Tweed Coast Waste Water Strategy

Servicing Future Urban and Employment Lands

September 2012

PLANIT CONSULTING

ADG> ALLIANCE DESIGN GROUP CONSULTING ENGINEERS

harvest water management consultants pty ltd

Solo water

Tweed Coast Waste Water Strategy – Servicing Future Urban and Employment Lands

Checker Solo Water

Wayne Williamson

Checker ADG

Dr Charles Kelly

Checker Planit Consulting

Adam Smith

Report No – 4 For review

September 2012

Table of Contents

Appendices

1. Concept Irrigation & STP Areas
2. Sample only of Typical Waste Water Treatment Plant Layout Designs
3. Tweed Coast Waste Water Strategy – Schematic Overview
4. Sample only of Operational Water Quality Data from Existing Sites
5. Pressure Sewerage Network Information
6. Overview of Water & Nutrient Balance Modelling using MEDLI
7. IPART: Combined Application Form – Network Operator & Retail Supplier
8. Zoned Area Cost Estimates Excluding Power estimates and Irrigation Systems & Type

Index of Tables:

Index of Figures

Glossary and Definitions

AWTP	After Water Treatment Plant
Class A	is defined as recycled water used for restricted agricultural irrigation of processed foods (sugar cane, beef cattle pasture, turf farming) and is the same as the "low" risk exposure level from Tables 7.1 and 7.2 in the NSW Management of Private Recycled Water Scheme Guidelines (2008) and Table 3.8 in the National Guidelines for Water Recycling (2006).
Class A+	is defined as recycled water used for dual reticulation and is the same as "High" risk exposure level from Tables 7.1 and 7.2 in the NSW Interim Guideline - Management of Private Recycled Water Scheme (2008) and Table 3.7 in the National Guidelines for Water Recycling (2006).
ET	Equivalent Tenement/Lot
EP	Equivalent Persons
Ha	Hectare
HACCP	Hazard Analysis Critical Control Point
IPART	Independent Pricing and Regulatory Tribunal
kL	Kilolitres
kPa	Kilopascals
MBR	Membrane Bio Reactor
MHD	Metres Head
ML	Mega litres
mm	Millimetres
NHMRC	National Health and Medical Research Council
PDC	Pottsville Development Corporation
PSP	Pressure Sewer Pump Station
PSU	Pressure Sewer Unit
PW	Potable Water
RM	Rising Main
RO	Reverse Osmosis Membrane Desalination Plant
RW	Recycled Water
TDS	Total Dissolved Solids
TSC	Tweed Shire Council
UF WTP	Ultra Filtration Membrane Water Treatment Plant
UV	Ultra Violet Disinfection Unit
WWTP	Waste Water Treatment Plant
TCWWS	Tweed Coast Waste Water Strategy

Executive Summary

The "Tweed Coast Waste Water Strategy - Servicing Future Urban and Employment Lands" (TCWWS), has been developed as a key stakeholder funded strategy that will set the strategic direction of Sewerage Infrastructure to underpin the future and on-going growth of the Lower Tweed Coast area.

This strategy is a pre requisite component to the demonstration of available or potentially available services vital to the development (and indeed rezoning) of future development (release) areas identified in Tweed Shire Council's forward planning documents, whilst also identifying and committing future wastewater facilities and infrastructure to high level environmental initiatives such as reclaimed water re-use and third pipe technology.

It is important to note that this strategy is a high level plan committing to a decentralised approach to wastewater treatment, and therefore is not to be used as a detailed specification. There are many steps to follow in the event that this strategy is endorsed, including future rezoning of land, commitments to relevant Voluntary Planning Agreements (VPA's), development approvals and IPART licensing, completion of detailed design and stake holder agreements including adjacent landowners for irrigation areas. Other requirements such as detailed environmental investigations and other types of applications including detailed analysis reports will form part of the IPART application and endorsement by other regulatory authorities including Council. Importantly, this document covers the broader Pottsville area (inclusive of identified release areas) including lands outside of the control of those that have financially contributed to the strategy.

To give background and structure to the purpose of this Strategy, the following diagram outlines the steps applicable in the use of this document and the development of lands relating to same.

Stage 1	***Stage 2***	***Stage 3***
Strategy Preparation & Adoption by Council and Stakeholders	*Rezoning Proposal* *(Planning Proposal)*	*Development Application*
• *Commitment to environmental and engineering standards* • *Identification of potential irrigation areas and STP locations* • *Identification of applicable demand from future development areas* • *Identification of key constraints and alternatives*	• *Undertake further investigation of environmental and land constraints in order to demonstrate irrigation areas are capable of supporting development of the land – preliminary only* • *Refinement of applicable demand from future development areas based on detailed site analysis and yield (master planning required).* • *Identification and preliminary design of STP location, access and serviceability* • *Preparation of a Voluntary Planning Agreement between Council and Proponents that commits to the provision of necessary infrastructure inclusive of cost apportionment, timing of IPART approvals and relevant engineering and*	• *Evidence of compliance with the terms of the VPA* • *Evidence of IPART application being made (can be run concurrent with Development Application)* • *Evidence of IPART approval to be provided prior to development consent being granted* • *Evidence of commercial agreements with respect to areas required for irrigation*

	environmental investigations (VPA to be exhibited with rezoning proposal)	

The budget costing in Appendix 8 are budgets for information only, and for future planning to each particular stake holder. These budgets do not include the cost of power supply to each proposed WWTP site due to unknown size and location of the supply, which will not be known until final design is completed and who the chosen power service provider will be until after negotiations with the stake holders. The same applies for proposed irrigation areas; these will not be known until detailed geotechnical investigations have been conducted, and then final design and type of irrigation application system is designed and agreed by the stake holders. This will form part of both the rezoning stage and the IPART application and responses received from other regulatory authorities including Council.

Following is a table of the relevant release areas, potential development land and a likely Equivalent Tenement (ET) generation. Please note that the calculations arrived at are based on the tables provided within the Tweed Urban and Employment Lands Release Strategy 2009 and in the instance of residential lands a relatively high uptake rate of 13 dwellings per net hectare has been applied so as to provide flexibility should higher densities be sought when the lands are ultimately developed. These areas are also graphically identified in Appendix 1.

N.B. EP = Equivalent Person

Area	**Growth Area**	**Net (Assume 80% developable)**	**Yield**	**Assumed ET rate**	**Total ET**
Tanglewood	Existing Zoned Lands				794
Tweed Shire Council	Existing Development				798
Sea Breeze North	27ha (as per TUELRS 2009)	22ha	Assume 13 lots per ha	1ET per allotment	286
Sea Breeze West	3ha (as per TUELRS 2009)	2.4ha	Assume 13 lots per ha	" "	30
Dunloe Park – Petersen	165ha (as per TUELRS 2009)	132ha	Assume 13 lots per ha	" "	1,720
Dunloe Park – Cowan – Pottsville Development Corporation	63.75ha	55ha (higher rate reflective of fewer constraints)	Assume 13 lots per ha	" "	720
Pottsville Employment Lands - Springfield RTA	15ha (as per TUELRS 2009)	12ha	30EP per ha	2.8EP = 1ET	114
Dunloe Park - Tagget Residential	6.8ha	5.44ha	Assume 13 lots per ha	1ET per allotment	71
Pottsville Employment Lands (inclusive)	113ha (as per TUELRS 2009)	Minus 20ha (Slopes and buffers) = 90.4ha	30EP per ha	2.8EP=1ET	968
Pottsville Employment Lands – Jackson's	7.85ha (as per TUELRS 2009)	6.3ha	30EP per ha	2.8EP=1ET	71

Pottsville Employment Lands - Pottsville (HP) Industrial	14.75ha (as per TSC resolution 17th August 2010)	11.66ha	30EP per ha	2.8EP=1ET	125
Total					**5,697 ET**

Currently, all wastewater from Pottsville is pumped north for treatment in the regional sewerage scheme centralised at the Hastings Point Waste Water Treatment Plant (WWTP). The Hastings Point WWTP services the existing urban development areas in Pottsville, Hastings Point and Cabarita Beach. Whilst, traditionally, future urban growth in Pottsville, Hastings Point, Cabarita Beach would be dependent on the connection to and upgrade of the wastewater treatment plant and off site effluent management system at Hastings Point WWTP, there are genuine concerns that augmentation of this plant is not viable and accordingly, the provision of essential sewerage infrastructure remains an issue which limits the ability to affect the urban expansion that has been identified for the Pottsville Locality.

The strategy also provides a potential alternative to the existing strategy that connects the existing urban zoned land at Tanglewood to the Hastings Point Wastewater Treatment Plant. In this regard, also it is noted that notwithstanding existing zonings in Tanglewood, there are significant constraints to connecting to the existing Hastings Point WWTP and accordingly this area, along with three (3) other zones (stand-alone STP schemes) have been identified within this strategy.

As outlined above, the strategy identifies, based on locational criteria, four (4) stand-alone zones, as follows:-

Zone 1 - Tanglewood

Tanglewood comprises an existing zoned area to the north of Pottsville and the west of Bogangar.

This area has been included largely due to its isolation from any other urban areas and the significant constraints in connecting with the existing Hastings Point Wastewater Treatment Plant which is the existing strategy for the servicing of Tanglewood.

A stand-alone scheme is recommended for this area and alternative STP plant locations and irrigation areas are shown in Appendix 1. Detailed consideration will need to be given within the design phase to ensure that STP locations are accessible in flood events (1 in 100 year immunity and access) and that buffering is addressed to adjoining future residential areas.

The use of a stand-alone treatment and disposal system at Tanglewood also provides the opportunity to connect other areas, where viable, to the existing Hastings Point WWTP service area.

Zone 2 - Seabreeze North (Kings Land) and Seabreeze West

This zone comprises the future release areas identified as Seabreeze North and Seabreeze West. This zone sits between Koala Beach and Seabreeze Estate and to the west of the Pottsville Village area.

The new areas benefit from their position adjoining the existing waste water transfer system to Hastings Point STP thus having access to the system which has the capacity to transfer the future 316 residential dwellings to Hastings Point STP. The existing system has the capacity to transfer and treat the waste water generated from these future development sites.

Importantly, TSC have advised that these future zones may be provided with Class A recycled water for domestic reuse to enable reduction in potable water usage as detailed in the Tweed Coast Waste Water Strategy. A sewer mining solution will be provided to treat a pre committed capacity of waste water from the existing system that collects and transfers the waste water to Hastings Point STP. This will help reduce the volume of waste water to Hastings Point in the future. The implementation of a Sewer Mining solution in this zone would however require a detailed design for an After

Water Treatment Plant (AWT) and funding for the AWT Plant and third pipe infrastructure would be provided by the developers. A budget costing for this solution has been included in Appendix 8 Zoned Area Cost Estimates.

Zone 3 - Pottsville Employment, RTA, Springfield, Jacksons, Pottsville Industrial, Dunloe (Tagget) and Dunloe (PDC)

This zone comprises significant areas of future employment lands as identified in the Tweed Urban and Employment Lands Release Strategy and sits largely within the area bounded by the Pottsville Industrial area to the south and Pottsville Mooball Road and Cudgera Creek Road. This zone also comprises the northern areas of the Dunloe Residential release area, namely those lands in the ownership of both Tagget and Pottsville Development Corporation (PDC). All of these areas have been identified within the Tweed Urban and Employment Lands Release Strategy.

This area may take some considerable time to develop given the area of land involved. The area also benefits from its proximity to agricultural lands to the north of the area and a potential flood free STP site and storage locations.

Whilst separated by Pottsville Mooball Road, these lands are effectively adjoining and therefore are able to realise efficiencies through co-development of necessary infrastructure. Potential STP, Storage and irrigation areas have been identified in the central portion of the zone and within the proposed Industrial footprint (see Appendix 1). These options could be pursued in the shorter term, however it is noted that whilst a plant could potentially be located in the Industrial footprint, cooperation between landowners will need to be considered with respect to the siting of both storage and the undertaking of irrigation. In this regard both a short and long term irrigation option has been identified, therefore also allowing the gradual development of this zone over a number of years.

Zone 4 - Dunloe Park (Petersen)

This area comprises the majority of the identified residential release areas and comprises all of those lands to the south of the Dunloe (PDC) landholding.

This area, like the Dunloe (PDC and Tagget areas) is constrained by potential STP, Storage and Irrigation opportunities within the development footprint and therefore a site to the south of the identified release areas and to the south of an existing low ridge separating proposed residential and existing agricultural area has been identified for both STP and storage location. The Dunloe (Petersen) zone enjoys good access to irrigation and reuse opportunities to the south, inclusive of the possible use of high quality recycled water in operations associated with the existing Dunloe Sands facility to the south of the site. The identified STP and storage location also enjoys strong visual buffering to the proposed STP location from future residential areas.

