmental Protection (Air) Policy 2008.*

1.2 Guidelines for "odour impact assessment from developments"

The potential odour impacts of new or upgraded developments are assessed against the Odour Impact Assessment from Developments Guideline (EPA 2004).

The Odour Impact Assessment from Developments Guideline states:

- A new facility or an upgrade to an existing facility must not generate odours that cause environmental harm at any odour sensitive receptor;
- Odour sensitive receptors include residences, schools, hospitals, caravan parks, national parks, shops and business premises that may be affected by odour;
- An odour impact assessment for a new facility or an upgrade to an existing facility is required to predict the potential odour concentrations; and
- The predicted odour concentrations at the most exposed existing or likely future off-site sensitive receptors should be compared to the 99.5th percentile 2.5 OU, one hour average, for ground-level sources.

1.3 Sensitive receptors

Odour sensitive receptors are defined by EPA (2004) as:

- A dwelling, mobile home or caravan park, residential marina or other residential premises;
- A motel, hotel or hostel;
- A kindergarten, school, university or other educational institution;
- A medical centre or hospital;
- A protected area;
- A public park or gardens;
- A commercial place or part of the place potentially affected.

2. Odour modelling

2.1.1 Methodology

The STP odour emissions have been modelled using Ausplume (Ver. 6) with the following key inputs:

- Meteorological dataset for 2012 generated with TAPM and BoM surface files;
- 2 km x 2 km grid domain with a grid spacing of 100 m;
- The terrain has assumed to be flat;
- Odour emission rates as presented below;
- Average surface roughness of 0.1 m with Irwin rural wind profile exponents;
- No building wake effects;
- Emissions were modelled as continuous sources for the entire year with an averaging time of one hour.

2.2 Emissions

The odour emission rates have generally been sourced from the Sinclair Knight Merz Odour Library. Odour emission rates can vary significantly depending on the wastewater characteristics and the time of year. The specific odour emission rates (SOER) adopted for each treatment process unit are presented below.

Table 2-1 Odour emission rates adopted for the Gracemere and Rockhampton STPs

Treatment process unit	SOER ($OU.m^3/m^2.s$)	Odour conc	Source / justification
Inlet works / PTA	10		Data from Goodna and Bundamba STPs
Septage storage	10		90th percentile from SKM odour library
Air treatment facility	N/A	500 OU	Typical manufacturer specification
Pump station vent	N/A	4,400 OU	90th percentile from SKM odour library
Primary sedimentation tank	5		90th percentile rom SKM odour library
Activated sludge aeration tank	1.2		90th percentile from SKM odour library
Biotrickling filter	2		90th percentile from SKM odour library
Oxidation Ditch	0.5		90th percentile rom SKM odour library
Membrane bioreactor	0.03		Data from Goodna and Cairns STPs
Secondary sedimentation tank after trickling filter	0.5		90th percentile from SKM odour library
Clarifier / sec sed tank after activated sludge	0.02		90th percentile rom SKM odour library
Anaerobic sludge digester	0.5		90th percentile rom SKM odour library
Digester gas flaring vent	N/A	50 OU	Assumed 99% reduction by flare
Sludge drying bed	10		90th percentile from SKM odour library
Sludge lagoon	0.6		Average from SKM odour library

The emission rates adopted for the assessment are considered to be conservative. In the absence of site specific monitoring data it is considered appropriate to determine a likely worst-case odour footprint.

2.3 Dispersion

Dispersion modelling has been undertaken for the 99.5th percentile, one hour average case and odour contours (typically 1, 2.5 and OU) have been develop for each of the STP sites.

3. Baseline (existing) odour behaviour

3.1 Gracemere STP

3.1.1 Sensitive receptors

The nearest sensitive receptors to GSTP (as identified by aerial photography) are presented in **Figure 3-1** and **Table 3-1.**

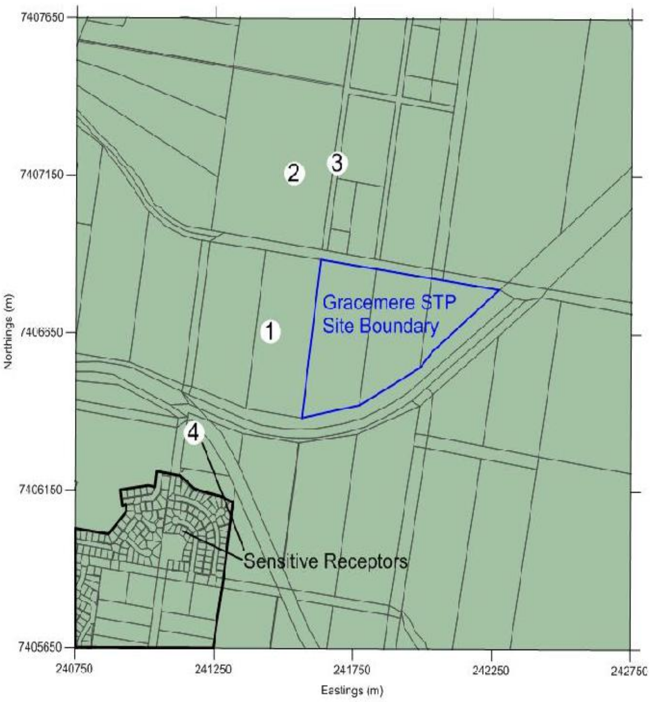
There are four close individual receptors and an area of mixed residential development to the south-west.

Calm conditions and light breezes from the north, east and south-east are most likely to affect the sensitive receptors.

Table 3-1 Nearest sensitive receptors for Gracemere STP

Receptor	Description	Location
1	Rural residence	0.15 km east of the site boundary
2	Rural residence	0.4 km north of the site boundary
3	Rural residence	0.45 km north of the site boundary
4	Commercial place. Mixed residential development area	0.4 km southwest of the site boundary

Figure 3-1 Nearest sensitive receptors to Gracemere STP



3.1.2 Wind analysis

Dispersion modelling requires an hourly breakdown of wind speed, wind direction and other meteorological parameters. A site specific meteorological dataset has been generated (using TAPM) from a surface meteorological file (from the Bureau of Meteorology (BoM)) for the Rockhampton area.

Figure 3-2 presents the annual and seasonal wind roses (extracted from the 2012 meteorological dataset) for the Gracemere STP site.

A statistical analysis of wind speed and wind direction is presented in **Table 3-2**.

Rockhampton sewage treatment plants planning study
Odour modelling

SKM

Figure 3-2 Annual and seasonal wind roses for Gracemere STP for 2012

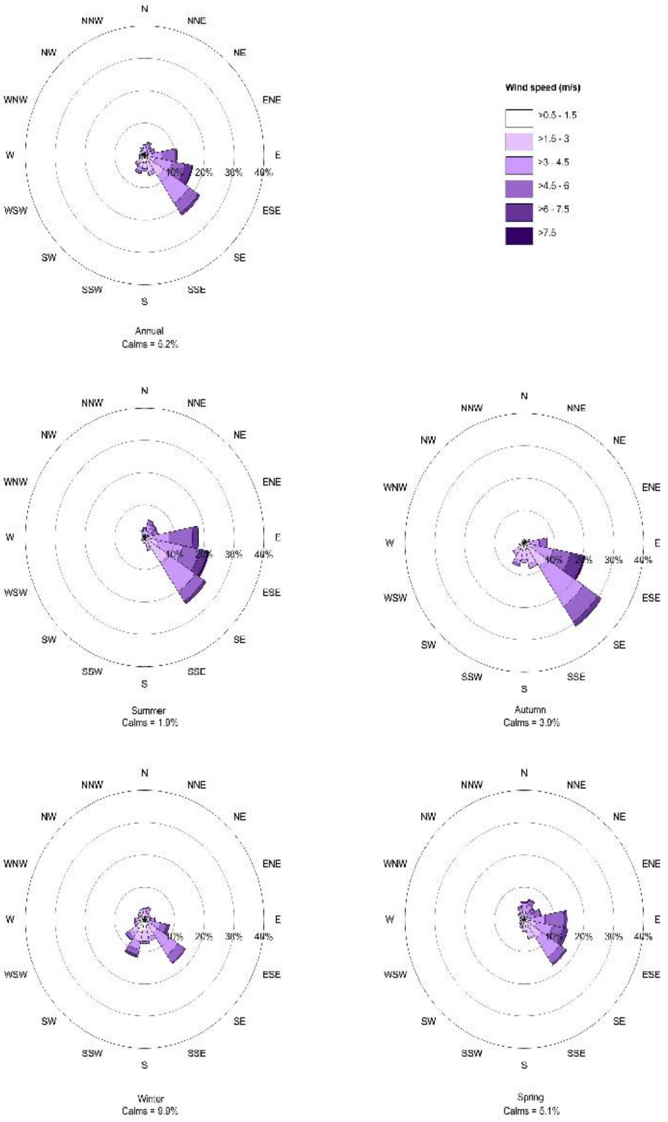


Table 3-2 Statistical analysis of wind speed and direction at Gracemere STP for 2012

Sector / Wind speed (m/s)	0.5 - 1.5	1.5 - 3	3 - 4.5	4.5 - 6	6 - 7.5	>7.5	Total
NNE	0%	1%	2%	1%	0%	0%	4%
NE	0%	1%	1%	1%	0%	0%	3%
ENE	0%	1%	1%	1%	0%	0%	4%
E	0%	2%	4%	4%	1%	0%	11%
ESE	1%	3%	6%	4%	2%	0%	17%
SE	1%	6%	10%	4%	1%	0%	22%
SSE	2%	3%	1%	0%	0%	0%	6%
S	2%	2%	1%	0%	0%	0%	5%
SSW	2%	2%	1%	1%	0%	0%	6%
SW	2%	1%	1%	0%	0%	0%	4%
WSW	1%	1%	0%	0%	0%	0%	2%
W	1%	0%	0%	0%	0%	0%	2%
WNW	1%	0%	0%	0%	0%	0%	1%
NW	1%	1%	0%	0%	0%	0%	2%
NNW	1%	1%	1%	0%	0%	0%	3%
N	1%	2%	1%	0%	0%	0%	3%
Calm	**5%**						
Total	**16%**	**27%**	**29%**	**17%**	**5%**	**1%**	**100%**
Average wind speed	3.15m/s						

The key features of the wind analysis for the site are;

- The most common winds are from the east to south-east sector
- The average wind speed for the 2012 year was 3.15 m/s
- Calm winds (less than 0.5m/s) occur for approximately 5% of the year
- Light breezes (0.5 to 1.5m/s) occur for approximately 16% of the year and are distributed from the ESE to W to N wind directions. There are very few NNE to E light breezes.

3.1.3 Odour emissions inventory

The following odour emissions have been adopted for the existing GSTP.

Table 3-3 Modelled emission rates – existing operations at Gracemere STP

Process Unit	Area (m^2)	SOER ($OU.m^3/m^2.s$)	Odour Emission (OU/s)	Percentage
Inlet Works	40	10	400	**4%**
Oxidation Ditch	1,350	0.5	675	**7%**
Clarifier	200	0.02	4	**0%**
Sludge Drying Beds	400	10	4,000	**44%**
Sludge Drying Beds	400	10	4,000	**44%**
Total			9,079	100%

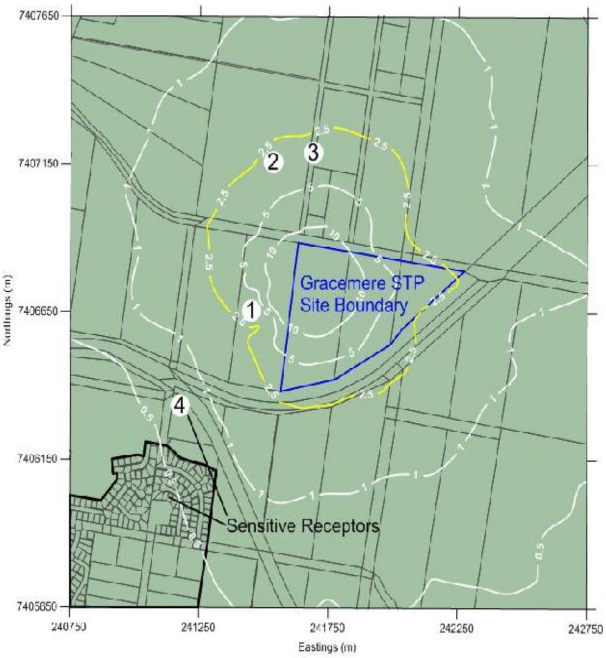
3.1.4 Odour modelling results

The odour modelling results for the current operations at Gracemere STP are presented in **Figure 3-3**.

The modelling results indicate that odour emissions from Gracemere STP have the potential to exceed the odour guideline of 2.5 OU at three of the sensitive receptors to the west and north-west.

The potential for odour nuisance appears to be driven by the sludge drying beds which account for nearly 90% of the total odour emissions from the plant.

Figure 3-3 Predicted 99.5th percentile odour contours for Gracemere STP (existing)



Odour emissions from sludge drying beds tend to be worst when the beds are filled. They reduce over time. The model adopts an average emission rate but assumes a constant rate of emissions. This may account for the low level of odour complaints reported by FRW.

3.2 West Rockhampton STP

3.2.1 Sensitive receptors

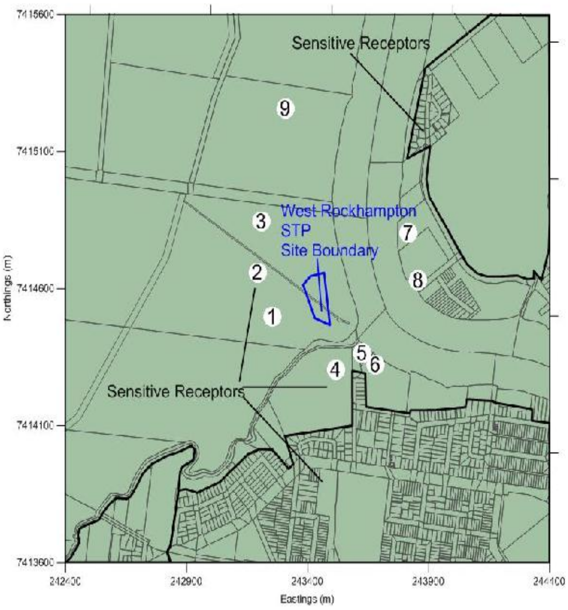
The nearest sensitive receptors to WRSTP (as identified by aerial photography) are presented in **Table 3-4** and **Figure 3-4**.

In addition to the nine individual receptors nominated in the table there are areas to the north-east and south containing residences, sporting grounds and commercial properties.

Table 3-4 Nearest sensitive receptors to West Rockhampton STP

Sensitive receptor	Description	Location
1	Residences	0.18 km west of the site boundary
2	Buildings	0.19 km west of the site boundary
3	Buildings	0.3 km northwest of the site boundary
4	Residences	0.2 km south of the site boundary
5	Residences	0.2 km southeast of the site boundary
6	Residences	0.3 km southeast of the site boundary
7	Residences	0.4 km east of the site boundary
8	Residences	0.4km east of the site boundary
9	Buildings	0.6 km north of the site boundary

Figure 3-4 Nearest sensitive receptors to West Rockhampton STP



3.2.2 Wind analysis

Figure 3-5 presents the annual and seasonal wind roses (extracted from the 2012 meteorological dataset) for the West Rockhampton STP site.

A statistical analysis of wind speed and wind direction is presented in **Table 3-5**.

Figure 3-5 Annual and seasonal wind roses for West Rockhampton STP for 2012

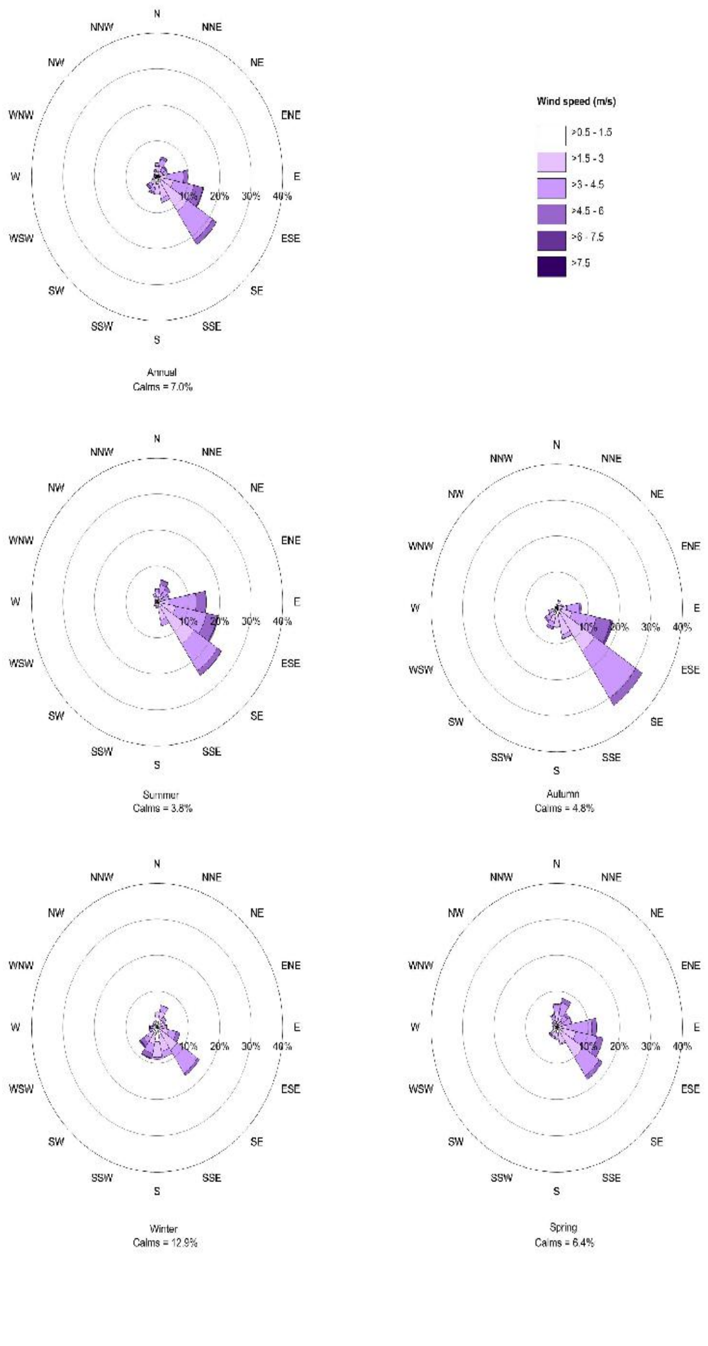


Table 3-5 Statistical analysis of wind speed and direction at West Rockhampton STP for 2012

Sector / Wind speed (m/s)	0.5 - 1.5	1.5 - 3	3 - 4.5	4.5 - 6	6 - 7.5	>7.5	Total
NNE	1.3%	1.7%	2.0%	0.7%	0.0%	0.0%	5.7%
NE	0.7%	1.2%	1.2%	0.5%	0.0%	0.0%	3.6%
ENE	0.6%	1.4%	1.4%	0.1%	0.0%	0.0%	3.4%
E	0.7%	2.4%	5.3%	1.3%	0.0%	0.0%	9.8%
ESE	0.8%	4.4%	6.8%	2.9%	0.3%	0.0%	15.1%
SE	1.4%	10.1%	9.7%	1.5%	0.0%	0.0%	22.7%
SSE	1.7%	4.4%	1.2%	0.0%	0.0%	0.0%	7.3%
S	2.0%	2.5%	0.3%	0.0%	0.0%	0.0%	4.9%
SSW	1.7%	1.4%	1.2%	0.5%	0.1%	0.0%	4.9%
SW	1.2%	1.3%	0.9%	0.5%	0.2%	0.0%	4.1%
WSW	0.5%	0.8%	0.4%	0.1%	0.0%	0.0%	1.8%
W	0.4%	0.5%	0.3%	0.1%	0.0%	0.0%	1.2%
WNW	0.5%	0.4%	0.2%	0.1%	0.0%	0.0%	1.1%
NW	0.4%	0.7%	0.2%	0.0%	0.0%	0.0%	1.3%
NNW	0.5%	0.9%	0.6%	0.1%	0.0%	0.0%	2.1%
N	1.3%	1.7%	0.7%	0.1%	0.0%	0.0%	3.8%
Calm	**7.0%**						
Total	**15.7%**	**35.7%**	**32.2%**	**8.7%**	**0.7%**	**0.0%**	**100%**
Average wind speed	2.70m/s						

The key features of the wind analysis for the site are;

- The most common winds are from the east to south-east sector
- The average wind speed for the 2012 year was 2.70 m/s
- Calm winds (less than 0.5m/s) occur for approximately 7% of the year
- Light breezes (0.5 to 1.5m/s) occur for approximately 15.7% of the year are distributed across all wind directions

3.2.3 Odour emissions inventory

The following odour emissions have been adopted for the existing WRSTP.

Table 3-6 Modelled emission rates – existing operations at West Rockhampton STP

Process Unit	Area (m^2)	SOER ($OU.m^3/m^2.s$)	Odour Emission (OU/s)	Percentage
Inlet Works	66	10	660	4%
Primary sed tank 1	154	5	770	5%
Primary sed tank 2	154	5	770	5%
Secondary sed tank 1	154	0.5	77	1%
Secondary sed tank 2	154	0.5	77	1%
Trickling filter 1	1,075	2.0	2,150	14%
Trickling filter 2	1,075	2.0	2,150	14%
Sludge digester (open top)	380	0.5	190	1%
Sludge drying beds (total)	700	10	7,000	46%
Sludge pump station vent		(4,400 ou)	1,266	8%
Total			15,110	100%

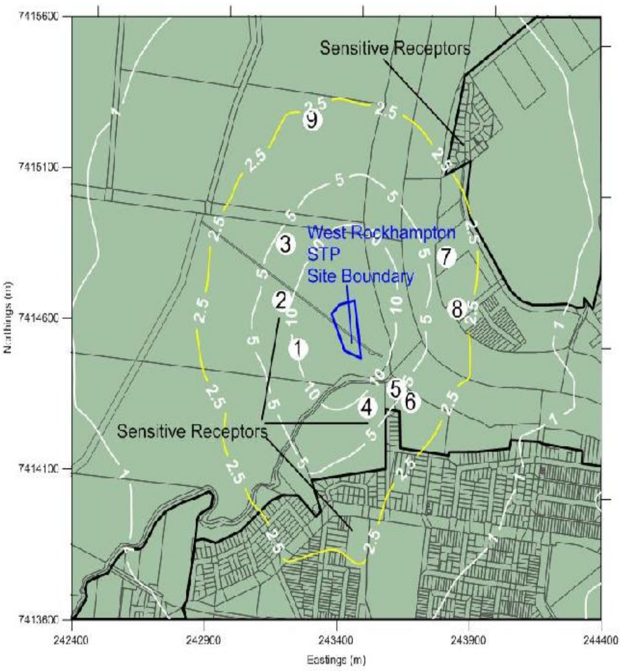
The major odour sources are the trickling filters (14% each) and the sludge drying beds (46%).

3.2.4 Odour modelling results

The odour modelling results for the existing operations at West Rockhampton STP are presented in **Figure 3-6**.

The 99.5th percentile 2.5 OU contour extends beyond the site boundary and indicates there is potential to impact sensitive receptors surrounding the plant.

Figure 3-6 Predicted 99.5th percentile odour contours for West Rockhampton STP (existing)



FRW reports a very low level of odour complaints for WRSTP.

This may be due to community acceptance (of WRSTP odours because the plant has existed for a long time) or because the odour model is too conservative. The emissions from sludge drying beds are usually worst when the beds are first filled. They reduce after that and the actual impact may be less than modelled because the worst odour emission conditions do not (or rarely) coincide with the most adverse wind conditions.

3.3 South Rockhampton STP

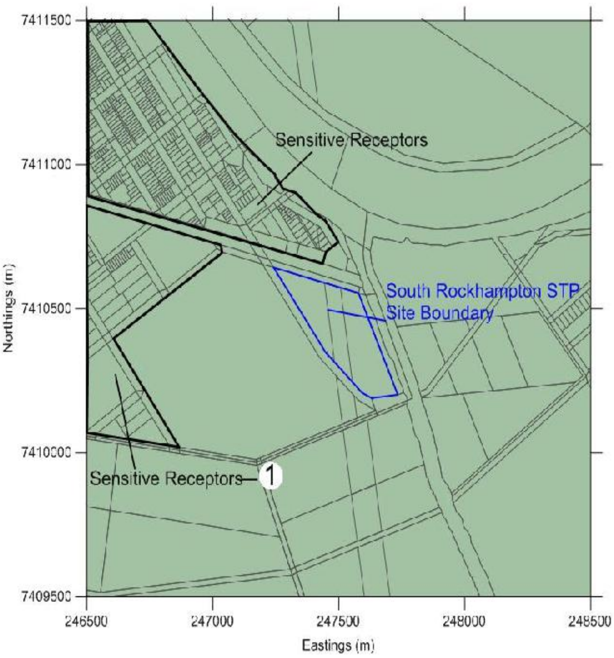
3.3.1 Sensitive receptors

The nearest sensitive receptors to SRSTP (as identified by aerial photography) are presented in **Table 3-7** and in **Figure 3-7** below. There are a number of commercial / industrial properties approximately 200m to the north of the site boundary and a rural property 400m to the south.

Table 3-7 Nearest sensitive receptors to South Rockhampton STP

Sensitive receptor	Description	Location
1	Rural property	0.4 km southwest of the site boundary
	Commercial / industrial properties	0.2km north of the site boundary

Figure 3-7 Nearest sensitive receptors to South Rockhampton STP



3.3.2 Wind analysis

Figure 3-8 presents the annual and seasonal wind roses (extracted from the 2012 meteorological dataset) for the South Rockhampton STP site.

A statistical analysis of wind speed and wind direction is presented in **Table 3-8**.

Figure 3-8 Annual and seasonal wind roses for South Rockhampton STP for 2012

Table 3-8 Statistical analysis of wind speed and direction at West Rockhampton STP for 2012

Sector / Wind speed (m/s)	0.5 - 1.5	1.5 - 3	3 - 4.5	4.5 - 6	6 - 7.5	>7.5	Total
NNE	1%	2%	1%	0%	0%	0%	3%
NE	1%	1%	1%	0%	0%	0%	3%
ENE	1%	1%	1%	0%	0%	0%	3%
E	1%	3%	5%	3%	0%	0%	11%
ESE	1%	4%	7%	4%	1%	0%	17%
SE	2%	9%	10%	2%	0%	0%	24%
SSE	2%	3%	1%	0%	0%	0%	6%
S	2%	2%	0%	0%	0%	0%	4%
SSW	2%	1%	1%	0%	0%	0%	5%
SW	1%	1%	0%	0%	0%	0%	3%
WSW	1%	1%	0%	0%	0%	0%	2%
W	1%	1%	0%	0%	0%	0%	2%
WNW	1%	1%	0%	0%	0%	0%	1%
NW	1%	1%	0%	0%	0%	0%	2%
NNW	1%	1%	1%	0%	0%	0%	3%
N	1%	1%	1%	0%	0%	0%	3%
Calm	**8%**						
Total	**20%**	**33%**	**29%**	**9%**	**1%**	**0%**	**100%**
Average wind speed	2.74m/s						

The key features of the wind analysis for the site are;

- The most common winds are from the east to south-east sector
- The average wind speed for the 2012 year was 2.74 m/s
- Calm winds (less than 0.5m/s) occur for approximately 8% of the year
- Light breezes (0.5 to 1.5m/s) occur for approximately 20% of the year are distributed across all wind directions

3.3.3 Odour emissions inventory

The following odour emissions have been adopted for the existing SRSTP.

Table 3-9 Modelled emission rates – existing operations at South Rockhampton STP

Process Unit	Area (m^2)	SOER ($OU.m^3/m^2.s$)	Odour Emission (OU/s)	Percentage
Inlet Works	125	10	1,250	8%
Primary Sed Tank 1	380	5.0	1,900	12%
Primary Sed Tank 2	380	5.0	1,900	12%
Aeration Tank 1	280	1.2	336	2%
Aeration Tank 2	280	1.2	336	2%
Secondary Sed Tank 1	380	0.02	7.6	0%
Secondary Sed Tank 2	380	0.02	7.6	0%
Sludge Digester flare	0.031	(50 ou)	2	0%
Sludge Lagoon 1	2,400	0.6	1,440	9%
Sludge Lagoon 2	2,400	0.6	1,440	9%
Sludge Lagoon 3	2,400	0.6	1,440	9%
Sludge Lagoon 4	2,400	0.6	1,440	9%
Sludge transfer PS vent	0.110	(4,400 ou)	4,452	28%
Total			**15,951**	**100%**

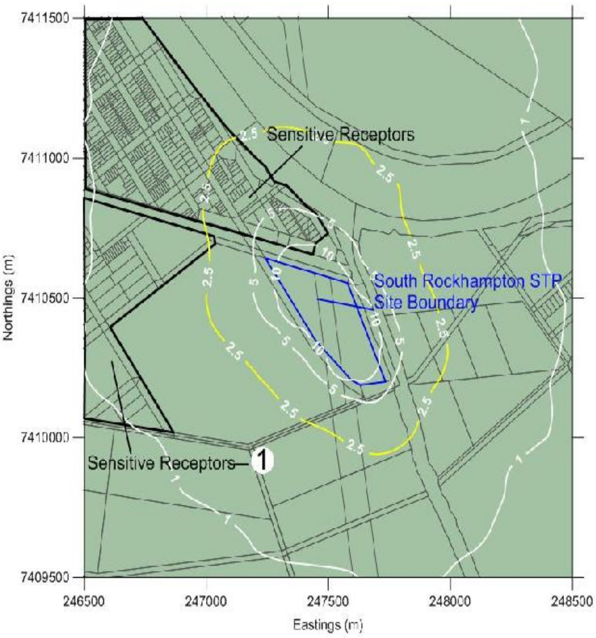
The major odour sources are the primary sedimentation tanks (12% each), the sludge lagoons (9% each) and the sludge transfer pump station vent.

3.3.4 Odour modelling results

The odour modelling results for the existing operations at SRSTP are presented in **Figure 3-9**.

The 99.5th percentile 2.5 OU contour extends beyond the site boundary and across the sensitive receptors to the north.

Figure 3-9 Predicted 99.5th percentile odour contours for South Rockhampton STP (existing)



The sensitive receptor area to the north of SRSTP is not densely developed. Both these developments and the SRSTP have been located in this area for a long time and there may be a relatively high level of odour tolerance.

Alternatively the modelled emissions for the sludge lagoons may be overly conservative and this may explain the low level of odour complaints reported by FRW for SRSTP.

3.4 North Rockhampton STP

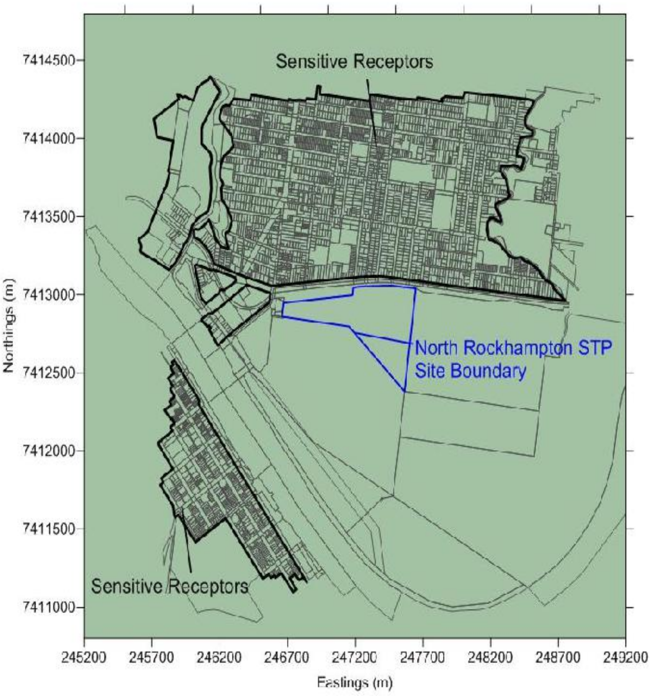
3.4.1 Sensitive receptors

The nearest sensitive receptors to NRSTP (as identified by aerial photography) are shown in **Figure 3-10.**

These include many residential and commercial properties approximately 200m to the north and west of the site boundary.

The racecourse is also located immediately adjacent to the south boundary of the STP.

Figure 3-10 Nearest sensitive receptors to North Rockhampton STP (existing)



3.4.2 Wind analysis

Figure 3-11 presents the annual and seasonal wind roses (extracted from the 2012 meteorological dataset) for the North Rockhampton STP.

A statistical analysis of wind speed and wind direction is presented in **Table 3-10**.

Figure 3-11 Annual and seasonal wind roses for North Rockhampton STP for 2012

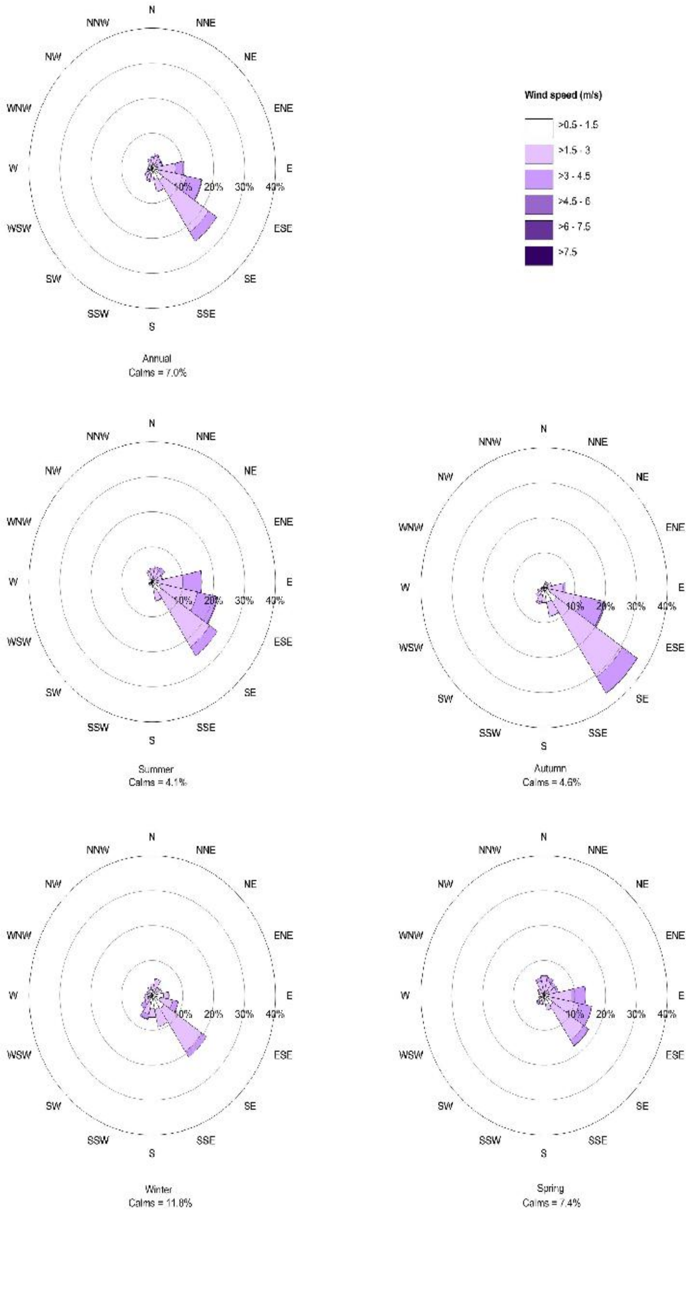


Table 3-10 Statistical analysis of wind speed and direction at West Rockhampton STP for 2012

Sector / Wind speed (m/s)	0.5 - 1.5	1.5 - 3	3 - 4.5	4.5 - 6	6 - 7.5	>7.5	Total
NNE	1%	3%	0%	0%	0%	0%	**4%**
NE	1%	2%	1%	0%	0%	0%	**3%**
ENE	1%	2%	0%	0%	0%	0%	**3%**
E	2%	6%	3%	0%	0%	0%	**10%**
ESE	2%	9%	5%	0%	0%	0%	**17%**
SE	4%	18%	3%	0%	0%	0%	**25%**
SSE	3%	4%	0%	0%	0%	0%	**7%**
S	2%	1%	0%	0%	0%	0%	**4%**
SSW	2%	2%	1%	0%	0%	0%	**4%**
SW	1%	1%	1%	0%	0%	0%	**3%**
WSW	1%	1%	0%	0%	0%	0%	**2%**
W	1%	1%	0%	0%	0%	0%	**1%**
WNW	1%	1%	0%	0%	0%	0%	**1%**
NW	1%	1%	0%	0%	0%	0%	**2%**
NNW	1%	2%	0%	0%	0%	0%	**3%**
N	1%	2%	0%	0%	0%	0%	**3%**
Calm	**7%**						
Total	**25%**	**53%**	**15%**	**0%**	**0%**	**0%**	**100%**
Average wind speed	2.02m/s						

The key features of the wind analysis for the site are;

- The most common winds are from the east to south-east sector
- The average wind speed for the 2012 year was 2.02 m/s
- Calm winds (less than 0.5m/s) occur for approximately 7% of the year
- Light breezes (0.5 to 1.5m/s) occur for approximately 25% of the year and are distributed across all wind directions (with a slight preference for the E to S quadrant)

3.4.3 STP odour emission inventory

The following odour emissions have been adopted for the existing NRSTP.

Table 3-11 Modelled emission rates – existing operations at North Rockhampton STP

Process Unit	Area (m^2)	SOER ($OU.m^3/m^2.s$)	Odour Emission (OU/s)	Percentage
Inlet works (covered)	25	1	125	**0%**
Inlet works AC stack	0.031	(500 ou)	144	**0%**
Oxidation ditches 1 & 2	3,400	0.5	1,700	**6%**
Secondary sed tank 1	804	0.02	16	**0%**
Secondary sed tank 2	804	0.02	16	**0%**
Sludge lagoon 1	5,000	0.6	3,000	**10%**
Sludge lagoon 2	5,000	0.6	3,000	**10%**
Sludge lagoon 3	5,000	0.6	3,000	**10%**
Sludge lagoon 4	5,000	0.6	3,000	**10%**
Sludge lagoon 5	5,000	0.6	3,000	**10%**
Septage storage tank	154	10	1,540	**5%**
Pump station 1	0.110	(4,400 ou)	4,452	**15%**
Pump station 2	0.110	(4,400 ou)	4,452	**15%**
Supernatant pump station	0.866	(4,400 ou)	1,745	**6%**
Total			**29,190**	**100%**

The major odour sources are the sludge lagoons (10% each) and the raw sewage pump stations (15% each).

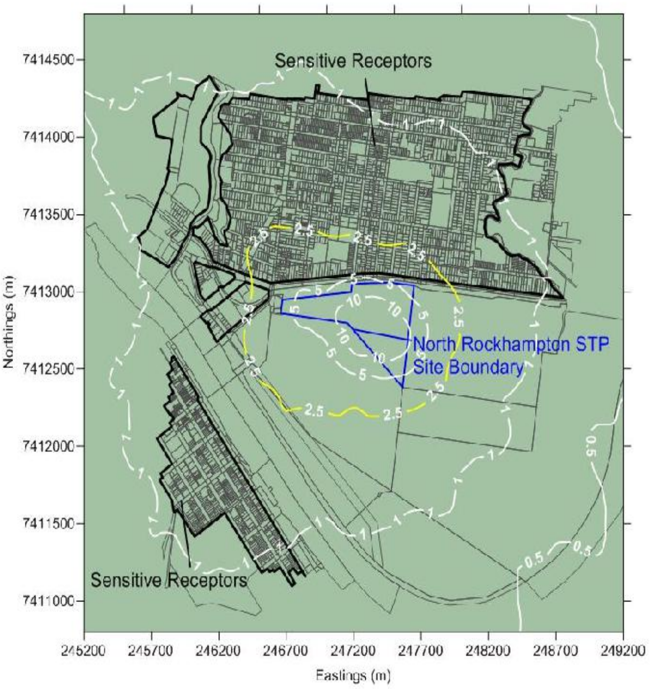
3.4.4 Odour modelling results

The odour modelling results for the current operations at NRSTP are presented in **Figure 3-12**.

The odour modelling results indicate that odours from NRSTP could cause odour nuisance to large areas of residential / commercial receptors to the north and west.

The racecourse to the south could also be adversely impacted.

Figure 3-12 Predicted 99.5th percentile odour contours for North Rockhampton (existing)



FRW reports a relatively low level of odour complaints for NRSTP.

The sludge lagoons are the major odour source and it might be argued that the odour model is conservative (in that it assumes continuing emission rates while, in practice, odour emissions reduce after the initial disturbance made by new WAS additions).

However, the NRSTP inlet works has been covered and provided with activated carbon air treatment – this indicates a significant historical concern for odours.

4. Odour behaviour for STP upgrades

Preliminary odour assessments for optimisation / augmentation works to accommodate 2027 loads have been undertaken for SRSTP and NRSTP.

4.1 South Rockhampton STP

4.1.1 Odour emission inventory

The SRSTP 35,000EP EBPR / MBR (treated water quality A) optimisation has been modelled.