Again, detailed consideration will need to be given within the design phase to ensure that the STP location is accessible in flood events (1 in 100 year immunity and access) and that buffering is addressed to adjoining future residential areas.

This strategy seeks to provide for the flexible implementation of a private water utility scheme as an alternative to the traditional means outlined above. In this regard, the private water utility model has been developed based around the principles of integrated water management and ecological sustainability. The solution involves treating wastewater relatively close to its source using robust and proven technology to produce high quality recycled water suitable for non-potable reuse in toilet flushing, laundry washing machines, irrigation, fire fighting and open space watering.

1 Introduction

1.1 Background

The Lower Tweed Coast locality has been a one of a number of growth areas in the Tweed LGA over recent years. Given competing infrastructure and resource demands across the shire including Casuarina, Beach/Seaside, City/Salt, and Kings Forest in the Kingscliff Catchment plus Terranora (Area E), Cobaki, Bilambil Heights, (Including The Rise and McAllister's Road), there are finite resources available to address the infrastructure requirements of the subject area. These resources are further stretched with regards to the densification of the Tweed Heads area in the Banora Point catchment and West Murwillumbah residential and South Murwillumbah Industrial areas in the Murwillumbah catchment.

Furthermore, growth in existing areas already zoned for development throughout the Shire has already seen upgrading of the Hasting Point WWTP to service full development of already zoned land within its catchment area. To enable development to proceed in land that is not already zoned, but identified in forward planning documents, it is necessary to provide waste water services to those areas also.

This future development is considered critical to Pottsville and indeed the broader Tweed Shire, for it will provide much needed employment opportunities through the development of industrial and commercial zoned land, as well as providing areas for future residential development to accommodate projected growth.

Currently all wastewater from the township of Pottsville is pumped North for treatment in the regional sewerage scheme that is centralised at the Hastings Point Waste Water Treatment Plant (WWTP). The Hastings Point WWTP services the existing urban development areas in Pottsville, Hastings Point and Cabarita Beach. The regional sewerage scheme at Hastings Point WWTP is currently constrained as outlined in the Tweed Urban and Employment Lands Release Strategy 2009, wherein it states:-

> *'Hastings Point STP was augmented in 2004 with a view to achieving its ultimate capacity of 18,000 persons. To date it is estimated that the real capacity of the plant is 16,000 persons. The current method of disposing treated water into the coastal dune system is not ideal and may be a limitation that cannot be overcome. Although Council is investigating opportunities for providing effluent to a nearby turf farm and/or for irrigation of local sporting fields these options are not certain. If these disposal issues cannot be overcome then this STP may not reach its projected capacity. Urban development on the lower Tweed Coast that exceeds the capacity of this STP will more than likely require a new STP and effluent disposal system.'*

Traditionally, future urban growth in Pottsville, Hastings Point, Cabarita Beach and Tanglewood would be dependent on the upgrade of the wastewater treatment plant and off site effluent management system at Hastings Point WWTP. However, there are genuine concerns that augmentation of this plant is not viable and accordingly, the provision of essential sewerage infrastructure remains an issue which limits the ability to affect the urban expansion that has been identified for the Pottsville Locality. Furthermore, this strategy facilitates (via the inclusion of Tanglewood), the reduction in committed load at Hastings Point, therefore setting the foundation for the potential diversion of sewage from existing catchments to a proposed new decentralised WWTP.

Whilst traditionally Tweed Shire Council (TSC) would itself be responsible for the carrying out or coordination of a forward infrastructure strategy for Pottsville, resources are currently allocated on a variety of other pressing projects and hence an alternative to the traditional path is warranted. In this regard, at its meeting of 16th February 2010, Council was advised that Solo Water was engaged by the key land owners (key stake holders), and that Council may contribute to the strategy costs provided it may legally do so and there are benefits to Council. TSC resolved to proceed with negotiations for the preparation of a Memorandum of Understanding for a Landholder/proponent funded sewerage and reuse strategy to facilitate the development of the Urban Land Release Strategy Areas 5, 6 and 7, and Employment Land Release Area 7. This strategy is a direct result of that resolution. Furthermore, Council, on the 16th February 2011 provided conditional and in principal agreement to contributing to the strategy (as a stakeholder).

Accordingly, TSC, along with several key landowners in the Pottsville locality are the key stakeholders in this strategy, with Council's involvement focused on the reduction in committed load associated with the existing Hastings Point STP.

Those stakeholders that have financially contributed to the strategy include as follows:-

Stakeholder	Related Properties under Control	Comment
Jefferson Lane P/L (c/- PO Box 1623 Kingscliff NSW 2487)	Lot 250 in DP 755701	Kings Land
Pottsville Development Corporation (c/- PO Box N27, Grosvenor Place, Sydney NSW 1220)	Lot 6 in DP 840977	Northern Dunloe
Ian & Rhonda Tagget (c/- PO Box 1623 Kingscliff NSW 2487)	Lot 5 in DP 840977, Lot 2 in DP 592115, Lot 1 in DP 706163 and Lot 2 in DP 706163	Part Northern Dunloe
Pottsville Retail Trust (Jefferson Lane P/L) (c/- PO Box 1623 Kingscliff NSW 2487)	Lot 9 in DP 1072659	Jackson's Land
Heritage Pacific Industrial / Ian & Rhonda Tagget (c/- PO Box 1623 Kingscliff NSW 2487)	Lot 12 in DP 1015369	Pottsville Employment Lands
Tweed Shire Council The General Manager PO Box 816 Murwillumbah NSW 2484	Various	Various

The above key stakeholders engaged the services of Solo Water to assist in developing an alternative decentralized strategy for servicing future development areas (including those outside of their own control so as to ensure that the strategy was integrated and able to be utilised across the board) with coordinated water supply and sewerage services. This private water utility model is permitted under the Water Industry Competition Act (2006) and Regulation (2008). Approval of private water utility schemes is a structured process regulated by the Independent Pricing and Regulatory Tribunal (IPART) and a number of referral agencies to ensure private utility schemes operate in an environmentally, socially and economically sustainable manner.

The first step in the process to implementation of a private water utility scheme is to prepare an alternative water supply and sewerage strategy (this document) that is endorsed by relevant stakeholders including the Tweed Shire Council as an official strategy for the area. Once this strategy is formally endorsed the detailed IPART approval process can commence. Direction can also be given to both the Council and the community ensuring that essential infrastructure can and will be provided, consistent with the release of development areas within the locality.

To give background to the purpose of this Strategy, the following diagram outlines the steps applicable in the use of this document and the development of lands relating to same.

Stage 1	***Stage 2***	***Stage 3***
Strategy Preparation & Adoption by Council and Stakeholders	*Rezoning Proposal* *(Planning Proposal)*	*Development Application*
• *Commitment to environmental and engineering standards* • *Identification of potential irrigation areas and STP locations*	• *Undertake further investigation of environmental and land constraints in order to demonstrate irrigation areas are capable of supporting development of the land –*	• *Evidence of compliance with the terms of the VPA* • *Evidence of IPART application being made (can be run concurrent with Development*

• *Identification of applicable demand from future development areas* • *Identification of key constraints and alternatives*	*preliminary only* • *Refinement of applicable demand from future development areas based on detailed site analysis and yield (master planning required).* • *Identification and preliminary design of STP location, access and serviceability* • *Preparation of a Voluntary Planning Agreement between Council and Proponents that commits to the provision of necessary infrastructure inclusive of cost apportionment, timing of IPART approvals and relevant engineering and environmental investigations (VPA to be exhibited with rezoning proposal)*	*Application)* • *Evidence of IPART approval to be provided prior to development consent being granted* • *Evidence of commercial agreements with respect to areas required for irrigation*

It is important that all future release areas abide by the process outlined above.

The private water utility model has been developed based around the principles of integrated water management and ecological sustainability. The Decentralised solution involves treating wastewater relatively close to its source using robust and proven technology to produce high quality recycled water suitable for non-potable reuse in toilet flushing, laundry washing machines, irrigation, fire fighting etc. The decentralised solution provides a number of benefits to the community and the environment including minimizing the size, scale and impact of the effluent management system, as well as significantly reducing demand for potable water, thus reducing the overall cost of water supply and wastewater management infrastructure.

It is important to note that this Strategy seeks a commitment to a decentralised wastewater treatment model, which utilises the latest technologies and best management practices. This approach however, will not result in a commitment to a particular service provider and retailer in any or all of the schemes identified. Rather, the selection process will involve a number of potential service providers gaining licences through the NSW Independent Pricing and Regulatory Tribunal (IPART), and the decision to appoint a particular services provider at the discretion of the individual stakeholders.

1.2 Purpose and Scope of the Strategy Plan

The Tweed Coast Waste Water Strategy (TCWWS) has been developed as the first step in the IPART approval process and will demonstrate from a high level that the proposed private water utility model or its equivalent will be functional and will operate in a sustainable manner. The Strategy is also a pre requisite to the demonstration of available or potentially available services vital to the development (and indeed rezoning) of future development areas identified in TSC's forward planning documents.

Importantly, this Strategy will outline the key 'commitments' relating to the future provision of sewerage facilities in the Pottsville area, which have been based on the decentralised model scheme approach.

The scope of this Tweed Coast Waste Water Strategy is to:

- Describe the areas and future developments included under the proposed strategy plan and the future boundaries of the private water utility's operations;
- Provide an overview of the proposed scheme and the main infrastructure requirements like wastewater treatment plants, effluent irrigation areas and wet weather storages, existing potable storages and new recycled water storages;
- Provide preliminary locations for main infrastructure items giving consideration to high level environmental, technical and social constraints;
- Describe the proposed effluent management and recycled water use strategy and demonstrate this will be sustainable through allocation of sufficient areas for effluent irrigation and wet weather storage and domestic recycled water use requirements;
- Document the recycled water quality targets based on the intended end uses of recycled water Class A and Class A+ sustainable loading rates for nutrients and salts;
- Describe the decentralised wastewater treatment system, its robust design basis and how the system will achieve the required recycled water quality targets;
- Describe how the public health risks associated with recycled water usage will be managed for the scheme through the recycled water management plan and HACCP processes;
- Describe how the potential and actual environmental impacts of the scheme will be managed;
- Provide an overview of the IPART approval process and future investigations required.

To give background to the purpose of this Strategy, the following diagram outlines the steps applicable in the future use of this document and the development of lands relating to same.

Stage 1	***Stage 2***	***Stage 3***
Strategy Preparation & Adoption by Council and Stakeholders	*Rezoning Proposal* *(Planning Proposal)*	*Development Application*
• *Commitment to environmental and engineering standards* • *Identification of potential irrigation areas and STP locations* • *Identification of applicable demand from future development areas* • *Identification of key constraints and alternatives*	• *Undertake further investigation of environmental and land constraints in order to demonstrate irrigation areas are capable of supporting development of the land – preliminary only* • *Refinement of applicable demand from future development areas based on detailed site analysis and yield (master planning required).* • *Identification and preliminary design of STP location, access and*	• *Evidence of compliance with the terms of the VPA* • *Evidence of IPART application being made (can be run concurrent with Development Application)* • *Evidence of IPART approval to be provided prior to development consent being granted* • *Evidence of commercial agreements with respect to areas*

	serviceability • *Preparation of a Voluntary Planning Agreement between Council and Proponents that commits to the provision of necessary infrastructure inclusive of cost apportionment, timing of IPART approvals and relevant engineering and environmental investigations (VPA to be exhibited with rezoning proposal)*	*required for irrigation*

It is important that all future release areas abide by the process outlined above.

Indeed, it is intended that upon endorsement of this strategy, both the progression of rezoning proposals (underpinned by a VPA and subject to further land capability investigations) and the commencement of the detailed IPART approval process can proceed. During this process the information contained in this strategy plan will be expanded and the detailed investigations, management plans and design documentation will be prepared to facilitate IPART approval of the scheme from the various regulatory and referral agencies.

1.3 Strategy Overview

The TCWWS Plan has been developed based on an understanding of local environmental constraints, sustainable water management principles and importantly, a review of potential development release areas contained within the broader Pottsville Locality. The overall scheme will be decentralized and has been divided into four separate zones based on geographical, environmental and technical constraints.

This decentralised approach allows wastewater to be collected locally via a computer controlled pressure sewer collection system to be treated and reused close to its source. This approach minimizes the overall cost of the scheme by reducing the size of the WWTP (Designed to 1 ADWF) and reducing the size and length of the raw sewage, recycled water and potable water transfer pipelines. The potable water infrastructure is reduced due to Class A+ recycled water reducing the potable water demand by 60%. This type of arrangement also provides greater flexibility for the staging and sequencing of future development within the zoned areas.

All schemes within the zones will be of similar concept with only slight variations to the service populations, infrastructure capacities, final effluent loads and irrigation area locations. An overall schematic of the strategy is provided in Appendix 3.

The core components of the TCWWS include:

- Wastewater minimization measures to minimise water demand and wastewater generation.
- Pressure sewerage network to minimise stormwater and groundwater infiltration.
- Membrane Bioreactor (MBR) for treatment of all wastewater to Class A recycled water standards.
- Advanced Wastewater Treatment Plant (AWTP) for polishing to Class A+ recycled water standards for domestic reuse purposes including; - toilet flushing, cold water supply for washing machines, garden watering, hosing down, car washing and uncontrolled open space watering.
- Class A+ recycled water storage and reticulation systems (Purple Pipe) to all new lots.

- Class A recycled water agricultural irrigation supply system with wet weather storage.

- Potable water supply and storage system to minimize demands placed on the existing TSC potable water network by 60%.

- On-going operation, management, monitoring and continuous improvement to ensure the scheme is appropriate and functional across its entire life cycle.

There is scope for some variation to the zones identified, which will become more evident once more detailed design and planning has commenced. There will however be a desire to remain committed to the benefits of this strategy and the technologies identified. In this regard, individual stakeholders will be responsible for the commercial negotiation and agreements that relate to the locking in place of required irrigation, plant and reticulation areas.

The strategy and its core components are discussed in more detail in this report.

2 Description of Environment

2.1 Interaction with Development Release Areas

As discussed above, the TCWWS is linked directly to the servicing of proposed future release areas outlined in both the Far North Coast Strategy and the Tweed Urban and Employment Lands Release Strategy 2009. In this regard, the strategy outlines the relevant areas and their likely demand generation in respect of services.

All of the lands identified are not currently zoned, with the exception of the Tanglewood release area which comprises zoned urban lands pursuant to the provisions of the Tweed Local Environmental Plan 2000 (TLEP 2000). It is noted however that notwithstanding the existing zonings in Tanglewood, there are constraints to connecting to the existing Hastings Point WWTP and therefore, this area has been included within this strategy allowing for consideration of potentially more economically viable alternatives.

Following is a table of the relevant release areas, potential development land and a likely Equivalent Tenement (ET) generation. Please note that the calculations arrived at are based on the tables provided within the Tweed Urban and Employment Lands Release Strategy 2009 and in the instance of residential lands a relatively high uptake rate of 13 dwellings per net hectare has been applied so as to provide flexibility should higher densities be sought when the lands are ultimately developed. Appendix 1 shows each of the areas.

Table 2-1: Relevant Release Areas

N.B. EP = Equivalent Person

Area & Current Zoning[1]	Growth Area	Net (Assume 80% developable)	Yield	Assumed ET rate	Total ET
Tanglewood 1(c), 2(d) & 6(b) Zones	Existing Zoned Lands				794
Tweed Shire Council Various zones	Existing Development				798
Sea Breeze North 1(a) General Rural Zone	27ha (as per TUELRS 2009)	22ha	Assume 13 lots per ha	1ET per allotment	286
Sea Breeze West 1(a) General Rural Zone	3ha (as per TUELRS 2009)	2.4ha	Assume 13 lots per ha	" "	30
Dunloe Park – Petersen 1(a) General Rural Zone	165ha (as per TUELRS 2009)	132ha	Assume 13 lots per ha	" "	1,720
Dunloe Park – Cowan – Pottsville Development Corporation 1(a) General Rural	63.75ha	55ha (higher rate reflective of fewer constraints)	Assume 13 lots per ha	" "	720

[1] Refer to Tweed Local Environmental Plan 2000 for additional detail in this regard (www.tweed.nsw.gov.au)

Zone					
Pottsville Employment Lands - Springfield RTA 1(a) General Rural Zone	15ha (as per TUELRS 2009)	12ha	30EP per ha	2.8EP = 1ET	114
Dunloe Park - Tagget Residential 1(a) General Rural Zone	6.8ha	5.44ha	Assume 13 lots per ha	1ET per allotment	71
Pottsville Employment Lands (inclusive) 1(a) General Rural Zone	113ha (as per TUELRS 2009)	Minus 20ha (Slopes and buffers) = 90.4ha	30EP per ha	2.8EP=1ET	968
Pottsville Employment Lands – Jackson's 1(a) General Rural Zone	7.85ha (as per TUELRS 2009)	6.3ha	30EP per ha	2.8EP=1ET	71
Pottsville Employment Lands - Pottsville (HP) Industrial[2] 1(a) General Rural Zone	14.75ha (as per TSC resolution 17th August 2010)	11.66ha	30EP per ha	2.8EP=1ET	125
Total					**5,697 ET**

The yield of 30EP/ha adopted for the industrial and employment lands has been taken from the Tweed Urban and Employment Lands Release Strategy 2009, where it was identified that this value represents the uppermost density for manufacturing facilities. Other industries within the Pottsville Employment Lands will likely have densities of around 20EP/ha, however the upper value was adopted for this strategy to accommodate worst case scenarios.

It is important to note that this strategy is a high level plan committing to a decentralised approach to wastewater treatment, and therefore is not to be used as a detailed specification. There are many steps to follow if this strategy is endorsed: including future zoning applications, development approvals and IPART licensing, completion of detailed design, stake holder agreements including adjacent landowners for irrigation areas. Other requirements such as detailed environmental investigations and other types of applications including detailed analysis reports will form part of the IPART application and endorsement by other regulatory authorities including Council.

To give background to the purpose of this Strategy, the following diagram outlines the steps applicable in the use of this document and the development of lands relating to same.

[2] Note current application to rezone lands for Employment purposes is under consideration by Council

Stage 1	***Stage 2***	***Stage 3***
Strategy Preparation & Adoption by Council and Stakeholders	*Rezoning Proposal* *(Planning Proposal)*	*Development Application*
• *Commitment to environmental and engineering standards* • *Identification of potential irrigation areas and STP locations* • *Identification of applicable demand from future development areas* • *Identification of key constraints and alternatives*	• *Undertake further investigation of environmental and land constraints in order to demonstrate irrigation areas are capable of supporting development of the land – preliminary only* • *Refinement of applicable demand from future development areas based on detailed site analysis and yield (master planning required).* • *Identification and preliminary design of STP location, access and serviceability* • *Preparation of a Voluntary Planning Agreement between Council and Proponents that commits to the provision of necessary infrastructure inclusive of cost apportionment, timing of IPART approvals and relevant engineering and environmental investigations (VPA to be exhibited with rezoning proposal)*	• *Evidence of compliance with the terms of the VPA* • *Evidence of IPART application being made (can be run concurrent with Development Application)* • *Evidence of IPART approval to be provided prior to development consent being granted* • *Evidence of commercial agreements with respect to areas required for irrigation*

It is important that all future release areas abide by the process outlined above.

2.2 General Description of Subject Lands & Existing Environment

The Pottsville locality sits in the south of the TSC LGA and to the north of the Byron Shire LGA and is located approximately 24km south of the Queensland border and to the east of the Pacific Highway corridor. The Pottsville Locality possesses a defined town centre and a number of residential estates including Seabreeze, Koala Beach and Black Rocks that site adjacent existing agricultural areas or areas of environmental significance (inclusive of mapped SEPP 14 wetlands).

The recently adopted Pottsville Locality Plan (TSC 2010) identified a number of key features contributing to the physical character of Pottsville, inclusive of the following:

- The area's location between the Pacific Ocean and the Pacific Highway
- A pattern of distinct residential areas separated by green buffers including wetland and bush land areas, wildlife corridors and rural lands.

- An existing village centre that is located at the centre of these communities, and the separation of the village centre from the beachfront, by open reserves that support a range of passive and active recreational uses.

- Floodplains feeding off a rolling topography, resulting in the presence of several high points on the periphery of the area that serve to provide a visual backdrop from most locations.

- All approaches to Pottsville are through non-urban areas, adding to a "perceived isolation" in the context of other coastal Tweed locations.

- A significant and continuing sugar cane industry, occupying a large proportion of the northern part of the study area.

- Single and dominant north-south and east-west road connections.

Figure 2-1: Potential Pottsville Release Areas (Pottsville Locality Plan 2010)

- An undeveloped frontal ocean beach dune system. This frontal dune is flanked by Mooball Creek in the southern part of the area, discharging to the Ocean adjacent to the village centre.

Whilst it is not the function of this Strategy to comment or justify the release areas previously identified, the above comments highlight the sensitive environment that Pottsville enjoys and hence the reasonable expectation that the Strategy deliver recommendations and commitments that befit the sensitivity of the location.

Pursuant to the 2006 census, Pottsville enjoys a population of 3,781 persons (at 2006). This population, when compared to 2001 statistics confirmed an average growth rate of approximately 7.2% between 1991 and 2001 and an accelerated growth rate nearing 8% from 2001 onwards, thereby exceeding the Tweed average (over 15 years) (Pottsville Locality Plan 2010). Given population growth and the need to plan for same, Tweed Shire Council prepared and then adopted the Tweed Urban and Employment Land Release Strategy 2009 (Tweed UELRS). The strategy is of significance for the Pottsville locality as four (4) potential release areas within the Pottsville locality were identified, with three (3) being for urban purposes and one (1) for employment purposes. These areas have been included within the body of this strategy.

These key areas are depicted in the plan extract following **(Fig 2-1)** as shown within the adopted Pottsville Locality Plan (TSC 2010).

It has been identified (Pottsville Locality Plan 2010) that Pottsville will need to accommodate for a potential population of approximately 12,000 persons within the next 15-20 years.

The Pottsville locality enjoys a varied topography, with elevated and sloping areas interspersed with existing low lying Wetland areas and agricultural floodplains that interact with existing waterways draining from the West. Mooball Creek and its drainage catchments represent the main waterways affecting the Strategy area. Flooding impacts within the Pottsville area are significant, with much of the low lying areas to the west of the Town Centre and to the south of Dunloe Park being subject to inundation during flood events.

It is important that the flooding constraints of the land be acknowledged within the Strategy document as addressing site specific drainage constraints will play a significant role in the seeking of IPART approvals going forward. The area surrounding and within the Strategy area comprise high value conservation areas and identified corridors.

These areas include the wetland areas to the east of the Dunloe Park Release area and to the north and east of the Seabreeze North release areas. As discussed above, it is important that the Strategy recognise the environmental constraints of the land.

3 Regulatory Approvals

Upon acceptance of the TCWWS it will be open for the chosen service provider or providers to gain all necessary approvals as required by the applicable legislation and regulations in NSW. Once the necessary approvals have been gained, the chosen service provider can construct and operate the proposed water cycle infrastructure for the West Pottsville area covered in this TCWWS as well as to provide retail services to customers.

Whilst this strategy commits stakeholders to the contents of this strategy, there are many steps to follow in addition to this document including future zoning applications, development approvals and IPART licensing, completion of detailed design, stake holder agreements including adjacent landowners for irrigation areas. Other requirements such as detailed environmental investigations and other types of applications including detailed analysis reports will form part of the IPART application and endorsement by other regulatory authorities including Council.

To give background to the purpose of this Strategy and its use in respect of future land use approvals and zoning designations, the following diagram outlines the steps applicable in the use of this document and the development of lands relating to same.

Stage 1	***Stage 2***	***Stage 3***
Strategy Preparation & Adoption by Council and Stakeholders	*Rezoning Proposal* *(Planning Proposal)*	*Development Application*
• *Commitment to environmental and engineering standards* • *Identification of potential irrigation areas and STP locations* • *Identification of applicable demand from future development areas* • *Identification of key constraints and alternatives*	• *Undertake further investigation of environmental and land constraints in order to demonstrate irrigation areas are capable of supporting development of the land – preliminary only* • *Refinement of applicable demand from future development areas based on detailed site analysis and yield (master planning required).* • *Identification and preliminary design of STP location, access and serviceability* • *Preparation of a Voluntary Planning Agreement between Council and Proponents that commits to the provision of necessary infrastructure inclusive of cost apportionment, timing of IPART approvals and relevant engineering and environmental investigations (VPA to be exhibited with rezoning proposal)*	• *Evidence of compliance with the terms of the VPA* • *Evidence of IPART application being made (can be run concurrent with Development Application)* • *Evidence of IPART approval to be provided prior to development consent being granted* • *Evidence of commercial agreements with respect to areas required for irrigation*

Fundamental to the implementation and use of the TCWWS recommendations is the need to seek:

3.1 Tweed Shire Council Strategy Adoption / Endorsement

Council is a stakeholder within this Strategy and an integral part of the process in which proposed release areas will be zoned and ultimately developed. In this regard, Council's endorsement of the Strategy is vital to both the credibility of the document and the ability for the Strategy to satisfy the pre requisite requirement of 'prior provision of essential infrastructure' prior to the rezoning of lands.