Two scenarios have been considered i.e. retaining the existing sludge lagoons and replacing the sludge lagoons with a dewatering building (containing GDD / BFPs or centrifuges) and a sludge out-loading silo. Both scenarios adopt a covered inlet works with an air treatment facility

The odour emissions for the “with sludge lagoons” scenario are as follows:

Table 4-1 Modelled emission rates – South Rockhampton STP 35,000EP EBPR/MBR with sludge lagoons

Process Unit	Area (m^2)	SOER ($OU.m^3/m^2.s$)	Odour Emission (OU/s)	Percentage
Covered inlet works (covered with 1% leakage)	207	0.1	21	**0.2%**
Air treatment facility	(0.67 Nm^3/sec)		337	**4%**
Anaerobic zone	200	0.74	148	**2%**
Bioreactor (anoxic zone 1)	300	0.11	33	**0.4%**
Bioreactor (aeration zone 1)	300	0.11	33	**0.4%**
Membrane bioreactor	300	0.03	9	**0.1%**
Aeration zone (2)	190	0.11	21	**0.2%**
Anoxic zone (2)	190	0.12	23	**0.3%**
Primary Digester Flare #1			12	**0.1%**
Primary Digester Flare #2			12	**0.1%**
Sludge Lagoon 1	2,400	0.6	1,440	**17%**
Sludge Lagoon 2	2,400	0.6	1,440	**17%**
Sludge Lagoon 3	2,400	0.6	1,440	**17%**
Sludge Lagoon 4	2,400	0.6	1,440	**17%**
Sludge transfer PS vent		(2,200 OU)	2,226	**26%**
Total			**8,635**	**100%**

For this scenario the sludge lagoons (68% total) are the major emission source.

The odour emissions for the “without sludge lagoons” scenario are as follows:

Table 4-2 Modelled emission rates – South Rockhampton STP 35,000EP EBPR/MBR without sludge lagoons

Process Unit	Area (m^2)	SOER ($OU.m^3/m^2.s$)	Odour Emission (OU/s)	Percentage
Covered inlet works (with 1% leakage)	207	0.1	21	**0.6%**
Air treatment facility[1]	(0.67 Nm^3/s)		337	**9%**
Anaerobic zone	200	0.74	148	**4%**
Bioreactor (anoxic zone 1)	300	0.11	33	**1%**
Bioreactor (aeration zone 1)	300	0.11	33	**1%**
Membrane bioreactor	300	0.03	9	**0.2%**
Aeration zone (2)	190	0.11	21	**0.6%**
Anoxic zone (2)	190	0.12	23	**0.6%**
Primary Digester Flare #1			12	**0.4%**
Primary Digester Flare #2			12	**0.4%**
Sludge transfer PS vent		(2,200 OU)	2,226	**60%**
One belt filter press (de-watering building)[2]			340	**9%**
Sludge outloading[2] (one hour per day)			500	**13%**
Total			**3,715**	**100%**

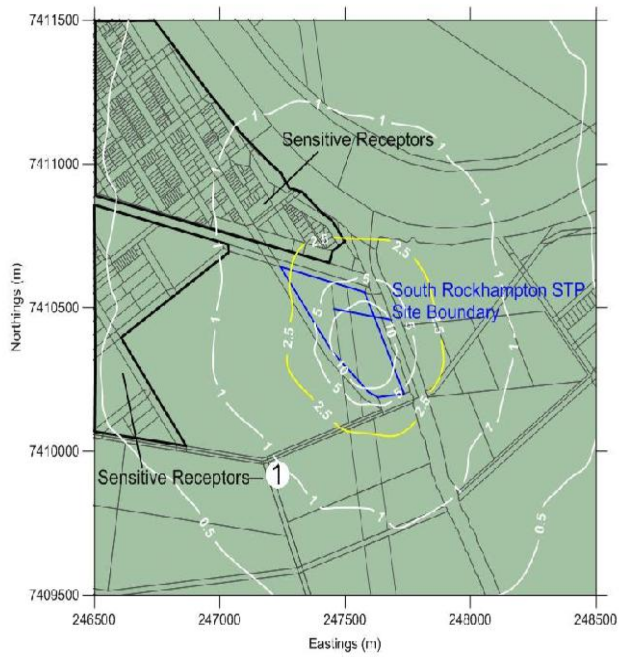
Notes: 1. Modelled as point source 2. Modelled as volume source

The major emission source for this scenario is the sludge transfer pump station vent. This is probably overly conservative and would need to be sampled and investigated further prior to any design action.

4.1.2 Odour modelling results

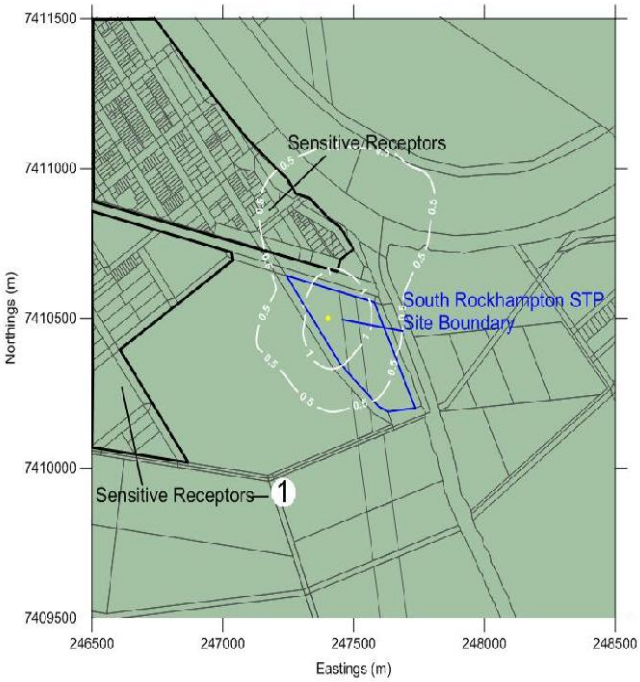
The modelling results for the SRSTP EBPR/MBR 35,000EP treated water quality A (with and without sludge lagoons) cases are shown below.

Figure 4-1 Predicted 99.5th percentile odour contours for upgraded SRSTP with sludge lagoons



This modelling indicates that the 2.5OU contour would extend up to 100m beyond the SRSTP boundary and has the potential to cause odour nuisance in the enveloped area.

Figure 4-2 Predicted 99.5th percentile odour contours for upgraded SRSTP without sludge lagoons



This modelling indicates that replacement of the sludge lagoons with a mechanical dewatering building completely eliminates the odour nuisance risk.

4.2 North Rockhampton STP

4.2.1 Odour emission inventory

The NRSTP 80,000EP EBPR / MBR (treated water quality A) optimisation has been modelled.

Two scenarios have been considered i.e. retaining the existing sludge lagoons and replacing the sludge lagoons with a dewatering building (containing GDD / BFPs or centrifuges) and a sludge out-loading silo. Both scenarios adopt a covered inlet works with an air treatment facility

The odour emissions for the "with sludge lagoons" scenario are as follows:

Table 4-3 Modelled emission rates – North Rockhampton STP 80,000EP EBPR/MBR with sludge lagoons

Process Unit	Area (m2)	SOER (OU.m3/m2.s)	Odour Emission (OU/s)	Percentage
Covered inlet works	256	0.1	26	0.1%
Air treatment facility1	(0.67 Nm3/s)	(500 ou)	337	2%
Anaerobic zone	140	0.74	104	0.5%
Oxidation ditch (anoxic zone)	1,700	0.12	204	0.9%
Oxidation ditch (aeration zone)	1,700	0.12	204	0.9%
Membrane reactor	440	0.03	13	0.1%
Anoxic / de-aeration swing zone	140	0.11	15	0.1%
Sludge Lagoon 1	5,000	0.6	3,000	14%
Sludge Lagoon 2	5,000	0.6	3,000	14%
Sludge Lagoon 3	5,000	0.6	3,000	14%
Sludge Lagoon 4	5,000	0.6	3,000	14%
Sludge Lagoon 5	5,000	0.6	3,000	14%
Septage storage (open tank)	154	10	1,539	7%
Pump station 11	(1.01 Nm3/s)	(2,200 ou)	2,226	10%
Pump station 21	(1.01 Nm3/s)	(2,200 ou)	2,226	10%
Supernatant pump station	1	0.6	0.5	0.0%
Total			**21,895**	**100%**

Notes: 1. Modelled as point source

For this scenario the sludge lagoons (70% total) are the major emission source.

The odour emissions for the "without sludge lagoons" scenario are as follows:

Table 4-4 Modelled emission rates – North Rockhampton STP 35,000EP EBPR/MBR without sludge lagoons

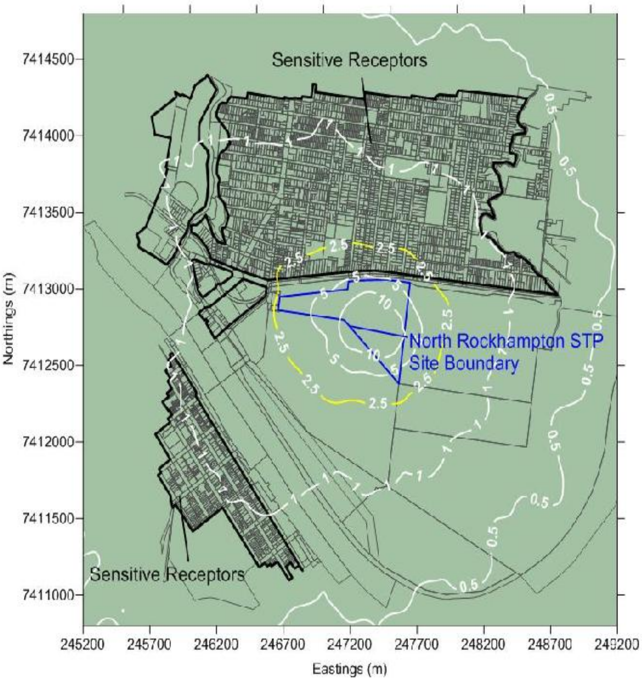
Process Unit	Area (m^2)	SOER ($OU.m^3/m^2.s$)	Odour Emission (OU/s)	Percentage
Covered inlet works	256	0.1	26	**0.3%**
Air treatment facility[1]	(0.67 Nm^3/s)	(500 ou)	337	**4%**
Anaerobic zone	140	0.74	104	**1%**
Oxidation ditch (anoxic zone)	1,700	0.12	204	**3%**
Oxidation ditch (aeration zone)	1,700	0.12	204	**3%**
Anoxic / de-aeration swing zone	140	0.11	15	**0.2%**
Membrane reactor	440	0.03	13	**0.2%**
Septage storage (open tank)	154	10	1,539	**19%**
Pump station 1[1]	(1.01 Nm^3/s)	(2,200 ou)	2,226	**28%**
Pump station 2[1]	(1.01 Nm^3/s)	(2,200 ou)	2,226	**28%**
Dewatering building[2]			680	**8%**
Sludge outloading[2] (one hour per day)			500	**6%**
Total			**8,074**	**100%**

Notes: 1. Modelled as point source 2. Modelled as volume source

4.2.2 Odour modelling results

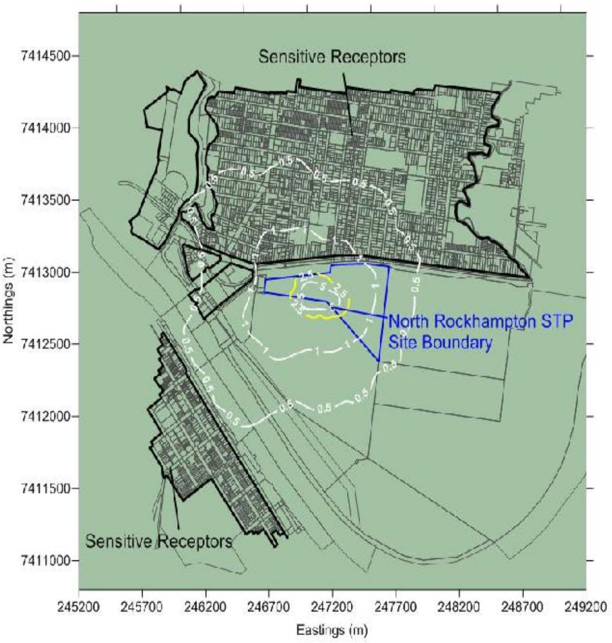
The modelling results for the NRSTP EBPR/MBR 80,000EP treated water quality A (with and without sludge lagoons) cases are shown below.

Figure 4-3 Predicted 99.5th percentile odour contours for upgraded NRSTP with sludge lagoons



This modelling indicates that receptors 200m from the north STP site boundary and more than 500m from the south STP boundary have a potential for odour nuisance.

Figure 4-4 Predicted 99.5th percentile odour contours for upgraded NRSTP without sludge lagoons



This modelling shows that replacing the sludge lagoons with a dewatering building reduces the odour footprint considerably although it still extends over the southern boundary into the racecourse

5. Future investigations

It is recommended that site specific data be collected for each STP site for future concept design and certainly prior to any detailed design and augmentation.

This data should include:

- Liquid phase sulphides data (e.g. raw sewage pH, temperature, sulphide, BOD / COD, sulphate)
- Vapour phase olfactometry for each relevant existing process unit

Preferably the data should be collected in summer when H_2S generation is highest.

Appendix E. Cost estimates

Rockhampton STPs Strategy
LT1A - New STP

Item	Description	Capacity	Unit	Qty	Rate	Amount
	2015/16 Works					
	Direct Costs					
1	**Jardine Park SPS & SRM (6,259EP)**					
	SRM - brownfield	250 dia	m	2,600	520	1,352,000
	SRM - brownfield & ASS	250 dia	m	1,000	584	584,000
	SRM - city	250 dia	m	1,600	798	1,276,800
	SRM - city & ASS	250 dia	m	800	861	688,800
	SPS - civils	70 kL		LS		369,519
	SPS - pumps & elect	100 kW		LS		714,100
	SPS - pipes & valves	100 kW		LS		280,600
	Sub-total					5,265,819
2	**Armstrong St SPS & SRM to Albert St SPS (13,158EP)**					
	SRM - greenfield	450 dia	m	6,000	868	5,208,000
	SRM - greenfiled & ASS	450 dia	m	2,500	1,128	2,820,000
	SRM - brownfield	450 dia	m	1,400	1,189	1,664,600
	SRM - brownfield & ASS	450 dia	m	600	1,450	870,000
	SPS - civils	70 kL		LS		369,519
	SPS - pumps & elect	100 kW		LS		714,100
	SPS - pipes & valves	100 kW		LS		280,600
	Sub-total					11,926,819
3	**Arthur St SPS & SRM to NRSTP SPS (41,694EP)**					
	SRM - bridge crossing	600 dia	m	300	2,760	828,000
	SRM - brownfield	2/600 dia	m	2,000	2,670	5,340,000
	SRM - brownfields & ASS	2/600 dia	m	900	4,326	3,893,400
	SRM - city	2/600 dia	m	1,200	3,209	3,850,800
	SRM - city & ASS	2/600 dia	m	400	4,864	1,945,600
	SPS - civils	100 kL		LS		551,343
	SPS - pumps & elect	150 kW		LS		959,691
	SPS - pipes & valves	150 kW		LS		377,103
	Sub-total					17,745,937
4	**NRSTP SPS & SRM to new STP (103,711EP)**					
	SRM - brownfield	2/1000 dia	m	6,000	5,456	32,736,000
	SPS - civils	160 kL		LS		786,287
	SPS - pumps & elect	300 kW		LS		1,735,842
	SPS - pipes & valves	300 kW		LS		915,328
	Sub-total					36,173,457
5	**New STP (103,711EP)**					
	Preliminares			LS		8,646,985
	Inlet works			LS		7,460,168
	Bioreactor			LS		9,936,283
	MBR			LS		15,821,840
	RAS pump station			LS		763,578
	Aerobic digester			LS		6,622,969
	Sludge dewatering			LS		4,238,609
	General purpose pump station			LS		770,770
	Disinfection - chlorinated service water			LS		1,102,074
	Chemical systems			LS		5,308,769
	Siteworks			LS		11,987,100
	Electrical & instrumentation			LS		21,196,697
	Testing, commissioning & process proving			LS		1,140,772
	Odour control			LS		4,321,386
	Administration building			LS		1,250,000
	Sub-total new STP					100,568,001
	Total - Direct Costs					171,680,033
	Indirect Costs					
	Concept design & investigations				0.2%	343,360
	Detailed design, tender doc & const support				7.5%	12,876,002
	Project management				7.5%	12,876,002
	Contingency				30%	51,504,010
	Land acquisition (STP & pipeline easements)			LS		2,000,000
	Development approval for new STP site			LS		3,000,000
	Total - Indirect Costs					82,599,375
	TOTAL					**254,279,407**
	Annual Operating Costs (2027 load)					
	Power - pump stations		kWh	0.38	1,146,867	435,810
	Power - treatment plant		kWh	0.38	6,359,559	2,416,632
	Power - total					2,852,442
	Alum		t	350		8,281
	Caustic		t	1,200		54,511
	NaOCl		t	310		8,809
	Citric Acid		t	3,000		136,121
	Chemicals - total					207,721
	Lead operator		no	1	120,000	120,000
	Assistant operators		no	4	100,000	400,000
	Labour - total					520,000
	TOTAL					**3,500,163**
	Greenhouse (CO2e)		t		6,606	

Item	Description	Capacity	Unit	Qty	Rate	Amount
	2027 Works					
	Direct Costs					
2	**Armstrong St SPS & SRM to Albert St SPS (13,158EP to 20,501EP)**					
	SRM - greenfield					0
	SRM - greenfiled & ASS					0
	SRM - brownfield					0
	SRM - brownfield & ASS					0
	SPS - civils					0
	SPS - pumps & elect	300 kW		LS		1,735,842
	SPS - pipes & valves	300 kW		LS		915,328
	Sub-total					2,651,170
3	**Arthur St SPS & SRM to NRSTP SPS (41,694EP to 53,105EP)**					
	SRM - bridge crossing					0
	SRM - brownfield					0
	SRM - brownfields & ASS					0
	SRM - city					0
	SRM - city & ASS					0
	SPS - civils					0
	SPS - pumps & elect	240 kW		LS		1,540,472
	SPS - pipes & valves	240 kW		LS		641,993
	Sub-total					2,182,465
4	**NRSTP SPS & SRM to new STP (103,711EP)**					
	SRM - brownfield	1000 dia	m	6,000	3,638	21,828,000
	SPS - civils					
	SPS - pumps & elect	300 kW		LS		867,921
	SPS - pipes & valves	300 kW		LS		457,664
	Sub-total					23,153,585
5	**New STP (103,711EP to 128,381EP ie 24,670EP)**					
	Preliminaries			LS		4,279,113
	Inlet works			LS		3,666,598
	Bioreactor			LS		4,317,562
	MBR			LS		6,023,429
	RAS pump station			LS		322,597
	Aerobic digester			LS		2,798,075
	Sludge dewatering			LS		1,790,729
	General purpose pump station			LS		325,635
	Disinfection - chlorinated service water			LS		465,605
	Chemical systems			LS		2,242,851
	Siteworks			LS		5,045,664
	Electrical & instrumentation			LS		8,955,190
	Testing, commissioning & process proving			LS		414,480
	Odour control			LS		1,805,425
	Administration building			LS		0
	Sub-total new STP					42,452,953
	Total - Direct Costs					70,440,173
	Indirect Costs					
	Concept design & investigations				0.5%	352,201
	Detailed design, tender doc & const support				7.5%	5,283,013
	Project management				7.5%	5,283,013
	Contingency				30%	21,132,052
	Land acquisition (STP & pipeline easements)			LS		0
	Development approval for new STP site			LS		0
	Total - Indirect Costs					32,050,279
	TOTAL					**102,490,452**
	Annual Operating Costs (2042 load)					
	Power - pump stations		kWh	0.38	1,737,020	660,067
	Power - treatment plant		kWh	0.38	8,952,869	3,402,090
	Power - total					4,062,158
	Alum		t	350		10,250
	Caustic		t	1,200		67,477
	NaOCl		t	310		10,905
	Citric Acid		t	3,000		168,500
	Chemicals - total					257,132
	Lead operator		no	1	120,000	120,000
	Assistant operators		no	5	100,000	500,000
	Labour - total					620,000
	TOTAL					**4,939,290**
	CO2e		t		9,407	

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Rockhampton STPs Strategy Study

LT1A - New STP

Description / Year	Rate		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Load (EP)																							
Gracemere STP			8200	8,461	8,722	8,984	9,245	9506	9,838	10,170	10,502	10,834	11,166	11,498	11,830	12,162	12,494	12,826	13158	13,648	14,137	14,627	15,116
West Rockhampton STP			6160	6,166	6,172	6,179	6,185	6191	6,197	6,203	6,210	6,216	6,222	6,228	6,234	6,240	6,247	6,253	6259	6,265	6,272	6,278	6,284
South Rockhampton STP			18700	18,910	19,120	19,331	19,541	19751	19,981	20,210	20,440	20,670	20,899	21,129	21,358	21,588	21,818	22,047	22277	22,542	22,807	23,072	23,336
North Rockhampton STP			50430	51,105	51,780	52,454	53,129	53804	54,551	55,297	56,044	56,791	57,537	58,284	59,030	59,777	60,524	61,270	62017	62,901	63,785	64,669	65,553
Diversions (EP)																							
Pump WRSTP to SRSTP									6,197	6,203	6,210	6,216	6,222	6,228	6,234	6,240	6,247	6,253	6,259	6,265	6,272	6,278	6,284
Pump GSTP to SRSTP									9,838	10,170	10,502	10,834	11,166	11,498	11,830	12,162	12,494	12,826	13,158	13,648	14,137	14,627	15,116
Pump SRSTP to NRSTP									36,016	36,584	37,151	37,719	38,287	38,855	39,423	39,991	40,558	41,126	41,694	42,455	43,215	43,976	44,737
Pump NRSTP to new STP									90,566	91,881	93,195	94,510	95,824	97,139	98,453	99,768	101,082	102,397	103,711	105,356	107,000	108,645	110,290
Capital Costs (2013 base)		Design & construction																					
Direct Costs																							
Jardine Park SPS & SRM		2016	6,259EP					5,265,819											0				
Armstrong St SPS & SRM to SRSTP		2015/16	13,158EP	2027	7,343EP		5,000,000	6,926,819											2,651,170				
Arthur St SPS & SRM to NRSTP		2015/16	41,694EP	2027	11,411EP		10,000,000	7,745,937											2,182,465				
NRSTP SPS to new STP		2016	103,711EP	2027	24,670EP		15,000,000	21,173,457											23,153,585				
New STP		2015/16	103,711EP	2027	24,670EP		50,000,000	50,560,001											42,452,953				
Indirect Costs & Contingency							40,000,000	42,599,375											32,050,279				
Capital Costs - total (2013 base)					356,769,859		120,000,000	134,279,407	-	-	-	-	-	-	-	-	-	-	102,490,452				
Capital Costs - (inflated)	4%				458,318,373		129,792,000	151,046,071	-	-	-	-	-	-	-	-	-	-	177,480,302				
Operating Costs (2013 base)																							
Pumping Power (kWh/yr)					35,208,855			1,067,238	1,074,477	1,081,716	1,088,955	1,096,194	1,103,433	1,110,672	1,117,911	1,125,150	1,132,389	1,139,628	1,146,867	1,186,211	1,225,554	1,264,898	1,304,241
Treatment Power (kWh/yr)					191,825,893			6,254,780	6,264,305	6,273,831	6,283,356	6,292,881	6,302,407	6,311,932	6,321,457	6,330,983	6,340,508	6,350,033	6,359,559	6,532,446	6,705,333	6,878,221	7,051,108
Power ($ 2013 at c/kWh))	38				86,273,204			2,782,367	2,788,737	2,795,108	2,801,478	2,807,849	2,814,219	2,820,589	2,826,960	2,833,330	2,839,701	2,846,071	2,852,442	2,933,089	3,013,737	3,094,385	3,175,033
Power (inflated)	10%				563,023,621			3,703,330	4,082,990	4,501,549	4,962,989	5,471,703	6,032,528	6,650,802	7,332,406	8,083,822	8,912,198	9,825,410	10,832,143	12,252,243	13,848,041	15,640,477	17,652,919
Chemicals ($ 2013)					5,830,000			178,761	181,394	184,027	186,659	189,292	191,925	194,558	197,190	199,823	202,456	205,088	207,721	211,015	214,309	217,603	220,897
Chemicals (inflated)	5%				14,222,724			206,939	220,486	234,870	250,142	266,353	283,560	301,823	321,202	341,765	363,581	386,725	411,274	438,685	467,810	498,751	531,616
Labour ($ 2013)					15,540,000			520,000	520,000	520,000	520,000	520,000	520,000	520,000	520,000	520,000	520,000	520,000	520,000	620,000	620,000	620,000	620,000
Labour (inflated)	3.5%				28,461,255			576,533	596,712	617,597	639,213	661,585	684,741	708,707	733,511	759,184	785,756	813,257	841,721	1,038,716	1,075,071	1,112,699	1,151,643
Operating Costs - total (2013 base)					107,643,204			3,481,128	3,490,131	3,499,134	3,508,138	3,517,141	3,526,144	3,535,147	3,544,150	3,553,153	3,562,157	3,571,160	3,580,163	3,764,105	3,848,046	3,931,988	4,015,930
Operating Costs - total (inflated)					605,707,600			4,486,802	4,900,188	5,354,016	5,852,344	6,399,641	7,000,830	7,661,332	8,387,120	9,184,772	10,061,535	11,025,392	12,085,137	13,729,644	15,390,923	17,251,926	19,336,178
Annual Costs - total (2013 base)					464,413,063		120,000,000	137,760,535	3,490,131	3,499,134	3,508,138	3,517,141	3,526,144	3,535,147	3,544,150	3,553,153	3,562,157	3,571,160	106,070,615	3,764,105	3,848,046	3,931,988	4,015,930
Annual Costs - total (inflated)					1,064,025,972		129,792,000	155,532,873	4,900,188	5,354,016	5,852,344	6,399,641	7,000,830	7,661,332	8,387,120	9,184,772	10,061,535	11,025,392	189,565,439	13,729,644	15,390,923	17,251,926	19,336,178
NPV	8%				$456,257,892																		

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Rockhampton STPs Strategy Study

LT1A - New STP

Description / Year	Rate		2011	2012	2013	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Load (EP)																
Gracemere STP			8200	8,461	8,722	15,606	16,095	16,585	17,074	17,564	18,053	18,543	19,032	19,522	20,011	20501
West Rockhampton STP			6160	6,166	6,172	6,291	6,297	6,303	6,310	6,316	6,322	6,329	6,335	6,341	6,348	6354
South Rockhampton STP			18700	18,910	19,120	23,601	23,866	24,131	24,396	24,661	24,926	25,191	25,455	25,720	25,985	26250
North Rockhampton STP			50430	51,105	51,780	66,437	67,321	68,205	69,088	69,972	70,856	71,740	72,624	73,508	74,392	75276
Diversions (EP)																
Pump WRSTP to SRSTP						6,291	6,297	6,303	6,310	6,316	6,322	6,329	6,335	6,341	6,348	6,354
Pump GSTP to SRSTP						15,606	16,095	16,585	17,074	17,564	18,053	18,543	19,032	19,522	20,011	20,501
Pump SRSTP to NRSTP						45,498	46,258	47,019	47,780	48,541	49,301	50,062	50,823	51,584	52,344	53,105
Pump NRSTP to new STP						111,934	113,579	115,224	116,868	118,513	120,158	121,802	123,447	125,092	126,736	128,381
Capital Costs (2013 base)		Design & construction														
Direct Costs																
Jardine Park SPS & SRM		2016	6,259EP													
Armstrong St SPS & SRM to SRSTP		2015/16	13,158EP	2027	7,343EP											
Arthur St SPS & SRM to NRSTP		2015/16	41,694EP	2027	11,411EP											
NRSTP SPS to new STP		2016	103,711EP	2027	24,670EP											
New STP		2015/16	103,711EP	2027	24,670EP											
Indirect Costs & Contingency																
Capital Costs - total (2013 base)					356,769,859											
Capital Costs - (inflated)	4%				458,318,373											
Operating Costs (2013 base)																
Pumping Power (kWh/yr)					35,208,855	1,343,585	1,382,928	1,422,272	1,461,615	1,500,959	1,540,302	1,579,646	1,618,989	1,658,333	1,697,676	1,737,020
Treatment Power (kWh/yr)					191,825,893	7,223,995	7,396,883	7,569,770	7,742,657	7,915,545	8,088,432	8,261,319	8,434,207	8,607,094	8,779,982	8,952,869
Power ($ 2013 at c/kWh))	38				86,273,204	3,255,680	3,336,328	3,416,976	3,497,624	3,578,271	3,658,919	3,739,567	3,820,214	3,900,862	3,981,510	4,062,158
Power (inflated)	10%				563,023,621	19,911,445	22,445,147	25,206,475	28,471,617	32,040,923	36,039,374	40,517,106	45,529,990	51,140,280	57,417,329	64,438,384
Chemicals ($ 2013)					5,830,000	224,191	227,486	230,780	234,074	237,368	240,662	243,956	247,250	250,544	253,838	257,132
Chemicals (inflated)	5%				14,222,724	566,521	603,587	642,943	684,727	729,081	776,158	826,121	879,140	935,395	995,078	1,058,391
Labour ($ 2013)					15,540,000	620,000	620,000	620,000	620,000	620,000	620,000	620,000	620,000	620,000	620,000	620,000
Labour (inflated)	3.5%				28,461,255	1,191,951	1,233,669	1,276,848	1,321,537	1,367,791	1,415,664	1,465,212	1,516,494	1,569,572	1,624,507	1,681,364
Operating Costs - total (2013 base)					107,643,204	4,099,872	4,183,814	4,267,755	4,351,697	4,435,639	4,519,581	4,603,523	4,687,464	4,771,406	4,855,348	4,939,290
Operating Costs - total (inflated)					605,707,600	21,669,916	24,282,403	27,206,266	30,477,881	34,137,795	38,231,196	42,808,439	47,925,625	53,645,247	60,036,914	67,178,140
Annual Costs - total (2013 base)					464,413,063	4,099,872	4,183,814	4,267,755	4,351,697	4,435,639	4,519,581	4,603,523	4,687,464	4,771,406	4,855,348	4,939,290
Annual Costs - total (inflated)					1,064,025,972	21,669,916	24,282,403	27,206,266	30,477,881	34,137,795	38,231,196	42,808,439	47,925,625	53,645,247	60,036,914	67,178,140
NPV	8%				$456,257,892											

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Rockhampton STPs Strategy

LT6A - Optimise Gracemere STP / Reuse + Optimise SRSTP + NRSTP Upgrade

2015/16 Works

Item	Description	Capacity	Unit	Qty	Rate	Amount
	Direct Costs					
1	**Jardine Park SPS & SRM (6,354EP)**					
	SRM - brownfield	250 dia	m	2,600	520	1,352,000
	SRM - brownfield & ASS	250 dia	m	1,000	584	584,000
	SRM - city	250 dia	m	1,600	798	1,276,800
	SRM - city & ASS	250 dia	m	800	861	688,800
	SPS - civils	70 kL		LS		369,519
	SPS - pumps & elect	100 kW		LS		714,100
	SPS - pipes & valves	100 kW		LS		280,600
	Sub-total					5,265,819
2	**Armstrong St SPS & SRM to Albert St SPS (5,158EP)**					
	SRM - greenfield	2/200 dia	m	6,000	402	2,412,000
	SRM - greenfiled & ASS	2/200 dia	m	2,500	483	1,207,500
	SRM - brownfield	2/200 dia	m	1,400	699	978,600
	SRM - brownfield & ASS	2/200 dia	m	600	780	468,000
	SPS - civils	70 kL		LS		369,519
	SPS - pumps & elect	10 kW		LS		96,370
	SPS - pipes & valves	10 kW		LS		42,200
	Sub-total					5,574,189
4	**Optimise Gracemere STP (8,000EP)**					
	Preliminaries			LS		280,000
	Inlet works			LS		1,399,191
	Bioreactor - aeration			LS		225,000
	Chemical systems			LS		570,588
	Electrical & instrumentation			LS		455,646
	Testing & commissioning			LS		42,178
	Sub-total					2,972,603
5	**Optimise Gracemere Reuse**					
	Notional allowance			LS		2,000,000
6	**Optimise South Rockhampton STP (35,000EP)**					
	Preliminaries			LS		2,639,144
	Inlet works			LS		4,522,751
	Bioreactor			LS		1,736,646
	MBR			LS		7,429,903
	RAS pump station			LS		397,923
	Chlorinated service water			LS		287,162
	Chemical systems			LS		2,766,558
	Siteworks			LS		1,244,766
	Electrical & instrumentation			LS		8,284,673
	Testing, commissioning & process proving			LS		511,261
	Odour control			LS		2,226,993
	Sub-total					32,047,780
7	**Optimise North Rockhampton STP (62,017EP)**					
	Preliminaries			LS		3,719,878
	Inlet works			LS		6,374,825
	MBR			LS		10,472,461
	RAS pump station			LS		560,873
	General purpose pump station			LS		566,156
	Chlorinated service water			LS		809,510
	Chemical systems			LS		3,899,469
	Siteworks			LS		1,754,500
	Electrical & instrumentation			LS		15,569,683
	Testing, commissioning & process proving			LS		720,624
	Odour control			LS		3,138,950
	Sub-total					47,586,930
	Total - Direct Costs					95,447,322
	Indirect Costs					
	Concept design & investigations				0.5%	477,237
	Detailed design, tender doc & const support				7.5%	7,158,549
	Project management				7.5%	7,158,549
	Contingency				30%	28,634,197
	Land acquisition (Reuse & pipeline easements)			LS		500,000
	Development approvals			LS		300,000
	Total - Indirect Costs					44,228,531
	TOTAL					**139,675,853**

Description	Unit	Qty	Rate	Amount
Annual Operating Costs (2027 Load)				
Power - pump stations	kWh	0.38	259,859	98,746
Power - treatment plants	kWh	0.38	8,919,020	3,389,228
Power - total				3,487,974
Alum	t	350		9,821
Caustic	t	1,200		46,680
NaOCl	t	310		13,744
Citric Acid	t	3,000		141,397
Chemicals - total				211,642
Lead operator	no	1	120,000	120,000
Assistant operators	no	4	100,000	400,000
Labour - total				520,000
TOTAL				**4,219,616**
CO2e	t		8,077	

2027 Works

Item	Description	Capacity	Unit	Qty	Rate	Amount
	Direct Costs					
2	**Armstrong St SPS & SRM to Albert St SPS (5,158EP to 12,501EP)**					
	SRM - greenfield	200 dia	m	6,000	268	1,608,000
	SRM - greenfiled & ASS	200 dia	m	2,500	322	805,000
	SRM - brownfield	200 dia	m	1,400	466	652,400
	SRM - brownfield & ASS	200dia	m	600	520	312,000
	SPS - civils	Nil		LS		0
	SPS - pumps & elect	220 kW		LS		1,735,842
	SPS - pipes & valves	220 kW		LS		915,328
	Sub-total					6,028,570
3	**Arthur St SPS & SRM to NRSTP SPS (10,105EP)**					
	SRM - bridge crossing	375 dia	m	300	1,462	438,600
	SRM - brownfield	375 dia	m	2,000	736	1,472,000
	SRM - brownfields & ASS	375 dia	m	900	893	803,700
	SRM - city	375 dia	m	1,200	1,028	1,233,600
	SRM - city & ASS	375 dia	m	400	1,185	474,000
	SPS - civils	70 kL		LS		369,519
	SPS - pumps & elect	70 kW		LS		379,502
	SPS - pipes & valves	70 kW		LS		214,762
	Sub-total					5,385,683
7	**Optimise North Rockhampton STP (62,017EP to 80,000EP - 18,000EP)**					
	Preliminaries			LS		1,770,866
	Inlet works			LS		1,517,383
	MBR			LS		3,739,100
	RAS pump station			LS		133,503
	General purpose pump station			LS		0
	Chlorinated service water			LS		77,074
	Chemical systems			LS		371,272
	Siteworks			LS		835,238
	Electrical & instrumentation			LS		3,706,012
	Testing, commissioning & process proving			LS		343,057
	Odour control			LS		747,156
	Sub-total					13,240,663
8	**New North Rockhampton STP (5,381EP)**					
	Preliminaries			LS		1,716,209
	Inlet works			LS		1,470,549
	Bioreactor			LS		1,731,629
	MBR			LS		2,415,795
	RAS pump station			LS		129,383
	Disinfection - chlorinated service water			LS		37,348
	Chemical systems			LS		179,906
	Siteworks			LS		404,729
	Electrical & instrumentation			LS		3,591,626
	Testing, commissioning & process proving			LS		166,234
	Odour control			LS		362,048
	Sub-total new STP					12,205,456
	Total - Direct Costs					36,860,372
	Indirect Costs					
	Concept design & investigations				0.5%	184,302
	Detailed design, tender doc & const support				7.5%	2,764,528
	Project management				7.5%	2,764,528
	Contingency				30%	11,058,111
	Land acquisition (STP & pipeline easements)			LS		0
	Development approvals			LS		200,000
	Total - Indirect Costs					16,971,469
	TOTAL					**53,831,841**

Description	Unit	Qty	Rate	Amount
Annual Operating Costs (2042 load)				
Power - pump stations	kWh	0.38	687,553	261,270
Power - treatment plants	kWh	0.38	11,423,969	4,341,108
Power - total				4,602,378
Alum	t	350		11,688
Caustic	t	1,200		58,969
NaOCl	t	310		15,730
Citric Acid	t	3,000		172,085
Chemicals - total				258,471
Lead operator	no	1	120,000	120,000
Assistant operators	no	5	100,000	500,000
Labour - total				620,000
TOTAL				**5,480,850**
CO2e	t		10,658	

Rockhampton STPs Strategy Study

LT6A - Optimise Gracemere STP / Reuse + Optimise SRSTP + NRSTP Upgrade

Description / Year	Rate	Design & construction	2011	2012	2013	2014	2015	2016
Load (EP)								
Gracemere STP			8200	8,461	8,722	8,984	9,245	9506
West Rockhampton STP			6160	6,166	6,172	6,179	6,185	6191
South Rockhampton STP			18700	18,910	19,120	19,331	19,541	19751
North Rockhampton STP			50430	51,105	51,780	52,454	53,129	53804
Diversions (EP)								
Pump WRSTP to SRSTP								
Pump GSTP to SRSTP								
Pump SRSTP to NRSTP								
Capital Costs (2013 base)								
Direct Costs								
Jardine Park SPS & SRM		2016	6,2598EP				2,000,000	3,265,819
Armstrong St SPS & SRM to SRSTP		2015/16	5,158EP	2027	10,105EP		2,000,000	3,574,189
Arthur St SPS & SRM to NRSTP				2029	10,105EP			
Optimise GSTP		2015/16	8,000EP					2,972,603
GSTP reuse		2015/16	8,000EP				1,000,000	1,000,000
Optimise SRSTP		2015/16	35,000EP				10,000,000	22,047,780
Optimise NRSTP		2015/16	61,017EP	2027	18,000EP		20,000,000	27,586,930
New NRSTP				2027	5,301EP			
Indirect Costs & Contingency							20,000,000	24,228,531
Capital Costs - total (2013 base)					193,507,694		55,000,000	84,675,853
Capital Costs - (inflated)	4%				248,717,172		59,488,000	95,248,819
Operating Costs (2013 base)								
Pumping Power (kWh/yr)					9,918,633			173,340
Treatment Power (kWh/yr)					249,550,778			7,036,628
Power ($ 2013 at c/kWh))	38				98,601,416			2,739,788
Power (inflated)	10%				649,563,302			3,646,657
Chemicals ($ 2013)					5,891,683			178,761
Chemicals (inflated)	5%				14,369,793			206,939
Labour ($ 2013)					15,540,000			520,000
Labour (inflated)	3.5%				28,461,255			576,533
Operating Costs - total (2013 base)					120,033,100			3,438,549
Operating Costs - total (inflated)					692,394,350			4,430,129
Annual Costs - total (2013 base)					313,540,793		55,000,000	88,114,402
Annual Costs - total (inflated)					941,111,522		59,488,000	99,678,948
NPV	8%				$331,013,459			