Importantly, this strategy will likely have implications with respect to the levying of Head works Charges pursuant to S.64 of the Local Government Act, 1993, potentially relating to both Water and Sewerage charges.

3.2 IPART Application and the Water Industry Competition Act 2006

The IPART license is the main legislative vehicle for pollution control in New South Wales (NSW) relative to Water Supply infrastructure. The granting of an IPART license is the authorised mechanism for the operation of a private Waste Water Treatment Plant in accordance with the provisions of the Water Industry Competition Act 2006 (WICA).

The NSW Government introduced the WICA as part of its strategy for a sustainable water future to harness the innovation and investment potential of the private sector in the water and wastewater industries. Further, the Act establishes a licensing regime for private sector entrants to ensure the continued protection of public health, consumers and the environment. A corporation (other than a state owned public water utility) must now obtain a licence under the Act: to construct, maintain or operate any water industry infrastructure; or to supply water (potable or non-potable); or to provide sewerage services by means of any water industry infrastructure.

Licence applications are forwarded to the NSW Independent Pricing and Regulatory Tribunal (IPART) for assessment and ultimately ministerial approval.

Under the WICA, IPART must provide the application to, and invite submissions from the following Ministers:

- Minister administering the Public Health Act 1991 (Minister for Health)
- Minister administering Chapter 2 of the Water Management Act 2000 (Minister for Water)
- Minister administering the Protection of the Environment Operations Act 1997 (Minister for Climate Change and the Environment)
- Minister administering the Environmental Planning and Assessment Act 1979 (Minister for Planning)

IPART must also call for submissions on the application from the public, inclusive of TSC. The IPART process is aimed at integrating the relative components outlined below into one consolidated process.

3.2.1 Network Operator & Retail Supplier's License under IPART

A network operator's licence authorises the licensee to construct, maintain and operate water industry infrastructure. A retail supplier's licence authorises the licensee to supply water (drinking or non-potable) or provide sewerage services by means of any water industry infrastructure.

Note: The application for the Retail Suppliers License under IPART takes into account financial modelling. The modelling includes for whole of life requirements such as pump maintenance/replacement, filter/membrane replacements, UV globe replacement other operational and maintenance costs and funding of asset replacements in the long term in the way of sinking funds etc. This is assessed when submitting the rating charges that is being applied for to substantiate that adequate funds are available in the rating charge to cover the above costs.

At a minimum, the licence application would include the following:

- Comprehensive study regarding probability of incidents and circumstances that could adversely impact on carrying out the licensing activities and measures taken to minimise this likelihood.
- Comprehensive study and infrastructure plan regarding the design, construction, operation and maintenance of the infrastructure, life span and arrangements for renewal, safe and reliable performance, security of water supply, alternative water supplies and maintenance, monitoring and reporting standards.
- Comprehensive capacity assessment with respect to sites identified for infrastructure associated with the license, inclusive of physical assessment with respect to flooding, environmental impacts and risks, appearance and human interactions.
- Comprehensive study and water quality plan regarding the levels of contaminants retained in the water supply, how these levels are maintained and how public health is protected according to the framework provided by the Australian Guidelines for Water Recycling.
- Preparing a comprehensive study and retail supply management plan regarding probability of incidents and circumstances that could adversely impact on carrying out the licensing activities and measures taken to minimise this likelihood.
- Public consultation.

3.2.2 Application Form

A copy of the IPART Combined Application Form Network Operator and Retail Supplier can be found in Appendix 7 and accessed at http://www.ipart.nsw.gov.au/water/water.asp

3.3 Environmental Planning and Assessment Act 1979

The ***Environmental Planning and Assessment Act 1979*** (EP&A Act) defines and regulates planning and development within NSW and sets out the development approval process and approvals required. Proponents of a recycled water scheme will be required to apply for development approval if the local council specifies in their local environmental plan (LEP) that recycled water schemes require development approval.

Alternatively, opportunity exists for Schemes permitted under the Water Industry Competition Act, to be exempt from approval (pursuant to State Environmental Planning Policy Infrastructure) under Part IV of the EPA& Act, 1979 and therefore subject to approval procedures under Part V of the EP&A Act, 1979.

3.4 Protection of the Environment Operations Act 1997 (POEO Act)

The Protection of the ***Environment Operations Act 1997*** (POEO Act) states that it is an offence to pollute waters, or permit waters to be polluted except where that pollution occurs in compliance with an environment protection license. Other offences relating to land, air (including odour) and noise pollution are covered in the POEO Act.

In addition, the POEO Act requires environment protection licenses for certain activities listed in Schedule 1 of the Act ('scheduled activities'). The Department of Environment and Climate Change (DECC) issues these licenses. Sewage treatment systems are a scheduled activity, defined under the Act as:

Sewage treatment systems (including the treatment works, pumping stations, sewage overflow structures and the reticulation system) that have an intended processing capacity of more than 2,500 persons equivalent capacity or 750 kiloliters per day and that involve the discharge or likely discharge of wastes or by-products to land or waters.

Non-scheduled wastewater recycling systems, will not typically be licensed, as these systems can typically be designed and operated to avoid pollution e.g. by using all the recycled water or by discharging surplus recycled water or untreated wastewater to the sewer.

3.5 Local Government (General) Regulation 2005

Under the Water Industry Competition Amendment Act 2011, an amendment to the Local Government (General) Regulation 2005 was enacted to exempt Activities authorized by license under the Water Industry Competition Act 2006 from requiring approval under section 68 of the Local Government Act.

The regulations also reference the NSW Code of Practice: Plumbing and Drainage which adopts and varies the Australian Standard AS/NZS 3500:2003, Plumbing and Drainage. The NSW Code of Practice provides the regulatory requirements for work carried out on a range of facilities including recycled water treatment schemes and in accord with the latest edition of WSA03 - 2011.

3.6 Local Government Act 1993

This strategy will likely have implications with respect to the levying of Head works Charges pursuant to S.64 of the Local Government Act, 1993, potentially relating to both Water and Sewerage charges. In this regard, depending on the structure of Water and Sewerage provision, credit will need to be acknowledged and applied with respect to works not required to be undertaken by Council or the use of existing infrastructure that is not under the control and or ownership of Council.

Section 68 of the ***Local Government Act 1993*** (LG Act) requires approval from the local council for water supply, sewerage and storm water drainage work as well as the installation and operation of a sewage management system, including private recycled water schemes that process sewage. A section 68 approval may also be required to install other types of recycled water schemes (e.g. schemes which recycled industrial process water) but approval to operate is only required where the source of the recycled water includes grey water or sewage.

Approval under section 68 is required regardless of whether the sewage is generated on the premises on which the system is operated. Private individuals or companies wishing to produce and use recycled water in schemes larger than a single dwelling are required to apply to their local council under section 68 of the LG Act for approval.

Approval is required under section 68 for the installation of the treatment system and again for the operation of the treatment system. However, an approval to install and an approval to operate are not required where an environment protection license under the ***Protection of the Environment Operations Act 1997*** is in force for the scheme (clause 48 of the Local Government (General) Regulation).

3.7 Public Health Act 1991

Under the ***Public Health Act 1991***, the Minister for Health has powers to issue orders and direct public authorities to take action to prevent public health risks. NSW Health has responsibilities under the ***Public Health Act 1991*** for monitoring and managing public health risks and improving public health through regulation, health promotion and other public health measures. NSW Health plays a key role in setting water quality compliance values for recycled water and must be informed of any incident that poses a risk to public health.

3.8 Office of Environment and Heritage

The Office of Environment and Heritage (OEH) issues environment protection licences to the owners or operators of various industrial premises under the Protection of the Environment Operations Act 1997 (POEO Act); an operational licence under this Act would be required for the West Pottsville Water and Wastewater schemes.

The licence assessment process generally includes environmental assessment of topography, geology, soil type, water quality and hydrology, flora and fauna, heritage and conservation, noise, air quality, visual amenity, social and economic impacts, public health and safety, waste and hazardous materials, traffic and access, lighting, material and lifecycle analysis, landscaping, infrastructure and utilities.

The proposed wastewater treatment plants and associated activities may also require approval under the Environmental Planning and Assessment Act 1979.

3.9 Other Documents and Policies of Relevance

Any requirements within the following documents will also be adhered to:

- NSW Groundwater Protection Policy
- NSW Guidelines for Management of Private Recycled Water Schemes
- NSW Guidelines for Use of Effluent by Irrigation
- Australian Guidelines for Water Recycling
- Environmental Planning & Assessment Act
- Water Industry Competition Amendment Act 2011
- NSW Groundwater Protection Policy
- NSW Industrial Noise Policy
- Environmental Planning and Assessment Regulation 2000 – for further development approval details
- Local Government (General) Regulation 2005 – clause 45 – for technical matters in relation to S.68 approvals
- Local Government Act 1993 – section 60 – for council schemes
- Local Government Act 1993 – section 68 – for private schemes

- NSW Code of Practice: Plumbing and Drainage
- Occupational Health and Safety Act 2000 - for workplace health, safety and welfare
- Public Health Act 1991 – for prevention of public health risks

4 Design Criteria & Wastewater Loads

4.1 Breakdown of Total Water Demand

A breakdown of total water demand has been estimated for the proposed scheme based on the wastewater minimization strategy discussed in Section 5.2, local climate data and water usage data presented in the NSW Metropolitan Water Plan (NSW Government, 2006). The adopted breakdown of water use for a water efficient house in the Pottsville region is provided below in Table 4-1.

As indicated in , total average day water demand is estimated to be 600 L/ET/day, of which approximately 70% (420 L/ET/day) is indoor water demand and 30% (180 L/ET/day) is outdoor water demand. This distribution of indoor and outdoor demand is considered a reasonable given the relatively high rainfall in the Pottsville region.

Table 4-1: Estimated break down of average day total water use based on 2.8 EP/ET.

End Use	Quality	%	L/EP/day	L/ET/day
Toilet flushing	Non-Potable	14%	30	84
Clothes washing machine	Non-Potable*	17%	36	100.8
Shower	Potable	23%	50	140
Dishwasher	Potable	1%	2	5.6
Kitchen, bathroom, laundry taps	Potable	15%	32	89.6
TOTAL INDOOR (WASTEWATER GENERATION)		***70%***	***150***	***420***
Outdoor cleaning & wash down	Non-Potable	3.3%	7.14	20
Private lot irrigation	Non-Potable	23.3%	50	140
Pool top-up	Potable	3.3%	7.14	20
	TOTAL OUTDOOR	***30%***	***64.3***	***180***
	TOTAL WATER DEMAND	***100%***	***214.3***	***600.0***

* Cold water supply to laundry washing machine is non-potable, however hot water is a potable water source.

Water balance modelling in MEDLI (Model for Effluent Disposal by Land Irrigation) was undertaken for the investigation based on local climate data (see Appendix 6). This modelling indicated a long term average irrigation demand of approximately 0.7 mm/day is likely in the high rainfall region of Pottsville. At this average irrigation rate the irrigation demand shown in of 140 L/ET/day corresponds to a private lot irrigation area of approximately 200 m^2.

4.2 Wastewater Generation

Wastewater generation within the scheme has been minimised through the use of water efficient fixtures and the wastewater minimization strategy discussed in Section 5.2.

A per capita wastewater generation rate of 150 L/EP/day and an occupancy rate of 2.8 EP/ET has been adopted for all new development in the scheme, as indicated in Table 4.1.

Wastewater generation for each zone in the scheme is presented in Table 5-2.

4.3 Recycled Water Demand

4.3.1 Class A+ Dual Reticulation

The demands for Class A+ recycled water have been estimated based on the breakdown of water use presented above in Section 4.2 and are presented below in . Average day demand for Class A+ recycled water is estimated to be 320 L/ET/day. This represents approximately 75% of total wastewater generation. The remaining 25% of excess recycled water in the scheme will require management by irrigation of agricultural land, as discussed below in Section 4.3.2.

The demand for Class A+ recycled water was not applied to existing TSC lots within the Sea Breeze estate, as retrofitting a dual reticulation system into existing lots is not being pursued and likely to be cost prohibitive.

Table 4-2: Summary of average day Class A+ recycled water demand

End Use	Average Day (AD)	
	L/EP/day	**L/ET/day**
Toilet flushing	30	84
Clothes washing machine*	27	76
Outdoor cleaning & wash down	7	20
Private lot irrigation	50	140
TOTAL RECYCLED WATER	*114*	*320*
% of Wastewater generation	*76.1%*	
% Excess recycled water	*23.9%*	
% of Total water demand	*53.3%*	

* Assumes 75% of laundry washing machine water use is cold water. Hot water supply to laundry washing machine is a potable water source. Actual recycled water demand will vary depending on degree of hot water clothes washing undertaken by residents.

Irrigation demands shown in do not account for irrigation of public open space, parklands and sports fields. These will be evaluated in more detail during the development master planning processes for each of the land release areas in the scheme.

The demand for Class A+ recycled water is expected to quite variable based on user behaviour and local climatic conditions. Irrigation is expected to have the highest variability, while toilet flushing demand would be relatively constant. Overall peak day demand for Class A+ recycled water could be up to 4 x AD or higher during peak irrigation periods.

4.3.2 Class A Agricultural Irrigation Supply

The Class A recycled water agricultural irrigation supply system was assessed using daily water and pollutant balance modelling in MEDLI. The modelling was undertaken to achieve the discharge performance criteria set out in NSW DEC (2004) of less than one overflow event every two years. Details of this MEDLI modelling are provided in Appendix 6.

The modelling was undertaken assuming 40% of wastewater generation (100% for TSC lots) will be supplied to the agricultural land irrigation system for final disposal by land irrigation. This is considered conservative in terms of sizing final irrigation/disposal areas, as the surplus recycled water following reuse of Class A+ recycled water is estimated to be approximately 24%, as indicated in .

The MEDLI modelling using local climate data indicated that a combination of 110-day wet weather storage and a design long term average irrigation rate of 0.7 mm/day would be required to achieve less than one overflow event every two years for the scheme. The minimum required irrigation area and wet weather storage sizes for each zone in the scheme are provided in Table 5-5.

4.4 Pollutant Generation Rates

The wastewater treatment processes within the scheme will be design using proven technologies based on robust design criteria. Treatment systems design will be based on the influent pollutant generation rates outlined in .

Table 4-3: Typical pollutant generation rates for treatment system design.

Pollutant	Generation Rate
BOD	70 g/EP/day
SS	70 g/EP/day
TN	17 g/EP/day
TP	3 g/EP/day
Fats & Oils	20 g/EP/day

5 Proposed Works & Wastewater Management Strategy

5.1 Overview

The TCWWS Plan has been developed based on local environmental constraints and sustainable water management principles. The overall scheme has been divided into a number of zones based on geographical, environmental and technical constraints and the potential for staging and timing of developments within the scheme. All zones within the scheme will be of similar concept with only slight variations to service the populations, infrastructure capacities and the final effluent irrigation locations. An overall schematic of the strategy is provided in Appendix 3.

The core components of the TCWWS include:

- Wastewater minimization to reduce wastewater generation
- Potable Water supply storage and reticulation
- Pressure sewerage network to minimise infiltration
- Membrane Bioreactor for treatment of all wastewater to Class A recycled water standards
- Advanced Wastewater Treatment Plant for treatment to Class A+ recycled water standards
- Class A+ recycled water supply storage and reticulation system
- Class A wet weather storage and agricultural irrigation systems
- On-going operation, management, monitoring and continuous improvement to ensure the scheme is appropriate and functional across its entire life cycle.

There is scope for some variation to the zones identified, which will become more evident once more detailed design and planning has commenced. There will however be a desire to remain committed to the benefits of this strategy and the technologies identified. In this regard, individual stakeholders will be responsible for the commercial negotiation and agreements that relate to the locking in place of required irrigation, plant and reticulation areas.

Each of the above scheme components are outlined in more detail below.

5.2 Wastewater Minimization

The sustainable wastewater management scheme has been designed to minimise wastewater generation and sewerage system inflow and infiltration. Given the effluent management strategy for the proposed scheme involves non-potable reuse and agricultural irrigation, the wastewater minimization strategy also extends to cover issues of trade waste to avoid excessive levels of chemicals, metals, salts and other pollutants of concern from entering the wastewater system.

The proposed wastewater management scheme will be detailed in the IPART application and agreed with the developer to be implemented by the developer and its contractors.

An overview of the wastewater minimization strategy for the scheme is outlined below:

- A minimum of 3-star rated water efficient fixtures and appliances, based on AS6400, will be mandatory on all plumbing fittings within the scheme. This will include:
    - 4-star rated dual flush toilets

- 3-star rated showerheads
- 3-star rated tap fittings or flow restriction devices on all indoor and outdoor taps
- 4-star rated laundry washing machines
- 4-star rated dishwashers
- 4-star rated men's urinals in commercial developments

- Pressure control at each lot/dwelling to minimise supply pressures in the potable and recycled water networks.
- On-going customer education and recycled water use agreements to inform and guide behaviours relating to potable water use, recycled water use and disposal of appropriate substances to the sewerage system.
- Water-tight pressure sewerage network with fusion welded polyethylene pipe and fittings construction to minimise stormwater and groundwater infiltration.
- Monitoring of flows in the pressure sewerage network to ensure any potential excessive inflows can be traced, identified and managed.
- Trade waste standards and agreements to be developed for all industrial and commercial lots within the scheme (Based on TSC Regulations) to avoid discharge of inappropriate chemicals and other substances to the sewerage system.
- Concept Wastewater Management Plan will be required at the Development Application stage for all developments within the scheme to demonstrate how water efficiency, wastewater generation and recycled water usage rates will be achieved.
- Detailed Wastewater Management Plan at Building Application stage will be required for all industrial and commercial lots to demonstrate how wastewater generation, recycled water usage and trade waste discharge requirements will be achieved.
- One pressure sewerage duty/standby pump station per lot for commercial/industrial users to allow monitoring and tracing of wastewater generation and trade waste requirements. Pressure sewerage duty/standby pump stations in residential areas may have multiple lots (4 to 6 lots) connected in a cluster type arrangement.

The wastewater minimization measures propose under TCWWS will provide substantial benefits to the scheme and will:

- Minimise the demand for potable water;
- Reduce the peak capacity and capital cost of wastewater infrastructure;
- Reduce energy consumption of the scheme as less water is transferred and treated;
- Minimise the size of effluent irrigation areas and wet weather storages required for final management of effluent;
- Minimise the long term risk of salt, metal and chemical contamination of the recycled water supply;
- Minimise environmental impacts.

Wastewater hydraulic loads, pollutant loads and wet weather peaking factors will be monitoring on a regular basis for the life of the scheme to ensure wastewater generation rates are within acceptable limits.

5.3 General Description of Gravity and Pressure Sewer

Gravity sewers will collect waste water from each residential dwelling and transfer the waste water to a connection point located at the boundary at each individual property. Then via a combined gravity sewer installed in the road reserve or a dedicated easement (4 to 6 lots) the waste water will gravitate to a dedicated Pressure Sewer Unit. The gravity sewer installation will be constructed in approved UPVC pipe and fittings.

Note: Gravity sewers are to be installed as to AS3500 and the Plumbing Code of NSW. Gravity sewer drains and connection points are detailed on drawings provided in Appendix 5 of this strategy plan.

The gravity sewers are connected to the Pressure Sewer Units via a rubber ring joint connection and there are four connection points per unit. The pump units are located in a suitable location within the selected property to house the pump station (An easement of approximately 1.5m x 1.5m is to be formed over this area to provide 24/7 access to the control turret and pump station access lid) which will be detailed on the pressure sewer design drawings. (Refer to Appendix 5 for further details) Each Pressure Pump Unit contains a duty and standby grinder pumps. The large solids are broken down by the grinder pumps before being transported through the pressurised reticulation system to be installed in the road reserve where possible to the inlet of the WWTP screening unit. The new pressure sewers are to be constructed in PN 16 Poly pipe with fusion welded fittings so as to eliminate ground water infiltration throughout the collection system. Each Pressure Sewer Unit has its own combined electrical and control turret that provides power supply to the pumps and a control panel that stop/starts and monitors the levels, number of stops and starts, pump failures and raises the remote alarms necessary to protect the system; especially in the event of a power failure and start up after such an event, pump failure or line breakage.

The pressure sewer systems are designed to provide 24 hour retention times in the network.

(For more details of a sample pressure sewerage network refer to Appendix 5.)

The advantages of a combined gravity and pressure sewer system include:

- Provide flexible solutions for development staging.
- No topographical constraints.
- The system is fully sealed and eliminates ground water infiltration.
- Therefore the systems are designed on 1 average dry weather flow thus reducing the WWTP capacity needed to treat the daily waste water generated.
- Can be more cost effective than conventional systems.
- The pressure sewer collection systems require smaller pipe sizing, shallower trenching only 600mm cover required, no grading requirements which means the system can be installed to the lay of the land in most cases.
- Flows from the pump units are programmed so as to minimise peak flows directed towards the WWTP especially after the start up after a power failure. The system is programed to allow only a certain number of pumps to start and run at any one time so as not to over load the WWTP.
- Due to controlled flow, 24 hour retention time and no wet weather or ground water infiltration only a small footprint is required for the WWTP.
- Grinder pumps are used, which have a maximum discharge rate of 0.75 l/s or 0.45 l/s at a pressure of 45 m.

- 4 to 6 residences are connected by gravity sewers to a pump unit (each tank unit is 1100mm diameter x 2200mm deep) with a duty/standby grinder pump in each pump unit to transport wastewater to the WWTP. This unit can manage (5000 – 7000) L/day of wastewater and the tank unit is moulded from strong polyethylene materials for the application.

- Larger pressure sewer pump stations would be used for high density residential and commercial areas.

- Sizing for the reticulation pipes are undertaken using standard hydraulic principles and according to the manufacturer's technical manual. (Refer to Appendix 5 for more details)

- The pressure sewer pump system is designed to have excess holding capacity to provide wastewater storage of 24 hours. This can happen due to electrical power outages, land movement or accidental breakages due to operator era etc.

- The piping reticulation system is installed in PN16 fusion welded poly pipe and fittings forming a sealed system providing for no infiltration due to ground water levels or during wet weather events. Air relief valves should be fitted at all high points throughout the system.

To counteract any odour problems, which may develop in pressure sewer systems because of improper house venting or long retention times in the system, the addition of strong oxidizing agents, such as chlorine or hydrogen peroxide will be utilised at designated chemical dosing units if required.

The grinder pumps within the pressure pump units reduce the likelihood of blockage as they produce a finely ground slurry that is pumped to the treatment plant. Whilst the risk of blockage downstream of the pump units is minimised, flushing points will be located immediately downstream of all pump units and upstream of all pipe junctions to ensure that inspection and maintenance access can be maintained.

5.3.1 Spillage Prevention and Management

Pressure sewers are fusion welded and rated at 1650kPa, well above the expected peak pressure within the sewer system. The pressure sewer system, including the pump units and the reticulation network throughout the development sites will be serviced by the service provider. The pump-well for each pump unit will have 24 hours storage to provide flow balancing and the capacity to cater for WWTP/MBR maintenance and emergencies (e.g. pressure sewer pump shut down due to blockages, power outage and other unplanned events).

Duty/standby grinder pumps in each pump unit, as well as a computer control system with alarms and flow control over the system protect the WWTP/MBR plant from being overloaded from high flow events. The individual pump well storage also prevents overflow of raw sewage from the system to storm water drains. Each pump unit can be pumped out by a fully qualified contractor in the case of an emergency.

5.3.2 Interaction with Existing TSC Sewerage System at SPS 5023

The new lots to be developed at Seabreeze North & West will discharge to the existing SPS5023 and be transferred for treatment to Hastings Point for Process due to the spare capacity that has been created in the existing TSC scheme. All the new lots will require Class A + Recycled Water to be made available. To achieve this, a new WWTP & AWT will be built to accommodate the recycled water demand to the new allotments. The feed water required to supply this new plant will be by sewer mining the existing system. Note: All new allotments in the zones detailed throughout this strategy plan are to be provided Class A+ recycled water for all domestic re-use purposes.

5.3.3 Monitoring and Alarm Systems

The pressure sewer pump units and the WWTP are all monitored and controlled by the DDC (Direct Digital Control) computer system. All points that are logged on the system and which are considered an alarm category are listed as to what level: i.e. "Local"or Critical". The following is a list of monitoring and alarms (also to be described in the Operations & Maintenance {O&M} manuals).

1. All sewerage pump stations will have the following monitoring and alarms:

    a. **Local** alarm will be displayed on the HMI (Human Machine Interface) screen;

    b. **Critical** alarms are connected to an internet system which call the listed operators mobile and house phones and listed on the HMI screen and operator laptop computer. The operator that answers the call is logged and the operator can dial in via lap top or home PC and assess the situation.

2. Duty/Standby Pumps: each pump is trend logged for starts and running times, with this log being linked to the schedule for pump servicing.

3. Pump failure alarm (Local) duty and standby failure (Critical alarm) for MBR Plant, Pressure Sewer or Gravity system.

4. High level alarm in any sewer storage tank (Critical Alarm): Alarm level is set to provide maximum storage (utilizing reserve capacity in the MBR Plant, Pressure Sewer or Gravity system) to address the problem.