Description / Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Load (EP)															
Gracemere STP	9,838	10,170	10,502	10,834	11,166	11,498	11,830	12,162	12,494	12,826	13158	13,640	14,137	14,627	15,116
West Rockhampton STP	6,197	6,203	6,210	6,216	6,222	6,228	6,234	6,240	6,247	6,253	6259	6,265	6,272	6,278	6,284
South Rockhampton STP	19,981	20,210	20,440	20,670	20,899	21,129	21,358	21,588	21,818	22,047	22277	22,542	22,807	23,072	23,336
North Rockhampton STP	54,551	55,297	56,044	56,791	57,537	58,284	59,030	59,777	60,524	61,270	62017	62,901	63,785	64,669	65,553
Diversions (EP)															
Pump WRSTP to SRSTP	6,197	6,203	6,210	6,216	6,222	6,228	6,234	6,240	6,247	6,253	6,259	6,265	6,272	6,278	6,284
Pump GSTP to SRSTP	1,838	2,170	2,502	2,834	3,166	3,498	3,830	4,162	4,494	4,826	5,158	5,648	6,137	6,627	7,116
Pump SRSTP to NRSTP													215	976	1,737
Capital Costs (2013 base)															
Direct Costs															
Jardine Park SPS & SRM															
Armstrong St SPS & SRM to SRSTP											6,028,570				
Arthur St SPS & SRM to NRSTP													5,385,683		
Optimise GSTP															
GSTP reuse															
Optimise SRSTP															
Optimise NRSTP											13,240,663				
New NRSTP											12,205,456				
Indirect Costs & Contingency											16,971,469				
Capital Costs - total (2013 base)	-	-	-	-	-	-	-	-	-	-	40,446,158	-	5,385,683		
Capital Costs - (inflated)	-	-	-	-	-	-	-	-	-	-	83,893,070	-	10,087,283		
Operating Costs (2013 base)															
Pumping Power (kWh/yr)	181,205	189,071	196,936	204,801	212,667	220,532	228,397	236,263	244,128	251,994	259,859	288,372	316,885	345,398	373,911
Treatment Power (kWh/yr)	7,207,754	7,378,881	7,550,007	7,721,134	7,892,261	8,063,387	8,234,514	8,405,640	8,576,767	8,747,894	8,919,020	9,086,017	9,253,013	9,420,010	9,587,006
Power ($ 2013 at c/kWh))	2,807,805	2,875,822	2,943,839	3,011,855	3,079,872	3,147,889	3,215,906	3,283,923	3,351,940	3,419,957	3,487,974	3,562,268	3,636,561	3,710,855	3,785,149
Power (inflated)	4,110,907	4,631,539	5,215,189	5,869,254	6,601,980	7,422,558	8,341,233	9,369,416	10,519,824	11,806,620	13,245,576	14,880,476	16,709,901	18,756,406	21,045,113
Chemicals ($ 2013)	181,751	184,740	187,729	190,718	193,707	196,696	199,685	202,674	205,664	208,653	211,642	214,764	217,886	221,008	224,130
Chemicals (inflated)	220,919	235,780	251,575	268,359	286,194	305,140	325,266	346,642	369,342	393,446	419,036	446,479	475,617	506,554	539,395
Labour ($ 2013)	520,000	520,000	520,000	520,000	520,000	520,000	520,000	520,000	520,000	520,000	520,000	620,000	620,000	620,000	620,000
Labour (inflated)	596,712	617,597	639,213	661,585	684,741	708,707	733,511	759,184	785,756	813,257	841,721	1,038,716	1,075,071	1,112,699	1,151,643
Operating Costs - total (2013 base)	3,509,555	3,580,561	3,651,567	3,722,573	3,793,579	3,864,586	3,935,592	4,006,598	4,077,604	4,148,610	4,219,616	4,397,032	4,474,447	4,551,863	4,629,278
Operating Costs - total (inflated)	4,928,538	5,484,916	6,105,977	6,799,199	7,572,914	8,436,405	9,400,011	10,475,243	11,674,922	13,013,323	14,506,334	16,365,671	18,260,590	20,375,659	22,736,151
Annual Costs - total (2013 base)	3,509,555	3,580,561	3,651,567	3,722,573	3,793,579	3,864,586	3,935,592	4,006,598	4,077,604	4,148,610	52,665,774	4,397,032	9,860,130	4,551,863	4,629,278
Annual Costs - total (inflated)	4,928,538	5,484,916	6,105,977	6,799,199	7,572,914	8,436,405	9,400,011	10,475,243	11,674,922	13,013,323	98,399,404	16,365,671	28,347,873	20,375,659	22,736,151
NPV															

QE06678 Cost Estimates 20130613.xlsx\LT6A Schedule

Rockhampton STPs Strategy Study

LT6A - Optimise Gracemere STP / Reuse + Optimise SRSTP + NRSTP Upgrade

Description / Year	Rate		2011	2012	2013	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Load (EP)																
Gracemere STP			8200	8,461	8,722	15,606	16,095	16,585	17,074	17,564	18,053	18,543	19,032	19,522	20,011	20501
West Rockhampton STP			6160	6,166	6,172	6,291	6,297	6,303	6,310	6,316	6,322	6,329	6,335	6,341	6,348	6354
South Rockhampton STP			18700	18,910	19,120	23,601	23,866	24,131	24,396	24,661	24,926	25,191	25,455	25,720	25,985	26250
North Rockhampton STP			50430	51,105	51,780	66,437	67,321	68,205	69,088	69,972	70,856	71,740	72,624	73,508	74,392	75276
Diversions (EP)																
Pump WRSTP to SRSTP						6,291	6,297	6,303	6,310	6,316	6,322	6,329	6,335	6,341	6,348	6,354
Pump GSTP to SRSTP						7,606	8,095	8,585	9,074	9,564	10,053	10,543	11,032	11,522	12,011	12,501
Pump SRSTP to NRSTP						2,498	3,258	4,019	4,780	5,541	6,301	7,062	7,823	8,584	9,344	10,105
Capital Costs (2013 base)		Design & construction														
Direct Costs																
Jardine Park SPS & SRM		2016	6,2598EP													
Armstrong St SPS & SRM to SRSTP		2015/16	5,158EP	2027	10,105EP											
Arthur St SPS & SRM to NRSTP				2029	10,105EP											
Optimise GSTP		2015/16	8,000EP													
GSTP reuse		2015/16	8,000EP													
Optimise SRSTP		2015/16	35,000EP													
Optimise NRSTP		2015/16	61,017EP	2027	18,000EP											
New NRSTP				2027	5,381EP											
Indirect Costs & Contingency																
Capital Costs - total (2013 base)					193,507,694											
Capital Costs - (inflated)	4%				248,717,172											
Operating Costs (2013 base)																
Pumping Power (kWh/yr)					9,918,633	402,424	430,937	459,450	487,963	516,476	544,989	573,502	602,015	630,527	659,040	687,553
Treatment Power (kWh/yr)					249,558,778	9,754,003	9,921,000	10,087,996	10,254,993	10,421,989	10,588,986	10,755,982	10,922,979	11,089,975	11,256,972	11,423,969
Power ($ 2013 at c/kWh))	38				98,601,416	3,859,442	3,933,736	4,008,029	4,082,323	4,156,617	4,230,910	4,305,204	4,379,498	4,453,791	4,528,085	4,602,378
Power (inflated)	10%				649,563,302	23,603,998	26,464,208	29,660,420	33,231,232	37,219,603	41,673,335	46,645,618	52,195,624	58,389,176	65,299,481	73,007,956
Chemicals ($ 2013)					5,891,683	227,252	230,374	233,496	236,618	239,740	242,862	245,983	249,105	252,227	255,349	258,471
Chemicals (inflated)	5%				14,369,793	574,254	611,250	650,510	692,168	736,366	783,253	832,987	885,737	941,680	1,001,002	1,063,903
Labour ($ 2013)					15,540,000	620,000	620,000	620,000	620,000	620,000	620,000	620,000	620,000	620,000	620,000	620,000
Labour (inflated)	3.5%				28,461,255	1,191,951	1,233,669	1,276,848	1,321,537	1,367,791	1,415,664	1,465,212	1,516,494	1,569,572	1,624,507	1,681,364
Operating Costs - total (2013 base)					120,033,100	4,706,694	4,784,109	4,861,525	4,938,941	5,016,356	5,093,772	5,171,187	5,248,603	5,326,019	5,403,434	5,480,850
Operating Costs - total (inflated)					692,394,350	25,370,202	28,309,127	31,587,777	35,244,937	39,323,759	43,872,252	48,943,817	54,597,856	60,900,427	67,924,990	75,753,223
Annual Costs - total (2013 base)					313,540,793	4,706,694	4,784,109	4,861,525	4,938,941	5,016,356	5,093,772	5,171,187	5,248,603	5,326,019	5,403,434	5,480,850
Annual Costs - total (inflated)					941,111,522	25,370,202	28,309,127	31,587,777	35,244,937	39,323,759	43,872,252	48,943,817	54,597,856	60,900,427	67,924,990	75,753,223
NPV	8%				$331,013,459											

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Rockhampton STPs Strategy

LT7A - Optimise Gracemere STP / Reuse + Optimise NRSTP + SRSTP Upgrade

2015/16 Works

Item	Description	Capacity	Unit	Qty	Rate	Amount
	Direct Costs					
1	**Jardine Park SPS & SRM (6,354EP)**					
	SRM - brownfield	250 dia	m	2,600	520	1,352,000
	SRM - brownfield & ASS	250 dia	m	1,000	584	584,000
	SRM - city	250 dia	m	1,600	798	1,276,800
	SRM - city & ASS	250 dia	m	800	861	688,800
	SPS - civils	70 kL		LS		369,519
	SPS - pumps & elect	100 kW		LS		714,100
	SPS - pipes & valves	100 kW		LS		280,600
	Sub-total					5,265,819
2	**Armstrong St SPS & SRM to Albert St SPS (5,158EP)**					
	SRM - greenfield	2/200 dia	m	6,000	402	2,412,000
	SRM - greenfiled & ASS	2/200 dia	m	2,500	483	1,207,500
	SRM - brownfield	2/200 dia	m	1,400	699	978,600
	SRM - brownfield & ASS	2/200 dia	m	600	780	468,000
	SPS - civils	70 kL		LS		369,519
	SPS - pumps & elect	10 kW		LS		96,370
	SPS - pipes & valves	10 kW		LS		42,200
	Sub-total					5,574,189
3	**Optimise Gracemere STP (8,000EP)**					
	Preliminaries			LS		280,000
	Inlet works			LS		1,399,191
	Bioreactor - aeration			LS		225,000
	Chemical systems			LS		570,588
	Electrical & instrumentation			LS		455,646
	Testing & commissioning			LS		42,178
	Sub-total					2,972,603
4	**Optimise Gracemere Reuse**					
	Notional allowance			LS		2,000,000
5	**Optimise South Rockhampton STP (35,000EP)**					
	Preliminaries			LS		2,639,144
	Inlet works			LS		4,522,751
	Bioreactor			LS		1,736,646
	MBR			LS		7,429,903
	RAS pump station			LS		397,923
	Chlorinated service water			LS		287,162
	Chemical systems			LS		2,766,558
	Siteworks			LS		1,244,766
	Electrical & instrumentation			LS		8,284,673
	Testing, commissioning & process proving			LS		511,261
	Odour control			LS		2,226,993
	Sub-total					32,047,780
6	**Optimise North Rockhampton STP (62,017EP)**					
	Preliminaries			LS		3,719,078
	Inlet works			LS		6,374,825
	MBR			LS		10,472,461
	RAS pump station			LS		560,873
	General purpose pump station			LS		566,156
	Chlorinated service water			LS		809,510
	Chemical systems			LS		3,899,469
	Siteworks			LS		1,754,500
	Electrical & instrumentation			LS		15,569,683
	Testing, commissioning & process proving			LS		720,624
	Odour control			LS		3,138,950
	Sub-total					47,586,930
	Total - Direct Costs					95,447,322
	Indirect Costs					
	Concept design & investigations				0.5%	477,237
	Detailed design, tender doc & const support				7.5%	7,158,549
	Project management				7.5%	7,158,549
	Contingency				30%	28,634,197
	Land acquisition (Reuse & pipeline easements)			LS		500,000
	Development approvals			LS		300,000
	Total - Indirect Costs					44,228,531
	TOTAL					**139,675,853**
	Annual Operating Costs (2027 Load)					
	Power - pump stations		kWh	0.38	259,859	98,746
	Power - treatment plants		kWh	0.38	8,919,020	3,389,228
	Power - total					3,487,974
	Alum		t	350		9,821
	Caustic		t	1,200		46,680
	NaOCl		t	310		13,744
	Citric Acid		t	3,000		141,397
	Chemicals - total					211,642
	Lead operator		no	1	120,000	120,000
	Assistant operators		no	4	100,000	400,000
	Labour - total					520,000
	TOTAL					**4,219,616**
	CO2e		t		8,077	

2027 Works

Item	Description	Capacity	Unit	Qty	Rate	Amount
	Direct Costs					
2	**Armstrong St SPS & SRM to Albert St SPS (5,158EP to 12,501EP)**					
	SRM - greenfield	200 dia	m	6,000	268	1,608,000
	SRM - greenfiled & ASS	200 dia	m	2,500	322	805,000
	SRM - brownfield	200 dia	m	1,400	466	652,400
	SRM - brownfield & ASS	200dia	m	600	520	312,000
	SPS - civils	Nil		LS		0
	SPS - pumps & elect	220 kW		LS		1,735,842
	SPS - pipes & valves	220 kW		LS		915,328
	Sub-total					6,028,570
6	**Optimise North Rockhampton STP (62,017EP to 75,276EP - 13,259EP)**					
	Preliminaries			LS		1,770,866
	Inlet works			LS		1,517,383
	MBR			LS		3,739,100
	RAS pump station			LS		133,503
	General purpose pump station			LS		0
	Chlorinated service water			LS		77,074
	Chemical systems			LS		371,272
	Siteworks			LS		835,238
	Electrical & instrumentation			LS		3,706,012
	Testing, commissioning & process proving			LS		343,057
	Odour control			LS		747,156
	Sub-total					13,240,663
7	**New South Rockhampton STP (10,105EP)**					
	Preliminaries			LS		1,716,209
	Inlet works			LS		1,470,549
	Bioreactor			LS		1,731,629
	MBR			LS		2,415,795
	RAS pump station			LS		129,383
	Disinfection - chlorinated service water			LS		37,348
	Chemical systems			LS		179,906
	Siteworks			LS		404,729
	Electrical & instrumentation			LS		3,591,626
	Testing, commissioning & process proving			LS		166,234
	Odour control			LS		362,048
	Sub-total new STP					12,205,456
	Total - Direct Costs					31,474,689
	Indirect Costs					
	Concept design & investigations				0.5%	157,373
	Detailed design, tender doc & const support				7.5%	2,360,602
	Project management				7.5%	2,360,602
	Contingency				30%	9,442,407
	Land acquisition (STP & pipeline easements)			LS		0
	Development approvals			LS		200,000
	Total - Indirect Costs					14,520,983
	TOTAL					**45,995,672**
	Annual Operating Costs (2042 load)					
	Power - pump stations		kWh	0.38	687,553	261,270
	Power - treatment plants		kWh	0.38	11,375,044	4,322,517
	Power - total					4,583,787
	Alum		t	350		11,686
	Caustic		t	1,200		58,960
	NaOCl		t	310		15,381
	Citric Acid		t	3,000		172,063
	Chemicals - total					258,089
	Lead operator		no	1	120,000	120,000
	Assistant operators		no	5	100,000	500,000
	Labour - total					620,000
	TOTAL					**5,461,876**
	CO2e		t		10,615	

Rockhampton STPs Strategy Study

LT7A - Optimise Gracemere STP / Reuse + Optimise NRSTP + SRSTP Upgrade

Description / Year	Rate		2011	2012	2013	2014	2015	2016
Load (EP)								
Gracemere STP			8200	8,461	8,722	8,984	9,245	9506
West Rockhampton STP			6160	6,166	6,172	6,179	6,185	6191
South Rockhampton STP			18700	18,910	19,120	19,331	19,541	19751
North Rockhampton STP			50430	51,105	51,780	52,454	53,129	53804
Diversions (EP)								
Pump WRSTP to SRSTP								
Pump GSTP to SRSTP								
Capital Costs (2013 base)		Design & construction						
Direct Costs								
Jardine Park SPS & SRM		2016	6,259EP				2,000,000	3,265,819
Armstrong St SPS & SRM to SRSTP		2015/16	5,158EP	2027	10,105EP		2,000,000	3,574,189
Optimise GSTP		2015/16	8,000EP					2,972,603
GSTP reuse		2015/16	8,000EP				1,000,000	1,000,000
Optimise SRSTP		2015/16	35,000EP				10,000,000	22,047,780
Optimise NRSTP		2015/16	62,017EP	2027	13,259EP		20,000,000	27,586,930
New NRSTP				2027	10,105EP			
Indirect Costs & Contingency							20,000,000	24,228,531
Capital Costs - total (2013 base)					185,671,525		55,000,000	84,675,853
Capital Costs - (inflated)	4%				234,386,440		59,488,000	95,248,819
Operating Costs (2013 base)								
Pumping Power (kWh/yr)					8,930,759			173,340
Treatment Power (kWh/yr)					249,167,381			7,036,628
Power ($ 2013 at c/kWh))	38				98,077,293			2,739,788
Power (inflated)	10%				643,920,127			3,646,657
Chemicals ($ 2013)					5,888,628			178,761
Chemicals (inflated)	5%				14,359,626			206,939
Labour ($ 2013)					15,540,000			520,000
Labour (inflated)	3.5%				28,461,255			576,533
Operating Costs - total (2013 base)					119,505,922			3,438,549
Operating Costs - total (inflated)					686,749,008			4,430,129
Annual Costs - total (2013 base)					305,177,447		55,000,000	88,114,402
Annual Costs - total (inflated)					921,135,448		59,488,000	99,678,948
NPV	8%				$325,384,960			

Description / Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Load (EP)															
Gracemere STP	9,838	10,170	10,502	10,834	11,166	11,498	11,830	12,162	12,494	12,826	13158	13,648	14,137	14,627	15,116
West Rockhampton STP	6,197	6,203	6,210	6,216	6,222	6,228	6,234	6,240	6,247	6,253	6259	6,265	6,272	6,278	6,284
South Rockhampton STP	19,981	20,210	20,440	20,670	20,899	21,129	21,358	21,588	21,818	22,047	22277	22,542	22,807	23,072	23,336
North Rockhampton STP	54,551	55,297	56,044	56,791	57,537	58,284	59,030	59,777	60,524	61,270	62017	62,901	63,785	64,669	65,553
Diversions (EP)															
Pump WRSTP to SRSTP	6,197	6,203	6,210	6,216	6,222	6,228	6,234	6,240	6,247	6,253	6,259	6,265	6,272	6,278	6,284
Pump GSTP to SRSTP	1,838	2,170	2,502	2,834	3,166	3,498	3,830	4,162	4,494	4,826	5,158	5,648	6,137	6,627	7,116
Capital Costs (2013 base)															
Direct Costs															
Jardine Park SPS & SRM															
Armstrong St SPS & SRM to SRSTP											6,028,570				
Optimise GSTP															
GSTP reuse															
Optimise SRSTP															
Optimise NRSTP											13,240,663				
New NRSTP											12,205,456				
Indirect Costs & Contingency											14,520,983				
Capital Costs - total (2013 base)	-	-	-	-	-	-	-	-	-	-	45,995,672	-	-		
Capital Costs - (inflated)	-	-	-	-	-	-	-	-	-	-	79,649,622	-	-		
Operating Costs (2013 base)															
Pumping Power (kWh/yr)	181,205	189,071	196,936	204,801	212,667	220,532	228,397	236,263	244,128	251,994	259,859	280,140	300,420	320,701	340,982
Treatment Power (kWh/yr)	7,207,754	7,378,881	7,550,007	7,721,134	7,892,261	8,063,387	8,234,514	8,405,640	8,576,767	8,747,894	8,919,020	9,082,755	9,246,490	9,410,225	9,573,960
Power ($ 2013 at c/kWh))	2,807,805	2,875,822	2,943,839	3,011,855	3,079,872	3,147,889	3,215,906	3,283,923	3,351,940	3,419,957	3,487,974	3,557,900	3,627,826	3,697,752	3,767,678
Power (inflated)	4,110,907	4,631,539	5,215,189	5,869,254	6,601,980	7,422,558	8,341,233	9,369,416	10,519,824	11,806,620	13,245,576	14,862,232	16,669,762	18,690,177	20,947,977
Chemicals ($ 2013)	181,751	184,740	187,729	190,718	193,707	196,696	199,685	202,674	205,664	208,653	211,642	214,738	217,835	220,931	224,028
Chemicals (inflated)	220,919	235,780	251,575	268,359	286,194	305,140	325,266	346,642	369,342	393,446	419,036	446,426	475,506	506,379	539,150
Labour ($ 2013)	520,000	520,000	520,000	520,000	520,000	520,000	520,000	520,000	520,000	520,000	520,000	620,000	620,000	620,000	620,000
Labour (inflated)	596,712	617,597	639,213	661,585	684,741	708,707	733,511	759,184	785,756	813,257	841,721	1,038,716	1,075,071	1,112,699	1,151,643
Operating Costs - total (2013 base)	3,509,555	3,580,561	3,651,567	3,722,573	3,793,579	3,864,586	3,935,592	4,006,598	4,077,604	4,148,610	4,219,616	4,392,638	4,465,661	4,538,683	4,611,706
Operating Costs - total (inflated)	4,928,538	5,484,916	6,105,977	6,799,199	7,572,914	8,436,405	9,400,011	10,475,243	11,674,922	13,013,323	14,506,334	16,347,373	18,220,340	20,309,255	22,638,770
Annual Costs - total (2013 base)	3,509,555	3,580,561	3,651,567	3,722,573	3,793,579	3,864,586	3,935,592	4,006,598	4,077,604	4,148,610	50,215,288	4,392,638	4,465,661	4,538,683	4,611,706
Annual Costs - total (inflated)	4,928,538	5,484,916	6,105,977	6,799,199	7,572,914	8,436,405	9,400,011	10,475,243	11,674,922	13,013,323	94,155,955	16,347,373	18,220,340	20,309,255	22,638,770
NPV															

QE06678 Cost Estimates 20130613.xlsx\LT7A Schedule

Rockhampton STPs Strategy Study

LT7A - Optimise Gracemere STP / Reuse + Optimise NRSTP + SRSTP Upgrade

Description / Year	Rate		2011	2012	2013	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Load (EP)																
Gracemere STP			8200	8,461	8,722	15,606	16,095	16,585	17,074	17,564	18,053	18,543	19,032	19,522	20,011	20501
West Rockhampton STP			6160	6,166	6,172	6,291	6,297	6,303	6,310	6,316	6,322	6,329	6,335	6,341	6,348	6354
South Rockhampton STP			18700	18,910	19,120	23,601	23,866	24,131	24,396	24,661	24,926	25,191	25,455	25,720	25,985	26250
North Rockhampton STP			50430	51,105	51,780	66,437	67,321	68,205	69,088	69,972	70,856	71,740	72,624	73,508	74,392	75276
Diversions (EP)																
Pump WRSTP to SRSTP						6,291	6,297	6,303	6,310	6,316	6,322	6,329	6,335	6,341	6,348	6,354
Pump GSTP to SRSTP						7,606	8,095	8,585	9,074	9,564	10,053	10,543	11,032	11,522	12,011	12,501
Capital Costs (2013 base)		Design & construction														
Direct Costs																
Jardine Park SPS & SRM		2016	6,2598EP													
Armstrong St SPS & SRM to SRSTP		2015/16	5,158EP	2027	10,105EP											
Optimise GSTP		2015/16	8,000EP													
GSTP reuse		2015/16	8,000EP													
Optimise SRSTP		2015/16	35,000EP													
Optimise NRSTP		2015/16	62,017EP	2027	13,259EP											
New NRSTP				2027	10,105EP											
Indirect Costs & Contingency																
Capital Costs - total (2013 base)					185,671,525											
Capital Costs - (inflated)	4%				234,386,440											
Operating Costs (2013 base)																
Pumping Power (kWh/yr)					8,930,759	361,262	381,543	401,824	422,104	442,385	462,666	482,946	503,227	523,508	543,788	564,069
Treatment Power (kWh/yr)					249,167,381	9,737,695	9,901,430	10,065,165	10,228,900	10,392,634	10,556,369	10,720,104	10,883,839	11,047,574	11,211,309	11,375,044
Power ($ 2013 at c/kWh))	38				98,077,293	3,837,604	3,907,530	3,977,456	4,047,382	4,117,307	4,187,233	4,257,159	4,327,085	4,397,011	4,466,937	4,536,863
Power (inflated)	10%				643,928,127	23,470,435	26,287,906	29,434,166	32,946,798	36,867,616	41,243,129	46,125,069	51,570,965	57,644,790	64,417,671	71,968,679
Chemicals ($ 2013)					5,888,628	227,124	230,221	233,317	236,414	239,510	242,607	245,703	248,800	251,896	254,993	258,089
Chemicals (inflated)	5%				14,359,626	573,932	610,845	650,014	691,572	735,662	782,432	832,039	884,651	940,444	999,605	1,062,331
Labour ($ 2013)					15,540,000	620,000	620,000	620,000	620,000	620,000	620,000	620,000	620,000	620,000	620,000	620,000
Labour (inflated)	3.5%				28,461,255	1,191,951	1,233,669	1,276,848	1,321,537	1,367,791	1,415,664	1,465,212	1,516,494	1,569,572	1,624,507	1,681,364
Operating Costs - total (2013 base)					119,505,922	4,684,728	4,757,751	4,830,773	4,903,795	4,976,818	5,049,840	5,122,863	5,195,885	5,268,908	5,341,930	5,414,952
Operating Costs - total (inflated)					686,749,008	25,236,318	28,132,419	31,361,027	34,959,908	38,971,069	43,441,224	48,422,320	53,972,111	60,154,806	67,041,782	74,712,375
Annual Costs - total (2013 base)					305,177,447	4,684,728	4,757,751	4,830,773	4,903,795	4,976,818	5,049,840	5,122,863	5,195,885	5,268,908	5,341,930	5,414,952
Annual Costs - total (inflated)					921,135,448	25,236,318	28,132,419	31,361,027	34,959,908	38,971,069	43,441,224	48,422,320	53,972,111	60,154,806	67,041,782	74,712,375
NPV	8%				$325,384,960											

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Rockhampton STPs Strategy

LT7B - Optimise Gracemere STP / Reuse + Optimise NRSTP + SRSTP Upgrade (EBPR)

2015/16 Works

Item	Description	Capacity	Unit	Qty	Rate	Amount
	Direct Costs					
1	**Jardine Park SPS & SRM (6,354EP)**					
	SRM - brownfield	250 dia	m	2,600	520	1,352,000
	SRM - brownfield & ASS	250 dia	m	1,000	584	584,000
	SRM - city	250 dia	m	1,600	798	1,276,800
	SRM - city & ASS	250 dia	m	800	861	688,800
	SPS - civils	70 kL		LS		369,519
	SPS - pumps & elect	100 kW		LS		714,100
	SPS - pipes & valves	100 kW		LS		280,600
	Sub-total					5,265,819
2	**Armstrong St SPS & SRM to Albert St SPS (5,158EP)**					
	SRM - greenfield	2/200 dia	m	6,000	402	2,412,000
	SRM - greenfiled & ASS	2/200 dia	m	2,500	483	1,207,500
	SRM - brownfield	2/200 dia	m	1,400	699	978,600
	SRM - brownfield & ASS	2/200 dia	m	600	780	468,000
	SPS - civils	70 kL		LS		369,519
	SPS - pumps & elect	10 kW		LS		96,370
	SPS - pipes & valves	10 kW		LS		42,200
	Sub-total					5,574,189
3	**Optimise Gracemere STP (8,000EP)**					
	Preliminaries			LS		280,000
	Inlet works			LS		1,399,191
	Bioreactor - aeration			LS		225,000
	Chemical systems			LS		570,588
	Electrical & instrumentation			LS		455,646
	Testing & commissioning			LS		42,178
	Sub-total					2,972,603
4	**Optimise Gracemere Reuse**					
	Notional allowance			LS		2,000,000
5	**Optimise South Rockhampton STP (19,000EP) EBPR**					
	Preliminaries			LS		1,829,256
	Inlet works			LS		3,134,830
	Bioreactor			LS		1,203,712
	MBR			LS		5,149,849
	RAS pump station			LS		275,810
	Chlorinated service water			LS		199,039
	Chemical systems			LS		1,917,570
	Siteworks			LS		2,156,945
	Electrical & instrumentation			LS		5,742,311
	Testing, commissioning & process proving			LS		354,368
	Odour control			LS		1,543,583
	Sub-total					23,507,273
6	**Optimise North Rockhampton STP (62,017EP) EBPR**					
	Preliminaries			LS		3,719,878
	Inlet works			LS		6,374,825
	Bioreactor			LS		815,935
	MBR			LS		10,472,461
	RAS pump station			LS		560,873
	General purpose pump station			LS		566,156
	Chlorinated service water			LS		809,510
	Chemical systems			LS		3,899,469
	Siteworks			LS		4,386,249
	Electrical & instrumentation			LS		15,569,683
	Testing, commissioning & process proving			LS		720,624
	Odour control			LS		3,138,950
	Sub-total					51,034,615
7	**New South Rockhampton STP (14,694EP) EBPR**					
	Preliminaries			LS		3,135,713
	Inlet works			LS		2,686,865
	Bioreactor			LS		3,439,009
	MBR			LS		4,413,939
	RAS pump station			LS		236,397
	General purpose pump station			LS		238,624
	Disinfection - chlorinated service water			LS		341,193
	Chemical systems			LS		1,643,550
	Siteworks			LS		3,697,438
	Electrical & instrumentation			LS		6,562,319
	Testing, commissioning & process proving			LS		303,729
	Odour control			LS		1,323,007
	Sub-total new STP					28,021,782
	Total - Direct Costs					118,376,281
	Indirect Costs					
	Concept design & investigations				0.5%	591,881
	Detailed design, tender doc & const support				7.5%	8,878,221
	Project management				7.5%	8,878,221
	Contingency				30%	35,512,884
	Land acquisition (Reuse & pipeline easements)			LS		500,000
	Development approvals			LS		300,000
	Total - Indirect Costs					54,661,208
	TOTAL					**173,037,489**
	Annual Operating Costs (2027 Load)					
	Power - pump stations		kWh	0.38	259,859	98,746
	Power - treatment plants		kWh	0.38	8,921,894	3,390,320
	Power - total					3,489,066
	Alum		t	350		9,717
	Caustic		t	1,200		49,197
	NaOCl		t	310		13,250
	Citric Acid		t	3,000		133,255
	Chemicals - total					205,418
	Lead operator		no	1	120,000	120,000
	Assistant operators		no	4	100,000	400,000
	Labour - total					520,000
	TOTAL					**4,214,484**
	CO2e		t		8,080	

2027 Works

Item	Description	Capacity	Unit	Qty	Rate	Amount
	Direct Costs					
2	**Armstrong St SPS & SRM to Albert St SPS (5,158EP to 12,501EP)**					
	SRM - greenfield	200 dia	m	6,000	268	1,608,000
	SRM - greenfiled & ASS	200 dia	m	2,500	322	805,000
	SRM - brownfield	200 dia	m	1,400	466	652,400
	SRM - brownfield & ASS	200dia	m	600	520	312,000
	SPS - civils	Nil		LS		0
	SPS - pumps & elect	220 kW		LS		1,735,842
	SPS - pipes & valves	220 kW		LS		915,328
	Sub-total					6,028,570
5	**Optimise North Rockhampton STP (62,017EP to 70,000EP - 7,983EP) EBPR**					
	Preliminaries			LS		1,087,231
	Inlet works			LS		931,604
	Bioreactor			LS		238,478
	MBR			LS		3,060,850
	RAS pump station			LS		81,965
	General purpose pump station			LS		0
	Chlorinated service water			LS		236,600
	Chemical systems			LS		569,861
	Siteworks			LS		1,281,996
	Electrical & instrumentation			LS		3,412,984
	Testing, commissioning & process proving			LS		210,621
	Odour control			LS		458,720
	Sub-total					11,570,910
7	**New South Rockhampton STP (11,411EP) EBPR**					
	Preliminaries			LS		2,694,303
	Inlet works			LS		2,308,639
	Bioreactor			LS		2,954,905
	MBR			LS		3,792,596
	RAS pump station			LS		203,120
	General purpose pump station					205,033
	Disinfection - chlorinated service water			LS		293,164
	Chemical systems			LS		1,412,190
	Siteworks			LS		3,176,955
	Electrical & instrumentation			LS		5,638,551
	Testing, commissioning & process proving			LS		260,974
	Odour control			LS		1,136,769
	Sub-total new STP					24,077,198
	Total - Direct Costs					41,676,679
	Indirect Costs					
	Concept design & investigations				0.5%	208,383
	Detailed design, tender doc & const support				7.5%	3,125,751
	Project management				7.5%	3,125,751
	Contingency				30%	12,503,004
	Land acquisition (STP & pipeline easements)			LS		0
	Development approvals			LS		200,000
	Total - Indirect Costs					19,162,889
	TOTAL					**60,839,567**
	Annual Operating Costs (2042 load)					
	Power - pump stations		kWh	0.38	564,069	214,346
	Power - treatment plants		kWh	0.38	11,375,044	4,322,517
	Power - total					4,536,863
	Alum		t	350		10,853
	Caustic		t	1,200		59,390
	NaOCl		t	310		14,915
	Citric Acid		t	3,000		158,709
	Chemicals - total					243,868
	Lead operator		no	1	120,000	120,000
	Assistant operators		no	5	100,000	500,000
	Labour - total					620,000
	TOTAL					**5,400,731**
	CO2e		t		10,506	

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Rockhampton STPs Strategy Study

LT7B - Optimise Gracemere STP / Reuse + Optimise NRSTP + SRSTP Upgrade

Description / Year	Rate		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Load (EP)																							
Gracemere STP			8200	8,461	8,722	8,984	9,245	9506	9,838	10,170	10,502	10,834	11,166	11,498	11,830	12,162	12,494	12,826	13158	13,648	14,137	14,627	15,116
West Rockhampton STP			6160	6,166	6,172	6,179	6,185	6191	6,197	6,203	6,210	6,216	6,222	6,228	6,234	6,240	6,247	6,253	6259	6,265	6,272	6,278	6,284
South Rockhampton STP			18700	18,910	19,120	19,331	19,541	19751	19,981	20,210	20,440	20,670	20,899	21,129	21,358	21,588	21,818	22,047	22277	22,542	22,807	23,072	23,336
North Rockhampton STP			50430	51,105	51,780	52,454	53,129	53804	54,551	55,297	56,044	56,791	57,537	58,284	59,030	59,777	60,524	61,270	62017	62,901	63,785	64,669	65,553
Diversions (EP)																							
Pump WRSTP to SRSTP									6,197	6,203	6,210	6,216	6,222	6,228	6,234	6,240	6,247	6,253	6,259	6,265	6,272	6,278	6,284
Pump GSTP to SRSTP									1,838	2,170	2,502	2,834	3,166	3,498	3,830	4,162	4,494	4,826	5,158	5,648	6,137	6,627	7,116
Capital Costs (2013 base)		Design & construction																					
Direct Costs																							
Jardine Park SPS & SRM		2016	6,259EP				2,000,000	3,265,819															
Armstrong St SPS & SRM to SRSTP		2015/16	5,158EP	2027	10,105EP		2,000,000	3,574,189											6,028,570				
Optimise GSTP		2015/16	8,000EP					2,972,603															
GSTP reuse		2015/16	8,000EP				1,000,000	1,000,000															
Optimise SRSTP		2015/16	19,000EP				10,000,000	13,507,273															
Optimise NRSTP		2015/16	62,017EP	2027	7,983EP		20,000,000	31,034,615											11,570,910				
New SRSTP		2015/16	14,694EP	2027	11,411EP		10,000,000	18,021,782											24,077,198				
Indirect Costs & Contingency							20,000,000	34,661,208											19,162,889				
Capital Costs - total (2013 base)					233,877,056		65,000,000	108,037,489	-	-	-	-	-	-	-	-	-	-	60,839,567	-	-		
Capital Costs - (inflated)	4%				297,185,928		70,304,000	121,527,482	-	-	-	-	-	-	-	-	-	-	105,354,446	-	-		
Operating Costs (2013 base)																							
Pumping Power (kWh/yr)					8,930,759			173,340	181,205	189,071	196,936	204,801	212,667	220,532	228,397	236,263	244,128	251,994	259,859	280,140	300,420	320,701	340,982
Treatment Power (kWh/yr)					249,204,734			7,036,628	7,208,015	7,379,403	7,550,791	7,722,179	7,893,567	8,064,955	8,236,342	8,407,730	8,579,118	8,750,506	8,921,894	9,085,437	9,248,980	9,412,524	9,576,067
Power ($ 2013 at c/kWh))	38				98,091,487			2,739,788	2,807,904	2,876,020	2,944,136	3,012,252	3,080,369	3,148,485	3,216,601	3,284,717	3,352,834	3,420,950	3,489,066	3,558,919	3,628,772	3,698,625	3,768,479
Power (inflated)	10%				643,997,804			3,646,657	4,111,052	4,631,859	5,215,717	5,870,020	6,603,044	7,423,963	8,343,035	9,371,682	10,522,628	11,810,046	13,249,722	14,866,480	16,674,110	18,694,592	20,952,429
Chemicals ($ 2013)					5,693,949			178,761	181,185	183,608	186,031	188,455	190,878	193,302	195,725	198,148	200,572	202,995	205,418	207,982	210,545	213,108	215,672
Chemicals (inflated)	5%				13,804,119			206,939	220,231	234,336	249,300	265,175	282,014	299,874	318,815	338,901	360,198	382,777	406,714	432,379	459,593	488,448	519,039
Labour ($ 2013)					15,540,000			520,000	520,000	520,000	520,000	520,000	520,000	520,000	520,000	520,000	520,000	520,000	520,000	620,000	620,000	620,000	620,000
Labour (inflated)	3.5%				28,461,255			576,533	596,712	617,597	639,213	661,585	684,741	708,707	733,511	759,184	785,756	813,257	841,721	1,038,716	1,075,071	1,112,699	1,151,643
Operating Costs - total (2013 base)					119,325,436			3,438,549	3,509,089	3,579,628	3,650,168	3,720,707	3,791,247	3,861,786	3,932,326	4,002,866	4,073,405	4,143,945	4,214,484	4,386,901	4,459,317	4,531,734	4,604,150
Operating Costs - total (inflated)					686,263,178			4,430,129	4,927,995	5,483,792	6,104,230	6,796,788	7,569,799	8,432,543	9,395,362	10,469,767	11,668,581	13,006,081	14,498,158	16,337,584	18,208,775	20,295,739	22,623,111
Annual Costs - total (2013 base)					353,202,492		65,000,000	111,476,038	3,509,089	3,579,628	3,650,168	3,720,707	3,791,247	3,861,786	3,932,326	4,002,866	4,073,405	4,143,945	65,054,052	4,386,901	4,459,317	4,531,734	4,604,150
Annual Costs - total (inflated)					983,449,106		70,304,000	125,957,611	4,927,995	5,483,792	6,104,230	6,796,788	7,569,799	8,432,543	9,395,362	10,469,767	11,668,581	13,006,081	119,852,604	16,337,584	18,208,775	20,295,739	22,623,111
NPV	8%				$367,281,906																		

QE06678 Cost Estimates 20130613.xlsx\LT7B Schedule (EBPR)

Rockhampton STPs Strategy Study

LT7B - Optimise Gracemere STP / Reuse + Optimise NRSTP + SRSTP Upgrade

Description / Year	Rate		2011	2012	2013	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Load (EP)																
Gracemere STP			8200	8,461	8,722	15,606	16,095	16,585	17,074	17,564	18,053	18,543	19,032	19,522	20,011	20501
West Rockhampton STP			6160	6,166	6,172	6,291	6,297	6,303	6,310	6,316	6,322	6,329	6,335	6,341	6,348	6354
South Rockhampton STP			18700	18,910	19,120	23,601	23,866	24,131	24,396	24,661	24,926	25,191	25,455	25,720	25,985	26250
North Rockhampton STP			50430	51,105	51,780	66,437	67,321	68,205	69,088	69,972	70,856	71,740	72,624	73,508	74,392	75276
Diversions (EP)																
Pump WRSTP to SRSTP						6,291	6,297	6,303	6,310	6,316	6,322	6,329	6,335	6,341	6,348	6,354
Pump GSTP to SRSTP						7,606	8,095	8,585	9,074	9,564	10,053	10,543	11,032	11,522	12,011	12,501
Capital Costs (2013 base)		Design & construction														
Direct Costs																
Jardine Park SPS & SRM		2016	6,2598EP													
Armstrong St SPS & SRM to SRSTP		2015/16	5,158EP	2027	10,105EP											
Optimise GSTP		2015/16	8,000EP													
GSTP reuse		2015/16	8,000EP													
Optimise SRSTP		2015/16	19,000EP													
Optimise NRSTP		2015/16	62,017EP	2027	7,983EP											
New SRSTP		2015/16	14,694EP	2027	11,411EP											
Indirect Costs & Contingency																
Capital Costs - total (2013 base)					233,877,056											
Capital Costs - (inflated)	4%				297,185,928											
Operating Costs (2013 base)																
Pumping Power (kWh/yr)					8,930,759	361,262	381,543	401,824	422,104	442,385	462,666	482,946	503,227	523,508	543,788	564,069
Treatment Power (kWh/yr)					249,204,734	9,739,610	9,903,154	10,066,697	10,230,240	10,393,784	10,557,327	10,720,871	10,884,414	11,047,957	11,211,501	11,375,044
Power ($ 2013 at c/kWh))	38				98,091,487	3,838,332	3,908,185	3,978,038	4,047,891	4,117,744	4,187,597	4,257,450	4,327,304	4,397,157	4,467,010	4,536,863
Power (inflated)	10%				643,997,804	23,474,087	26,292,313	29,438,475	32,950,946	36,871,527	41,246,714	46,128,224	51,573,568	57,646,699	64,418,720	71,968,679
Chemicals ($ 2013)					5,693,949	218,235	220,798	223,361	225,925	228,488	231,051	233,615	236,178	238,741	241,304	243,868
Chemicals (inflated)	5%				13,804,119	551,468	585,843	622,276	660,889	701,806	745,163	791,102	839,771	891,330	945,945	1,003,793
Labour ($ 2013)					15,540,000	620,000	620,000	620,000	620,000	620,000	620,000	620,000	620,000	620,000	620,000	620,000
Labour (inflated)	3.5%				28,461,255	1,191,951	1,233,669	1,276,848	1,321,537	1,367,791	1,415,664	1,465,212	1,516,494	1,569,572	1,624,507	1,681,364
Operating Costs - total (2013 base)					119,325,436	4,676,566	4,748,983	4,821,399	4,893,816	4,966,232	5,038,649	5,111,065	5,183,481	5,255,898	5,328,314	5,400,731
Operating Costs - total (inflated)					686,263,178	25,218,307	28,111,825	31,337,599	34,933,372	38,941,124	43,407,541	48,384,537	53,929,833	60,107,600	66,989,171	74,653,836
Annual Costs - total (2013 base)					353,202,492	4,676,566	4,748,983	4,821,399	4,893,816	4,966,232	5,038,649	5,111,065	5,183,481	5,255,898	5,328,314	5,400,731
Annual Costs - total (inflated)					983,449,106	25,218,307	28,111,825	31,337,599	34,933,372	38,941,124	43,407,541	48,384,537	53,929,833	60,107,600	66,989,171	74,653,836
NPV	8%				$367,281,906											

QE06678 Cost Estimates 20130613.xlsx\LT7B Schedule (EBPR)

Rockhampton STPs Strategy
SRSTP Short Term Works

Item	Description	Capacity	Unit	Qty	Rate	Amount	Amount
1	Preliminaries			LS			750,000
2	Inlet works						20,000
	blank-off PST2 outlet			LS		5,000	
	modify bypass for >3ADWF			LS		15,000	
3	PST1 to PST2 pipework						25,000
	extend MH as hydraulic structure 3mH			LS		20,000	
	blank-off outlet from MH to aeration tanks			LS		5,000	
4	Convert PST2 to anoxic tank						75,000
	remove weir			LS		5,000	
	cut down launder			LS		15,000	
	blank-off PST2 outlet to aeration tanks			LS		5,000	
	mixers & davits	10kW	no	2	25,000	50,000	
5	Anoxic tank to aeration tanks						924,000
	submersible pumps	80kW		LS		700,000	
	pipework	2/600dia	m	80	2,800	224,000	
6	Aeration tanks						1,419,000
	remove bridges & install metalwork bridge			LS		25,000	
	anoxic zone mixers & davits	10kW	no	2	25,000	50,000	
	blowers			LS		125,000	
	diffusers			LS		185,000	
	blower / diffuser installation			LS		200,000	
	aeration pipework	375dia	m	100	1,000	100,000	
	blower room extension		m2	70	5,000	350,000	
	submersible over-the wall pumps	40kW		LS		300,000	
	over-the wall pipework	2/600dia	m	30	2,800	84,000	
7	A Recycle						668,000
	submesrible pumps	60kW		LS		500,000	
	pipework	2/600dia	m	60	2,800	168,000	
8	SSTs flow splitter						188,500
	flow splitter box			LS		100,000	
	pipework		m	20	1,800	36,000	
	pipework		m	30	750	22,500	
	break into SST1 & SST2 feed lines			LS		20,000	
	blank-off SST1 & SST2 feeds at aeration tanks		no	2	5,000	10,000	
9	RAS						25,000
	modify pipework from aeration tanks to anoxic tank	250dia	m	50	500	25,000	
10	Siteworks			LS			250,000
11	Electrical & instrumentation			LS			2,250,000
12	Testing, commissioning & process proving			LS			210,000
	Total - direct costs						6,804,500
	Concept design & investigations				2%		136,090
	Detailed design, tender doc & const support				7.5%		510,338
	Project management				7.5%		510,338
	Contingency				30%		2,041,350
	Total - Indirect Costs						3,198,115
	TOTAL						10,002,615

QE06678 Cost Estimates 20130613.xlsx\SRSTP Short Term

FUTURE UPGRADING OF ROCKHAMPTON AND GRACEMERE SEWAGE TREATMENT PLANTS

South Rockhampton STP Interim Upgrade

Meeting Date: 5 February 2014

Attachment No: 2

South Rockhampton STP Interim Upgrade

PROCESS AND HYDRAULIC VALIDATION

FINAL | 11th NOVEMBER 2013

SINCLAIR KNIGHT MERZ
SKM

South Rockhampton STP Interim Upgrade Process and Hydraulic Validation

Document title:	South Rockhampton STP Interim Upgrade Process and Hydraulic Validation
Version:	Final
Date:	11th November 2013
Prepared by:	Damien Sharland, Graeme Lewis, John Swartz
Approved by:	Graeme Lewis
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Contents

1. Executive Summary

An investigation has been carried out at the request of Fitzroy River Water (FRW) to validate a proposed interim upgrade of the SRSTP to ensure compliance with existing Licence conditions for loads up to 27,200EP. The proposed upgrade is essentially to:

1) Convert the plant to the MLE process and achieve total nitrogen of 13mg/L in the effluent.