5. Power failure (Critical Alarm): All pump stations will start up in sequence when their alarm is raised. Only a maximum of 16 pumps can run at any time to control the flow into the MBR plant. The MBR will return the pressure sewer system to where it was after power is restored.

6. High Level in the MBR Influent Tank or the Anaerobic tank will raise a (Critical Alarm) and shut down the pressure sewer pump stations until the high level alarm has disengaged.

7. MBR Plant screening unit high level alarm will raise a (Critical Alarm) and shut down the pressure sewer pump stations. With these early warning systems the maintenance staff can monitor the system thus avoiding unnecessary sewage spills.

5.4 Wastewater Treatment System

Each zone in the scheme will have its own dedicated wastewater treatment system contained within a wastewater treatment building. The overall treatment process at each zone consists of:

- Membrane Bio Reactor (MBR)
    - Treats raw wastewater to Class A recycled water standards with nutrient reduction;
    - Includes flow balancing tank to minimise peak treatment capacity;
    - Peak treatment capacity based on treatment of average dry weather flow (ADWF) plus a safety factor of 20%;
- Advanced Wastewater Treatment Plant (AWTP)
    - Treats MBR permeate to Class A+ recycled water standards.
    - Achieves log reduction targets of virus (7-log), bacteria (6-log) and protozoa (6-log)
    - Peak capacity based on demand for recycled water in the dual reticulation system.

More information on the treatment systems and each of the unit processes are provided below.

5.4.1 Membrane Bioreactor

5.4.1.1 MBR Treatment Capacity and Water Quality Targets

All sewage from the developments will be treated in a MBR plant situated in the WWTP building on the respective sites.

The MBR plant is a modified activated sludge process with a two-tier membrane bioreactor contained within a large aerobic chamber (MBR tank). The MBR system is designed with five distinct zones contained within separate stainless steel tanks. The MBR systems will be designed to achieve treatment of raw wastewater to Class A recycled water standards and has been specifically designed to oxidize BOD and remove nutrients, both nitrogen and phosphorus. The water quality targets for treated MBR permeate are outlined below in Table 5-1.

Table 5-1: Class A recycled water quality targets for MBR permeate.

Parameter	MBR Water Quality
BOD	< 10 mg/L
SS	< 10 mg/L
pH	6.5-9
Turbidity	<1 NTU
E.Coli	< 10 cfu/100 mL
TN	< 10 mg/L
TP	< 0.3 mg/L
TDS	700 - 850 mg/L

The MBR permeate to the above specification will be further treated in the AWTP to a standard complying with EPA/IPART and DOH requirements for Class A+ suitable for domestic reuse via a dual pipe reticulation recycled water system, as discussed in Section 5.5.2.

The MBR plants will have peak capacity to treat ADWF for each zone within the scheme plus a safety margin of around 20%. Each MBR plant will be designed with an inlet buffer tank to absorb diurnal peaks in wastewater flows; hence treatment of peak dry weather flow is not required.

The 20% safety margin on top of ADWF has been included in MBR peak capacity to manage the potential for "peak day" wastewater flows, where the total daily wastewater volume is higher than ADWF. This additional capacity may be utilized in a number of circumstances including peak holiday periods, during wet weather if infiltration occurs and when recovering from power failure in the pressure sewerage network.

A summary of ADWF wastewater generation and MBR peak capacity for each zone within the scheme is provided below in Table 5-2. Peak MBR capacity varies from 400 kL/day in Zone 1 up to 1055 kL/d in Zone 3.

Table 5-2: Summary of wastewater generation and MBR capacity for each Zone.

WWTP Zone	Development Area	ET	EP	Wastewater Generation ADWF (KL/d)	MBR Peak Capacity^ (KL/d)
1	Tanglewood	794	2223.2	333.5	400
	ZONE 1 TOTAL	***794***	***2223.2***	***333.5***	
2	Seabreeze North (Kings Land)	286	800.8	120.1	132.7 Existing lots not included
	Seabreeze West	30	84	12.6	
	Existing TSC Lots at Sea Breeze	798	2234.4	536.3	
	ZONE 2 TOTAL	***1114***	***3119.2***	***669.0***	
3	Pottsville Employment	968	2710.4	406.6	1055
	Pottsville Employment - RTA	114	319.2	47.9	
	Pottsville Employment - Jacksons	71	198.8	29.8	
	Pottsville Employment -HP Industrial	125	350	52.5	
	Dunloe Park - Cowan	720	2016	302.4	
	Dunloe Park - Tagget	96	268.8	40.3	
	ZONE 3 TOTAL	***2094***	***5863.2***	***879.5***	
4	Dunloe Park - Peterson	1720	4816	722.4	867
	ZONE 4 TOTAL	***1720***	***4816***	***722.4***	
	SCHEME TOTAL	**5722**	**16022**	**2604.3**	3125

^ Peak capacity of MBR based on 1.2 x ADWF to cater for potential peak day events. Inlet buffer tank used to manage diurnal peaks

As indicated in Table 5-2 total wastewater generation for the scheme is estimated to be approximately 2.6 ML/day spread across the proposed four treatment plant zones. Tanglewood is the smallest isolated zone in the north of the study area and has an ADWF of approximately 334 KL/day. The other three zones vary are located within the West Pottsville expansion area and vary in ADWF from 132.7 KL/day (Proposed Sewer Mining only for Seabreeze North & West) to 880 KL/day.

A summary description of the MBR treatment process is provided below.

5.4.1.2 MBR Process Description

<u>Principals of MBR Operation</u>

Raw sewage from the development is received from the pressure sewer system and discharged via a rotating sealed screening unit prior to transfer to the MBR tanks. The first zone is the Influent Tank, followed by the anaerobic zone, coupled with the anoxic zone. The feed from the anoxic zone is then pumped into the aerobic zone and then pumped into the MBR tank.

The MBR separates treated effluent from the mixed liquor solids utilizing a hollow fibre microfiltration membrane with a 0.4 micron pore size. The submerged membranes are typically placed directly into the MBR tank. The membranes allow the purified water to pass through the pores, while creating a complete barrier to the passage of any solid greater than 0.4 microns, which includes almost all bacteria (mixed liquor solids).

Treated wastewater (or "Permeate") is drawn through the membranes using a suction lift pump leaving the suspended biomass material in the MBR tank. Biomass (mixed liquor) is removed using a sludge pump when required to maintain the optimum mixed liquor suspended solids (MLSS) levels and food (organic waste matter) to biomass (F:M) ratios. The illustration below gives a basic flow sheet of a typical MBR system.

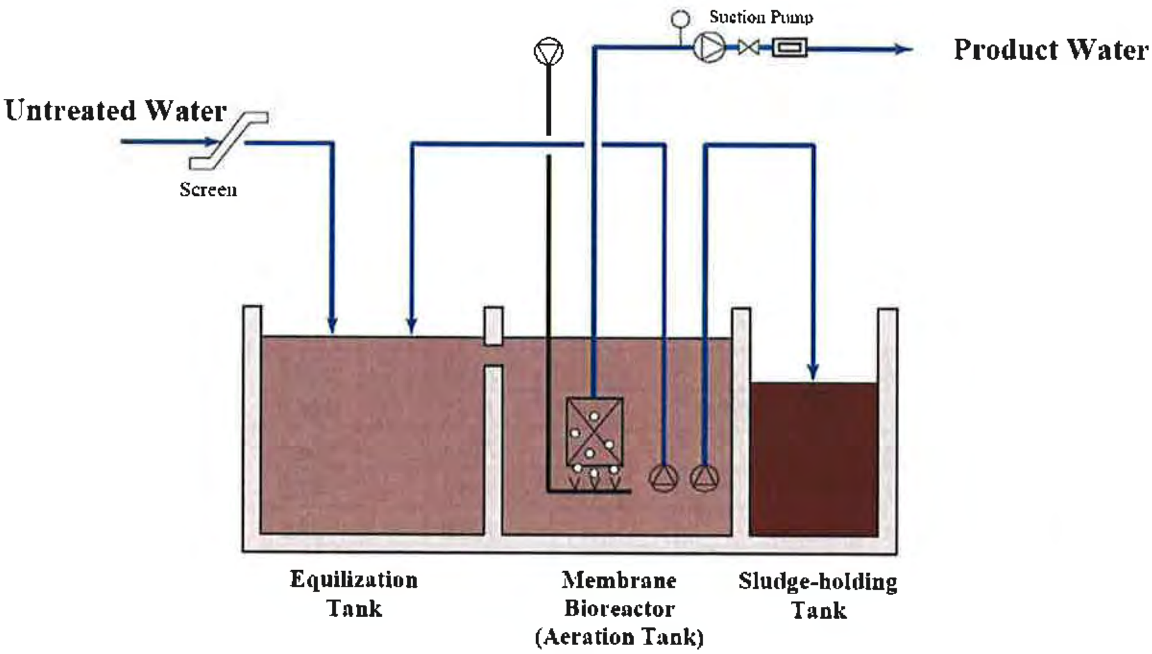


Figure 5-1: Simplified schematic of MBR process

In a conventional wastewater treatment plant, the secondary clarifier limits the solids concentration in the aeration tank. Typical mixed liquor suspended solids (MLSS) concentrations are 2,000 mg/L to 8,000 mg/L. The larger the clarifier relative to hydraulic and solids loading of the facility, the higher the possible concentration in the aeration tank.

Membranes create a solids barrier and therefore are not subject to gravity settling solids limitations, as in conventional clarifiers. MBRs are limited instead by the fluid dynamics of high solids mixed liquor, the effects on the ability to get permeate through the membrane, premature fouling of the membranes, and the effect on oxygen transfer.

Typical MLSS concentrations in MBR systems are 10,000 mg/L to 15,000 mg/L and have been reported to be as high as 20,000 mg/L in certain instances. Hydraulic retention times (HRT), the amount of time the wastewater spends in the system, for MBRs are typically 4-20 hours. On most domestic wastes this is enough time to allow for the oxidation of organic material and ammonia (nitrification).

The average sludge age, the time the biomass spends in the aeration tank, or sludge retention time (SRT) is 15-45 days. The older sludge ages and the higher MLSS concentrations in the MBR process compared to conventional systems enable the MBR to produce significantly less sludge for disposal than conventional treatment systems.

Excess sludge in the system is removed on a regular basis when the mixed liquor suspended solids concentration in the return activated sludge reaches about 13,000 mg/L (1.2% solids). The sludge is transferred via the MBR sump pump to a collection tanker and disposed of to an EPA licensed facility by an approved septic tank contractor.

Influent, Anaerobic and Anoxic Tanks

Feed water flows through the rotary brush screen to the Influent Tank. The influent tank serves as an equalization basin as well as a surge tank. From the Influent Tank, water is pumped to the Anaerobic Tank. The main purpose of this tank is to allow the micro- organisms to take up phosphorus. Water is then sent from the anaerobic zone to the Anoxic Tank. Mixed liquor will also enter the anaerobic zone via a weir between the anaerobic and anoxic zones. The main role of the Anoxic Tank is to convert nitrate nitrogen to nitrogen gas. Mixed liquor will then be sent to the aerobic zone.

Aerobic Tank

In the Aeration Tank, micro- organisms break down organic matter through aerobic digestion. Air is added to aid in this process. The end products of the degradation process are energy, additional cell mass, carbon dioxide, and other materials in smaller amounts. Cell mass is removed as sludge, carbon dioxide gasses off, and energy is consumed by the micro- organisms.

Excess liquid in the Aeration Tank is sent back to the Anoxic Tank utilizing an overflow weir. The dissolved oxygen level is also monitored so that digestion conditions can be assessed. The aerobic zone provides the nitrification and organic matter reduction. The aeration is provided in this zone by fine bubble diffused (FBDA) grids to achieve nitrification and BOD removal. Airflow via a blower unit to the FBDA grid can be adjusted by VFD (Variable Flow Drive) control and is linked to an online DO (Dissolved Oxygen) measurement sensor. A DO of approximately 2 mg/L will be sustained within the aeration tank.

To maintain the MLSS levels acidic acid can be dosed into the aeration tank as a substitute feed. This is controlled via the MLSS sensor if the MLSS drops below 3000, the dosing pump will be activated. An alum pump will be activated if the phosphorus level rises above 0.3 mg/L to control the phosphorus levels and discharge alum into the aeration tank.