2) Minimise capital cost by using only existing assets and not adding tankage.

The analysis has found that:

- At a loading of 27,200EP, it is expected that the MLE process can achieve close to 13mg/L, based on the process modelling assumptions used. The current loading to the unmodified plant is ≈19,000EP. Going forward, it is strongly recommended that FRW monitor raw sewage characteristics and if they vary materially from those assumed here then appropriate action should be taken. Indeed, we would also recommend doing this at both North Rockhampton and Gracemere so that FRW has a sound body of data on which to make future decisions.
- It is imperative that a baffle wall be provided to properly compartmentalise the tanks into well defined anoxic and aerated zones (primarily to avoid DO back flowing into the anoxic zone). Not doing so will significantly increase total nitrogen and cause licence exceedance.
- At a loading of 27,000EP, the converted MLE plant does not fully denitrify and will run on a "knife edge" in terms of meeting the TN removal objective of 13mg/L. A particular constraint of the process is solids flux capacity of the clarifiers, which defines the allowable system biomass. Hence FRW needs to be ready to implement a more stable and permanent upgrade before load reaches 27,200EP.
- Total phosphorus is relatively high. If this needs to be controlled alum can be readily utilised. However any appreciable alum dosing may reduce capacity (due to additional chemical solids in the system) and potentially reduce nitrogen removal performance .
- Hydraulically, the maximum design flows have only been marginally increased in some areas and can be passed through the process structures with suitable freeboard.
- Construction of the works within the Reactor tanks is best conducted with a Reactor taken offline one at a time. FRW plans to conduct installation works with each tank off-line sequentially with a TEP in place. FRW is currently seeking an extension of the existing TEP in order to allow sufficient time to complete these works. It would be prudent to assume a downtime of 10 weeks for each tank, though it is expected an experienced team could halve this timing. If it is not possible to take a Reactor offline, the installation and construction process will be more complicated and subject to higher risk of not achieving the required outcome. It will also be more costly and reduce the life of the constructed works.
- FRW should be prepared for the fact that some repair of the existing concrete tank below water level is required and should make plans for carry out any urgent repairs that may arise.

2. Introduction

In its current configuration and operating state, South Rockhampton STP (SRSTP) achieved a median performance of 10BOD / 11SS / 30TN / 5TP with a hydraulic load of ≈19,000EP (4.65ML/d, 250L/EP/d) for the 2012 calendar year.

Fitzroy River Water (FRW) proposes to undertake an interim upgrade of the SRSTP to ensure compliance with existing Licence conditions for loads up to 27,200EP.

The existing licence permits a total nitrogen (TN) load discharge of 1,380kg/wk for North, South and West Rockhampton STPs combined. With a diversion of WRSTP flows to SRSTP, and expected performance of NRSTP, the expected required effluent median TN is 13mg/L to meet the Licence load requirement (*FRW Brief 2013*).

SRSTP was not designed to specifically remove nitrogen (or phosphorus). Subsequently, the interim upgrade involves modification of the current configuration to a modified Ludzack Ettinger (MLE) process.

To minimise the capital cost associated with an interim upgrade, FRW require that only existing tankage is to be utilised. The following modification are expected to be made:

- Provision of a 5xADWF A-Recycle using new A-Recycle Pumps and Pipe from the end of the Aerobic Zone back to the Anoxic Zone in each process train.
- Establishment of approximately 50% Anoxic and 50% Aerobic Zones by installation of a baffle in each process train.
- New Diffusers, DO analysers, blowers and aeration control.

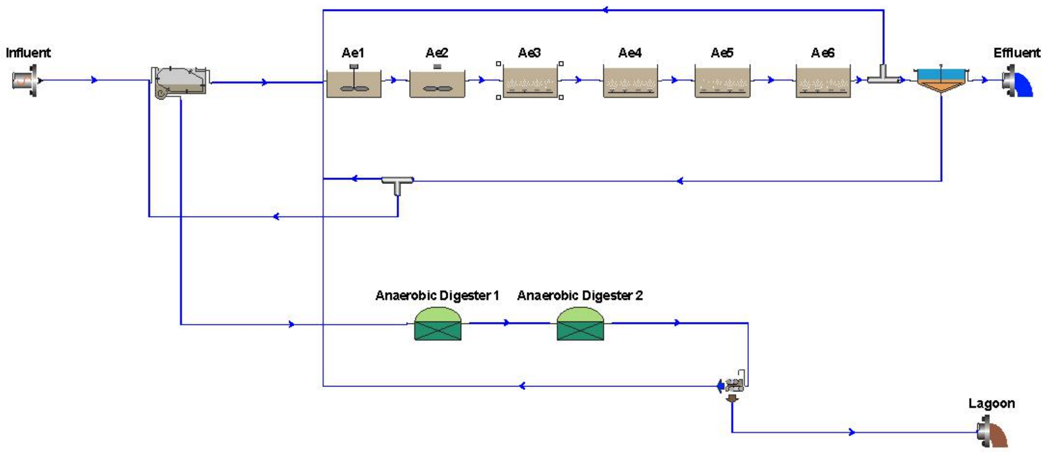
This report validates the proposed FRW modification in terms of achieving both process requirements using Biowin™ simulation software and hydraulic requirements using static model techniques.

The amenability of the proposed interim upgrade configuration to a larger future upgrade (which is likely to incorporate MBR technology) is also briefly discussed.

3. Process Modelling

3.1 Process Model

A Biowin™ process model was developed for the proposed MLE process at SRSTP and run with an influent load of 27,200EP. The process configuration is shown below:



3.1.1 Model Assumptions

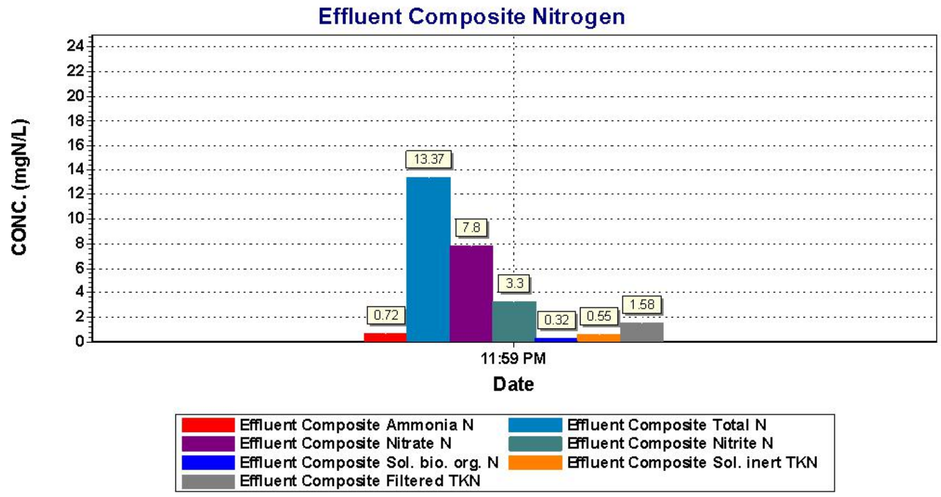
The following modelling assumptions are noted:

- ADWF of 6.8ML/d (based on 250L/EP/d) at 27,200EP.
- PDWF / ADWF = 1.75, based on diurnal flow profiles provided by FRW.
- PWWF = 3xADWF and Abnormal Maximum Flow = 5xADWF.
- Modelling of wet weather flows is not considered.
- Assumed raw sewage characteristics are less than or consistent with measured values (as provided by FRW based on several flow weighted composite sampling events for previous months), and are as follows:
  - 520mgCOD/L
  - 55mgTN/L and 38mgNH_3/L
  - 10mgTP/L
  - 260mgTSS/L and 225mgVSS/L
  - pH is 7.8 and average temperature is 25°C.
- Default Biowin kinetic and stoichiometric settings have been applied.
- Primary Settling Tank (PST) solids removal performance is 55%.

- Modelling showed that an MLE configuration with 50% anoxic and 50% aerobic fraction provided the best overall nitrogen removal performance. Importantly, it is assumed there is no back mixing between zones. Discussion is provided is subsequent sections.
- A DO profile in the aerobic fraction of 1.5mg/L, 1.75mg/L, 0.5mg/L. A lower DO is set in the final aeration fraction to minimise DO carryover to the anoxic fraction via the A-Recycle, to help conserve rbCOD required for denitrification.
- A-Recycle operates at 5xADWF (ie, max instantaneous flow of 690L/s total, or 345L/s each Stage).
- Waste activated sludge (WAS) is wasted via the PSTs to the anaerobic digesters.
- Alum dosing is **not** provided for chemical phosphorus removal or trimming.
- Caustic dosing is not provided for alkalinity supplementation.
- RAS rate of 11.6ML/d maximum (or 1.7xADWF)
- Sludge settleability (SSVI) of 120mL/g and peak hydraulic flux at 3xADWF result in a maximum MLSS of less than 3,100mg/L in the bioreactor. (Note that clarifier solids flux is the limiting process parameter.)
- Clarifier effluent TSS performance of ≈10mg/L median under ADWF conditions.
- Anaerobic digester volume of 1.2ML each (assumes digesters have been cleaned out).
- Digested sludge (DWAS) is stored (and eventually removed from a lagoon at a concentration of 7% dry solids. Supernatant is returned to the main process.

3.1.2 Model Results

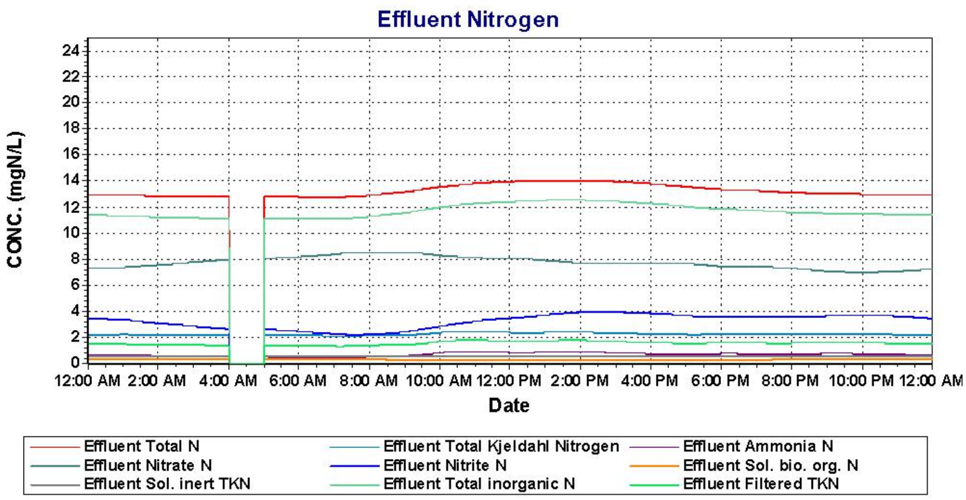
A diurnal day simulation was undertaken to assess the expected process performance and operating conditions at 27,200EP. The resultant sludge age is 7.4 days (4.04d SRT / 55% capture of PST co-settled WAS), at a Bioreactor MLSS of <3100mg/L. The solids production of the system is estimated as 952kg/d SS produced from the sludge lagoons. Actual solids production will depend on actual residence time in the sludge lagoon.



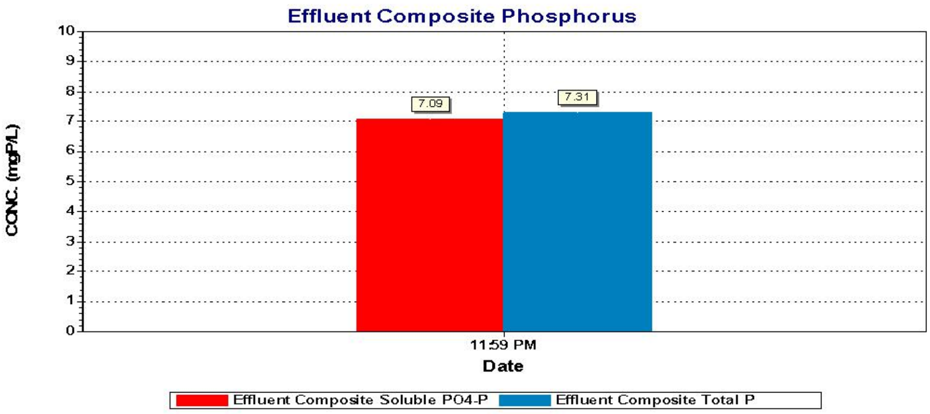
The diurnal process simulation predicts a median time weighted effluent TN of 13.4mg/L, which marginally exceeds the required effluent quality. It is noted that the bulk of the nitrogen is in the form of nitrate (7.8mg/L), then nitrite (3.3mg/L) and ammonia (0.72mg/L) – as shown above.

The diurnal effluent nitrogen profile shows a slight increase with load, and exhibits a no flow period were effluent is not produced. At 27,200EP, the nitrogen species profile shows that the reactor is overloaded in terms of nitrification capacity with relatively high concentrations of nitrite. Increasing the aerobic fraction (ie 60%) would improve nitrification performance and reduce ammonia breakthrough, however denitrification performance would be reduced. Overall nitrogen removal is hence noted to be constrained as the denitrification performance is also limited as indicated by the presence of high nitrate concentrations. Therefore to improve nitrogen removal, additional reactor volume and biomass inventory is necessary, including additional compartments, and will need to be provided at future upgrades of the facility.

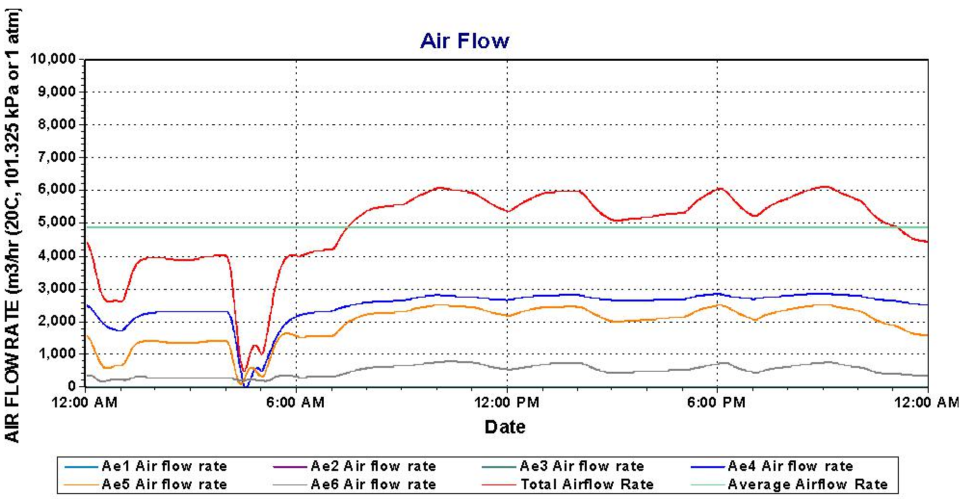
The process model has been set up and simulated for near complete nitrification of ammonia to reduce the toxicity of the effluent to the receiving environment. This is a significant reduction in ammonia load compared to the current SRSTP, significantly improving the facilities environmental impact. Selection of lower Aerobic Zone DO conditions may provide lower overall effluent TN concentrations through reduced nitrate concentrations resulting from increased availability of COD for denitrification. Operating the process for overall total nitrogen removal performance over ammonia removal performance may be an option as the current Licence does not indicate specific ammonia concentration criteria. Conversely, selecting higher DO setpoints in the aerobic zone through the diurnal period will reduce ammonia breakthrough. Manipulation of the DO setpoints will provide the degree of control required to optimise nitrogen removal as required.



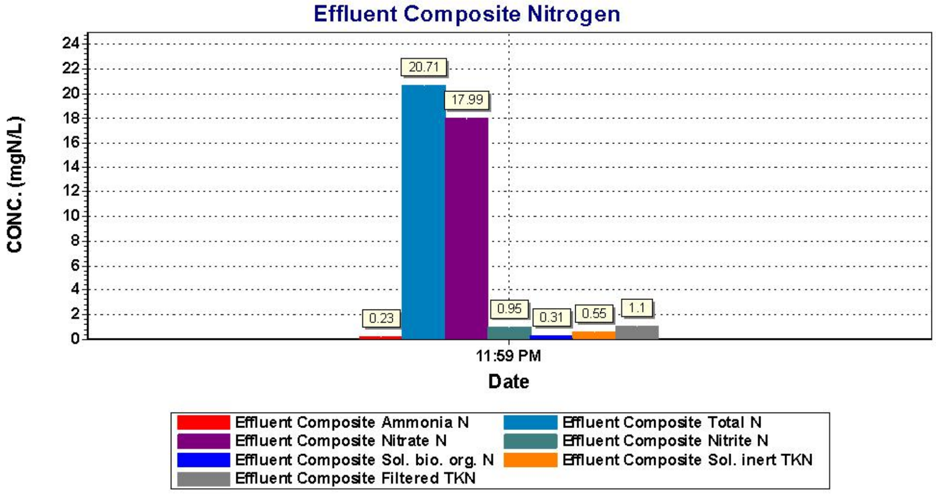
The median time weighted effluent total phosphorus (TP) concentration is 7.3mg/L. This is expected as there is no provision for Enhanced Biological Phosphorus Removal (EBPR) in the process. Phosphorus reduction is by endogenous mechanisms. If phosphorus has to be reduced, alum dosing is the simplest technique, however the additional inorganic solids contribution should be assessed as this is likely to reduce nitrogen removal caused by additional chemical solids loading effectively reducing the active biomass sludge age. Alkalinity and/or pH buffering may also be required depending on the degree of alum addition.



Airflow is also modelled over the diurnal period. Expected airflows are presented below. The expected median peak daily airflow is 6,000m^3/hr (NTP.), and a median average daily airflow of 4,800m^3/hr (NTP) for an assumed alpha of 0.5. *Note: NTP = 20°C (293.15 K) 1atm (101.325kPa) Density 1.204 kg/m^3*. Based on commonly available 230mm disc diffusers, it is expected that the required diffuser density is feasible, with a coverage of ≈20% of the floor area. Approximately 600 diffusers per tank (total of 1200 diffusers) will be required. Conceptually the aerobic zone of each train may be arranged with 3 equally sized diffuser grids, with Grids 1 and 2 comprised of ≈240 diffusers each (20% density) and Grid 3 comprised of ≈120 diffusers (10% density). Airflow rates per diffuser equate to ≈4.5Nm3/hr on average, ≈6Nm3/hr at peak. In terms of high flow protection, if all three blowers are operated for a typical duty/duty/standby blower system, the abnormal peak airflow per diffuser is ≈8.5Nm3/hr. It is noted that later conversion to MBR is likely to require a greater density of diffusers in the primary aerobic zone. Thus reusing the diffusers may require some modification to the grid design.

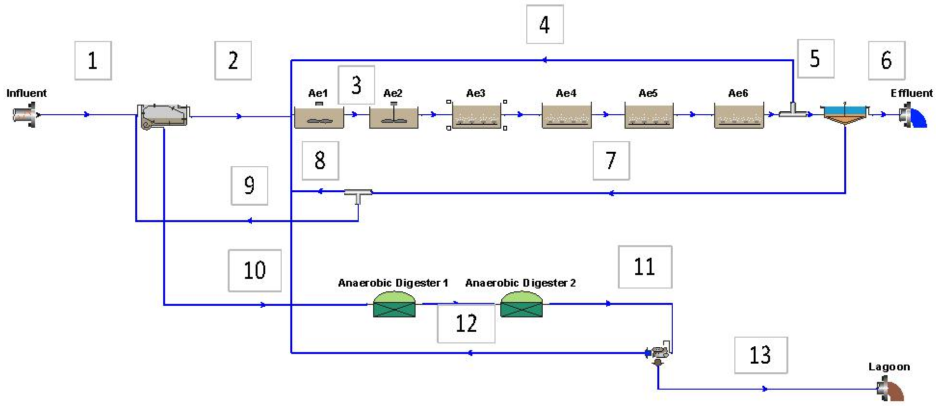


DO back mixing from the aerobic fraction into the upstream anoxic fraction is expected if a baffle wall is not installed. The impact on nitrogen removal is shown below as a time weighted composite result. The reduced denitrification performance results in TN increasing from ≈13mg/L to ≈21mg/L. Hence it is proposed to install a baffle wall between the anoxic and aerobic fractions (Refer **Section** 5).



3.2 Mass Balance

A mass balance of the modelled system is provided below based on noted assumptions in **Section 3.1.1**.



No.	Stream	ADWF	PDWF	PWWF	PIF	PIF per Stage	Abnormal Flow
-	Units	(ML/d)	(ML/d)	(ML/d)	(L/s)	(L/s)	(L/s)
1	Raw Sewage	6.8	11.9	20.4	236	118	394
2	PST Effluent	7.05	12.15	20.65	239	120	396
3	Mixed Liquor	52.45	83.05	91.55	1060	530	1217
4	A-Recycle	34	59.5	59.5	689	344	689
5	Bioreactor Effluent	18.45	23.55	32.05	371	185	528
6	Effluent	6.79	11.89	20.39	236	118	393
7	RAS & WAS	11.66	11.66	11.66	135	135	135
8	RAS	11.34	11.34	11.34	131	131	131
9	WAS	0.32	0.32	0.32	4.4	4.4	3.7
10	Primary Sludge (Co-Settled)	0.07	0.07	0.07	0.8	0.8	0.8
11	DWAS	0.07	0.07	0.07	0.8	0.8	0.8
12	Lagoon Supernatant	0.06	0.06	0.06	0.7	0.7	0.7
13	Lagoon Sludge	0.01	0.01	0.01	0.1	0.1	0.1

Also refer to supplementary drawings detailing the Process Flow Diagram (PFD) and Mass Balance.

The PFD and mass balance shall be used for determination of the hydraulic capacity (Refer **Section** 4).

4. Hydraulics

Based on the design flow rates identified in **Section 3.2**, a review of the plant hydraulics has been undertaken to demonstrate that the upgrade will perform satisfactorily. A basic hydraulic grade line drawing has been prepared to show the water levels in key structures for the maximum hydraulic design loads.

Key points arising from the hydraulic assessment are as follows:

- The maximum design flows can be passed through the process structures with suitable freeboard.
- The Primary Settling Tanks and Secondary Sedimentation Tanks have the least freeboard, however the freeboard is comparable to that of the original design (flow rates through these structures are within 7-8% of the original design flow ratings, based on existing drawing information).
- Allowance has been made for all incoming plant flow through one channel of the PTA structure.
- The HGL is based on 2 parallel process streams in operation.

FRW may consider reducing the freeboard to ≈300mm by raising the Bioreactor outlet weirs to achieve an additional 5-6% reactor volume. For a reduced freeboard, the hydraulics should be confirmed in the case were all flows are accepted by a single stage.

5. Constructability

5.1 Introduction

The interim works proposed by FRW for MLE augmentation to increase nitrogen removal capacity and delay major augmentation of the facility are relatively minor and involve the installation of the following:

- New Blowers and Diffusers,
- New A-Recycle Pumps and pipework (each Reactor),
- New baffle installed between Anoxic and Aerobic Zones (each Reactor)
- Ancillary components (DO probes etc), electrical works and control system.

It is intended that the blowers and diffusers are retained for the major augmentation where possible. The existing tanks are not being modified and hence the interim works do not impede future proposed major augmentation. A-recycle pumps may also be reused in the future augmentation provided their condition and sizing allows this.

It is highly likely that an MBR installation will be incorporated in the future major augmentation. If so this will require new tankage. It is noted that installation of membranes into the final settling tanks is not possible as these tanks are not sufficiently deep enough to accommodate the membrane cassettes currently on the market (a minimum depth of 3.3m is required). The installation time for the cassettes and associated pipework would also pose problems with providing sufficient clarification capacity while work occurs.

The process modelling conducted indicates the benefit to nitrogen removal capacity of the process if a baffle is installed between the Anoxic and Aerobic Zones of each Reactor. The baffle reduces potential for DO leakage and back mixing into the Anoxic Zone. If a baffle is not provided then the effectiveness of denitrification is greatly reduced. It is therefore recommended that a baffle is installed for optimal nitrogen removal performance from the available tank volume.

Construction of the works in the Reactor tanks will pose some challenges, particularly if it is considered mandatory to maintain tank operation during the Works. It is noted that taking a reactor offline for works will reduce the effluent quality in terms of total nitrogen concentration. Subsequently FRW is seeking the extension of the current TEP to allow reduced treatment performance when taking Stages offline sequentially for modification works, including the installation of baffle walls, diffusers and the A-recycle system. It would be prudent to assume a downtime of 10 weeks for each tank, though it is expected an experienced team could halve this timing.

5.2 Construction with Both Reactor Tanks Operational

As noted this is a more difficult construction process. Typically, the weight of each item is used to provide a stable location – however this invariably leads to small movements and vibration, both of which tend to stress the item and cause earlier failure than would otherwise be the case. Comments on each of the key elements of the work are provided below.

5.2.1 Baffle Wall

Each baffle wall will need to fully prefabricated outside the tank and installed using its weight and whatever top restraint can be provided to minimise vibration and movement. The options are:

- Precast concrete. This is preferred as it has the longest life and is very durable. The weight is such that it can typically be hung from the top of the tank and rest on the floor with minimal side restraint. A narrow opening would be provided on each side of the wall and a larger slot under the wall.
- Marine grade timber (a hardwood such as iron bark may be suitable). This may be cheaper than concrete but will also have a more limited life (probably 20-30 years). Care needs to be taken to minimise gaps between the planks of timber and the inevitable movement that will occur. It is preferable to arrange "feet" at 90° to the baffle wall that rest on the tank floor and provide some resistance to the wall moving, in

combination with as much restraint as is possible at the top of the wall. Openings at the side and bottom as per the concrete wall.

- The cheapest solution is usually a steel frame with heavy duty GRP sheeting. A galvanised steel frame with an additional high build epoxy coating may provide a life of around 10 years. If grade 316 stainless steel is used then the frame itself will have a longer life but the GRP sheeting is the weak link. It would require replacement after about 10 years before it begins to disintegrate. Note that fixings need to be SS316 and should have a high degree of redundancy as the GRP tends to vibrate. The lightweight of this construction makes it difficult to hold the wall firmly in place so inevitably precast concrete blocks are need as "feet" to stabilise the wall.

Based on the above a concrete wall is preferred as it is a more reliable solution and could be readily incorporated into the future upgrade. The GRP and steel frame solution is not advised as it requires very careful fabrication and installation to avoid damage and even then will have a short life.

5.2.2 Diffusers

It is essential that each diffuser grid is level and that all diffusers grids are at approximately the same depth, as otherwise there will be variance in air distribution, which can also create rolling movements of the mixed liquor and generally compromise aeration efficiency.

It is expected that a more robust (than normal) diffuser grid will be required as the floor and wall guides will not be as secure as normal. Guides will need to have concrete weights to allow them to sit reasonably securely on the floor. Wall guides will also need a bottom weight to position them. Even so, divers will be required to check that the weights sit firmly on the floor and it will be advisable to use divers when installing grids to ensure they do not clash with other grids and are seated securely. Having installed the grids it will be advisable not to remove them frequently, so an acid injection system for regularly cleaning the diffusers in situ is recommended.

5.2.3 A-Recycle

The main issue with the A-recycle is installing the pumps, which typically have guide bars and a lower mounting pedestal fixed to the tank floor. Once again the use of a precast concrete pad onto which the pump is likely to the best approach. The riser pipe should be a flexible pipe if possible.

5.2.4 Other Works

Other works are generally above water level or away from the tank and while they will need careful attention they do not pose the same issue as underwater work. Care does need to be exercised when working on top of the tanks and the safety issues involved will invariably increase the cost of this work.

5.2.5 Conclusion

For this scenario it is recommended that the design and installation method be developed in collaboration between FRW, the designer and relevant contractors and suppliers for a safe and effective outcome. It is likely that number of plant shutdowns will be required (mainly for electrical works) but these can generally be short in duration and programmed when to occur when flow is at its lowest.

5.3 Work with One Tank Off Line

Taking each tank off line is clearly preferable from a construction and cost perspective. Note that the work will still be near operating tanks and hence there will still be a safety premium to pay, but not as much when both reactor tanks remain on line.

To minimise tank downtime, it advisable to prefabricate all items prior to taking a tank off line. Note that each tank will need to be dewatered and cleaned out, which can take a 1-2 weeks depending on the condition of each tank. If the concrete is in poor condition below water level then it is highly preferable to address this at the time, however this can easily add 8 weeks to each tank being off line, due to the need to allow the concrete to dry out prior to carrying our repairs (normally such repair require epoxy mortars which, in turn, require dry concrete). Hence it may be pragmatic to only address major issues with cementitious repair products (which can be used with damp concrete) and delay more extensive repairs until additional tankage is available. SKM experience is that there will be defects in the existing tankage and this underlines the need for FRW to be in a position to expedite the major upgrade as soon as funding becomes available.

With each tank off line and clean, the baffle walls can be carried out by installing a precast wall by lowering the wall into place, packing and levelling on shims, grouting voids, and connecting the baffle to the top of the side walls with support brackets and bolted connection. Alternately the baffle could be connected to the side walls by concrete wet joints approximately 500mm wide or shear nibs either side of the wall. This will take 1-2 weeks depending on the method used and expertise of the construction crew.

Taking the Reactor offline will also enable easier installation of the diffusers, notably the location guides fixed to the tank wall and floor. It will also allow a more normal A - recycle system to be installed.

Allowing only for minor concrete repairs and using an experienced construction crew, it is feasible to carry out the works in each tank over a 5 week time from, from stopping flow to restarting. However, this assumes all materials and prefabricated items are on site ready to go, and works outside the tanks are generally complete. If minimal problems are encountered the work could be completed earlier. Wet weather will also delay the work.

5.4 Concluding Remarks

SKM re-iterates the end for an experienced crew to do this work regardless of whether the tank is on or off line. SKM strongly suggests that use of an experienced team is a more important criteria than lowest cost – a cheap offer that ends up with delays and poor work will ultimately cost FRW a lot more than the initial price.

6. Conclusion

This report has found that:

- It is expected that the MLE process can achieve close to 13mg/L, based on the process modelling assumptions used. FRW additionally note that a relatively conservative TN target of 10mg/L at 2020 for North Rockhampton STP (NRSTP) allows some safety margin for slightly reduced performance at SRSTP to meet the current overall load based licence for NRSTP, SRSTP and Gracemere. Going forward, it is strongly recommended that FRW monitor raw sewage characteristics and if they vary materially from those assumed here then appropriate action should be taken. Indeed, we would also recommend doing this at both NRSTP and Gracemere so that FRW has a sound body of data on which to make future decisions.
- It is imperative that a baffle wall be provided to properly compartmentalise the tanks into well defined anoxic and aerated zones (primarily to avoid DO back mixing into the anoxic zone). Not doing so will significantly increase total nitrogen and cause licence exceedance at the anticipated plant loading of 27,200EP.
- At a loading of 27,000EP, the converted MLE plant does not fully denitrify and will run on a "knife edge" in terms of meeting the TN removal objective of 13mg/L. A particular constraint of the process is solids flux capacity of the clarifiers, which defines the allowable system biomass. Hence FRW needs to be ready to implement a more stable and permanent upgrade before load reaches 27,200EP.
- Total phosphorus is relatively high. If this needs to be controlled alum can be readily utilised. However any appreciable alum dosing may reduce capacity (due to additional chemical solids in the system) and possibly reduce nitrogen removal potential.
- Hydraulically, the maximum design flows have only been marginally increased in some areas and can be passed through the process structures with suitable freeboard. FRW may consider reducing the freeboard to approximately 300mm by raising the outlet weirs to achieve an additional 5-6% reactor volume. For a reduced freeboard, the hydraulics should be confirmed in the case were all flows are treated by a single stage.
- Construction of the works within the Reactor tanks is best conducted with a Reactor taken offline one at a time. FRW plans to conduct installation works with **each** tank off-line sequentially with a TEP in place. FRW is currently seeking an extension of the existing TEP in order to allow sufficient time to complete these works. It would be prudent to assume a downtime of 10 weeks for each tank, though it is expected an experienced team could halve this timing. If it is not possible to take a Reactor offline, the installation and construction process will be more complicated and subject to higher risk of not achieving the required outcome. It will also be more costly and reduce the life of the constructed works.
- FRW should be prepared for the fact that some repair of the existing concrete tank below water level is required and should make plans for carry out any urgent repairs that may arise.

Appendix A. FRW Brief

The FRW brief is provided overleaf.

Proposal for Upgrading of South Rockhampton STP

Summary
Upgrading of the South Rockhampton STP (SRSTP) is required to improve its ability to consistently remove nitrogen and to ensure that the combined weekly 50%ile effluent Total N limit for the three Rockhampton STPs is consistently met. Based on consideration of existing loadings to the SRSTP and also the West Rockhampton STP (WRSTP), an interim upgrade is possible that would deliver sufficient capacity to cater for the eventual transfer of inflow from the West Rockhampton Sewerage Scheme to the SRSTP and the growth in loadings of these two catchments up until 2020. The upgrade works proposed below can be done at a relatively low cost and are generally compatible with further augmentation options that are achievable once sufficient additional capital funding is available. The completion of these relatively low cost upgrades at the SRSTP allows for available capital funding to be directed to the augmentation of the Gracemere STP in order to ensure it can meet future anticipated population growth.

Background
The three Rockhampton STPs are currently not consistently meeting their consolidated weekly 50%ile load-based licence limit for total nitrogen. All other licence limits for this consolidated licence are currently consistently met. The inability to consistently meet the weekly 50%ile effluent Total N limit is due primarily to the lack of sufficient nitrogen removal by the SRSTP and WRSTP which currently produce final effluents that typically contain Total N in the range of 25 to 35 mg/L. These two STPs (conventional activated sludge and trickling biofilter respectively) were not specifically designed to achieve nitrogen removal and as such improvement in their ability to consistently remove nitrogen without significant modification or process redesign is not readily possible. By contrast, the North Rockhampton STP (NRSTP, an extended aeration design) is capable of consistently achieving significant levels of nitrogen removal and is consistently producing a final effluent with Total N less than 10 mg/L and often less than 5 mg/L.

Typical performance with respect to meeting the weekly 50%ile effluent Total N limit is represented in Table 1. For further detailed description of this performance refer to the accompanying STP strategic planning study prepared by SKM (2013).

Table 1. Typical current performance since March 2013 of each of NRSTP, SRSTP and WRSTP towards meeting the weekly 50%ile effluent Total N limit.

	NRSTP	**SRSTP**	**WRSTP**
Ave. Daily flow (L)	10,000,000	5,500,000	1,600,000
Ave. Effluent TN (mg/L)	6	30	26
Weekly TN load (kg)	420	1,155	291.2
Total Weekly Load	**1,866.2 kg (weekly 50%ile limit = 1,380 kg)**		

Based on the indicated typical current performance of each STP in Table 1, it is clear that the relatively poor level of nitrogen removal by SRSTP and WRSTP is the main cause of the current inability to consistently meet the weekly 50%ile effluent Total N limit.

The average daily inflow data presented in Table 1 includes a number of periods where significant rainfall led to increased inflows to each STP. Based on inflow data recorded in the June and July 2013, the approximate average dry weather flows (ADWF) for each STP are as follows:

- NRSTP = 10.0 ML/d
- SRSTP = 5.0 ML/d
- WRSTP = 1.2 ML/d

The information provided in Table 2 uses the ADWF values for each STP listed above to indicate the effluent Total N required in order to consistently meet the combined 50%ile weekly Total N limit of 1,380 kg/week based on current loadings. The average effluent Total N concentration indicated for NRSTP and WRSTP is deliberately conservative in order to demonstrate what a more realistic Total N for SRSTP would need to be to consistently meet the 1,380 kg/week limit. Table 2 also provides an indication of future scenarios based on population projection data as presented in SKM (2013) and the required effluent Total N targets to meet the weekly 50%ile Total N load limit.

Table 2. Effluent Total N required at SRSTP to consistently meet the combined 50%ile weekly Total N limit for based on; Scenario 1, current STP performance with WRSTP separate to SRSTP; Scenario 2, with all flows to WRSTP are diverted to SRSTP; and Scenario 3, with increased flows expected with future population growth

Scenario 1 with current ADWF and three separate STPs				
	NRSTP	**SRSTP**	**WRSTP**	
Ave. Daily flow (L)	10,000,000	5,000,000	1200,000	
Effluent TN (mg/L)	8	15	30	
Weekly TN load (kg)	560	525	291.2	
Total (kg/week)	1,376.2 (Licence limit = 1,380 kg/week)			

Scenario 2 with 2016 NRSTP flow and WR flows diverted to SRSTP			
	NRSTP		**SRSTP + WR**
Ave. Daily flow (L)	10,400,000		6,490,000
Effluent TN (mg/L)	8		13
Weekly TN load (kg)	582.4		590.6
Total (kg/week)	1,173 (Licence limit = 1,380 kg/week)		

Scenario 3 with 2020 NRSTP flow expected with future population growth			
	NRSTP		**SRSTP + WR**
Ave. Daily flow (L)	10,800,000		6,800,000
Effluent TN (mg/L)	10		13
Weekly TN load (kg)	756		618.8
Total (kg/week)	1,374.8 (Licence limit = 1,380 kg/week)		

Scenario 2 and 3 represent the increased loadings expected to each STP by 2016 and 2020 respectively (based on SKM 2013), so achieving the effluent Total N target of 13 mg/L at the SRSTP has the potential to ensure compliance with the combined 50%ile weekly Total N limit for at least the next 5 years.

Objective
The overall objective of this proposed upgrade is to deliver improved performance to the SRSTP to consistently achieve effluent Total N of <13 mg/L assuming the diversion of WRSTP inflows to SRSTP by 2016. This upgrade will enable the three Rockhampton STPs (and then two STPs after the decommissioning of WRSTP) to consistently meet the 50%ile weekly Total N limit for potentially at least 5 years until further capital funding is made available for upgrades to be completed to satisfy longer term capacity demands.

The proposed upgrade will be achieved by completing the following works:

- Convert the existing conventional activated sludge plant into a Modified Ludzack-Ettinger (MLE) design configuration by retaining the parallel configuration of the existing primary sedimentation tanks and aeration tanks.
- Improve the aeration capacity through the installation of fine bubble diffused aeration into each of the existing aeration tanks.
- Create an anoxic zone in the front of the aeration tanks to receive the A-recycle flow and deliver improved nitrate reduction
- Install a pump at the downstream end of each of the aeration tanks to create an A-recycle in the aeration tanks

Further design detail for each element of the proposed works is provided below.

Constraints/Opportunities
The following points constrain the extent of the upgrade works being considered at this time and form the basis for the short to medium term design horizon targeted by the proposed works:

- Council is currently not in a position to fund a long-term upgrade/augmentation of the SRSTP due to other capital investment priorities including the planned augmentation of the Gracemere STP (GSTP) which is expected to commence a detailed design stage in the coming months prior to commencement of construction in 2014/15.
- The existing SRSTP design configuration is not readily amenable to being upgraded to augment capacity to satisfy long term capacity requirements (i.e. beyond 2020) without significant re-configuration of the existing tankage and process flow. Completing an upgrade of this extent would likely require capital investment in excess of $10 million (SKM 2013) which is not currently available.
- Assuming that the North Rockhampton STP (NRSTP) continues to consistently achieve an effluent Total N of <10 mg/L up to an average daily inflow of 10.8 ML, in order to achieve the combined 50%ile weekly effluent Total N limit of 1,380 mg/L the SRSTP will need to consistently achieve an effluent Total N of <13 mg/L. BioWin modelling of the proposed upgrades indicates that this level of nitrogen removal is possible to achieve consistently – see below for further detail.

- The WRSTP has reached the end of its useful life and has been earmarked for decommissioning once a new sewerage rising main has been constructed to enable diversion of the flows from the West Rockhampton catchment to the SRSTP. There is limited potential for significant future growth in the West Rockhampton catchment.

Design Considerations

Conversion to MLE

The existing SRSTP is relatively amenable to being converted to an MLE design configuration although such a conversion can be done in a number of different ways that vary according to the capital cost and the increased capacity gained.

An example of the type of upgrading that is possible to achieve a significant long term increase in capacity involves modifications to the existing SRSTP that would change the existing PST and aeration tanks to operate in series rather in parallel and would also include other significant works that would cost in the vicinity of $10M (SKM 2013). This SKM-proposed upgrade is based on achieving an effluent Total N concentration of 5 mg/L at a loading of up to 25,000 EP. An alternative interim upgrade is proposed here that would see the parallel mode of operation of the existing PST and aeration tanks retained in order to achieve a cost effective increase in capacity to service the increase in loadings expected for at least the next 5 years. Based on the projected increase in loadings outlined in Table 2 (see Scenario 3) above, this alternative upgrade will achieve an effluent Total N concentration less than 13 mg/L at a loading of up to 27,200 EP (based on 250 L/EP/d) which equates to the combined flow from the West Rockhampton and South Rockhampton catchments at the year 2020. This alternative upgrade is estimated to cost less than $1,000,000 to complete.

BioWin modelling was performed to confirm this as an option that included the design configuration shown in Figure 1 and the design assumptions listed in Table 3. The configuration and modelling conducted in BioWin was done on half the existing tankage (i.e. one of the parallel treatment trains) and half the inflow rate for simplicity of modelling.

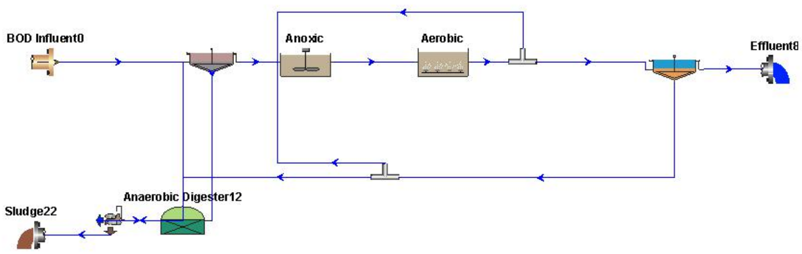


Figure 1. Configuration of SRSTP used for BioWin modelling.

Table 3. Design Configuration and Assumptions for BioWin modelling of a MLE-converted SRSTP.

Tank Configuration	Design Details
PST	Retained as is with 22 m diam. and 2.2 m depth with default BioWin settings used.
Anoxic Zone	Front 40% of each existing aeration tank to be converted to an anoxic zone by retaining and capping the air-intake on the existing 15 kW submersible jet aerators to provide mixing. The anoxic zone measures at least 12 m long x 10 m wide x 3.6 m deep but would be adjustable as required through manipulation of the DO setpoints in the front portion of each aeration tank in the zones containing fine bubble diffused aeration.
Aeration Tanks	Fine bubble diffused aeration covering the downstream 60% area of each of the existing aeration tanks (20 m long x 10 m wide x 3.6 m deep assuming a 200 mm raise in weir height).
Fine Bubble Diffused Aeration (FBDA)	Two positive displacement blowers will be installed in the top of the site pump station building with control via variable speed drive and an air delivery system will provide sufficient flow for grids of disc diffusers to achieve 10% diffuser density in the downstream two-thirds of each of the aeration tanks. DO to be maintained at 2.0 mg/L.
A-recycle	Constructed in each of the existing aeration tanks to transfer mixed liquor from the downstream end of each aeration tank a distance of 24 m to the front portion of the proposed anoxic zone to be created the upstream end of each existing aeration tank. The A-recycle will be achieved using flow of up to 400 L/s delivered by vertically-installed axial flow pumps connected to a transfer pipe that is suspended from the centre walkway in each aeration tank or alternatively along the inside of the outer wall of each tank using the existing baffle walls as supports. The assumed recycle rate is 5-times the hourly averaged inflow rate. The typical maximum hourly average instantaneous inflow rate is 90 L/s. Split between the two parallel aeration tanks this is further reduced to 45 L/s.
SST	Retained as is with 22 m diam. and 3.0 m depth, default BioWin settings used.
Return Activated Sludge (RAS)	Retained as is with the option provided (if required) to supply a low flow to the inlet to help limit the generation of H_2S in the PSTs and to manage sludge wasting.
Raw Sewage Feed (based on half-full-sized model)	Flow = 3.4 ML/d up to 4.0 ML/d Total carbonaceous BOD = 250 mg/L Total COD = 520 mg/L Volatile Suspended Solids = 225 mg/L Total Suspended Solids = 260 mg/L

Tank Configuration	Design Details
	Total Kjeldahl Nitrogen = 55 mg/L Total Ammonia = 38 mg/L Total Phosphorus = 10 mg/L pH = 7.8 Temperature = 25°C Otherwise default BioWin settings used
Anaerobic Digestion	Volume = 1.2 ML per digestor. BioWin default settings adopted.

Installation of Fine Bubble Diffused Aeration

Air for fine bubble diffused aeration will be delivered by two positive displacement blowers operated in a single duty/standby arrangement. Each of these two blowers (Aerzen GM60, 110 kW) are capable of delivering air flow up to 3160 m^3/h at 70 kPa and will be controlled by variable speed drive to meet the target DO setpoint via PLC/SCADA control. Each blower will be installed in the vacant upper floor of the existing site pump station building (old electrical switchroom) following some minor modifications to strengthen the floor and widen the access opening to this area. This location is above Q100 flood level and located alongside the new electrical switchroom.

Air delivery pipework will be installed using 200 mm (or 250 mm to be confirmed) spiral wound stainless steel pipe to connect the blowers to the existing aeration tanks where it will be split to supply each of four diffuser grids in each aeration tank as per the drawing in Figure 2. Diffuser grids will be fabricated out of stainless steel tubing and will comprise 9-inch disc diffusers (EDI/Sanitaire or equivalent) to achieve the density (10%) and number of diffusers (1092 diffusers) required to meet the target aeration requirement. Diffuser grids will be mounted approximately 250 mm above the floor of each aeration tank on adjustable mounts to allow for levelling of each grid and will then be weighted down using concrete blocks as ballast based on buoyancy calculations for the fabricated grids. Half grids will be installed in front of the 12 m full-length grids to complete the approximately 60% coverage of the floor area of each aeration tank.

Valving will be installed to enable isolation of any of the four of the diffuser grids in each tank if required or to help adjust air flow if required. Pressure sensors will be installed on the supply pipework to each tank to enable checking of the balance of air flow between each aeration tank.

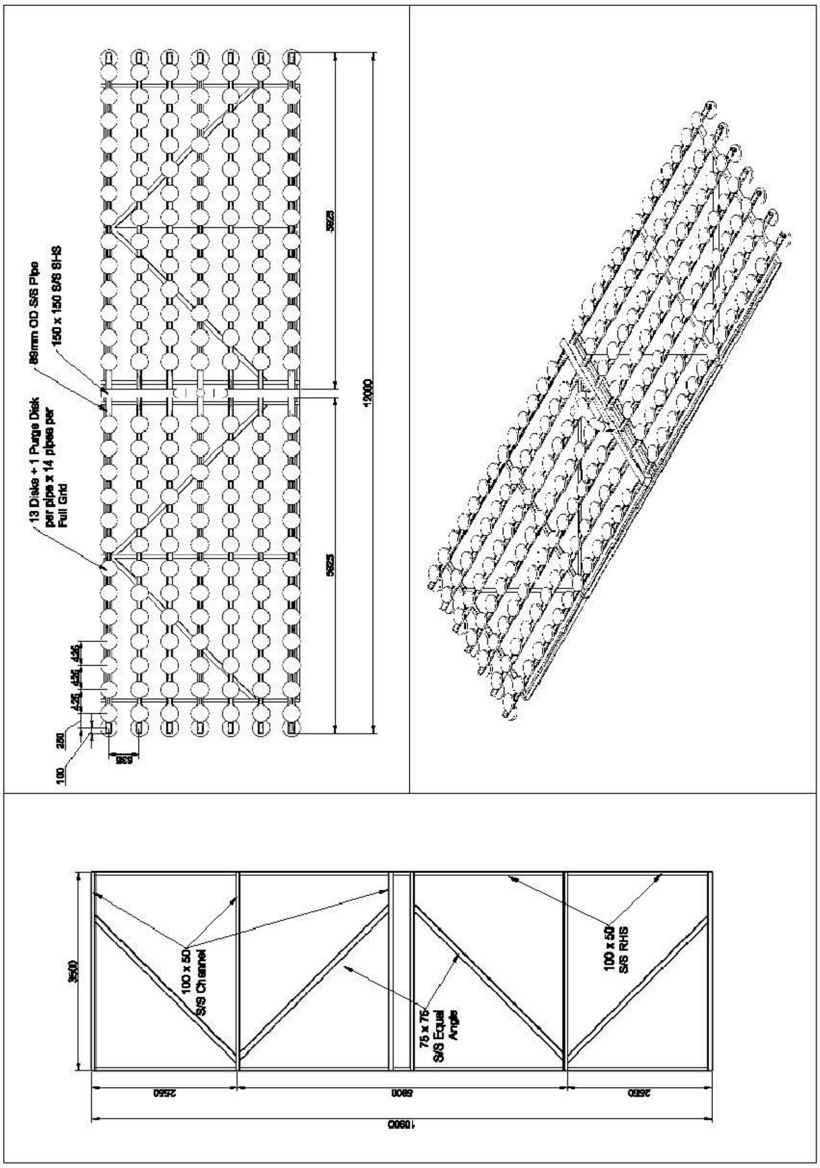


Figure 2. Design of fine bubble diffused aeration grids.

Installation of A-Recycle

Two submersible axial flow propeller pumps (one in each tank) will be installed in the downstream end of each of the two aeration tanks in the corner along the outside wall of each tank. Each submersible propeller pump will be similar to the Flygt PL7030 and will be installed vertically in 500 mm pipework at a depth to be confirmed to minimise vortexing and will be connected by an elbow connection to 500 mm discharge pipework that will convey the mixed liquor back to the front portion of the anoxic zone created in each of the existing aeration tanks. The 500 mm discharge pipework will be of a suitably robust material and will be suitably sized to enable flow of up to 400 L/s and will be installed by supporting it on the existing baffle wall and by mounting it to the side of the aeration tank. The outside wall of each aeration tank is chosen for ease of installation of the discharge pipework and installation of the submersible pumps and also for ease of access for removal of the pumps for maintenance. Longer reach across the tanks is problematic given the high tension power lines located overhead. The existing electrical cabling that supplies power to the existing submersible jet aerators will be able to be modified for installation of the propeller pumps. The A-recycle pumps will be controlled by variable speed drives to allow adjustment of recycle rate via PLC/SCADA control.

8.2 EXPANDED COAL MINE WATER RELEASE PROGRAM FOR THE FITZROY BASIN

File No: **1276**

Attachments: **1. Resources Activities - Mining - Operational Policy 2013-14**
2. Resources Activities - Mining - Guidline

Responsible Officer: **Nimish Chand - Strategic Manager Fitzroy River Water**

Author: **Jason Plumb - Manager Treatment and Supply**

SUMMARY

A pilot program for improved regulation of coal mine water releases in the Fitzroy Basin commenced in November 2012. This trial included four coal mining operations in the Isaac River catchment. In November 2013, the Queensland Government expanded this pilot mine water release program to include all mines across the Fitzroy Basin. The objective of the expanded program is to enable improved mine water management whilst maintaining acceptable water quality in the Fitzroy Basin to meet the needs of stakeholders located downstream. All releases made under this program are to be conducted in accordance with an Operational Policy and Guideline prepared by the Department of Environment and Heritage Protection (EHP). This report provides an overview of the expanded program, the changes made to the program since the pilot commenced in late 2012, and the implications of these changes for water quality in the lower Fitzroy River.

OFFICER'S RECOMMENDATION

THAT the report on the expanded mine water release program be received, and that Council continue to engage actively with the Queensland Government to seek a lowering of the cease release value at The Gap to help ensure that the current program and any future mine water release programs best maintain the highest possible standard of water quality to meet the needs of the community.

BACKGROUND

Careful regulation of mine water releases is required to ensure that mining companies can manage their site water inventories to maximise production and to minimise any cumulative impacts of the mine water releases on downstream water quality in the Fitzroy Basin. In November 2012, a small-scale pilot release program was initiated to achieve an improved level of regulation. Four mining operations in the Isaac River catchment were involved in this pilot that permitted mine water releases to be made under "enhanced environmental authority conditions". An expanded pilot program was announced in November 2013 that provides the same opportunity to all mining operations across the Fitzroy Basin to seek approval to release mine waters under the same style of management conditions.

The expanded mine release program is regulated by EHP and an Operational Policy and Guideline (see attachments) were prepared for the implementation of the expanded program. The Operational Policy defines the "rules" for the:

- application by a mining company for approval to amend their Environmental Authority (EA) to permit additional releases;
- use of "trigger" and "cease release values" based on Electrical Conductivity (EC) readings to manage cumulative impacts of releases;
- suspension of cease release values;
- pre-requisites for enhanced EA conditions;
- additional notification requirements; and,
- contribution by the mining company to an enhanced monitoring program.

The Operational Policy and its merits are discussed below.

COMMENTARY

Application for Amendments to the EA

Mining companies that wish to participate in the expanded release program require amendments to their existing EA in order to do so. This is done by the EA holder negotiating with EHP and providing sufficient evidence based on an environmental assessment to support the site-specific release limits, release rates and downstream flow and quality limits that are proposed by the applicant.

It is stated that this process will be completed with due consideration given to the position of the mining operation within the catchment and any sensitive receptors or downstream stakeholders yet the precise detail (e.g. use of water quality objectives, engagement with stakeholders etc.) of how this is achieved is not defined.

Trigger and Cease Release Values for Managing Cumulative Impacts

Six trigger value sites have been identified at key monitoring stations upstream of the Fitzroy River. The trigger value of 650 µS/cm has been adopted for each of these sites. When EC reaches or exceeds this value, an investigation will determine whether there is sufficient flow and appropriate water quality to provide sufficient dilution to minimise any risk of cumulative impacts. A cease release value of 650 µS/cm has been specified for The Gap on the Fitzroy River. The purpose of this cease release value is to protect the drinking water supplies in the lower Fitzroy River and if required EHP will direct an EA holder to cease releasing.

The establishment of the six trigger value sites appears to provide an improved means of regulating mine releases upstream of the Fitzroy River, although there are concerns that with the potential for whole of Basin releases and variable rainfall/flow conditions across the Basin, the ability to sufficiently monitor and predict the impact of all releases on downstream water quality is limited. Exceedance of the trigger values does not necessarily mean releases will cease and with only one cease release site (The Gap) located close to the bottom of the catchment there are concerns that by the time a cease release value is exceeded it may already be too late. The initial pilot trial had three cease release sites to enable cease release decisions to be made based on upstream EC at Yatton and Coolmaringa also. Another longer term problems exists (e.g. in 2013) where inputs of EC from non-mining sources (e.g. Marlborough Ck) cause EC to increase to well above 650 µS/cm under conditions of no base flow in the Fitzroy River (see Figure 1). This type of event can potentially lead to prolonged periods of high EC in the Fitzroy Barrage Storage.

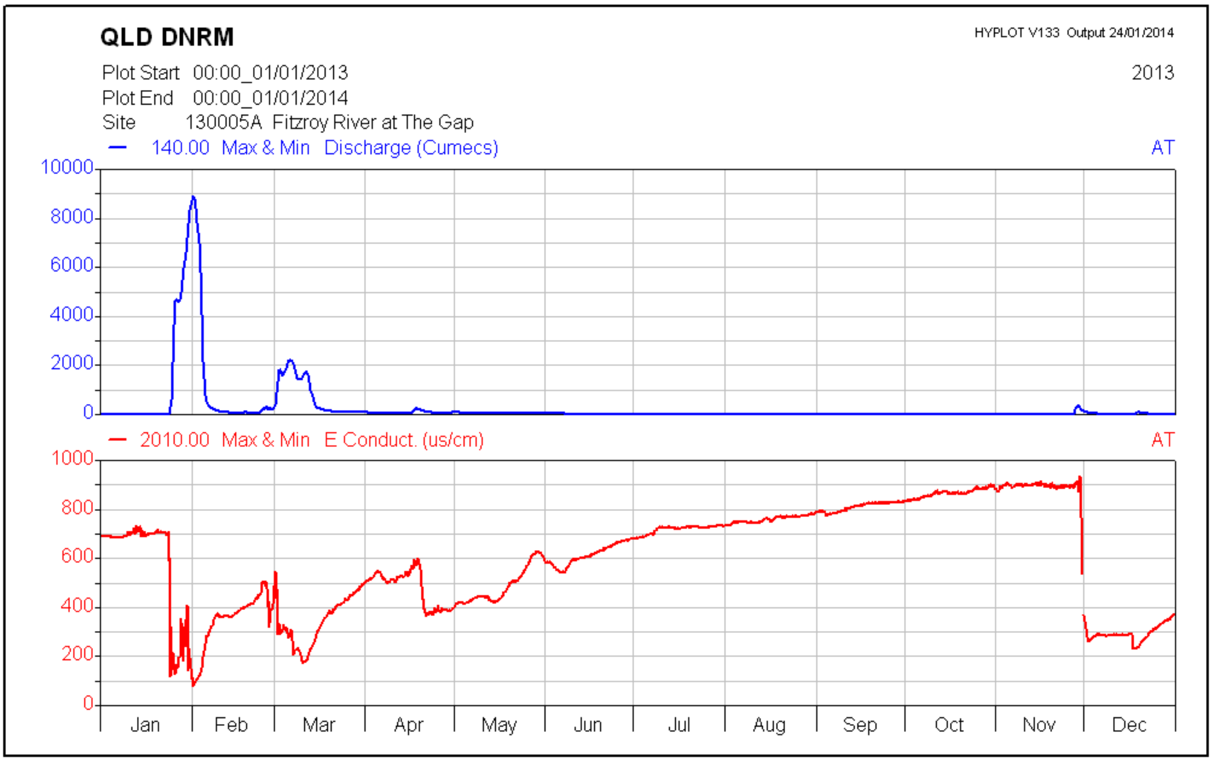


Figure 1. Flow and EC data at The Gap monitoring station during 2013 showing the increase in EC of ~300 µS/cm from June to November with no base flow in the river.

Suspension of Cease Release Values

EHP may decide to suspend the use of the cease release value in circumstances where it appears that sufficient flows are available upstream to minimise any cumulative impacts downstream despite the cease release value being currently exceeded, or where "natural factors" have led to EC exceeding the cease release value prior to the commencement of the wet season. Under these circumstances upstream mine releases could be permitted irrespective of the level of EC at The Gap.

Although consideration would still be given to downstream regional drinking water supplies when making this decision to suspend the cease release, there is a risk that approval to release upstream when there is unacceptable water quality downstream will create significant negative public perception. In recent months, this situation nearly occurred when EC values in the Fitzroy Barrage were approaching 900 µS/cm and upstream mining companies were seeking approval to release mine water. During this period EHP maintained close contact with FRW to manage this situation.

Pre-requisites for Enhanced EA Conditions

Mining operations are required to manage mine water effectively including being able to; keep separate mine-impacted and non-impacted waters; reduce or cease releases if required; reduce or control the amount of mine-impacted water generated; and monitor releases and downstream water quality in real time.

These pre-requisites represent a sensible approach to ensuring that mining operations can control the status of fate of all mine-impacted waters. Continued application of elements of this approach should help to avoid, or at least decrease, the impact of any mine water releases in the future.

Additional Notification Requirements

The enhanced release conditions approved by EHP will require mining operations to notify landholders immediately downstream as well as relevant local government authorities at the commencement of any releases under this program.

This requirement seems a sensible approach to ensuring effective communication and transparency in the community and guidance is provided on the content of the notification which includes the time, duration, location, quatity and quality of the release. The effectiveness of this additional notification is yet to be determined.

Requirement to Contribute to the Enhanced Monitoring Program

Participating mining operations are required to co-fund an enhanced monitoring program managed by the Department of Natural Resources and Mines (DNRM). The requirement to pay a contribution to this monitoring program will be a requirement of EAs and will influence the continued access to enhanced release conditions.

This initiative has the potential to significantly improve the monitoring across the entire Fitzroy Basin which should improve the overall regulation of mine releases. This is turn will help to grow public confidence in the program if it is successful.

CONCLUSION

The enhanced mine water release program currently underway has the potential to improve the regulation of mine water releases, however, there are still opportunities to improve the program to ensure it meets the needs of all Basin stakeholders. Based on recent events Council should engage with EHP to seek a lowering of the cease release trigger value at The Gap.

EXPANDED COAL MINE WATER RELEASE PROGRAM FOR THE FITZROY BASIN

Resources Activities - Mining - Operational Policy 2013-14

Meeting Date: 5 February 2014

Attachment No: 1

Operational policy

Mining

Release of mine-affected water under enhanced environmental authority conditions and management of cumulative impacts in the Fitzroy Basin

Operational policies provide a framework for consistent application and interpretation of legislation by the Department of Environment and Heritage Protection. Operational policies will not be applied inflexibly to all circumstances. Individual circumstances may require an alternative application of policy.

An independent review commissioned by the Department of State Development Infrastructure and Planning, conducted by Gilbert and Sutherland Pty Ltd (Gilbert and Sutherland) into the operation of the 2012–2013 pilot in the Isaac River catchment has found that there is an opportunity to enhance the management of mine water release and therefore water quality outcomes within the Fitzroy Basin.

This operational policy is to establish an effective framework under which the expanded pilot for mine-affected water releases to the Fitzroy Basin will be implemented. Participating mines[1] will manage mine-affected water releases through enhanced environmental authority (EA) conditions ('pilot-style' conditions), similar to those implemented as part of the Pilot release of mine-affected water in the Isaac River (the Pilot) during the 2012–2013 wet season. The policy provides protection to local environmental values such as stock and domestic and irrigation water supplies located downstream of mine water release points through the requirement for mines to conduct a detailed assessment on the localised impacts of these releases. The policy also specifies acceptable water quality limits for downstream locations that are subject to cumulative impacts from mine-affected water releases across the Fitzroy Basin. These management strategies have been put in place to ensure adequate protection of existing users located near mines and regional drinking water supplies.

Cumulative impact of releases

Trigger criteria

This operational policy aims to manage the cumulative impact of mine-affected water releases across the Fitzroy Basin.

To do this, six Fitzroy Basin trigger values ('trigger values') have been derived for the monitoring locations specified in **Table 1**. If in-stream electrical conductivity (EC) is reached or exceeded during times when mine affected water releases are being undertaken upstream of the monitoring locations specified in **Table 1**, further investigation will be undertaken to determine if all upstream mine affected water releases can continue. This investigation will determine if there is sufficient flow and appropriate water quality to provide sufficient dilution of release waters to minimise the risk of cumulative impacts.

[1] Participating coal mines are mines which have met the pre-requisites for participating in the pilot and have been issued with enhanced mine-affected water release conditions in accordance with this operational policy.

This decision will be based on all current mine water releases, the potential for stream-flow across the basin, current rainfall forecasts, additional monitoring point information existing within the Fitzroy Basin, and expert hydrology and water quality advice.

Table 1 – Fitzroy Basin trigger values

River	Monitoring location	Trigger value
Connors	Pink Lagoon (130404A)	650µS/cm
Isaac/Connors	Yatton (130401A)	650µS/cm
Comet/Nogoa	Rileys Crossing (130113A)	650µS/cm
Mackenzie/Roper	Bingegang Weir (TBA)	650µS/cm
Mackenzie	Coolmaringa (130105A)	650µS/cm
Dawson	Beckers (130322A)	650µS/cm

Cease release criteria

To protect drinking water supplies in the lower Fitzroy Basin, EC levels at the location specified in **Table 2** must be maintained below 650µS/cm irrespective of values up-stream.

Unless the administering authority has notified a suspension of the cease release value has been issued (see ‘Suspension of cease release values’), the holder of an environmental authority or transitional environmental program releasing mine-affected water, must immediately cease release of mine-affected water if the cease release value specified in **Table 2** is exceeded.

Table 2 – Cease Release Value

River	Monitoring location	Cease release value
Fitzroy	The Gap (130005A)	650µS/cm

Where necessary, the administering authority may issue a cease release direction using the emergency direction powers listed in section 467 of the *Environmental Protection Act 1994*.

Such direction will be given in the event that adverse flow conditions exist in one or more of the Fitzroy Basin sub-catchments that have the potential to compound water quality impacts downstream. It will be based on factors including current mine water releases, the potential for stream flow across the basin, current rainfall forecasts, additional monitoring information existing within the Fitzroy Basin, and expert hydrology and water quality advice.

The administering authority may decide not to apply the cease release order where EC is above the cease release value listed in **Table 2** due to natural factors unrelated to mine water releases. This circumstance may arise, for example, where EC is naturally above the cease release limit prior to commencement of the wet season.

Once a cease release direction is issued, releases will not be able to recommence until the administering authority advises environmental authority holders in writing.

Note: A cease release direction can be issued to participating mines and any other coal mines located in the Fitzroy Basin with conditions that authorise the release of mine-affected water.

Suspension of cease release values

The administering authority may suspend the cease release value specified in **Table 2** when appropriate. Suspension of the cease release value may occur in the event that the cease release value is exceeded at a time when favourable flow conditions exist upstream that will result in salinity levels declining significantly during the flow event. Suspension of cease release values will allow the relevant mines to release despite the cease release value being exceeded at the time of commencement.

At the completion of the suspension period, the cease release value specified in **Table 2** will again apply and all coal mines located in the Fitzroy Basin must comply with the value.

Note: Site-specific conditions of approvals for all mine-affected water releases require localised flow events sufficient to ensure the protection of water quality. The trigger values specified in **Table 1** and cease release value specified in **Table 2** are intended to provide a mechanism for managing the cumulative impacts of mine-affected water releases, and ceasing releases if required, as flows recede and salinity increases, particularly towards the end of the wet season. This management approach has been put in place during the pilot to ensure protection of regional drinking water supplies.

Environmental authority amendments

Each environmental authority holder who wishes to participate in the expanded pilot will require amendments to the environmental authority to establish site-specific release criteria. Amendments to the environmental authority will be made on application and are intended to provide additional release opportunities for successful applicants (‘pilot-style’ conditions).

Site specific release criteria will be negotiated with each applicant based on the location of a participating coal mine within the catchment, supported by a detailed environmental assessment (e.g. sensitive receptors, downstream land uses) to be completed by the environmental authority holder. The environmental assessment must provide sufficient evidence to support the site-specific release limits, release rates and receiving water flow and quality limits proposed by the applicant.

Prerequisites for enhanced environmental authority conditions

The government requires that mines that are authorised to participate in the expanded pilot have implemented effective water management and made necessary investments to ensure that capture of mine-affected water is minimised, beneficial reuse opportunities are maximised and mine water release can be regulated and monitored. Participating mines will be required to demonstrate to the administering authority that they meet a number of prerequisites relating to effective water management practices on site, including:

- adequate separation of mine-affected and non-mine-affected catchments on site
- adequate control of mine-affected water generation
- demonstrated ability to actively control mine-affected water releases
- mine-affected water catchments are being effectively reduced by the environmental authority holder’s implemented rehabilitation program
- ability to monitor all mine-affected water releases in real time

- the ability to access real-time water quality data from relevant downstream compliance monitoring locations.

This must be effectively demonstrated to the administering authority through an assessment and certification by a suitably qualified person that the mine has met the above prerequisites[2].

Note: Guidance material has been developed to assist in the application of this operational policy. This guidance material outlines the administering authority's expectations in relation to effective water management practices for mine sites in the Fitzroy Basin. This information will assist environmental authority holders to better understand their responsibilities in achieving acceptable environmental outcomes in relation to water management on site.

Additional notification conditions

Conditions requiring environmental authority holders to notify landholders immediately downstream and relevant local government authorities will be included with the enhanced release conditions to ensure adequate information transfer to the community and transparency.

These conditions will in most circumstances reflect effective landholder engagement strategies in place on coal mines. The conditions will provide for convenient notification of landholders and other parties at the commencement of mine-affected water releases with information that will assist with the effective management of property and services.

Note: Examples of additional conditions requiring notification of downstream landholders and/or relevant local governments are included within the guidance material, to assist in the application of this operational policy. Conditions will be developed on a case by case basis, with consideration for specific requirements that may apply to a particular mine location within the catchment.

Requirement to contribute to the enhanced monitoring program

Participating coal mines will be required to contribute towards the enhanced monitoring program, managed by the Department of Natural Resources and Mines. The cost of the program will be shared equally across all participating coal mines. The required contribution from participating mines will be capped prior to commencement of the wet season. The Department of Natural Resources and Mines will issue an invoice to all participating coal mines on the first working day in May 2014, based on actual program costs. The capped amount will be reviewed annually, to allow for any future amendments to the requirements of the enhanced monitoring program. Payment of the nominated contribution will be a requirement of the environmental authority, and continued access to the enhanced release conditions.

[2] Any attempt by an environmental authority holder to deceive the administering authority or provide false information in relation to their compliance with this requirement will be subject to high level enforcement action such as prosecution. This is the preferred enforcement option for unlawful conduct in accordance with the administering authority's enforcement guidelines. Ultimately, the administering authority has the discretion to determine the appropriate response to unlawful conduct under the legislation administered by it.

Disclaimer

While this document has been prepared with care it contains general information and does not profess to offer legal, professional or commercial advice. The Queensland Government accepts no liability for any external decisions or actions taken on the basis of this document. Persons external to the administering authority should satisfy themselves independently and by consulting their own professional advisors before embarking on any proposed course of action.

Approved By

Reuben Carlos	30 October 2013
Signature	Date

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EXPANDED COAL MINE WATER RELEASE PROGRAM FOR THE FITZROY BASIN

Resources Activities - Mining - Guidline

Meeting Date: 5 February 2014

Attachment No: 2

Guideline

Resource activities – mining

Application of operational policy requirements to obtain enhanced environmental authority conditions for Fitzroy Basin mines

This guideline has been prepared by the administering authority to provide information about prerequisite requirements for enhanced environmental authority conditions for the release of mine affected water in the Fitzroy Basin. The guideline also provides information about additional conditions to be placed on environmental authorities requiring notification of downstream landholders and local government authorities, in accordance with the operational policy.

1. When a cease release direction may be issued by the administering authority

In the event that unforeseen circumstances arise that pose a significant risk to water quality in the Fitzroy Basin, the administering authority may issue a cease release direction to mines. The cease release direction will instruct the relevant mines to immediately cease the release of mine-affected water. Mines in receipt of a cease release direction must cease releases of mine-affected water regardless of whether the relevant cease release values contained within the environmental authority or operational policy have been exceeded. A cease release direction can be issued to participating mines and any other coal mines located in the Fitzroy Basin with conditions that authorise the release of mine-affected water.

2. When a suspension of cease release values may be issued by the administering authority

In the event that the cease release values listed in Table 1 of the operational policy are exceeded at a time when favourable flow conditions exist upstream that will result in salinity levels declining significantly during the flow event, the administering authority will consider the following in relation to the issue of a suspension of cease release values:

2.1. The magnitude, anticipated duration and quality of a flow event (or a combination of flow events) currently occurring within one or more of the Fitzroy Basin sub-catchments

2.2. The potential impact on water quality in both the relevant sub-catchment and the lower Fitzroy River as a result of the flow event;

2.3. The potential impact on water quality in both the relevant sub-catchment and the lower Fitzroy River as a result of any releases of mine affected water into the flow event

2.4. Following reassessment of points **2.1–2.3** above, and at the discretion of the administering authority a suspension of cease release values may be cancelled. On cancellation of the suspension, all cease release values apply and where exceeded, mines must immediately cease releases.

Any suspension of cease release values applies only to cease release values prescribed within the operational policy. A suspension of cease release values does not apply to site-specific cease release values prescribed within an environmental authority.

3. Application for enhanced environmental authority conditions

The holder of an environmental authority that authorises releases of mine affected water in the Fitzroy Basin can apply to have enhanced environmental authority conditions added to their environmental authority by amendment. The process for the amendment application is set out in sections 224–240 of the *Environmental Protection Act 1994*.

The application should include supporting information that demonstrates to the satisfaction of the administering authority that the applicant meets the prerequisites outlined in this guideline, relating to effective water management practices on site that can demonstrate investment and improvement to on site water management.

Note: In the absence of the amendment application containing other factors that may warrant assessment as a major amendment, and provided that adequate information accompanies the application to allow the administering authority to make a decision about enhanced environmental authority conditions, such an application is likely to be assessed as a minor amendment.

4. What are the prerequisites for enhanced environmental authority conditions?

For an environmental authority holder to benefit from the operational policy and amend their environmental authority accordingly, they must demonstrate to the satisfaction of the administering authority that they meet a number of prerequisites relating to effective water management practices on site.

4.1. Adequate separation of mine-affected and non-mine-affected catchments on site

Mine-affected water is defined within environmental authorities for coal mines in the Fitzroy Basin, and includes run-off from areas disturbed by mining that have not yet been rehabilitated. Catchments that are not mine-affected , which includes not only those areas that have been rehabilitated, but areas on site, not yet disturbed by the mining operation, should be managed so as to shed all run-off in a manner that does not allow unnecessary generation and accumulation of mine-affected water. In addition, mines should put in place systems to clearly define and delineate areas on site that generate mine-affected water and those areas that are non mine-affected (clean) catchments. These systems should also allow for update and review when new disturbed areas are created or areas are successfully rehabilitated.

4.2. Adequate control of mine-affected water generation

Mine planning and development should include measures to effectively minimise the accumulation of mine-affected water. This includes factors such as:

4.2.1. minimisation of disturbance within rehabilitated or undisturbed areas

4.2.2. minimisation of raw water imports for mining processes

4.2.3. prioritised re-use of mine-affected water where practicable, particularly in high water usage processes such as coal beneficiation; and

4.2.4. effective irrigation, evaporation and re-use of treated sewage effluent to prevent it from entering mine-affected water storages.

4.3. Demonstrated ability to actively control mine-affected water releases

In order to comply with the operational policy, releases of mine-affected water must be controllable. Where downstream electrical conductivity (EC) is nearing compliance limits, or a cease release direction is issued by the administering authority, environmental authority holders must be able to reduce or stop the release as required. Such control measures may include the use of valves or gates on pipes or dams used as release points. The use of dam spillways as release points is not precluded by this prerequisite; however, where spillways are used, adequate pumping capacity must be available at the release point to control releases as required to comply with environmental authority conditions. Release control mechanisms do not necessarily need to be automated, but where manual actions are required to effect the control, safe personnel access to the release point must be available at all times.

4.4. Mine-affected water catchments are being effectively reduced by implementation of the environmental authority holder's rehabilitation program:

4.4.1. disturbed areas no longer required for mining operations are being progressively rehabilitated in accordance with environmental authority conditions

4.4.2. run-off from partially rehabilitated areas that is not mine-affected water (e.g. monitoring demonstrates that surface water meets the performance standard stated in the environmental authority) and is surplus to operational requirements, is being effectively separated from the mine-affected water system and diverted off site

4.4.3. run-off from rehabilitated areas that is not mine-affected water and is surplus to operational requirements, is being effectively separated from the mine-affected water system and diverted off site.

4.5. Demonstrated ability to monitor all mine-affected water releases in real time

To ensure compliance with enhanced release conditions, the release rate and EC of water released must be available to the EA holder at all times during a release event and be made available to the administering authority.

4.6. The ability to access real-time water quality data from relevant downstream compliance monitoring locations

4.6.1. Mine water releases must be able to be monitored at local downstream locations specified by conditions of an environmental authority. This monitoring does not necessarily need to be automated, real-time telemetry; however, where manual actions are required to undertake monitoring, safe personnel access to the monitoring point must be available at all times during release events.

4.6.2. Depending on the location of the mine, some environmental authority holders will be able to satisfy this prerequisite by making use of existing Department of Natural Resources and Mines (DNRM) ambient monitoring stations to ensure compliance with downstream cease release limits. Where a mine is located in a sub-catchment that does not yet have a DNRM-operated monitoring facility that can measure and transmit real-time water quality and flow data, releases of mine affected water under the policy will not be authorised. Contributions by environmental authority holders towards the establishment of appropriate monitoring facilities at these locations will be considered by both departments in relation to the satisfaction of this prerequisite.

An environmental authority holder must provide the administering authority with a certification in the approved form by a suitably qualified person that through an assessment, the mine applying for enhanced release conditions has met the required prerequisites and can demonstrate the effectiveness, achieved improvement and investment of on-site water management practices in line with the principles outlined above.[1]

5. Water quality monitoring and reporting

Participating mines must submit all water quality monitoring data, reports and notifications as required under the holder's environmental authority and operational policy. The mines must undertake submission through the Wastewater Tracking and Electronic Reporting System (WaTERS) via the Internet in the required digital format. In the unlikely event that WaTERS is not operational, notifications should occur through other means such as email to the administering authority's regional office in the required format.

6. Additional notification conditions

Conditions requiring environmental authority holders to notify landholders immediately downstream and relevant local government authorities or 'affected stakeholders' will be included with the enhanced release conditions to ensure adequate information transfer to the community and transparency.

The conditions below will be included in the suite of enhanced environmental authority conditions for mine water releases in the Fitzroy Basin. Environmental authority holders will be required to identify all potentially affected stakeholders located downstream of their mining operation.