MBR Module

Three, 2-tier MBR modules are installed in the MBR Tank (there are two pre-treatment streams and two MBR tanks). The microfiltration (MF) membranes are manufactured by Mitsubishi Rayon (Sterapore HF: SUN 10534 LP) or similar comprising a polyethylene hollow fibre hydrophilic material capable of particle cut-off to 0.4 microns. The module is inserted directly into the tank. Each membrane cartridge has an individual connection to the permeate line and valves on each membrane cartridge can isolate individual cartridges. Connections are provided on the permeate line from each cartridge to facilitate cleaning-in-plant (CIP). Purified water (permeate) is drawn through the membranes, from the MBR Tank, under a vacuum generated by the permeate pump.

The permeate is monitored continuously for NTU quality (if it reaches above 1 NTU, the plant will alarm and shut down if this level is exceeded). pH is monitored between 6.0 and 8.5 and is corrected by caustic dosing. The TDS levels are monitored and logged continuously.

Cleaning facilities have been installed to carry out insitu cleans when the pressure drop across the membrane reaches 34 KPA. The pressure drop is logged 24 hours a day seven days a week via the control system. A critical alarm will be activated if this pressure is ever reached. The cleaning process is carried out over a 12 hour period. The pressure sewerage system, the influent tank and the anaerobic tank have enough storage capacity while this process is being carried out.

Figure 5-2: Photo of existing MBR treatment works at Forest Resort (Creswick, VIC)

5.4.2 Advanced Wastewater Treatment Plant (Class A+)

5.4.2.1 Flow Rates and Water Quality Targets

The Advanced Wastewater Treatment Plant (AWTP) is designed to treat Class A MBR permeate to Class A+ recycled water standards to allow reuse in the non-potable water reticulation system. The pathogen log reduction targets for Class A+ recycled water are provided below in Table 5-3.

Table 5-3: Log reduction targets for viruses, bacteria and protozoa in Class A+ recycled water.

Health Parameter	Log Reduction Target
Viruses	7-log reduction from raw sewage to recycled water
Bacteria	6-log reduction from raw sewage to recycled water
Protozoa	6-log reduction from raw sewage to recycled water

The targets shown above are based on a reduction from raw sewage; hence the MBR provides some of the overall log reduction targets. Verification and validation monitoring will be undertaken during plant commissioning to ensure the targets are achieved; this is addressed in more detailed in Section 6.5.

The expected quality of Class A+ recycled water from the AWTP is outlined below in Table 5-4. This will be achieved through the use of a robust treatment process as described in Section 5.4.2.

Table 5-4: Class A+ recycled water quality targets from AWTP

Parameter	AWTP Water Quality
BOD	<5 mg/L
SS	<5 mg/L
pH	6.5-8.5
Turbidity	<1 NTU
Viruses	<1 indicator pfu/100 mL
Bacteria	<1 indicator cfu/100 mL
Protozoa	<1 indicator cfu/100 mL
TN	< 7 mg/L
TP	< 0.25mg/L
TDS	<500mg/L

The peak design capacity of the AWTP will be based on peak day demand for recycled water from the dual reticulation system. As discussed in Section 4.2, average day demand for Class A+ recycled water at each lot is expected to be approximately 320 L/ET/day. This does not include irrigation of common use open space and parkland areas.

The peak design capacity of the AWTP will be defined during the next stage of this project as part of the IPART approval process when more information is available, however an overall value in the order of 1000 L/ET/day would be expected. This would equate to peak capacity in the order of between 0.8 and 2 ML/day across the various zones in the scheme.

5.4.2.2 AWTP Process Description

The AWTP design is based on the principle of providing multiple barriers for protection against pathogens and includes the sophisticated online monitoring systems required to ensure the various unit processes are performing within specification. If non-compliant recycled water is detected the system will be shut down to avoid supply to customers until the fault is rectified.

To ensure the required water quality and pathogen log removal targets are achieved, the AWTP includes the following unit processes:

- Multimedia filter pre-filtration step
- Membrane Ultra filtration
- 30% side stream Reverse Osmosis
- Ultraviolet disinfection
- Residual chlorination

A brief description of the AWTP unit processes is provided below.

Membrane Ultra filtration

The UF membrane unit will be installed in series after the MBR unit. Ultra filtration is a pressure driven process in which the fine-pore membrane acts as a selective barrier to restrict the passage of pollutants in the feed water. The UF unit is manufactured by DOW (model SFX2860) with a nominal pore size of 0.03 µm. The primary function of the UF unit is to filter the MBR permeate to remove microorganisms and microbes such as viruses and protozoa. The UF membrane unit is sized to treat a maximum of daily flow, which can cater for the average daily operational flow from the MBR plus treating previously treated Class A recycled water stored in the recycled water dams.

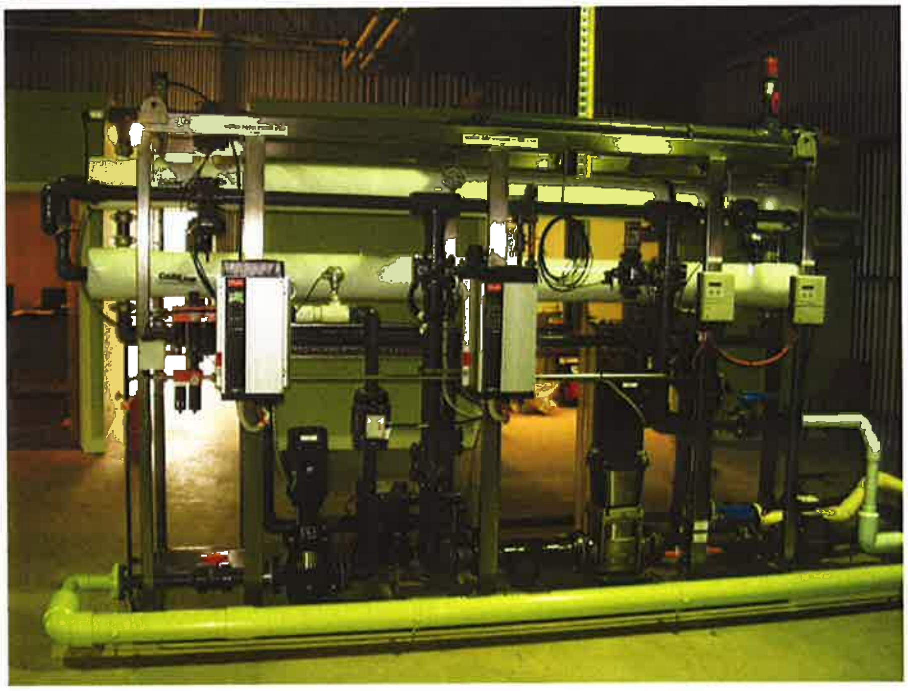


Figure 5-3: Existing Ultrafiltration membrane unit at Deep Creek Marina Resort (Moama, NSW)

Reverse Osmosis (RO)

Reverse Osmosis is a process for the removal of dissolved ions from the permeate in which pressure is used to force the water through a semi-permeable membrane, which will pass the water but rejects most of the dissolved solids including salt and nitrates.

RO1 treatment unit has a design capacity of 0.4 ML/day with about 85% recovery and will be installed within the WWTP building. RO1 unit is skid-mounted low energy brackish water RO membranes manufactured in Thin Film Polyamide by Filmtech or similar.

RO1 is designed to treat about 1/3 of the UF permeate during normal operation to reduce salinity to around 500 TDS. However, since the recycled water quality standard for discharge to the water ways is more stringent, especially from a nutrient perspective to ensure that recycled water discharges don't compromise the River's environmental values, RO1 will have to fully treat the UF permeate during such circumstances.

It should be noted that there are already projects in Australia that use RO systems as additional treatment mechanisms to polish treated effluent to achieve very low nutrient levels. The Western Corridor recycled water project in South Eastern Queensland, which has a total capacity of 232 ML/day is being developed in stages. Stage 1A of this project, which involves wastewater treatment at Bundamba has been operational for about a year and to date, has met all of its critical water quality parameters including the very low nutrient levels of 0.5 mg/L TN and 0.01 mg/L TP. This WWTP uses UF membranes and RO membranes following the standard tertiary treatment of wastewater to reduce nutrients (and other contaminants) to this very low level. We are adopting similar concept of using MBR technology to produce high quality tertiary treated effluent, followed by UF and RO to achieve very low level nutrient discharges to the receiving waterways.

Figure 5-4: Reverse Osmosis unit with comparable capacity to RO1 at (Bridge Water Vic).

Ultraviolet Disinfection

A UV disinfection unit manufactured by Calgon Carbon Corporation will be used to treat the UF permeate (partially through RO1) as a further barrier to inactivation of bacteria, viruses and protozoa. The UV disinfection unit will be self-cleaning with intensity monitoring and failure detection to ensure its continuous effective operation.

The appropriate UV dose rate and UV transmission will be determined during the IPART approval process to ensure the final pathogen log reduction targets for Class A+ recycled water are achieved. This is discussed further in Section 6.5.

Residual Chlorination

Residual chlorination will be undertaken based on the following chlorine dosing philosophy:

- Pre-Chlorination of MBR permeate prior to feed into the UF membrane system (this is also used to minimise pathogen and algae growth in the wet weather storage).
- Chlorination using a baffled chlorine contact tank designed to provide a minimum of 0.6 mg/L free chlorine residual after a minimum 30 minute contact time.
- Chlorination at the dual pipe recycled water supply tank to ensure a continuous free chlorine residual of 0.6 mg/L at all times.
- If required chlorine booster stations will be provided in the extremes of the recycled water reticulation network.

Following treatment in the AWTP the recycled water will be of Class A+ standard suitable for reuse in the non-potable water reticulation system. Verification and validation monitoring will be undertaken during plant commissioning to ensure this standard is achieved. This is discussed further in Section 5.3.2.

5.4.3 Control System

The MBR equipment is controlled by the Main Plant Control System. Readings from instruments are electronically recorded and controls for many instruments can be electronically and remotely monitored and triggered using the Plant Control System. The Plant Control System can operate under Manual and Automatic control modes. The basic system logic and operating requirements are to be detailed in the Functional Description included in the WWTP Operation and Maintenance Manual, which is to be prepared and finalised during the commissioning phase.

A computer controlled blower aerates the sewage and a permeate pump draws the product water through the membranes and discharges it into the permeate pipe for subsequent UF, RO, UV and chlorine dosing. The level in the anaerobic tank controls the speed of permeate pump to maintain the consistency of the treatment process. As the concentration of solids increases in the permeate line to a set point, the operator will pump the sludge-liquor back to the inlet tank or directly to a tanker for offsite disposal. The MBR tank can be decanted back to the aeration tank as required.

After MBR effluent has undergone UF treatment a proportion of it is automatically diverted to the RO1 unit to be collected again with the remainder of the UF permeate in the UV feed tank.

5.4.4 Wastewater Treatment Plant Building

All equipment for the MBR and AWT plants will be enclosed in a building, with approximate dimensions of 70 m by 15 m located at a selected site within each zone of the scheme. The recycled water pumps and irrigation pumps will also be contained within the plant building. A typical layout of the WWTP building is shown in Appendix 2 and an example of an existing treatment plant building is provided below in Figure 5-5.

The plant building will assist in minimising noise, odour, aerosols and aesthetics impacts of the treatment plants and will incorporate the following control measures:

- Odours from treatment tanks will be ducted to activated carbon filters
- Activated carbon filters will be fitted on all building vents stacks
- Deodorising sprays will be fitted to all on vent stacks outlets

- Appropriate noise controls on the building and individual mechanical items to ensure noise levels at nearby residential properties are below threshold limits.
- Appropriately located with screening vegetation to minimise aesthetic impacts.

It is worth noting that the operational MBR sites of similar design at Deep Creek Resort (Moama NSW, approved by local council and EPA NSW) and Forest Resort (Creswick, VIC, approved by the EPA) have not resulted in any complaints from residents who reside within 60 m and 130 m of the MBR plants respectively and are used as an example only.

Figure 5-5: Existing treatment plant building at Deep Creek Marina NSW.

5.4.5 Treatment Residuals & Waste Management

5.4.5.1 Waste Activated Sludge

Liquid sludge is removed when the MLSS in the MBR tank becomes too high (the MBR tank should have an MLSS of approximately 8,000 mg/L for optimal operation; when MLSS is above 13,000 mg/L, an alarm is activated via the DCC system for the sludge to be removed). The MBR sump pump is used to remove sludge for recycling back to the inlet tank or for transfer to a waste sludge tank or collection tanker for offsite transport to an EPA approved treatment facility. The MBR produces around 1.2% activated sludge for removal from the system when required as detailed above.

Frequency of sludge removal is expected to be every 2 to 4 weeks when the treatment plant is fully loaded. At this stage the sludge is expected to be transported to an EPA approved facility.