Release notification – potentially affected stakeholder

The environmental authority holder must notify all potentially affected stakeholders on commencement (within two hours or another time frame as agreed to in writing with the relevant potentially affected stakeholder) of releasing mine-affected water to the receiving environment. Notification must be in the form agreed to by the potentially affected stakeholder. Notification must include the following information unless otherwise agreed to by the potentially affected stakeholder:

a) release commencement date/time
b) release location (release point/s)
c) release rate
d) receiving waters for the release
e) receiving water flow rate
f) water quality of the release including salinity and pH; and
g) estimated duration of the release.

[1] Any attempt by an environmental authority holder to deceive the administering authority or provide false information in relation to their compliance with this requirement will be subject to high level enforcement action such as prosecution. This is the preferred enforcement option for unlawful conduct in accordance with the administering authority's enforcement guidelines. Ultimately, the administering authority has the discretion to determine the appropriate response to unlawful conduct under the legislation administered by it.

7. Definitions

'Potentially affected stakeholders' includes (but should not be limited to):

i) the administering authority; and

ii) a local landholder whose property is riparian, downstream of the release point specified in Table W1 of the environmental authority and is determined by the environmental authority holder to be potentially impacted by mine affected water releases; and

iii) other party nominated by the administering authority; and

iv) the relevant local government authority; and

v) a resource operations licence (ROL) holder or other water entitlement holder under the *Water Act 2000* located between the nearest compliance point listed in Table 1 of the operational policy and the release point specified in Table W1 of the environmental authority; and

vi) does not include a landholder or other party who by written agreement with the environmental authority holder has declined to be notified for the purpose of this condition.

'Mine affected water' means the following types of water:

i) pit water, tailings dam water, processing plant water

ii) water contaminated by a mining activity which would have been an environmentally relevant activity under Schedule 2 of the Environmental Protection Regulation 2008 if it had not formed part of the mining activity

iii) rainfall run-off which has been in contact with any areas disturbed by mining activities which have not yet been rehabilitated, excluding rainfall run-off discharging through release points associated with erosion and sediment control structures that have been installed in accordance with the standards and requirements of an erosion and sediment control plan to manage run-off containing sediment only, provided that this water has not been mixed with pit water, tailings dam water, processing plant water or workshop water

iv) groundwater which has been in contact with any areas disturbed by mining activities which have not yet been rehabilitated

v) groundwater from the mine's dewatering activities

vi) a mix of mine affected water (under any of paragraphs i)–v) and other water.

Mine affected water does not include rainfall run-off which has been in contact with:

i) land that has been rehabilitated to a stable landform and is in accordance with the acceptance criteria set out in the environmental authority

ii) land that has partially been rehabilitated and monitoring demonstrates the landform does not generate pollution to waters or groundwater. Examples could include:
   a. areas that are been capped and have monitoring data demonstrating hazardous material adequately contained with the site
   b. evidences provided through monitoring that surface water meets the performance standard stated in the environmental authority.

Note: Acceptance of rainfall run-off coming into contact with partially rehabilitated areas as not being mine affected water is **not** to be considered as the administering authority accepting the rehabilitation works are complete.

'Suitably qualified person' in relation to effective water management practices means a person who has professional qualifications, training, skills or experience relevant to water management on mine sites and can give authoritative assessment, advice and analysis on performance using the relevant protocols, standards, methods or literature; AND the administering authority is satisfied that person has knowledge, suitable experience and demonstrated expertise in relevant fields.

Disclaimer

Approved By

Reuben Carlos	30 October 2013
Signature	Date

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8.3 EXPANSION OF THE GRACEMERE RECYCLED WATER SCHEME

File No: 8139

Attachments: 1. Expansion of the Gracemere Recycled Water Scheme - Planning Report

Responsible Officer: Nimish Chand - Strategic Manager Fitzroy River Water

Author: Jason Plumb - Manager Treatment and Supply

SUMMARY

The Gracemere Recycled Water Scheme needs to be expanded to increase the demand for recycled water and ensure the long term compliant land disposal of treated effluent produced by the Gracemere Sewage Treatment Plant (STP). An opportunity exists to fast-track the expansion of the recycled water network by constructing new sections of pipeline at the same time as other construction works are completed. This report provides the justification for acting now to expand the recycled water scheme and seeks approval for the reallocation capital funding to allow construction of the recycled water pipeline to commence this financial year.

OFFICER'S RECOMMENDATION

THAT Council approve the expansion of the Gracemere Recycled Water Scheme and the allocation of $260,000 of capital funding previously identified in a recent capital budget review as deferred capital funding, to allow construction to commence immediately.

COMMENTARY

A detailed planning report is attached that provides an analysis of the existing Gracemere Recycled Water Scheme and the options for the future expansion of the scheme to cater for the expected increases in inflows to the Gracemere STP. Based on an assessment of the available options and the cost benefit of each, commencing construction of a recycled water pipeline at the same time as other construction projects are completed represents the most cost-effective way of expanding the recycled water scheme. Once completed the expanded recycled water network will enable the pumping of recycled water from the Gracemere STP to the potential end-users in South Rockhampton such as the Rockhampton Golf Club.

BUDGET IMPLICATIONS

The capital investment required to construct the entire length of recycled water pipeline between Gracemere STP and South Rockhampton is outlined in Table 1. An allocation of $260,000 is required in 2013-14 to commence the construction of the recycled water pipeline alongside the new sewer rising main currently being constructed along Armstrong St in Gracemere.

Table 1. Capital funding required for the recycled water main to Rockhampton

Sub-project	2013-2014	2014-2015	2015-2016
Armstrong St – GSTP (1.1 km)	$90,000		
Water trunk duplication (6.8 km)	$170,000	$120,000	$120,000
Armstrong St to Old Cap WPS (1.1 km)			$700,000
Total	**$260,000**	**$120,000**	**$820,000**

Upon adoption of this proposed project, the funding for immediate commencement will be made available by retaining capital funds that had been identified as part of a budget savings target in recent budget review and will be confirmed in the upcoming budget revision to be submitted to Council in March 2014. The necessary planning for the budget allocations required for 2014-15 and 2015-16 will be undertaken accordingly.

CONCLUSION

Sustainable long term use of the recycled water produced by the Gracemere STP requires the expansion of the Gracemere Recycled Water Scheme to increase recycled water usage. By achieving growth in the demand for recycled water the existing licence conditions of 100% land disposal can continue to be met. An excellent opportunity exists to construct a recycled water main from the Gracemere STP to South Rockhampton at a greatly reduced cost due by taking advantage of other construction projects. If completed this project would provide a cost effective and environmentally favourable outcome for Council and the community.

EXPANSION OF THE GRACEMERE RECYCLED WATER SCHEME

Expansion of the Gracemere Recycled Water Scheme - Planning Report

Meeting Date: 5 February 2014

Attachment No: 1

EXPANSION OF THE GRACEMERE RECYCLED WATER SCHEME

PLANNING REPORT

Fitzroy River Water *January 2014*

EXECUTIVE SUMMARY

This report examines the recycled water irrigation requirements for water from the Gracemere Sewage Treatment Plant (STP), and examines the merits of building a recycled water pipeline to Rockhampton from Gracemere. Recent increases in Gracemere STP inflows will require a significant increase in recycled water irrigation demand if the rates of recycled water irrigation are to remain sustainable long term. Increasing recycled water irrigation use in Gracemere will require significant pipeline infrastructure to be developed and require new users and uses that currently do not exist to be developed. The possibility exists to utilise already planned potable water pipeline construction works between Rockhampton and Gracemere, to allow a recycled water pipeline to also be constructed from Gracemere to the Rockhampton Golf Club at essentially only the cost of materials. This is a significant savings with materials costs for the required pipeline being one eighth of normal construction costs and is a good opportunity to fast-track the expansion of the Gracemere Recycled Water Scheme in order to meet future disposal needs.

Prepared by	Endorsed by
Paul Dean Senior Environmental Scientist	Jason Plumb Coordinator Treatment and Supply

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1.0 BACKGROUND

This report seeks to provide a brief assessment of existing and future options for the use of recycled water from the Gracemere STP. This issue has arisen quickly following recent rapid increases in volumes treated by the Gracemere STP due to population growth and the possibility of utilising the construction of a potable water pipeline to save construction costs in installing a recycled water pipe line to potential recycled water users located in South Rockhampton.

2.0 SUSTAINABLE USE OF RECYCLED WATER

Sustainable recycled water usage is that which can be sustained long term. Greater irrigation than this will result in water logging and environmental damage over time and will result in breaches of environmental legislation. To maintain the ability to irrigate with recycled water long term, the sustainable irrigation rate must be greater than the actual irrigation rate. To accurately determine sustainable irrigation rates requires assessing soil profiles and vegetation types on the irrigated sites. This data is then integrated with climate data and recycled water quality data and modelled using software such as MEDLI to obtain seasonal average irrigation rates. Due to time constraints this report is prepared utilising annual maximum sustainable irrigation rates obtained from previous reports and an understanding of the current scheme.

Average daily influent into Gracemere STP is currently 1.65 ML/d. This has increased rapidly from 0.93 ML/d in 2008, 1.22 ML/d in 2011, and 1.49 ML/d in 2012. During wet weather the inflow volumes increase significantly.

There are currently four recycled water users in the Gracemere recycled water scheme. An additional user is likely to be added in Gracemere, and there is at least one potential user in South Rockhampton who could be serviced by the proposed recycled effluent main discussed in this document.

The users and their sustainable recycled water use are summarised in Table 1 below.

Table 1. Current and potential future users of recycled water from the Gracemere STP.

User	Current or proposed	Annual Sustainable daily usage
Gracemere Lakes Golf Club	Current	0.5 ML/d
Gracemere Sports Club	Current	0.035 ML/d
RE and KJ Maloney	Current	0.5 ML/d
Nugrow	Current	0.04 ML/d
Cedric Archer Park Fields	Proposed in Gracemere	0.009 ML/d

Annual sustainable daily usage of current users is 1.075 ML/d. This will increase to 1.084 ML/d with Cedric Archer Park Fields irrigated with recycled water. The current sustainable recycled water usage with the users currently in place (1.075 ML/d) is significantly less than the current STP inflow (1.65 ML/d). This means that the current irrigation discharge is too great for the areas that are currently irrigated, and is not sustainable long term (i.e. more recycled water users are required).

Previous reports for Fitzroy Shire Council (Hood 2005) have highlighted that some of the soils in the Gracemere Lakes Golf Club may only have a limited ability to take recycled water long term. This possibility further strengthens the need to significantly increase recycled water demand from the Gracemere STP.

3.0 POTENTIAL USERS OF RECYCLED WATER IN SOUTH ROCKHAMPTON

The Rockhampton Golf Club (RGC) uses up to 1.2 ML/d of water for the irrigation of their golf course. This could increase up to 1.5 ML/d if additional irrigation infrastructure is installed. They have their onsite irrigation infrastructure and storage ponds already installed and operating. Previously in 2007 they were ready to accept recycled water from the West Rockhampton STP to meet their irrigation demands and at this time the RGC examined the risks and requirements associated with using recycled water. Recent discussion with the RGC has resulted in their Greens Committee committing to use recycled water if it is made available from the Gracemere STP. Other sporting fields (e.g. Rugby Park) may also be interested in using recycled water.

If the RGC also used recycled water from the Gracemere STP, the sustainable recycled water irrigation usage would increase to 2.284 ML/d. This is greater than the current inflow to the STP, and therefore caters for future increases in inflow to the STP.

4.0 MINIMUM PROVISIONS OF THE RECYCLED WATER SCHEME

Recycled water schemes are a balance between disposing all the required effluent, including during wet times when demand for water is low, and still supplying sufficient recycled water to users during dry times when demand is high. This requires the use of wet weather storages. As the RGC would be a large user, another consideration is will this have a significant impact on the dry weather volumes able to be supplied to all users.

The wet weather storage volumes available are summarised in Table 2 below.

Table 2. Current and possible future wet weather storages for recycled water

Storage	Volume
Gracemere STP	50 ML
Gracemere Lakes Golf Club	3 ML
Rockhampton Golf Club	15 ML

During the peak usage periods (hot dry times) daily influent flows to the STP may decrease to somewhere in the order of 1.5 ML/d. With the RGC also using recycled water, this would cause a shortfall of effluent of 0.784 ML/d when compared to the annual sustainable daily usage. If the storage dams are full this peak usage demand could be sustained for 85 days. After 85 days of sustained peak usage and reduced inflow, usage could be sustained at 67% of sustainable demand. This is typical of most recycled water schemes that do not have access to extremely large storages or cannot discharge excess effluent to water ways when peak demand does not occur.

5.0 ALTERNATIVE USERS OF RECYCLED WATER

Ideal users to incorporate in to a recycled water scheme are those that are already operating and have their irrigation and other infrastructure already set up, are close by so that the costs of required pipelines are minimised, and ideally are large and stable organisations. There are no additional large-scale water users currently in Gracemere that are able to utilise recycled water in their activities.

Potentially, there could be grazing blocks on the south and southwestern edges of Gracemere that could be set up to take recycled water. These sites would require between 4 and 6 km of recycled water pipeline to be installed, at a cost of approximately $1.6 Million to $2.4 Million. Industrial users may eventuate in the Gracemere Industrial Area. These non-irrigation types of users typically require higher quality water than currently produced. To achieve higher quality water, additional STP infrastructure with additional capital and operating cost would be needed, as well as 4 to 6 km of pipeline.

Another alternative that could deal with effluent disposal issue due to the increased STP inflows, is to pump all or part of the inflow from Gracemere to the South Rockhampton STP for treatment. This would place an increased load on the South Rockhampton STP which would require significant expenditure to enable the plant to treat the load to meet ‘licence’ conditions. Gleaning cost data from the SKM report would suggest this option may cost $10 Million to $20 Million to complete.

6.0 QUALITATIVE COST BENEFIT ANALYSIS

The following items are assessed for each of the potential options with a summary provided in Table 3 below.

Capital cost – the cost to setup the option. For the pipeline to the RGC this is $1.4 Million. To reach potential irrigation sites to the South West of Gracemere the cost would be $3 Million. With costs of $10 Million to $20 Million to divert STP inflow to the South Rockhampton STP and provide necessary STP upgrades.

Operating cost – the relative level of costs to run the option. For the pipeline to the RGC and the new irrigators southwest of Gracemere the running costs are the electricity for pumping and maintenance of pumps and pipes. These costs are relatively minor compared to the operating costs of the diversion to South Rockhampton STP option. The South Rockhampton STP option has electricity costs for pumping and additional aeration, and maintenance and running costs of significant STP infrastructure.

Time till operating – how long it would be before the option is operational. This would be 3 years for the pipeline to RGC, 2-3 years for new irrigators, and 5 to 6 years for a diversion to South Rockhampton STP.

Future proofing – how well does the option provide for a solution into the future. Depending on real growth rate, the RGC pipeline and new irrigators using the same amount as the RGC, would remove the need for additional users to be brought online for possibly 7 to 10 years. The diversion to South STP would be a longer term option that may provide a solution for 20 years.

Confidence in setting up and operation – how likely is the set up and operation of the option, to go smoothly. The RGC have everything set up to take and use recycled water when supplied, and they are a stable single user with a defined management structure. The RGC option should go smoothly. The diversion to South Rockhampton STP option would be operated and handled by FRW so would have little risk of issues. The new irrigators would be a riskier option. To get the land area required for the reuse 6 or 7 land owners would be required to be on board. The more irrigators required, the greater the management requirements and more difficult it is to operate efficiently. The problems are not insurmountable, but would require significantly more time to manage.

Reliability in wet conditions – The RGC has a high reliability as the course is developed with good drainage and needs to be irrigated soon after rain ceases to maintain condition. The diversion to South Rockhampton STP also has a high reliability as the discharge from the plant still continues in wet weather. This reliability decreases to low to medium if the discharge from the South Rockhampton STP needs to be irrigated. The new irrigators would also have a low to medium wet weather reliability as although their land is above flood levels, the land appears to have a high proportion of clay and may not need irrigating for some time after rain.

Environmental merits – The RGC and new irrigator options have high environmental benefits by providing for substantial reuse. The diversion to South STP option would have low environmental benefits due to the increased electricity consumption required and the lack of reuse. This would increase if this option undertook reuse but would still be lower due to the increased electricity use.

Additional benefits to community – The RGC option would provide an additional benefit to the community by drought proofing a significant recreational facility enjoyed by many residents in the Rockhampton Region. The new irrigators option would provide low to medium additional benefit to the community. A small amount of additional employment may be created, but the majority of the benefit would be obtained by the irrigators. The diversion to South STP would provide little additional benefit to the community, unless South STP also irrigated which may provide a moderate increase in employement.

Table 3. Cost Benefit Analysis of Possible Options for Disposal of Recycled Water

Item	RGC Pipeline	New Irrigators	Pipe to SRSTP
Capital cost	$1.4 Million	$3 Million	$10-20 Million
Operating cost	Low	Low	High
Time till operating	3 yrs	2-3 yrs	5-6 yrs
Future proofing	Medium term	Medium term	Long term
Confidence set up and operating	High	Low	High
Reliability in wet	High	Low - Med	High (low if irrigating)
Environmental merits	High	High	Low (med if irrigating)
Additional community benefits	High	Low - Med	Low (med if irrigating)

7.0 BUDGET IMPLICATIONS OF THE ROCKHAMPTON TO GRACEMERE RECYCLED WATER PIPELINE

As indicated above, the construction of a recycled water main between Gracemere to Rockhampton can be in part completed in conjunction with a capital project to duplicate approximately 6.8 km of drinking water trunk main between the Athelstane Range Reservoir complex and the Old Capricorn Highway Water Pump Station (WPS) in Gracemere. A further cost saving is possible if approximately 1.1 km of recycled water main is constructed at the same time as a new rising main is constructed (currently underway) between the Armstrong St Sewerage Pump Station (SPS) and the Gracemere STP. If constructed at the same time as these other two construction projects, the recycled water main could be installed for virtually the cost of the pipe materials with the majority of construction costs borne by each of the other projects (i.e. share the trench). This has the potential to represent a cost saving of approximately $3.5M which would normally be incurred as the full construction cost. The remaining 1.1 km link between the Armstrong St SPS and the Old Capricorn Highway WPS could then be constructed as soon as possible thereafter to enable the pumping of recycled water from Gracemere STP to users in South Rockhampton. This final section would incur full construction cost.

Table 4 provides an indication of the capital investment required to complete the construction of the recycled water main between Gracemere STP and Rockhampton.

Table 4. Capital funding required for the recycled water main to Rockhampton

Sub-project	**2013-2014**	**2014-2015**	**2015-2016**
Armstrong St – GSTP (1.1 km)	$90,000		
Water trunk duplication (6.8 km)	$170,000	$120,000	$120,000
Armstrong St to Old Cap WPS (1.1 km)			$700,000
Total	**$260,000**	**$120,000**	**$820,000**

9 STRATEGIC REPORTS

9.1 FRW FINANCE AND STRATEGIC MATTERS REPORT - DECEMBER 2013

File No:	**1466**
Attachments:	**Nil**
Responsible Officer:	**Robert Holmes - General Manager Regional Services**
Author:	**Nimish Chand - Strategic Manager Fitzroy River Water**

SUMMARY

This report details Fitzroy River Water's financial position and other operational matters for the Council's information as at 31 December 2013.

OFFICER'S RECOMMENDATION

THAT the FRW Finance and Strategic Matters Report for December 2013 be received.

VARIATIONS, ISSUES AND INNOVATIONS

<u>Innovations</u>

<u>Improvements / Deterioration in Levels of Services or Cost Drivers</u>

In early December the construction of the new sewer gravity main along Chatterton Boulevard through to Breakspear Street in Gracemere was completed. The completion of this sewer main provides a significant increase in the capacity of the sewerage network that services the areas south of Lucas Street which have grown rapidly in the last couple of years. With the new sewer main now on-line some minor problems associated with sewer odours in the Buxton Drive area will be avoided with the majority of sewer flows now passing through the newly constructed gravity main.

COMPLIANCE MATTERS

All drinking water samples collected and tested during December were compliant with State legislation and Australian Drinking Water Guideline (ADWG) health values.

In accordance with legislative obligations associated with managing dam safety, FRW recently made contact with residents in Mount Morgan and Woodbury who are considered to be at risk in the event of a significant dam failure event at the Mount Morgan No. 7 Dam and Kelly's Off-Stream Storage respectively. Apart from providing important information about the possible impacts of dam emergency events, this exercise provided the opportunity for residents to advise FRW of any changes to their contact details so that they could be contacted in the event of a dam emergency event.

FINANCIALS

<u>Operational</u>

Revenue is trending slightly below percentage of year elapsed at 48.3%. A more componentised view indicates private works and lease revenue remain under budget as reported previously and fees and charges revenue is also slightly below budget.

Water and sewerage access charges are on target. Billed water consumption remains approximately 18% above that billed in the same period of the previous financial year with the Coast consumption yet to be realised. Revenue for water consumption in the second quarter is 49% of budget with 67% of second quarter revenue billed. At this stage consumption revenue appears to be on target relative to percentage of year elapsed, however it must not be disregarded that consumption patterns are influenced by weather.

Expenditure year to date is slightly below percentage of year elapsed compared with budget for both Councils. Contractors and consultants remain slightly over budget due to higher than expected legal fees for the Rockhampton to Yeppoon Pipeline, some easement claims, along with sewer and water pump rebuilds.

The reports for December do not reflect the October budget revision and also as a result of de-amalgamation several processes, such as payroll accruals, capital overhead allocations and fleet actuals have not been finalised in this version of the reports. Also to note, the October budget revision has not yet been adopted by Council and expenditure is compared with adopted budget.

Capital

Capital expenditure is below the percentage of year elapsed at 43%. The reports for December do not reflect the October budget revision and also, as a result of de-amalgamation several processes, such as payroll accruals, capital overhead allocations and fleet actuals have not been finalised in this version of the reports.

Water YTD is 42.68% and Sewer YTD is 41.91%.

Networks YTD is 50.46% and Treatment YTD is 24.93%.

Capital spend has increased by $1.38 million in the month of December compared to the previous month as a result of the liability for Tanby Heights infrastructure being taken up. The areas of prominent activity are the Tanby Heights water & sewerage development, Breakspear Street sewerage main, sewer relining program, Glenmore Water Treatment Plant Highlift pump station upgrade, Water Main Replacement programs, Emu Park Trunk Water Main and Agnes Street Water Pump Station upgrade.

A summary of financial performance against budget is presented below:

	YTD			
	Actual **$**	**Budget Both Cncls** **$**	**Variance to Budget** **$**	**Annual Revised Budget** **$**
Department Revenue				
Net rates and utility charges	(32,265,323)	(33,273,378)	1,008,054	(58,151,437)
Fees and Charges	(905,828)	(953,118)	47,290	(1,827,180)
Private and recoverable works	(521,554)	(633,817)	112,263	(1,080,117)
Rent/Lease Revenue	(16,480)	(38,475)	21,995	(66,177)
Grants Subsidies & Contributions	(9,073)	0	(9,073)	0
Interest revenue	(181,832)	(180,000)	(1,832)	(309,600)
Other income	(18,657)	(8,215)	(10,443)	(13,957)
Total Department Revenue	***(33,918,747)***	***(35,087,002)***	***1,168,255***	***(61,448,467)***
Expenses				
Employee costs	4,830,645	5,507,508	(676,862)	9,144,649
Contractors & Consultants	952,207	768,881	183,326	1,324,761
Materials & Plant	1,750,080	1,792,983	(42,903)	3,210,096
Asset Operational	1,759,560	1,968,130	(208,570)	3,265,562
Administrative expenses	159,083	205,174	(46,091)	347,010
Depreciation	5,385,723	8,027,642	(2,641,918)	10,771,447
Finance costs	1,088,640	2,209,437	(1,120,796)	3,689,759
Other Expenses	25,317	33,250	(7,933)	57,786
Accounting Adjustments	37,116	31,500	5,616	31,500
Total Expenses	***15,988,371***	***20,544,503***	***(4,556,132)***	***31,842,570***
Transfer / Overhead Allocation				

Transfer/Overhead Allocation	781,295	818,289	(36,993)	753,378
OH Allocation	1,432,683	1,631,841	(199,158)	2,822,696
Competitive Neutrality Adjustments	10,353,565	10,625,374	(271,809)	20,055,471
De-amalgamation internal transfers	(22,280)	0	(22,280)	0
Total Transfer / Overhead Allocation	***12,545,264***	***13,075,504***	***(530,240)***	***23,631,545***
TOTAL OPERATING POSITION (SURPLUS)/DEFICIT	**(5,385,112)**	**(1,466,996)**	**(3,918,116)**	***(5,974,352)***

ADMINISTRATION MATTERS

Business and Administration

The Administration team continues to provide high level administrative support to various sections across the business.

Pathway Statistics for the month of December 2013:

		Requests Completed for the Month				
	Customer requests received	**Priority 3**	**Priority 2**	**Priority 1**	**Action required by the Bus & Admin Team**	**Completed by the Bus & Admin Team**
RRWR	304	211	59	22	74	292
FRW	406	176	74	14	245	264
TOTAL	**710**	**387**	**133**	**36**	**319**	**556**

Priority 3 - requests completed within the required timeframe.
Priority 2 - requests not completed within the required timeframe and are escalated to the supervisor.
Priority 1 - requests not completed within the required timeframe and are escalated to the manager.

Communication and Education

Website Updates

All references to Livingstone Shire Council assets and offices were scheduled to be removed from the FRW website on 1 January 2014.

Education Activity Book

An activity book for mid-Primary School aged children has been drafted. The book follows the water treatment process at the Glenmore Water Treatment Plant and will be provided to students upon completion of a tour.

Don't Spoil It At The Toilet

The 'Don't spoil it at the toilet' content and flyer was designed and sent to the printers. The flyers will be inserted into Water Notices commencing January 2014. Collateral for a campaign has also been drafted including a media release, social media, web content, posters, and internal communication. The aim of the campaign is to educate residents as to the complications caused in the sewer network by flushing incorrect items down the toilet.

Mount Morgan No. 7 Dam Emergency Action Plan (EAP)

FRW rolled out an awareness campaign targeted at properties living downstream of the Dee River in Mount Morgan. The aim was to inform the general community of the existence of the EAP and encourage properties that have been identified as potentially being at-risk in the unlikely event of a major Dam emergency (including flooding), to update their details on FRW's Notification List. Activities included a detailed mail out, maps around town, public notices, media release, social media, and website content. Approximately 25% of recipients responded to the mail out within a fortnight by sending back the updated details form.

Media Releases and Community Notices
Two media releases were issued in December.

PROJECT AND CONTRACT MANAGEMENT

An update on the activities of current projects is provided in the table below.

Project	Start Date	Expected Completion Date	Status	Budget Estimate	YTD actual /committals
NETWORK CONSTRUCTION CAPITAL WORKS PROGRAM					
Rockhampton Water (water main replacement)					
WPS Agnes St Upgrade for Gracemere	June 2013	December 2013	100% complete	$186,000	$386,277
Comments: Cost has increased due to significant design changes to operational requirements upon commissioning of the Gracemere duplication project. Unforeseen infrastructure in the ground which wasn't documented on plans increased considerable extra cost to the project.					
Lion Ck Rd (Savage-Hamilton), 100 & 150mm water main replacement	June 2013	December 2013	100% complete	$493,594	$428,872
Comments: Completion delayed due to Civil Operation storm water work, crew has been relocated to Hamilton Av Project.					
Norman St (Wandal-Rundle), 100 & 150mm water main replacement	July 2013	December 2013	100% complete	$264,008	$302,158
Comments: Project costs have increased due to hard rock and alignment conflicts with other utilities.					
North St (Murray-Campbell), 250mm water main replacement	December 2013	February 2014	20% complete	$187,292	$82,352
Comments: Scheduled and materials ordered.					
Rockonia Rd (Blanchfield-Stack) 200mm water main replacement	September 2013	January 2014	95% complete	$303,727	$320,705
Comments: Project cost has increased due to two under bore directional drilling failures.					
Armstrong Street Gracemere 300mm sewer rising main replacement	December 2013	May 2013	5% complete	$640,000	$333,251
Comments: On schedule.					
Rockhampton Sewer					
Sewer rehabilitation program (including Building over Sewer works)	July 2013	June 2014	45% complete	$1,022,907	$461,617
Comment: Rehabilitation and renewals annual program of works.					
Capricorn Coast Water (new and replacement)					
Water Main (Trunk) Emu Park West stage 2, Design and	November 2012	January 2013	99%	$2,411,034	$1,346,307

Project	Start Date	Expected Completion Date	Status	Budget Estimate	YTD actual /committals
construct 450mm water main from EP West Reservoir site to the intersection of Emu Park Road and Hartley Street - Emu Park.			complete		
Comments: Revised schedule, completion date brought forward (easy digging at the reservoir hill location).					
Capricorn Coast Sewer					
Sewer Main Refurbishment (arising from relining)	July 2013	June 2014	71% complete	$179,178	$128,904
Comments: On schedule.					
Emu Park test infiltration at manholes	July 2013	June 2014	37% complete	$219,828	$81,788
Comments: On schedule.					
Sewer Main (Rising) Cooee Bay	March 2013	February 2014	85% complete	$742,640	$361,952
Comments: Re-scheduled to January 2014 completion, Shaw Av pump station connection design due for completion in October.					
Gracemere Water (new and replacements)					
Nil					
Gracemere Sewer					
GIA - S Main (Rising) 200mm Somerset Rd SPS 17 to SPS 4	November 2012	December 2013	100% complete	$270,000	$276,361
Comment: Completion re-scheduled to coincide with the commissioning of SPS17. Project is forecast to come in under budget - committals expected to reduce by approximately $30000.					
SPS17	Start of December 2013	End of February 2014	75% complete	$444,818	$332,949
Comments: On schedule - Outstanding work includes the electrical switchboard and communications, vent pole and concrete connecting slab.					
GIA S Main (Gravity) 300mm Somerset Rd	October 2012	November 2013	100% complete	$74,000	$133,548
Comment: On schedule (project expenditure is under review, may have incurred costs from the 225mm gravity project listed directly below).					
GIA Main (Gravity) 225mm (Gce) Industrial (Gibb to SPS17)	October 2013	December 2013	100% complete	$174,000	$116,858
Comment: On schedule.					
Sewer Main (Trunk) Breakspear St	April 2013	January 2014	95% complete	$989,224	$1,077,827
Comments: Re-scheduled - January completion.					
Mount Morgan (water mains replacement)					
Dee St (Central-East)	September 2013	October 2013	100% complete	$59,801	$83,752

Project	Start Date	Expected Completion Date	Status	Budget Estimate	YTD actual /committals
150mm main replacement					
Comments: Construction complete.					
East Street (Morgan-Dobbs) 200mm main replacement	October 2013	February 2014	76% complete	$167,377	$153,566
Comments: Scheduled.					
Morgan St (Central-East) 150mm main replacement	November 2013	February 2014	80% complete	$47,543	$33,932
Comments: On schedule.					
TREATMENT AND SUPPLY CAPITAL WORKS PROGRAM					
C-S Comms & Automation Upgrade of recycled water pump stations.	1 July 2012	31 March 2014	40% complete	$25,000	$0.00
Comments: On schedule for completion by end of FY.					
R-S GSTP Augmentation. Strategic planning and augmentation of Rockhampton and Gracemere STPs.	1 July 2012	31 December 2013	99% complete	$549,569	$388,411
Comments: Council strategic report has been finalized and subject to a discrete report to the Committee.					
C - W Reservoir St Faiths Rechlorination Installation of on-line chlorine analyser at St Faiths Reservoir and Pacific Heights Reservoir.	1 September 2012	31 January 2014	85% complete	$54,957	$11,967
Comments: The installation work is currently underway with completion expected by end of January 2014.					
R - NRSTP CCTV Camera Unit Installation of CCTV to improve physical security at NRSTP	1 September 2012	30 June 2013	100% complete	$28,760	$4,548
Comments: Project completed.					
M STP Communications Upgrade to enable monitoring of STP from Glenmore WTP.	1 April 2013	13 September 2013	100% complete	$17,256	$17,779
Comments: Project completed.					
M STP Chlorination Upgrade	1 April 2013	31 March 2014	50% complete	$15,716	$8,250
Comments: On schedule.					
R – S NRSTP Aerator Replacement	1 July 2012	31 March 2014	70% complete	$91,071	$54,228
Comments: On schedule.					

Project	Start Date	Expected Completion Date	Status	Budget Estimate	YTD actual /committals
Mt Charlton Reservoir Roof Remedial Works (Stage 1) & Internal Concrete Repairs (Stage 2)	28 November 2012	30 June 2014	50% complete	$0	$253
Comments: Project now closed off.					
Taranganba Reservoir Roof Replacement and Refurbishment	15 November 2011	29 November 2013	100% complete	$0	$15,467
Comments: Project not finished.					
Relocation of Existing Generator and Supply of Two New Generators	28 March 2012	31 December 2013	100% complete	$474,000	$483,499
Comments: Project Completed					
Barrage Crane & Rail Restoration	December 2012	June 2014	30% complete	$333,247	$82,691
Comments: On schedule.					
Emu Park Reservoir Wall Restoration	1 October 2012	10 May 2013	100% complete	$82,345	$89,706
Comments: Project Completed					
GWTP Highlift Pump Station Upgrade (1st Stage)	1 July 2012	16 August 2014 (1st Stage)	10% complete	$3,366,922	$256,704
Comments: On schedule.					
GWTP Lowlift Pump Station Upgrade	1 September 2012	Deferred	10% complete	FY 12/13: $549,569 FY 13/14: $0	FY 12/13: $50,088 FY 13/14: $5,784
Comments: Project deferred.					
Sewer Rehabilitation	28 November 2012	30 June 2014	75% complete	$0	$0
Comments: Project Completed					
Supply and Installation of Mechanical Dewatering: (1) Yeppoon Sewage Treatment Plant	29 May 2012	15 December 2013	100% complete	FY 12/13: $590,000 FY 13/14: $9,026	FY 12/13: $594,959 FY 13/14: $20,171
(2) North Rockhampton Sewage Treatment Plant	29 May 2012	31 March 2014	80% complete	FY 12/13: $840,000 FY 13/14: $611,470	FY 12/13: $638,762 FY 13/14: $564,945
Comments: Project has previously progressed slowly due to cash flow problems experienced by contractor. *(1) Yeppoon STP* ▪ Completed *(2) North Rockhampton STP* ▪ On schedule					
Design and Construction of the Emu Park Sewage Treatment	2010/11/12	30 June 2014	95% complete	$0	$28,347

Project	Start Date	Expected Completion Date	Status	Budget Estimate	YTD actual /committals
Plant (EPSTP)					
Comments: STP compliant with technical issues being addressed.					
Water Street (Kalka Shades) SPS Electrical Upgrade	9 November 2012	19 February 2013	100% complete	FY 12/13: $63,000 FY 13/14: $0	FY 12/13: $61,779 FY 13/14: $0
Comments: Project completed.					
Keppel Street North SPS Electrical Upgrade	9 November 2012	31 January 2013	100% complete	FY 12/13: $75,000 FY 13/14: $0	FY 12/13: $71,150 FY 13/14: $0
Comments: Completed.					
Gracemere Recycled Water Irrigation Electrical Upgrade	21 May 2013	31 January 2014	90% complete	FY 12/13: $143,797 FY 13/14: $0	FY 12/13: $21,924 FY 13/14: $152,009
Comments: On schedule.					
Arthur Street SPS Electrical Upgrade	1 August 2012	Deferred	10% complete	FY 12/13: $383,459 FY 13/14: $89,900	FY 12/13: $36,229 FY 13/14: $12,488
Comments: Technical Specifications for tender now complete. This project has been deferred due to insufficient available capital funding.					
Woodbury Water Treatment Plant PLC and Communications	18 June 2012	18 December 2012	100% complete	FY 12/13: $1,350,000 FY 13/14: $0	FY 11/12/13: $1,384,662 FY 13/14: $1,220
Comments: Completed.					

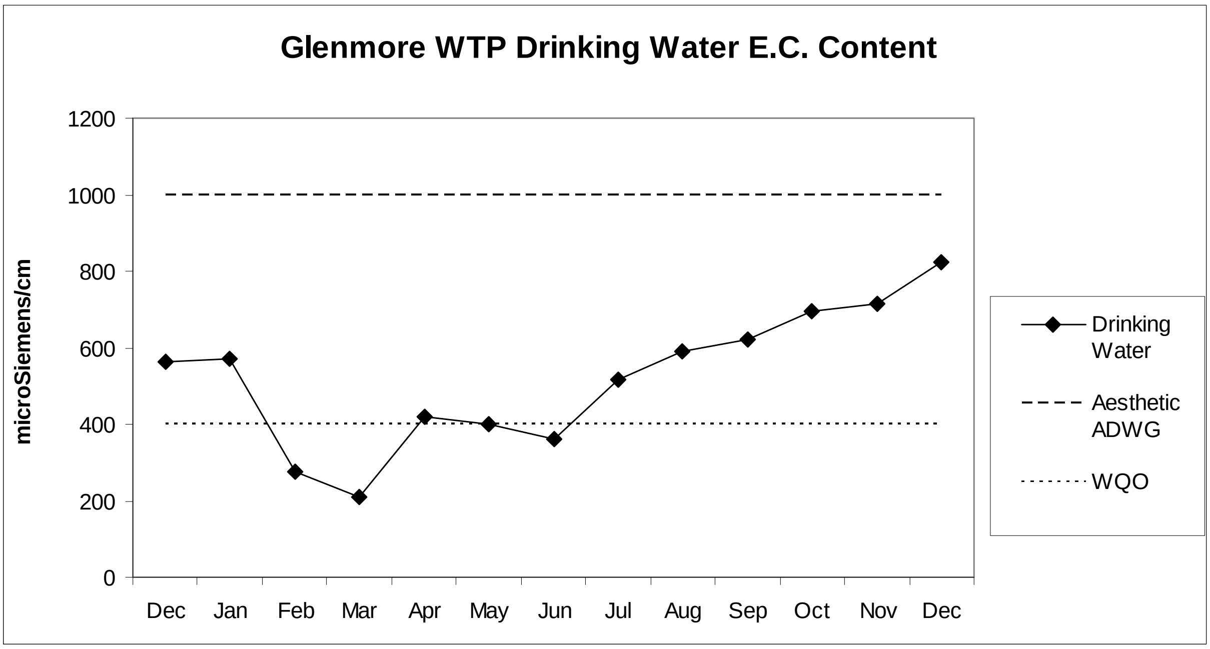
R = Rockhampton, C = Capricorn Coast, G = Gracemere, M = Mt Morgan, ML = Marlborough, O = Ogmore.
WPS = water pump station, SPS = sewage pump station, STP = sewage treatment plant, S = sewerage, W = water.

TREATMENT AND SUPPLY

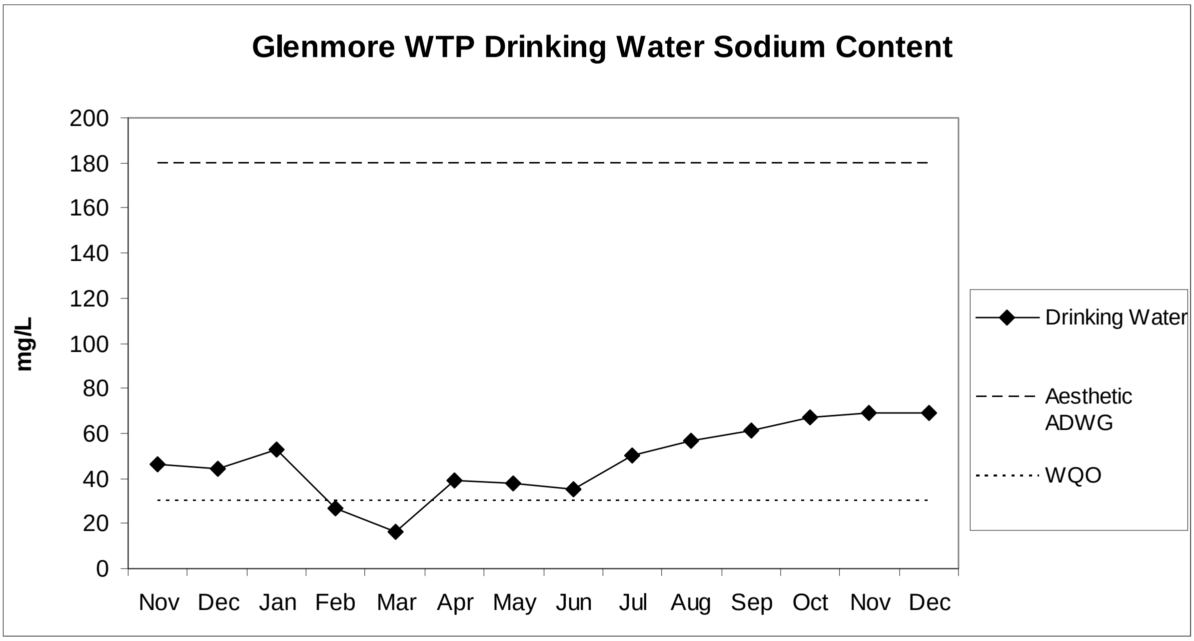
Workplace Health & Safety

- There were no lost time injuries for the month.
- One safety incident reported for the month.

Drinking Water E.C. and Sodium Content



The level of E.C. in drinking water supplied from the Glenmore Water Treatment Plant (GWTP) during December increased to be 823 µS/cm. The increase is due to the gradual arrival of higher E.C. water from the upstream catchment. The level of E.C. is now above the Water Quality Objective of 400 µS/cm but still beneath the previously used aesthetic guideline value of 1000 µS/cm. The current E.C. reading is not expected to decrease until after the arrival of heavy rainfall and the recommencement of a significant flow in the river.



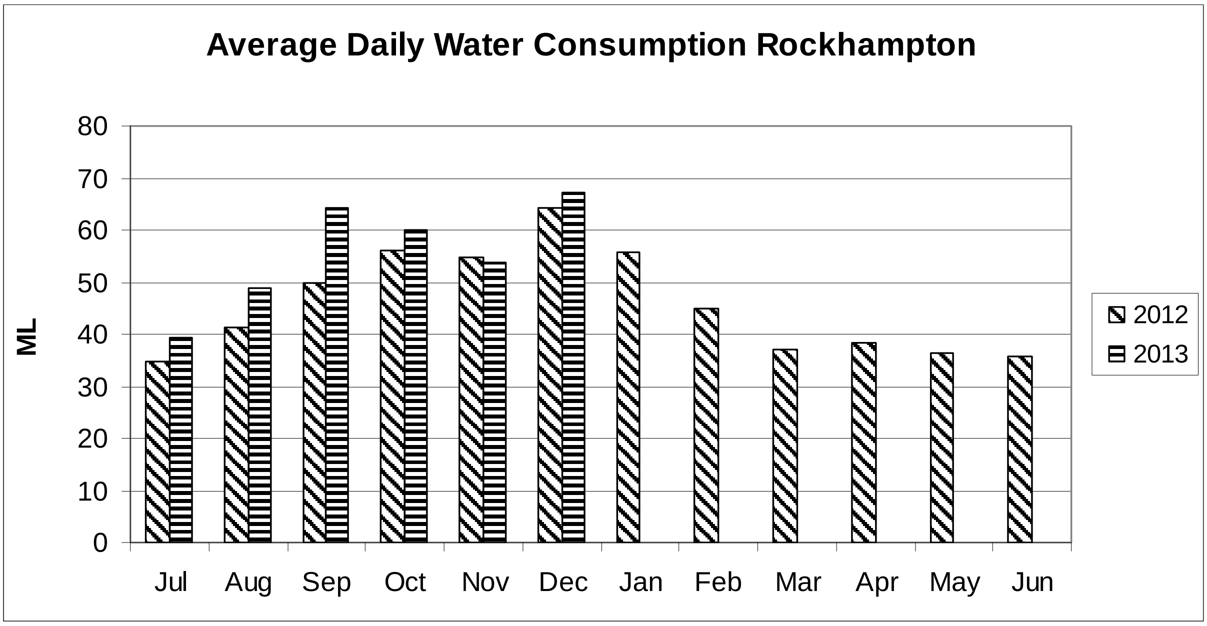
The concentration of sodium in drinking water supplied from the GWTP in December was unchanged at 69 mg/L. This relatively high sodium concentration is consistent with the high E.C. shown above. This level of sodium is above the Water Quality Objective value of 30 mg/L but is well beneath the aesthetic guideline of 180 mg/L for sodium in the Australian

Drinking Water Guidelines. The sodium concentration is not expected to decrease until after the arrival of heavy rainfall and the recommencement of a significant flow in the river.

Drinking Water Supplied

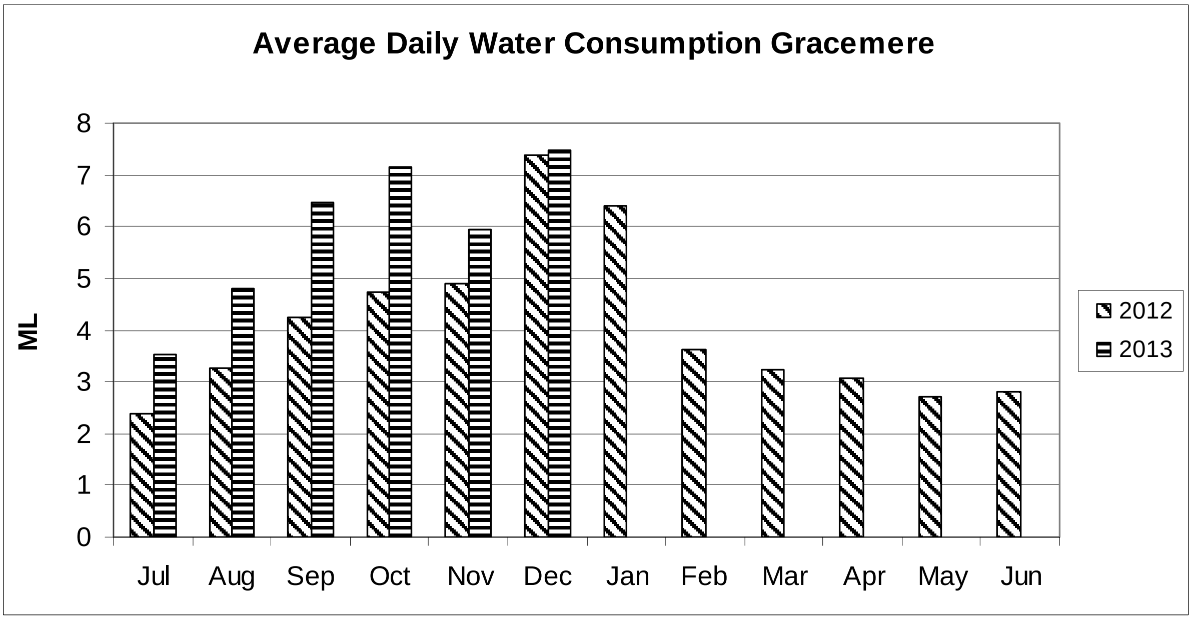
Data is presented in graphs for each water year (e.g. 2013 is the period from July 2013 to June 2014).

Rockhampton



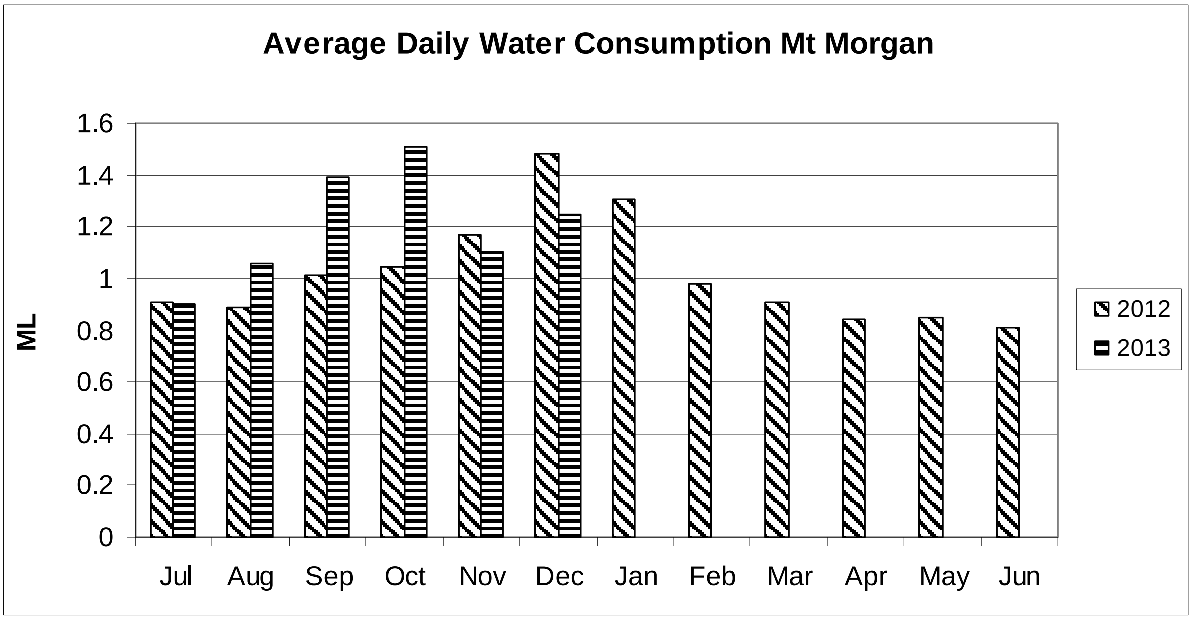
Average daily water consumption in Rockhampton during December increased significantly compared to that reported in November and was slightly higher than that reported in the same period last year. The increase was due to the relatively hot dry weather during the month. The Fitzroy Barrage Storage is currently at 98% storage level and is therefore well above the threshold in the Drought Management Plan (DMP) used to trigger the implementation of water restrictions.

Gracemere



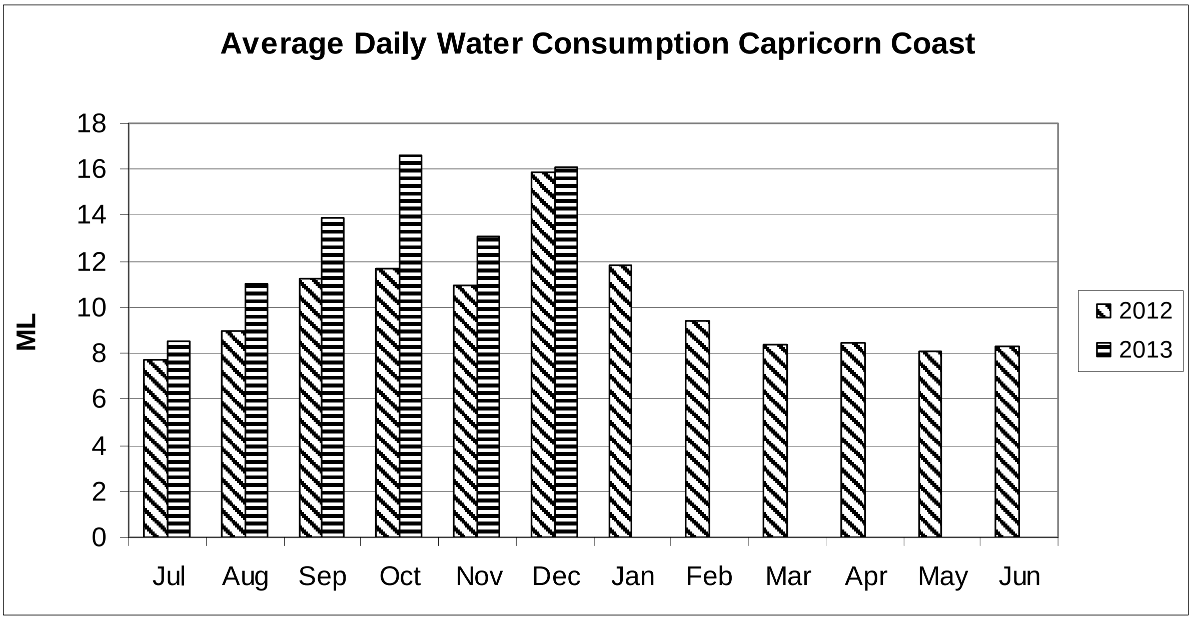
Average daily water consumption in Gracemere during December increased significantly compared to that reported in November and was slightly higher than that reported in the same period last year. The increase in consumption was due to the relatively hot dry weather during the month. The Fitzroy Barrage Storage is currently at 98% storage level and is therefore well above the threshold in the Drought Management Plan (DMP) used to trigger the implementation of water restrictions.

Mount Morgan



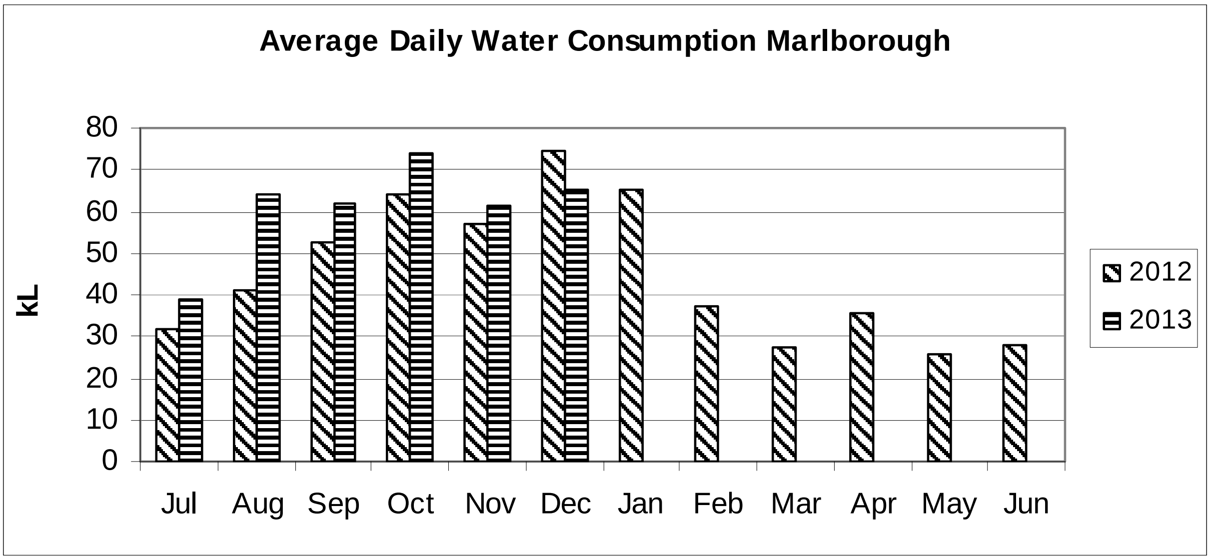
Average daily water consumption in Mount Morgan during December increased compared to that reported in November but was lower than that reported for the same period last year. The increase in consumption was due to the relatively hot dry weather during the month. The current storage level in No. 7 Dam is close to 92%, well above the 50% storage threshold value in the DMP that is used to trigger the implementation of water restrictions in Mount Morgan.

Capricorn Coast



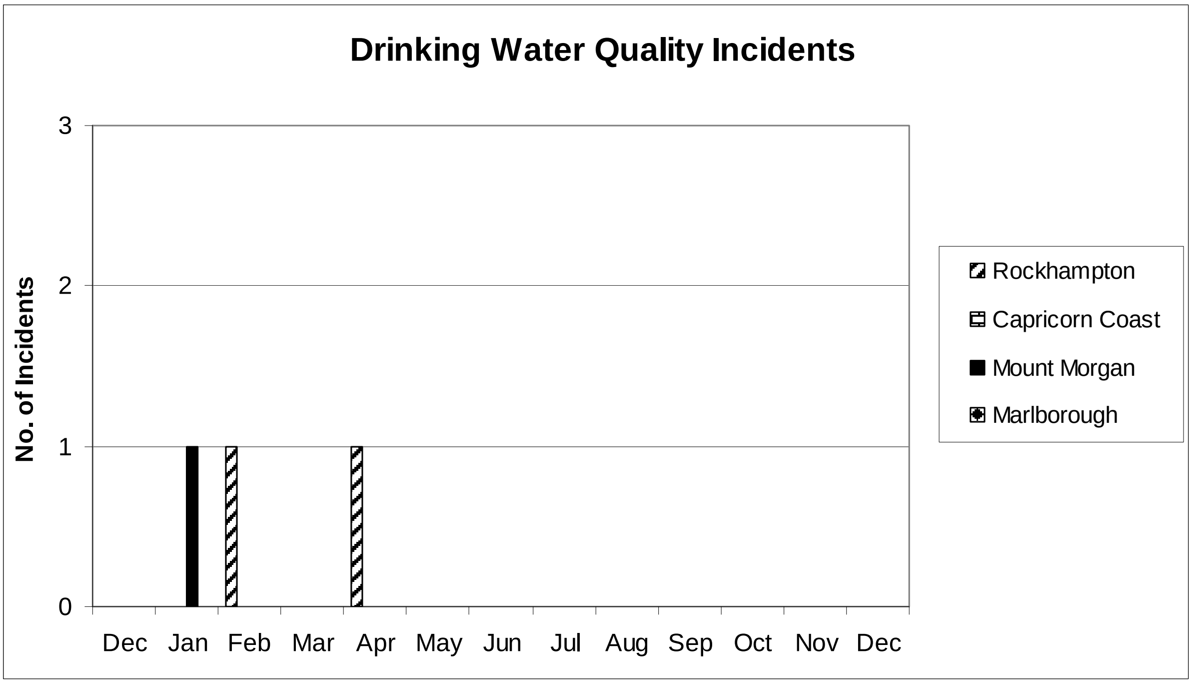
Average daily water consumption on the Capricorn Coast during December increased significantly compared to that reported in November and was slightly higher than that reported for the same period last year. The increase in consumption was due to the relatively hot dry weather during the month. The water source supply levels are well above the threshold values in the DMP that are used to trigger the implementation of water restrictions on the Capricorn Coast.

Marlborough



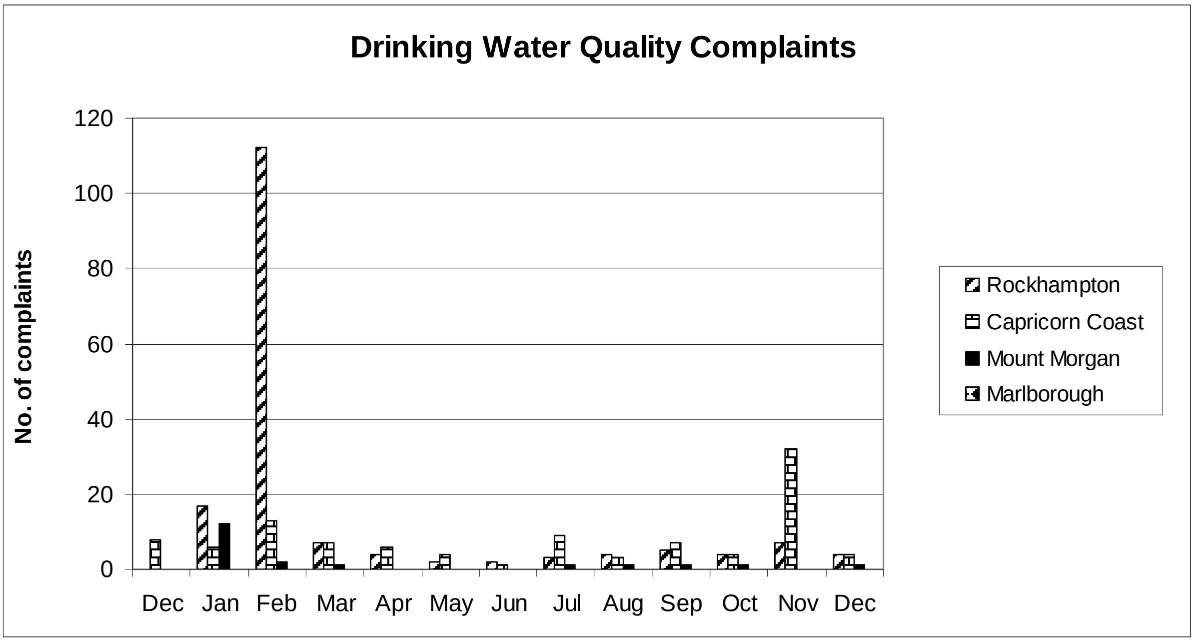
Average daily water consumption in Marlborough during December increased compared to that reported for November but was lower than that reported for the same period last year. The increase in consumption was due to the relatively hot dry weather during the month. This current level of consumption remains within the design capacity of the Marlborough WTP and is within the long term reliable extraction capacity of the bore water source.

Drinking Water Quality Incidents



No drinking water quality incidents occurred during the month of December and only two drinking water quality incidents have occurred over the past 24 months.

Drinking Water Quality Complaints

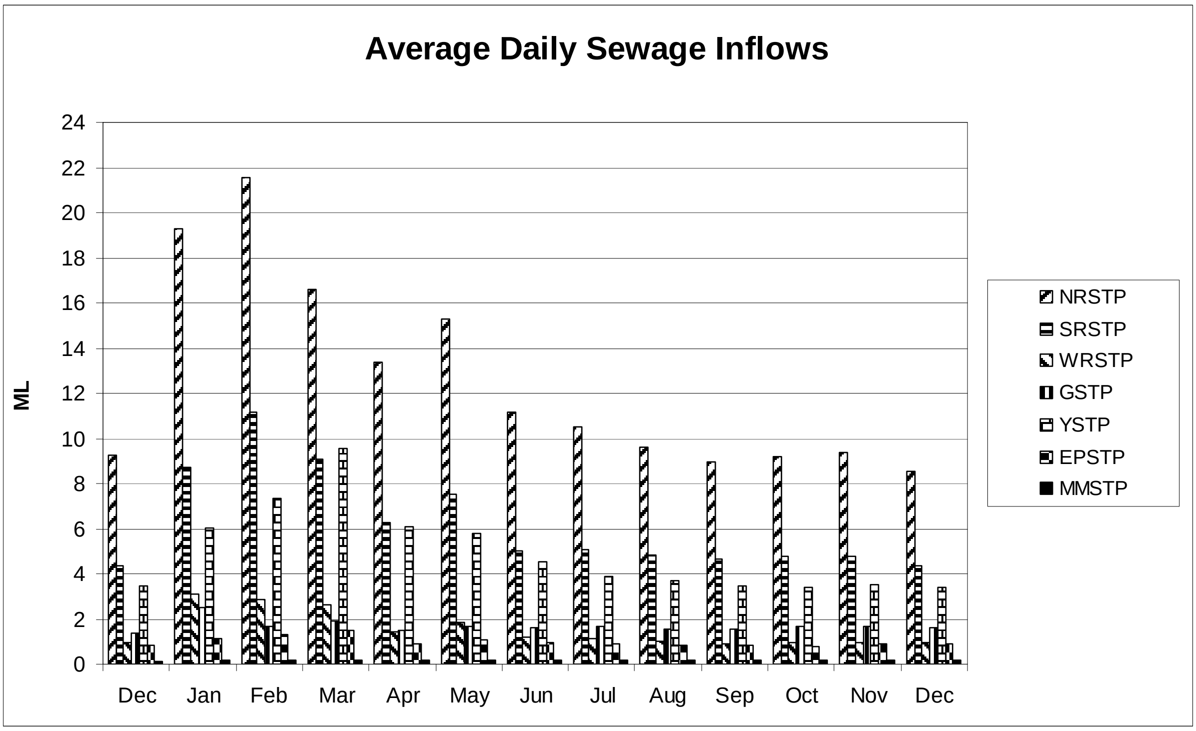


	Elevated Chlorine	Taste/Odour/Quality	Discoloured Water	Appearance (residue or air)
No. Complaints	1	2	5	1

The total number of drinking water quality complaints (9 complaints) received during December decreased from the 39 complaints received in November.

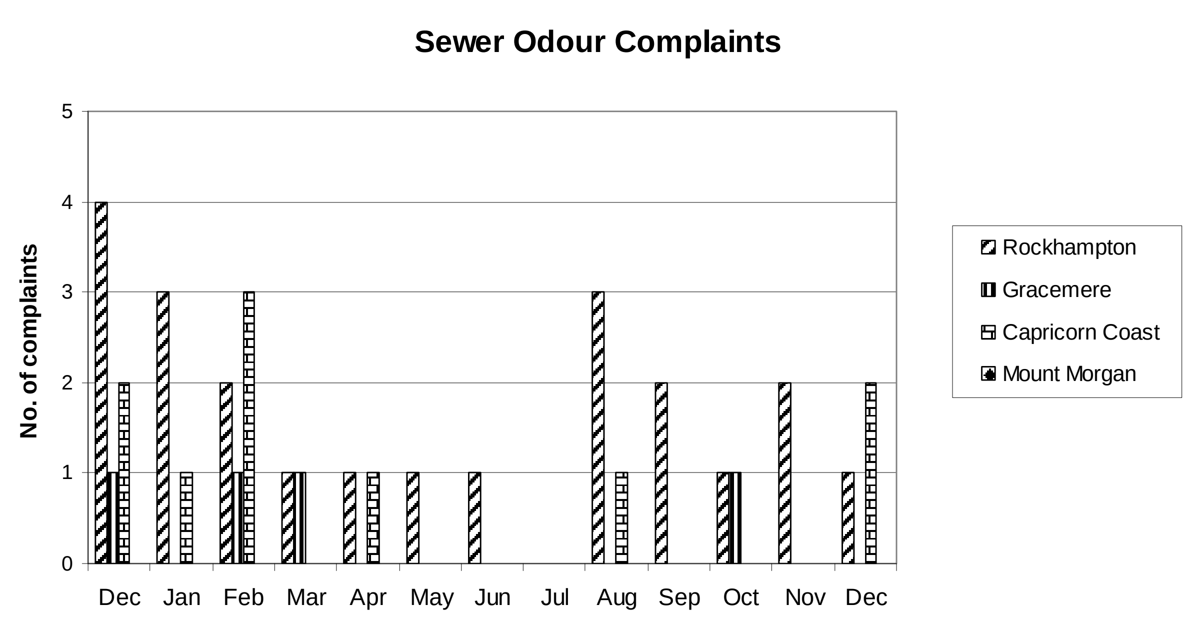
Five of the complaints were related to discoloured water with three of these received from the Capricorn Coast and two from Rockhampton. The other complaints included issues associated with taste and odour, an elevated chlorine taste and the appearance of a residue in the water. In all instances FRW assisted by taking action to address each issue by providing additional testing, information or through the flushing of water mains to resolve the issue.

Sewage Inflows to Treatment Plants



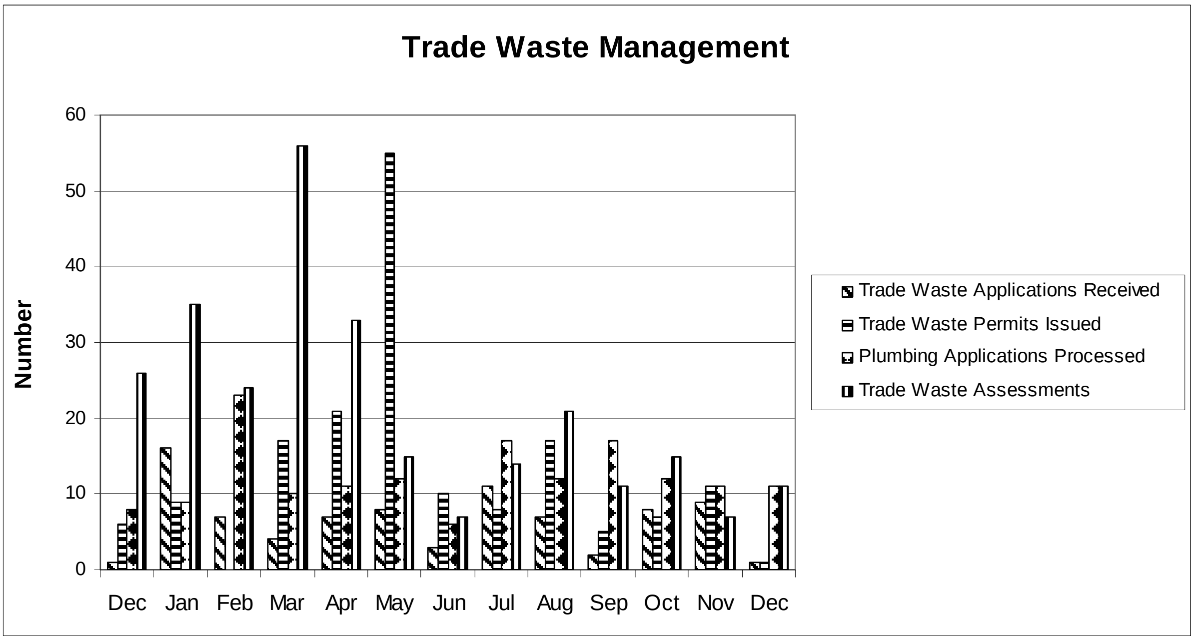
Average daily sewage inflows during December were slightly lower than that reported in November due to the ongoing hot, dry conditions and possibly also the holiday period reducing the population in some areas. The level of inflows was slightly lower than that reported during the same period last year.

Sewer Odour Complaints



Three sewer odour complaints were received during the month of December. Each of these complaints was related to sewer odour emanating from parts of the sewerage network with one complaint received from Rockhampton and the other two from the Capricorn Coast. Each complaint was investigated and action was taken where possible to resolve the odour problem.

Trade Waste Management Activities

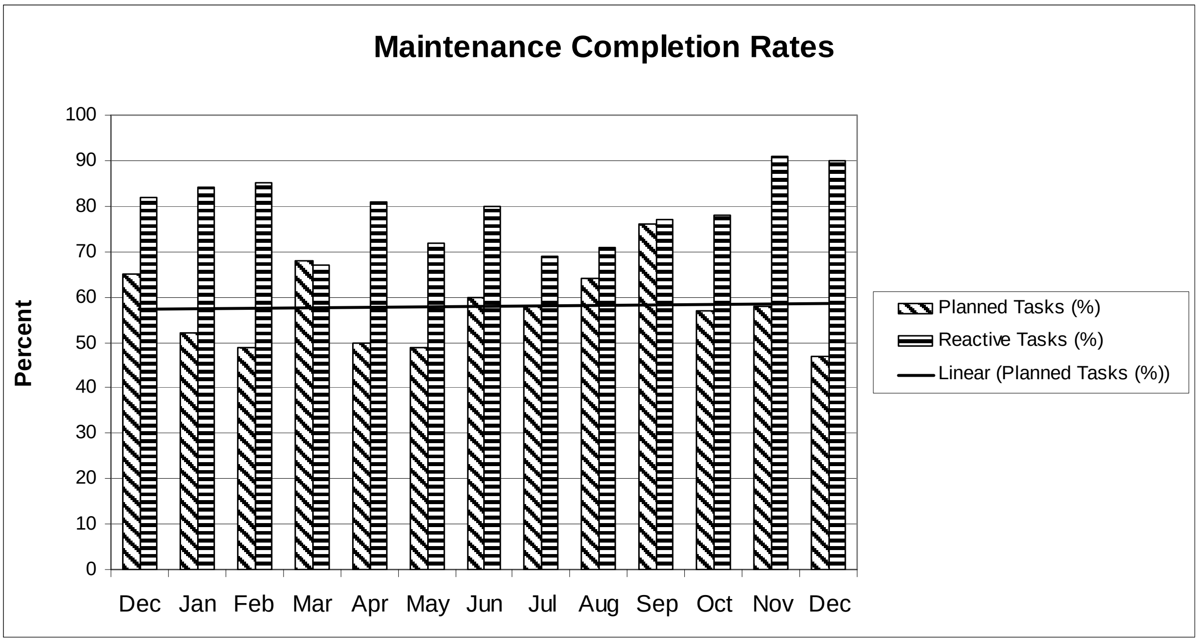


One Trade Waste application was received and one Trade Waste Permit was issued during the month of December. Eleven Plumbing Applications were processed and 11 Trade Waste Assessments completed by the team.

Maintenance Activities

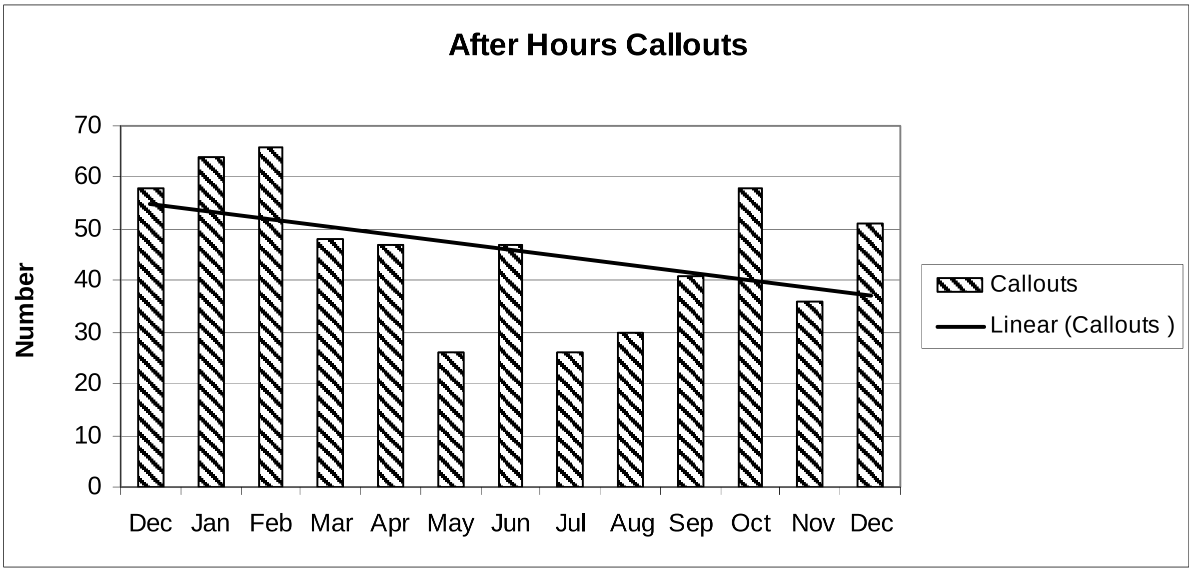
The table below shows the breakdown of work completed based on the category of the work activity.

Maintenance Type	Work Category			
	Electrical	Mechanical	General	Operator
Planned	61	63	54	N/A
Reactive	64	71	3	2
After hours callouts	16	24	1	6
Capital	1	2	0	N/A



A total of 383 maintenance activities were scheduled and 173 reactive maintenance activities were requested during the month of December. Completion rates for each type of maintenance activity by the end of the month were 47% and 90% respectively. The relatively low completion rate for planned tasks is due to a number of factors including staff absence due to leave, the relocation of some staff due to de-amalgamation and the incomplete processing of some of the completed tasks for the Capricorn Coast from late in the month.

The high completion rate for reactive maintenance has continued from last month and reflects the optimisation of work practices and the improved capturing of information about the completion of these tasks. Efforts are continuing to ensure that the completion rate for planned maintenance continues along the current trend of gradual improvement.



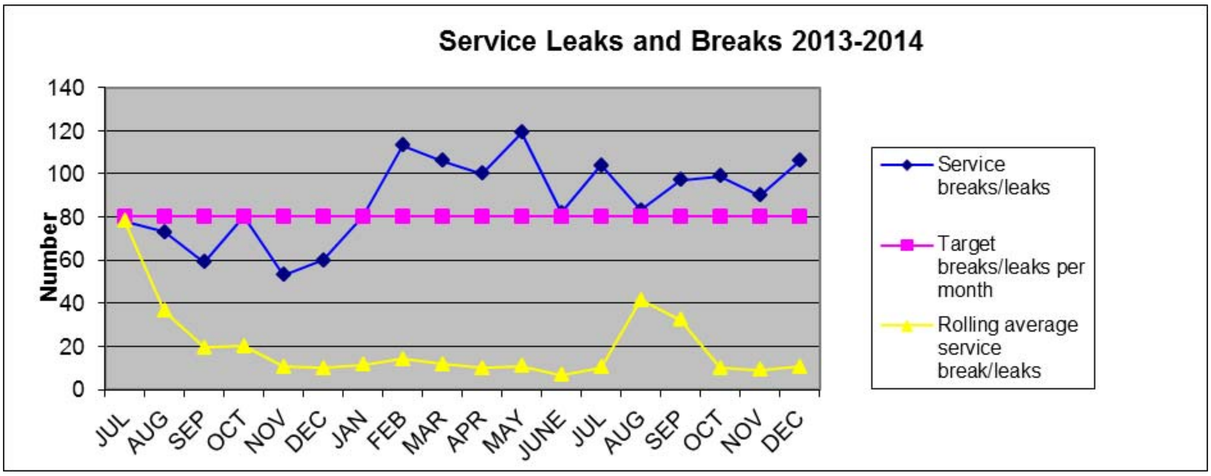
The number of after-hours call-outs for Treatment and Supply (51 call-outs) increased during December compared to November with some of these call-outs occurring on public holidays in late December. The number of callouts is higher than the 12 month rolling average of 45 call-outs although the trendline in the graph indicates a decreasing trend for call-outs over the last 12 months. Thirty-five call-outs were required to attend faults in Rockhampton, Gracemere, Mount Morgan and Marlborough at water treatment plants, sewage treatment plants, reservoirs and sewerage pump stations. Sixteen call-outs were required to attend faults along the Capricorn Coast associated with both water and sewerage assets.

NETWORK SERVICES

Workplace Health & Safety

- One lost time injuries for the month.
- Two safety incidents reported for the month.

Regional Service Leaks and Breaks



Performance

Target not achieved – service breaks and leaks continue to exceed the internal target of eighty per month.

Issues and Status

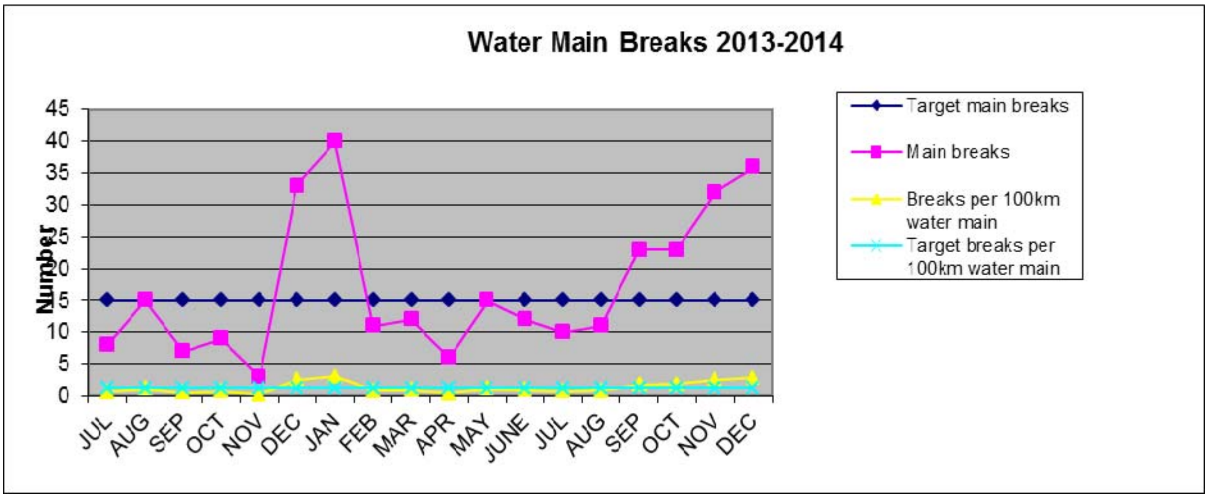
Maintenance records indicate a high percentage of service breaks consistently occurring on poly pipe.

Response to Issues

Water services subject to two failures are being replaced under the capital replacement program to minimise the risk of failure.

Locality	Service Leaks / Breaks
Rockhampton	61
Yeppoon	43
Mount Morgan	2
Regional Total	**106**

Regional Water Main Breaks



Performance

Target not achieved – water main breaks continue to exceed the internal target across the region, in no particular area, due to the dry weather conditions.

Issues and Status

The following table shows the number of breaks per month.

Water main type	September 2013	October 2013	November 2013	December 2013
Cast Iron	3	4	2	5
A C	15	14	22	26
PVC	4	3	5	2
Mild Steel	0	0	0	0
Poly	1	2	3	3
TOTAL	**23**	**23**	**32**	**36**

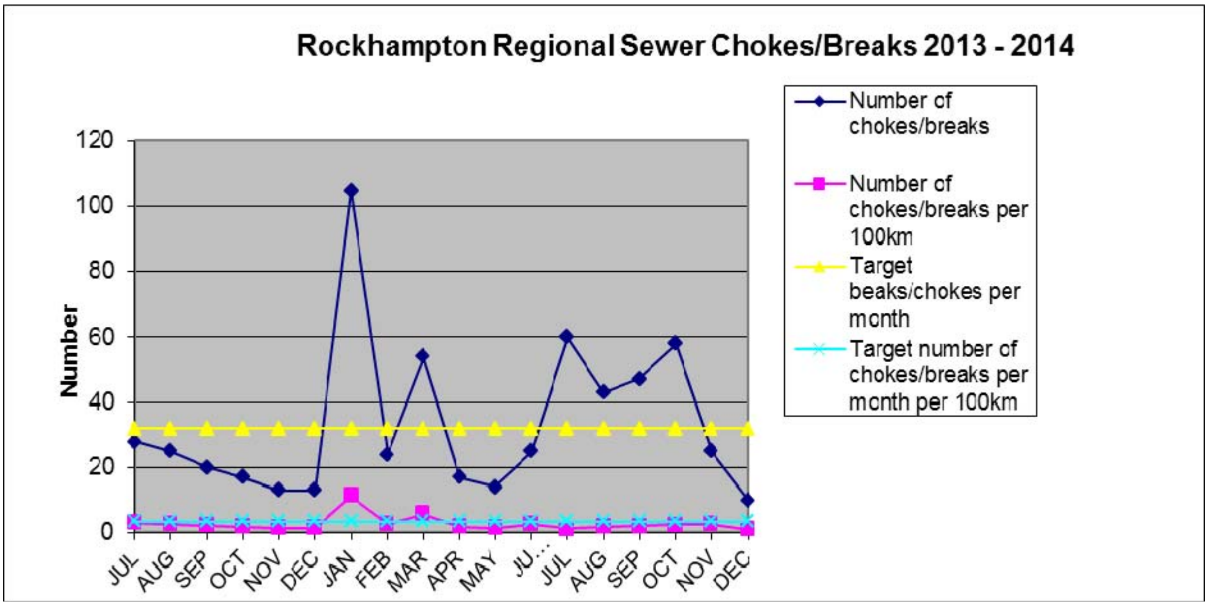
Response to Issues

Continue defect logging and rectification will reduce failure occurrences. Priority is given to AC mains old replacement program.

	Number of Main Breaks	Target Main Breaks	Breaks per 100 km	Target Breaks per 100 km	Rolling average per 100 km
December	36	**15**	2.89	**1.21**	1.78

Locality	Main Breaks
Rockhampton	35
Yeppoon	1
Mount Morgan	0
Regional Total	**36**

Rockhampton Regional Sewer Chokes/Breaks



Performance

Performance within target.

Issues and Status

Majority of blockages continue to be caused by tree root intrusion.

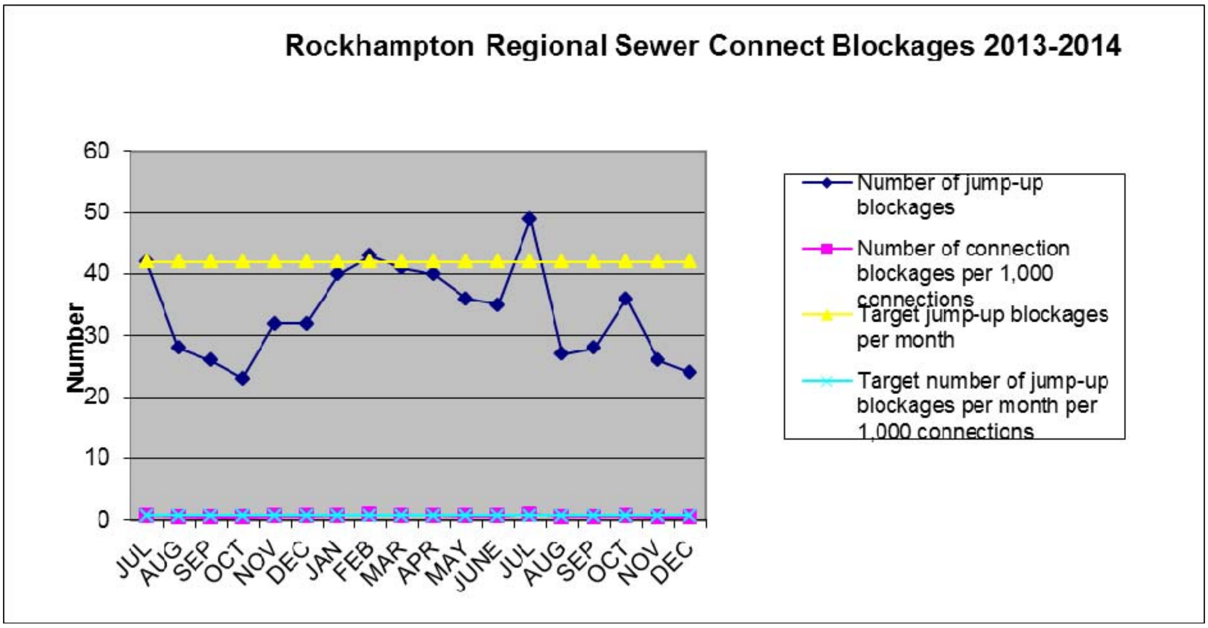
Response to Issues

Continue to log defects and monitor outcomes to ensure inclusion in the Capital rehabilitation program.

	Number of chokes/ breaks	Target chokes/breaks per month	Number of chokes/ breaks per 100 km	Target number of chokes / breaks per month per 100km	Rolling 12 month average per 100 km chokes / breaks
December	10	**32**	1.1	**3.46**	4.39

Locality	Surcharges	Blockages
Rockhampton	9	9
Yeppoon	1	1
Mount Morgan	0	0
Regional Total	**10**	**10**

Rockhampton Regional Sewer Connection Blockages



Performance

Performance within target – sewer connection blockages continue to trend downwards.

Issues and Status

Tree root intrusion through defective pipes and joints continues to be the cause of blockages.

Response to Issues

Continue to log defects against the asset and properties experiencing blockages and schedule those for repair.

	Number of connection blockages	Target connection blockages per month	Number of connection blockages per 1,000 connections	Target number of connection blockages per 1,000 connections	12 month average per 1,000 connections
December	24	**42**	0.45	**0.80**	0.58

Locality	Connection Blockages
Rockhampton	22
Yeppoon	2
Mount Morgan	0
Regional Total	**24**

Private Works

Table 1: New Water Connections

Region	December	Year to Date 2013	Year to Date 2012	Year to Date 2011	Year to Date 2010
Capricorn Coast	16	154	124	125	132
Gracemere	4	54	283	172	159
Rockhampton	13	146	87	52	52
Mount Morgan	0	0	0	0	0
Regional Total	**33**	**354**	**494**	**349**	**343**

The following table shows the water connection data, for December, for the past 4 years.

Region	December 2013	December 2012	December 2011	December 2010
Capricorn Coast	16	9	19	22
Gracemere	4	22	50	28
Rockhampton	13	10	10	2
Mount Morgan	0	0	0	0
Total	**33**	**41**	**79**	**52**

Table 2: Details on Private Works Jobs

Table 2 shows the quantity of private works jobs quoted and accepted during the reporting period and year to date. Jobs include both water and sewerage.

	December	Amount	YTD	Amount
Quotes Prepared	14	$82,617.62	161	$953,849.93
Quotes Accepted	22	$186,655.13	114	$641,346.11
Jobs Completed	15	$74,657.78	109	$601,168.81

Table 3: Undetected Leaks (Residential)

	December	YTD
New requests	0	45
Number declined	0	3
Number approved	15	61
Require more info	6	13
Total Kl rebated	6532	29,016
Total value approved	**$11,456.73**	**$56,224.12**

Table 4: Undetected Leaks (Commercial)

	December	YTD
New requests	0	1
Number declined	0	0
Number approved	2	6
Require more info	0	0
Total Kl rebated	1884	2429
Total value approved	**$730.06**	**$1507.91**

Table 5: Residential Rebates

	December	Total YTD Applications	Total YTD $
Washing machines	12	159	$15,900.00
Stand alone tank	0	5	$1,250.00
Integrated tank	0	0	$0
Dual flush toilet	0	7	$350
Shower rose	0	4	$100
Other	-	-	$0
Total	12	175	$17,600.00

Currently there is one unapproved application pending further advice from the applicant.

Water Meters

A total of 1,683 meters were read during the month of December 2013 and approximately 23,600 accounts were issued to customers. The difference in the reads compared to bills is due to two weeks lead time for bills to be processed and mailed to customers with there being overlaps from one month to the next.

Sectors Read for December	25	Totals
No. of meters in Sector	1683	1683
No-Reads	39	39
% Of No-Reads	2.3%	2.3%

Special Water Meter Reads

Reading Type	No. of Reads	$ Value
Water Account Search - Averaged Readings $27 per read	**114**	$3,078.00
Water Account Search - On-Site Readings $143.00 per read	**33**	$4,719.00
Total $ Value for Month		**$7,797.00**
Total $ Value Year to Date		**$57,486.00**

Customer Enquiries - Pathways

Request Type	No. of Requests	Requests Outstanding
NSWMRE - Network Services - Water Meter Reading Enquiry	10	3
NSSWMR - Network Services Special Water Meter Read Enquiry	2	0
FINIRR - Finance - Irrigators (Asset)	3	0

NETWORK SYSTEMS

Building Over Sewers

The following summary is an overview of the core business activity that requires ongoing negotiations with the respective stakeholders and detailed investigations to determine location and condition assessments of the associated infrastructure.

	December	YTD
General enquiries	30	300
Site investigations	10	107
Approval Permits issued	2	20
Permits closed	1	5

Sewer Network Investigations

Building Over/Adjacent to Local Government Sewerage Infrastructure Policy

The proposed amendments to the Building Act and other legislation associated with Building Over or Near Sewers came into effect on 1 November 2013 with the release of the policy MP 1.4. It was reported in November that an interpretation of the policy mandated acceptable solutions for all sewers under 1.5 metres in depth with FRW to function as a concurrence agency for all sewers over 1.5 metres in depth.

A later amendment to the policy MP 1.4 in December mandated acceptable solutions specifically for Building Classes 1 and 10 irrespective of the sewer depth and FRW will continue to function as a concurrence agency for those applications with Building Classes 1 and 10 that do not comply with an acceptable solution.

FRW will also continue to function as a concurrence agency for all applications with Building Classes 2 to 9. It is noted that Building Classes 1 and 10 may broadly be defined as typical residential type developments where Building Classes 2 to 9 are of a commercial nature.

The current Council Building Over/ Adjacent to Local Government Sewerage Infrastructure Policy has again been updated to comply with the latest amendment to MP 1.4 and to ensure consistency between the two documents.

Proposed Limestone Creek Sewer Pump Station

The Parkhurst sewer catchment currently flows into the Glenmore Road catchment that has limited available capacity. Given the increased development activity within the Parkhurst catchment it is necessary to divert this flow into the Norman Road catchment that has ample capacity.

This diversion is to be achieved by the proposed Limestone Creek sewer pump station. The optimal site for the pump station is adjacent to Boundary Road on land owned by the Department of Natural Resources and Mines that is currently leased to the Disabled Horse Riders Association (DHRA).

The acquisition of the pump station site has been the subject of dispute for a number of months. In a meeting facilitated by Bruce Young MP, between members of Council and the

DHRA it was agreed that Council would provide the DHRA with additional land currently assigned to the Heritage Village.

Ellida (Stocklands) Development - Sewer Strategy

The sewer strategy for the proposed Ellida development in Parkhurst has continued to be refined over the last few months. The technical issues surrounding the proposed size and staging of the two primary pump station sites and their associated rising mains have almost been resolved with further discussion to be held with the developers consultants early next year.

Gracemere Effluent Line to Rockhampton Golf Course

The duplication of the trunk water main from Rockhampton to Gracemere has presented an opportunity to construct an effluent main from the Gracemere Sewerage Treatment Plant to the Rockhampton Golf Course for little more than the cost of the pipe materials.

By jockeying on to the water main duplication project and another project named the Armstrong Street rising main, there is potential for 7.9km of the 9.0km required for the effluent main to be laid at a significantly reduced rate by using a shared trench.

The total cost of the project is estimated to be in the order of $1.4 million with approximately $210,000 required in 2013/14. The anticipated completion date for the project would be in 2016/17.

A business case for this project is currently being prepared.

<u>Water Network Investigations</u>

Edenbrook Development – Pumped Water Main Proposal

The Parkhurst Edenbrook development has an existing approval to construct a water pump station at the Birkbeck reservoir site, and provide a 200mm diameter main an estimated distance of 1.2km to the intersection of McLaughlin Street and William Palfrey Road to service the initial stages of the development.

The formulation of priority future trunk infrastructure strategies in this area has identified the need for a 300mm diameter trunk main on the same alignment as the proposed 200mm main. The 300mm main will ultimately connect through to Yaamba Road to enable the Birkbeck reservoir to be supplied by either the Boundary or Mt Charlton reservoirs, building further redundancy into the water network.

It has been proposed that the developer should construct the 300mm main via an Infrastructure Agreement rather than construct a 200mm main that would ultimately become redundant. The developer is currently looking at providing an amended design and a suggested re-payment proposal for inclusion into an infrastructure agreement.

<u>Water Loss Calculations</u>

The following water loss results were reported in the September customer service standards quarterly report.

Water Supply Scheme	Water Loss Per Connection 2013 (Litres per day)			
	March	**June**	**September**	**December**
Rockhampton	280	242	227	**161**
Capricorn Coast	0	119	7	**87**
Mount Morgan	172	160	172	**175**

The results indicate there are ongoing issues associated with the correlation of the Capricorn Coast production and consumption data that requires further investigation.

NETWORK CONSTRUCTION

<u>Workplace Health and Safety</u>

- One lost time injury for the month.

- One safety incident reported for the month.

Sewer Rehabilitation Program

Work Location	Number completed for the month	Year to date totals
Access Chambers raised	9	80
Sewers repaired	12	133

9.2 FRW ANNUAL PERFORMANCE PLAN AS AT 30 SEPTEMBER 2013

File No:	**1466**
Attachments:	**1. Customer Service Standards as at 30 September 2013** **2. Customer Service and Financial Targets** **3. Non Compliance Comments**
Responsible Officer:	**Robert Holmes - General Manager Regional Services**
Author:	**Nimish Chand - Strategic Manager Fitzroy River Water**

SUMMARY

Fitzroy River Water's performance against financial and non-financial targets and key strategies is reported to Council on a quarterly basis in accordance with the adopted 2013/14 Performance Plan. This report as at 30 September 2013 is presented for the Committee's information.

OFFICER'S RECOMMENDATION

THAT the Fitzroy River Water Annual Performance Plan quarterly report as at 30 September 2013 be received.

BACKGROUND

Fitzroy River Water (FRW) is required to provide a quarterly report on its performance against financial and non-financial performance targets and key strategies as adopted in the Annual Performance Plan for 2013/14.

FRW has legislative obligations to report to various external agencies and stakeholders. The data in these reports is presented based on water and sewerage schemes. The format of reporting actual non-financial performance against targets in accordance with the requirements of the Annual Performance Plan has been modified to be consistent with the external reporting requirements and is presented in Attachment 1.

COMMENTARY

Manager's Overview

Fitzroy River Water's performance remained consistent through the first quarter and focus continues on improving reliability and quality of services provided to customers.

Customer Service Performance

FRW has an internal service level agreement with Finance & Business for the provision of customer service related functions including:

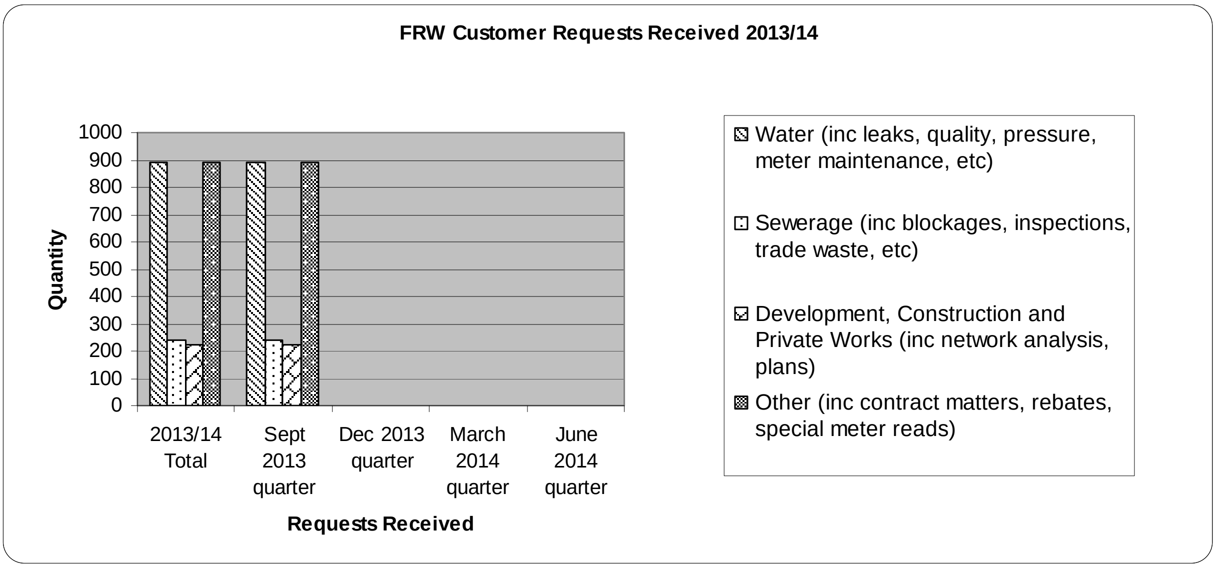
1. Face to Face Customer Support.
2. 24 Hour Telephone Contact Service.
3. Acceptance of Payment.

The following table summarises customer contacts made via the telephone and face to face at the Council Customer Service Centres. These customer contacts are then addressed by FRW.

Table 1: Customer Contact

1st quarter – 1July to 30 September 2013

Customer Contact Type	1st Quarter 2013/14	1st Quarter 2012/13	Total 2013/14 Year	Total 2012/13 Year	Total 2011/12 Year
Water (incl. leaks, quality, pressure, water meter maintenance, etc)	891	797	891	3923	3719
Sewerage (incl. blockages, trade waste etc)	240	275	240	1263	1118
Development, Construction and Private Works	224	220	224	953	1013
Other (incl. contract matters, rebate, special meter reads, etc)	893	859	893	3559	2997
Total Customer Contacts	**2248**	**2151**	**2248**	**9698**	**8847**



Financial Performance

Operational

The operational result is currently a surplus of $11.4 million. Revenue is currently $27.1 million compared with budget for both Councils of $70.2 million which indicates revenue is exceeding expectation. This is due to rates being levied for the first half of the year, and with this considered revenue is slightly behind percentage of year elapsed.

Expenditure year to date is slightly below percentage of the year elapsed at 23% compared with budget for both Councils.

There are no material exceptions to report following the first quarter results.

Capital

FRW's total capital expenditure is at 17% of budget with expenditure in the month of September remaining fairly static compared to the previous month. Water year to date is 19.08% and Sewer year to date is 12.89%. Networks year to date is 21.00% and Treatment year to date is 5.65%.

There are no other material exceptions to this report.

Compliance Matters

Drinking Water Quality

All drinking water samples collected and tested during this quarter were compliant with State legislation and Australian Drinking Water Guideline (ADWG) health values.

Variations / Concerns

The month of September contained some unusually hot weather which followed on from the relatively warm end to the winter in July and August. As a result, the volume of water supplied to customers during this first quarter of the water year has increased significantly compared to the previous year. Across the region an increase of approximately 20% in water demand was observed. This increased level of demand has placed some additional pressure on the water supply infrastructure in some locations, however, to date supply to all locations has been consistently maintained in order to meet demand.

Safety Management

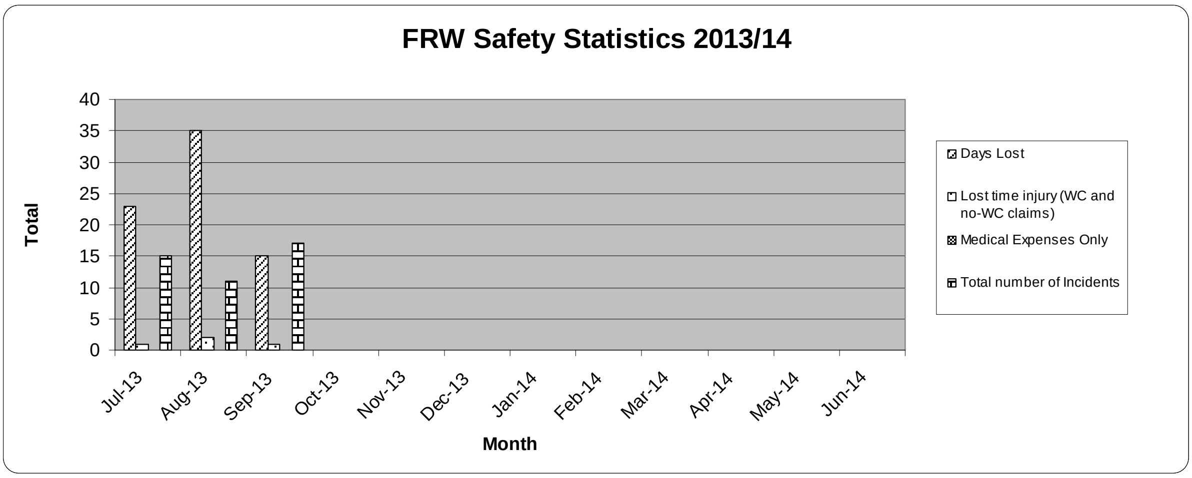
The safety statistics shown in Table 2 indicate incidents are still a regular occurrence in the workplace and this is being addressed through toolbox talks and the FRW Safety Committee.

Table 2: Safety Statistics

Please be advised that the data recorded in this report is accurate at the time of compilation. As this information is sourced from a live database, changes will occur as required when amendments or upgrades are made to injury severities including lost and rehabilitation days.

1st quarter – 1July to 30 September 2013

Lost Time Injury Statistics	1st Quarter 2013/14	1st Quarter 2012/13	Total 2013/14 Year
Days Lost *	73	52	73
Lost time Injury (Work Cover & non-Work Cover claims)	4	2	4
Medical Expense Only Claims	0	0	0
Total Number of Incidents Reported	43	22	43



Risk Management

Quarterly risk reviews and reporting requirements have been undertaken during this quarter and presented to the Risk Management Coordinating Committee.

CONCLUSION

Business performance is as expected for this quarter and this report serves two purposes – keeping the Council informed and meeting the legislative obligation of reporting on progress against the FRW Performance Plan.

FRW ANNUAL PERFORMANCE PLAN AS AT 30 SEPTEMBER 2013

Customer Service Standards as at 30 September 2013

Meeting Date: 5 February 2014

Attachment No: 1

Fitzroy River Water Performance Plan - Customer Service Standards Year to Date Reporting as at 30 September 2013

Non-Financial Performance Targets

Table Reference	CSS Reference	Performance indicator	Potable Water Schemes: Rockhampton & Gracemere Water Supply Scheme, Number of access charges - 32,807 as at 11 July 2013: 1st qtr	2nd qtr	3rd qtr	4th qtr	Annual Target	Year to Date	Potable Water Schemes: Capricorn Coast Water Supply Scheme, Number of access charges - 10,815 as at 11 July 2013: 1st qtr	2nd qtr	3rd qtr	4th qtr	Annual Target	Year to Date
Table 1 Water - Day to Day Continuity	CSS1	Extent of unplanned interruptions connections based (no. per 1,000 connections per year)	11				**<80**	11	18				**<80**	18
	CSS2	Extent of unplanned interruptions incidents based (no. per 100 km of main per year) Rockhampton & Gracemere 828km Capricorn Coast 414km Mt Morgan 88.3km	10				**<30**	10	10				**<30**	10
	CSS3	Time for restoration of service unplanned interruptions (% restored within 5 hours)	94%				**>90%**	94%	98%				**>90%**	98%
	CSS4	**Customer interruption frequency:**												
		1 interruption per year	1.83%				**12%**	1.83%	4.28%				**12%**	4.28%
		2 interruptions per year	0.20%				**2%**	0.20%	0.05%				**2%**	0.05%
		3 interruptions per year	0.00%				**1%**	0.00%	0.00%				**1%**	0.00%
		4 interruptions per year	0.00%				**0.50%**	0.00%	0.00%				**0.50%**	0.00%
		5 or more interruptions per year	0.00%				**0.25%**	0.00%	0.00%				**0.25%**	0.00%
	CSS5	Relative incidence of planned and unplanned interruption incidents (% of planned versus total number of interruptions)	25%				**>30%**	25%	19%				**>30%**	19%
	CSS6	Average interruption duration planned and unplanned (hours)	0.54				**3 hrs**	0.54	4.78				**3 hrs**	4.78
	CSS7	**Response time**												
		Priority 1 1 hour response	92%				**95%**	92%	100%				**95%**	100%
		Priority 2 2 hours response	87%				**95%**	87%	100%				**95%**	100%
		Priority 3 24 hours response	97%				**95%**	97%	100%				**95%**	100%
		Restoration time												
		Priority 1 5 hours restoration	92%				**95%**	92%	100%				**95%**	100%
		Priority 2 24 hours restoration	98%				**95%**	98%	100%				**95%**	100%
		Priority 3 5 days restoration	99%				**95%**	99%	100%				**95%**	100%

Table Reference	CSS Reference	Performance indicator	Potable Water Schemes: Rockhampton & Gracemere Water Supply Scheme Number of access charges - 32,807 as at 11 July 2013						Capricorn Coast Water Supply Scheme Number of access charges - 10,815 as at 11 July 2013					
Table 2 Adequacy and Quality of Normal Supply of Water Supply	CSS8	Minimum pressure standard at the water meter (kPa)	220				**220 kPa**	220	220				**220 kPa**	220
	CSS9	Minimum flow standard at the water meter	9 L/min				**9 L/min**	9 L/min	9 L/min				**9 L/min**	9 L/min
	CSS10	Connections with deficient pressure and/or flow (% of total connections)	<2.5%				**<2.5%**	0.0%	<2.5%				**<2.5%**	0.0%
	CSS11	Drinking water quality (compliance with industry standard)	100%				**>98%**	100%	100%				**>98%**	100%
	FRW's Drinking Water Quality Management Plan identifies the following key water quality parameters as reference indicators for customer service purposes: Physical and Chemical Water Quality Parameters Target: >99% of all samples tested compliant with Australian Drinking Water Guidelines and E.coli Target: None detected in >98% of all samples tested													
	CSS12	Drinking water quality complaints (number per 1,000 connections)	0.37				**<5**	0.37	1.76				**<5**	1.76
	CSS13	Drinking water quality incidents (number per 1,000 connections)	0				**<5**	0	0				**<5**	0

Table Reference	CSS Reference	Performance indicator	Potable Water Schemes: Rockhampton & Gracemere Water Supply Scheme Number of access charges - 32,807 as at 11 July 2013						Capricorn Coast Water Supply Scheme Number of access charges - 10,815 as at 11 July 2013					
			1st qtr	2nd qtr	3rd qtr	4th qtr	Annual Target	Year to Date	1st qtr	2nd qtr	3rd qtr	4th qtr	Annual Target	Year to Date
Table 3 Long Term Continuity of Water Services	CSS14	Water main breaks (number per 100 km main) Rockhampton & Gracemere 828km Capricorn Coast 414km Mt Morgan 66.3km	4				**<40**	4	0				**<40**	0
	CSS15	Water services breaks (number per 1,000 connections)	5				**<40**	5	9				**<40**	9
	CSS16	System water loss (litres per connection per day)	227				**< 200 L**	227	7				**≤ 130 L**	7

Table Reference	CSS Reference	Performance indicator	Sewerage Schemes: Rockhampton & Gracemere Sewerage Scheme Number of access connections - 41,401 as at 11 July 2013						Sewerage Schemes: Capricorn Coast Sewerage Scheme Number of access connections - 11,206 as at 11 July 2013					
			1st qtr	2nd qtr	3rd qtr	4th qtr	Annual Target	Year to Date	1st qtr	2nd qtr	3rd qtr	4th qtr	Annual Target	Year to Date
Table 4 Effective Transportation of Sewage	CSS17	Sewage overflows - total (number per 100 km main) Rockhampton & Gracemere 645.4km Capricorn Coast 270.6km Mt Morgan 5.6km	12.53				**<30**	12.53	1.86				**<10**	1.86
	CSS18	Sewage overflows to customer property (number per 1,000 connections)	2.13				**<10**	2.13	0.36				**<5**	0.36
	CSS19	Odour complaints (number per 1,000 connections)	0.12				**<1**	0.12	0.09				**<1**	0.09
	CSS20	**Response time**												
		Priority 1 - 1 hour response	82%				**>95%**	82%	100%				**>95%**	100%
		Priority 2 - 2 hours response	84%				**>95%**	84%	100%				**>95%**	100%
		Priority 3 - 24 hours response	96%				**>95%**	96%	100%				**>95%**	100%
		Restoration time												
		Priority 1 - 5 hours restoration	94%				**>95%**	94%	100%				**>95%**	100%
		Priority 2 - 24 hours restoration	97%				**>95%**	97%	100%				**>95%**	100%
		Priority 3 - 5 days restoration	98%				**>95%**	98%	100%				**>95%**	100%
Table 5 Long Term Continuity of Sewerage Services	CSS21	Sewer main breaks and chokes (number per 100 km main) Rockhampton & Gracemere 645.4km Capricorn Coast 270.6km Mt Morgan 5.6km	20.36				**<50**	20.36	3.26				**<20**	3.26
	CSS22	Sewer inflow and infiltration (ratio of Peak Day Flow to Average Day Flow)	1.2				**<5**	1.20	1.29				**<5**	1.29

Non-Financial Performance Targets

Table Reference	CSS Reference	Performance incicator	Potable Water Schemes: Mt Morgan Water Supply Scheme, Number of access charges - 1,462 as at 11 July 2013						Potable Water Schemes: Marlborough Water Supply Scheme, Number of access charges - 57 as at 11 July 2013						Non Potable Water Supply Scheme: Ogmore Water Supply Scheme, Number of access charges - 50 as at 11 July 2013					
			1st ctr	2nc ctr	3rc ctr	4th ctr	Annual Target	Year to Date	1st ctr	2nc ctr	3rc ctr	4th ctr	Annual Target	Year to Date	1st ctr	2nc ctr	3rc ctr	4th ctr	Annual Targe	Year to Date
Table 1 Water - Day to Day Continuity	CSS1	Extent of unplannec interruptions connections basec (no. per 1,000 connections per year)	40				**<80**	40	0				**<80**	0	0				**<500**	0
															The Ogmore supply system is basec on a timec constant flow type.					
	CSS2	Extent of unplannec interruptions incicents basec (no. per 100 km of main per year) Rockhampton & Gracemere 828km Capricorn Coast 414km Mt Morgan 66.3km	14				**<30**	14	0				**<30**	0					**NR**	
	CSS3	Time for restoration of service unplannec interruptions (% restorec within 5 hours)	100%				**>90%**	100%	100%				**>90%**	100%	100%				**>90%**	100%
													% restorec within 24 hours						% restorec within 5 cays	
	CSS4	**Customer interruption frequency:**																		
		1 interruption per year	8.13%				**12%**	8.13%	ND				**12%**	ND						
		2 interruptions per year	0.14%				**2%**	0.14%	ND				**2%**	ND						
		3 interruptions per year	0.00%				**1%**	0.00%	ND				**1%**	ND					**NR**	
		4 interruptions per year	0.00%				**0.50%**	0.00%	ND				**0.50%**	ND						
		5 or more interruptions per year	0.00%				**0.25%**	0.00%	ND				**0.25%**	ND						
	CSS5	Relative incicence of plannec anc unplannec interruption incicents (% of plannec versus total number of interruptions)	10%				**>30%**	10%	ND				**>30%**	ND	ND				**>80%**	ND
															The Ogmore supply system operates intermittently to supply raw water. No recorcs have been kept of plannec interruptions.					
	CSS6	Average interruption curation plannec anc unplannec (hours)	0.81				**3 hrs**	0.81	0				**3 hrs**	0	0				**<3 days**	0
	CSS7	**Response time**																		
		Priority 1 1 hour response	67%				**95%**	67%	100%				**95%**	100%	100%				**95%**	100%
		Priority 2 2 hours response	88%				**95%**	88%	100%				**95%**	100%	100%				**95%**	100%
		Priority 3 24 hours response	100%				**95%**	100%	100%				**95%**	100%	100%				**95%**	100%
		Restoration time																		
		Priority 1 5 hours restoration	100%				**95%**	100%	100%				**95%**	100%	100%				**95%**	100%
		Priority 2 24 hours restoration	100%				**95%**	100%	100%				**95%**	100%	100%				**95%**	100%
		Priority 3 5 cays restoration	100%				**95%**	100%	100%				**95%**	100%	100%				**95%**	100%

Table Reference	CSS Reference	Performance indicator	Potable Water Schemes: Mt Morgan Water Supply Scheme Number of access charges - 1,462 as at 11 July 2013						Potable Water Schemes: Marlborough Water Supply Scheme Number of access charges - 57 as at 11 July 2013						Non Potable Water Supply Scheme: Ogmore Water Supply Scheme Number of access charges - 50 as at 11 July 2013					
			1st qtr	2nd qtr	3rd qtr	4th qtr	Annual Target	Year to Date	1st qtr	2nd qtr	3rd qtr	4th qtr	Annual Target	Year to Date	1st qtr	2nd qtr	3rd qtr	4th qtr	Annual Target	Year to Date
Table 2 Adequacy and Quality of Normal Supply of Water Supply	CSS8	Minimum pressure standard at the water meter (kPa)	220				**220 kPa**	220	220				**220 kPa**	220					**NR**	
	CSS9	Minimum flow standard at the water meter	9 L/min				**9 L/min**	9 L/min	9 L/min				**9 L/min**	9 L/min					**NR**	
	CSS10	Connections with deficient pressure and/or flow (% of total connections)	<2.5%				**<2.5%**	0.0%	<2.5%				**<2.5%**	0.0%					**NR**	
	CSS11	Drinking water quality (compliance with industry standard)	100%				**>98%**	100%	100%				**>98%**	100%					**NR**	
	FRW's Drinking Water Quality Management Plan identifies the following key water quality parameters as reference indicators for customer service purposes: Physical and Chemical Water Quality Parameters Target: >99% of all samples tested compliant with Australian Drinking Water Guidelines and E.coli Target: None detected in >98% of all samples tested																			
	CSS12	Drinking water quality complaints (number per 1,000 connections)	2.05				**<5**	2.05	0				**<5**	0					**NR**	
	CSS13	Drinking water quality incidents (number per 1,000 connections)	0				**<5**	0	0				**<5**	0					**NR**	

Table Reference	CSS Reference	Performance indicator	Potable Water Schemes: Mt Morgan Water Supply Scheme Number of access charges - 1,462 as at 11 July 2013						Potable Water Schemes: Marlborough Water Supply Scheme Number of access charges - 57 as at 11 July 2013						Non Potable Water Supply Scheme: Ogmore Water Supply Scheme Number of access charges - 50 as at 11 July 2013					
			1st qtr	2nd qtr	3rd qtr	4th qtr	Annual Target	Year to Date	1st qtr	2nd qtr	3rd qtr	4th qtr	Annual Target	Year to Date	1st qtr	2nd qtr	3rd qtr	4th qtr	Annual Target	Year to Date
Table 3 Long Term Continuity of Water Services	CSS14	Water main breaks (number per 100 km main) Rockhampton & Gracemere 828km Capricorn Coast 414km Mt Morgan 66.3km	11				**<40**	11	0				**<40**	0	0				**<40**	0
	CSS15	Water services breaks (number per 1,000 connections)	8				**<40**	8	0				**<40**	0	0				**<40**	0
	CSS16	System water loss (litres per connection per day)	172				**≤ 200 L**	172	115				**< 200 L**	115					**NR**	
															Unable to measure this indicator due to the nature of the Ogmore system any assessment will need to be based on field observations					

Table Reference	CSS Reference	Performance indicator	Sewerage Schemes Mt Morgan Sewerage Scheme **Number of access connections - 494 as at 11 July 2013**					
			1st qtr	2nd qtr	3rd qtr	4th qtr	Annual Target	Year to Date
Table 4 Effective Transportation of Sewage	CSS17	Sewage overflows total (number per 100 km main) Rockhampton & Gracemere 645.4km Capricorn Coast 270.6km Mt Morgan 5.6km	0				**<10**	0
	CSS18	Sewage overflows to customer property (number per 1,000 connections)	0				**<5**	0
	CSS19	Odour complaints (number per 1,000 connections)	0				**<1**	0
	CSS20	**Response time**						
		Priority 1 1 hour response	100%				**>95%**	100%
		Priority 2 2 hours response	100%				**>95%**	100%
		Priority 3 24 hours response	100%				**>95%**	100%
		Restoration time						
		Priority 1 5 hours restoration	100%				**>95%**	100%
		Priority 2 24 hours restoration	100%				**>95%**	100%
		Priority 3 5 days restoration	100%				**>95%**	100%
Table 5 Long Term Continuity of Sewerage Services	CSS21	Sewer main breaks and chokes (number per 100 km main) Rockhampton & Gracemere 645.4km Capricorn Coast 270.6km Mt Morgan 5.6km	0				**<20**	0
	CSS22	Sewer inflow and infiltration (ratio of Peak Day Flow to Average Day Flow)	1.36				**<5**	1.36

Reference Codes
A blank field should contain one of the following:
a. **0** (zero)
b. **ND** (no data is available, although the indicator is relevant)
c. **NR** (not relevant; the indicator is not relevant to that scheme)

FRW ANNUAL PERFORMANCE PLAN AS AT 30 SEPTEMBER 2013

Customer Service and Financial Targets

Meeting Date: 5 February 2014

Attachment No: 2

Fitzroy River Water Performance Plan - Customer Service Standards Year to Date Reporting as at 30 September 2013 (cont)

Customer Service Targets

Table Reference	Performance indicator	1st qtr	2nd qtr	3rd qtr	4th qtr	Target	Year to Date
Table 6	Installation of new water connections (within the water service area)	83%				**15 working days**	83%
	Installation of sewerage connections (within the sewered area)	40%				**15 working days**	40%
	Complaints – (excluding maintenance of water and sewerage services) – advise outcome	100%				**20 working days**	100%

Financial Performance Targets

Table Reference	Performance indicator	1st qtr date reported	2nd qtr date reported	3rd qtr date reported	4th qtr date reported	Target
Table 7	RRC Operational Plan Reporting Frequency: quarterly	29/07/2013				**Initiatives successfully completed by year end**
	Operating Budget Reporting Frequency: quarterly or when variations arise	30/09/2013				**Conduct all activities in accordance with required timelines and budget**
	Annual Revenue Reporting Frequency: quarterly or when variations arise	30/09/2013				**Timely reporting of any significant variations to budget revenue and collection timing**
	Capital Works Reporting Frequency: quarterly or when variations arise	30/09/2013				**Completion of capital program in accordance with adopted timeframe and budget (within 3%)**

Customer and Financial

FRW ANNUAL PERFORMANCE PLAN AS AT 30 SEPTEMBER 2013

Non Compliance Comments

Meeting Date: 5 February 2014

Attachment No: 3

Customer Service Standards - Non Compliance Comments for the 30 September 2013 quarter

Table Reference	CSS Reference	Scheme	Comment
Table 1	CSS1	Mt Morgan Water Supply Scheme	Mt Morgan experienced 7 main breaks and 11 service breaks. A total of 9 unplanned incidents affecting 58 service connections.
	CSS5	Rockhampton & Gracemere Water Supply Scheme	Due to the ageing infrastructure Rockhampton has had 83 unplanned versus 27 planned water shut downs. A water main replacement program is in place.
	CSS5	Capricorn Coast Water Supply Scheme	Due to the ageing infrastructure Rockhampton has had 43 unplanned versus 10 planned water shut downs. A water main replacement program is in place.
	CSS5	Mt Morgan Water Supply Scheme	Due to the ageing infrastructure Rockhampton has had 9 unplanned versus 1 planned water shut downs. A water main replacement program is in place.
	CSS6	Capricorn Coast Water Supply Scheme	The planned duration for the quarter is 777 minutes based on 10 planned incidents compared to 84 minutes based on 43 unplanned incidents. A water main replacement program is in place.
	CSS7	Rockhampton & Gracemere Water Supply Scheme	**Response** P1 - Total requests 13 and 12 responsed to within 1 hour. P2 - Total requests 40 and 46 responsed to within 2 hours. **Restoration** P1 - Total requests 13 and 12 restoration to within 5 hours. Continue to monitor weekly reporting of priorities . The output of that monitoring will be to identify both issues and areas for improvement.
	CSS7	Mt Morgan Water Supply Scheme	**Response** P1 - Total requests 3 and 2 responsed to within 1 hour. P2 - Total requests 8 and 7 responsed to within 2 hours. Continue to monitor weekly reporting of priorities . The output of that monitoring will be to identify both issues and areas for improvement.
Table 2	CSS16	Rockhampton & Gracemere Water Supply Scheme	Although losses of 227L/s/connection are above the annual target of 200L/s, this figure shows contiued improvement over the 242L/s recorded over the last cycle and is considered an accurate representation of leakage within the Rockhampton and Gracemere area.
	CSS16	Capricorn Coast Water Supply Scheme	The calculated losses of 7L/s/connection are not considered to be an accurate representation of leakage within the Capricorn Coast Water Supply Scheme. Further investigaton is to be carried out including calibration and cross referencing of production data.
Table 4	CSS17	Rockhampton & Gracemere Sewerage Supply Scheme	A total number of 143 blockages and 88 overflows.
	CSS20	Rockhampton & Gracemere Sewerage Supply Scheme	**Response** P1 - Total requests 17 and 14 responsed to within 1 hour. P2 - Total requests 114 and 96 responsed to within 2 hours. **Restoration** P1 -Total requests 17 and 16 responsed to within 1 hour. Network Service supervisory staff continue to work with staff on improving resource
	CSS21	Rockhampton & Gracemere Sewerage Supply Scheme	Rockhampton and Gracemere sewerage system sustained 143 breaks and chokes during the first quarter. The majority were jump ups and Network Services are currently undertaking planned repair work.

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10 NOTICES OF MOTION

Nil

11 URGENT BUSINESS/QUESTIONS

Urgent Business is a provision in the Agenda for members to raise questions or matters of a genuinely urgent or emergent nature, that are not a change to Council Policy and can not be delayed until the next scheduled Council or Committee Meeting

12 CLOSURE OF MEETING