5.4.5.2 Screenings

Wastewater screening is via rotary brush screen with separation down to approximately 1 mm. The screenings are dewatered and temporarily stored in a sealed plastic bag which is collected in a wheel bin device until removed from the site for disposal at the nearest approved land fill managed facility. The frequency of screening removal is expected to be approximately fortnightly.

5.4.5.3 Reverse Osmosis System Concentrate

Reverse Osmosis units (treating UF permeate) will be designed to have permeate recovery ratio of 0.85 to minimize brine waste stream volume. The RO brine waste stream will be sent to an above ground evaporation pond where the volume will be further reduced through natural processes. The evaporation pond will be a turkey nest dam constructed with a polyethylene liner. The total footprint and depth of each PE lined dam will be confirmed during detailed design submitted as part of the IPART application when final sizes and details are known, but it is likely an evaporation pond area of approximately 2,500 m^2 will be required for each WWTP.

During periods of extended wet weather the evaporation ponds may accumulate rainwater. This rainwater-diluted brine waste will be managed by transferring small volumes to the wet weather storage for mixing with irrigation water (with salinity monitoring). Where this is not possible due to high salinity, the waste stream will be removed by an EPA licensed contractor for disposal at an approved disposal facility.

5.4.5.4 Chemical Storages

Chemicals used in the wastewater treatment plant include:

- Alum/metals salts for enhanced phosphorus removal will be dosed into the aeration tank;
- 15% caustic soda for pH control, which is dosed into the anoxic tank;
- 25% caustic soda, which is used for in situ membrane cleaning to control inorganic fouling;
- Sodium hypochlorite for membrane cleaning to control organic fouling; and
- Acetic acid, which is used as a supplementary carbon source in the aeration tank.

All chemicals will be stored in bund well ventilated areas within the confines of the wastewater treatment plant building in accordance with EPA regulations. Any spills that occur will be contained within the bund and removed by EPA licensed contractor for disposal at an approved disposal facility.

Waste oils, cleaning equipment and chemical containers will be stored temporarily in rubbish bins or skips located in or near the wastewater treatment plant for disposal by EPA licensed contractors.

5.5 Effluent Management System

5.5.1 Overview

The proposed effluent management strategy involves urban non-potable reuse of Class A+ Recycled Water supplied through a dual reticulation scheme, with excess recycled water being used for agricultural irrigation. A schematic of the effluent management system is provided in Appendix 3.

5.5.2 Class A+ Dual Reticulation and Storage System

The Class A+ dual reticulation and supply system is the first priority for recycled water usage and is expected to account for a significant proportion of wastewater generation. Class A+ recycled water from the dual reticulation system can be used for the following appropriate uses:

- Toilet flushing
- Laundry washing machine cold water service (hard plumbed)

- Outdoor cleaning and wash down
- Irrigation of private lots
- Irrigation of shared open space, road verges, parklands and sporting fields (subject to the agreement of the relevant asset owner)
- Fire fighting

As mentioned in Section 4.2 the average demand for Class A+ Recycled Water is expected to be approximately 320 L/ET/day. Demands for irrigation of open space, parklands and sporting fields will be more accurately defined during the master planning processes for each of the land developments within the scheme.

Recycled water storages will be utilised to improve the security of supply of the Class A+ dual pipe reticulation system. Class A+ treated recycled water will be first stored in a tank before it is pumped into the Class A+ non-potable water reticulation system. The recycled water tank may require top-up with potable water during peak demand periods. Appropriate backflow prevention will be used including an air gap and Reduced Pressure Zone (RPZ) device.

The recycled water piping system will use purple coloured pipe to distinguish it from the potable supply to the development in accordance with the plumbing code and AS3500. It will also be clearly labelled as non-potable water at the point of end use. Issues relating to health risks associated with recycled water use are discussed in Section 6.

Total demands for Class A+ recycled water are expected to represent an average of approximately 75% of total wastewater generation as indicated in Section 4.2. The remaining 25% of wastewater generation would be managed by irrigation of agricultural land in a separate irrigation reuse system.

5.5.3 Class A Agricultural Irrigation System

Excess recycled water not reused in the Class A+ recycled water supply system will be reused as Class A water for agricultural irrigation. Irrigation supply water will be taken from the wet weather storage dam and supplied through a dedicated irrigation pump to the irrigation supply network. This system will be separate and isolated from the Class A+ reuse system supplying urban development areas.

The wet weather storage will be managed to minimise algae growth and water quality decline during storage. If required stored water will be treated on supply to ensure Class A recycled water quality at the time of supply.

The agricultural irrigation system has been assessed based on water and pollutant balance modelling in MEDLI (model for effluent disposal by land irrigation) to ensure that adequate irrigation areas and wet weather storage volumes have been allowed for so the system can operate in a sustainable manner.

For the purpose of MEDLI modelling it was assumed that 40% of wastewater generation would be used to supply the agricultural irrigation system. In reality this figure would be lower depending on the amount of open space irrigation occurring within urban areas of the scheme. This defined in more detail during the master planning processes for each of the developments within the scheme. In this regard, all irrigation areas that are to be utilised will need to be subject to a more detailed assessment, with particular reference to soil suitability and tolerance. This analysis will need to be included within any IPART licence application.

The modelling was undertaken to achieve the overflow performance criteria set out in NSW DEC (2004) of less than one overflow event every two years. This resulted in a combination of a 110-day wet weather storage and a design long term average irrigation rate of 0.7 mm/day for the scheme.

This represents large irrigation areas and storage but is considered appropriate for a high rainfall area. The minimum required irrigation area and wet weather storage sizes for each zone in the scheme are provided in Table 5-5: Details of this MEDLI modelling are provided in Appendix 6.

As can be seen from Table 5-5 the effluent irrigation areas required for final management of Class A recycled water are quite large and vary from approximately 19 ha for the Zone 1, up to 90 ha for Zone 2. Wet weather storage sizes vary from approximately 14 ML for Zone 1 up to 69 ML for Zone 2.

The irrigation area and storage for Zone 2 is relatively large compared to other zones as Zone 2 contains the existing TSC lots in the Sea Breeze estate where there is no dual reticulation, hence all wastewater generated in this areas is managed through the land irrigation system.

Table 5-5: Effluent irrigation areas and wet weather storage sizes for each zone in the scheme.

WWTP Zone	ET	EP	Wastewater Generation ADWF (kL/d)	Class A Irrigation Supply^ (kL/d)	Effluent Irrigation Area* (ha)	Wet Weather Storage* (ML)
Zone 1	794	2223.2	333.5	133.4	19.1	14.7
Zone 2	1114	3119.2	669.0	N/A	N/A	N/A
Zone 3	2094	5863.2	879.5	351.8	50.3	38.7
Zone 4	1720	4816	722.4	289.0	41.3	31.8

^ Conservatively estimated to be 40% of total wastewater generation. Remaining >60% reused as Class A+ recycled water.

~ Zone 2 Existing TSC lot assumed 100% of wastewater generation goes to irrigation, as there is no dual reticulation system in this area.

* Based on 110 days wet weather storage and design irrigation rate of 0.7 mm/day to achieve <1 overflow every 2 years and >99% reuse.

There is scope for some variation to the zones identified, which will become more evident once more detailed design and planning has commenced. There will however be a desire to remain committed to the benefits of this strategy and the technologies identified. In this regard, individual stakeholders will be responsible for the commercial negotiation and agreements that relate to the locking in place of required irrigation, plant and reticulation areas.

5.5.4 Emergency Management of Surplus Treated Effluent

During periods of prolonged extreme weather the wet weather storage will approach full. This is expected to occur less than once every two years on average. Under the POEO ACT an appropriate discharge license will be required along the lines proposed in any specific scheme. Surplus recycled water is expected to account for less than 1% of total wastewater generation.

During significant wet periods when the wet weather storage is approaching full the following protocol will be used to minimise the environmental impacts of this surplus water:

- Increasing irrigation frequencies and rates when the wet weather storage is >85% full;
- Allow irrigation during rain events when the wet weather storage is >95% full;
- During prolonged extreme wet weather events treated effluent will receive full treatment in the AWTS and RO to allow direct release to local stormwater systems.

Given that surplus effluent is only likely to account for less than 1% of wastewater generation, the impacts of the above strategy are expected to be minimal. A formal emergency management plan for surplus recycled water will be developed as part of the IPART approval process. Furthermore, consultation will be needed with cane farmers in particular, so as to achieve a balance of irrigation and continued cane farming practices.

5.6 Fire Fighting Water Supply

Fire fighting water supply will be taken from the non-potable water system where applicable in lieu of drawing water from the gravity fed potable water system which may struggle providing flow when pumper trucks are connected during a fire event. A separate fire storage will be provided at each wastewater treatment plant and integrated with the recycled water storage. The fire storage will remain full at all times. Recirculation and chlorine dosing will be undertaken at the fire storage tanks and the recycled water supply tanks to ensure a minimum of 0.6 mg/L free chlorine residual.

The Class A+ recycled water reticulation system will be sized to achieve fire flow and pressure requirements at all points in the network. During fire the network will be pressurised by a specifically designed diesel fire pump system to ensure fire flows can be achieved during periods of power outage. Appropriate maintenance procedures will be developed for this system to ensure it will operate appropriately when required.

Details of fire storage volumes, fire flow demands, pump duty and reticulation main diameters will be more accurately quantified during development master planning processes for each of the land release areas and during the IPART approval process.

5.7 Potable Water Supply System

The potable water supply system will in general be supplied from the existing Tweed Shire Council Reservoir located adjacent to the HPI Industrial site. The existing potable water supply has ample capacity to cater for the new zones 2, 3 & 4 as detailed in this strategy plan. With 10ML storage capacity and a 76.8 THD, it will provide enough pressure and flow for domestic use and fire fighting requirements. In general the fire fighting requirements will be supplied from the new recycled water system. The recycled water system will be pressurised by new VSD pump sets and backed up by a diesel pump set with auto change over in the case of as power outage. It will also maintain flow and pressure required for pumper units when connected to hydrants throughout the designed systems plus providing water flushing for toilets in the case of a power outage. This will be assessed at final design stage. All potable water supply will either bulk metered at the entrance to the development or individually metered at each property boundary these arrangements where applicable and after final design will be agreed with the TSC and form part of the IPART license application.

Zone-1 will have a separate potable water storage tank located at the treatment plant site. Appropriate backflow prevention devices will be used to ensure contamination of the potable water network does not occur; this will include the use of air gaps and RPZ devices.

The potable water storage tanks in Zone-1 (Tanglewood) will be topped up with potable water from the existing TSC network. Water recirculation and chlorine dosing will be employed at the storage to ensure free chlorine residual is maintained in the potable supply. A booster pump may be required to transfer potable water from the existing TSC system and fill the onsite storage during nonpeak periods during the day. Pressure sensors will need to be installed in the existing system to maintain pressure and flow.

Water from the storage will be supplied through a potable water reticulation system pressurized with an appropriately sized variable speed drive pump set with built in redundancy. The pumps must have the ability to provide a wide range of flows at relatively constant pressure. Details of this will be confirmed during the IPART approval process.

Note: All new water meters under the strategy plan are to have remote data meter reading facility installed on both potable & recycled water supplies.

6 Managing Human Health Risks

6.1 Hazard Identification

Hazards to human health posed by recycled water are generally biological or chemical in nature. Biological hazards are derived from pathogenic microorganisms present in raw sewerage and domestic wastewater. These pathogens generally fall under four major microbial groups:

- Bacteria (including Salmonella, Campylobacter and Shigella)
- Viruses (including rota virus, hepatitis A virus and enterovirus)
- Protozoa (including Cryptosporidium and Giardia)
- Helminths (including the tapeworm Taenia and the roundworm Ascaris)

Chemical hazards are produced from industrial and domestic chemicals which may enter the sewerage system. Chemicals of potential concern to human health may include:

- Heavy metals
- Organic chemicals (including endocrine-disrupting chemicals)
- Pharmaceuticals
- Personal care products
- Plasticisers

6.2 Risk Assessment

The risks posed by pathogens via exposure through the expected uses of recycled water in dual pipe schemes have been analysed and assessed using a Quantitative Microbial Risk Assessment. A number of documents aid in this assessment including:

- Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (phase 1) (2006)
- Victoria's EPA document: Health Risk Management in Urban Recycling Schemes: Technical Background Paper
- GEM Dual Pipe Water Recycling Schemes - Health and Environmental Risk Management (2005)

These microbial criterions, which are expressed as water quality targets, are presented in Table 6-1 below.

Table 6-1, Human health microbial risk assessment

Pathogen Group	QMRA Criterion	Water Quality Target
Bacteria[1]	<10 *E.Coli*/100ml	<10 *E.Coli*/100ml
Viruses[2]	7-log reduction[3] from raw sewage to recycled water	7-log reduction
Protozoa[2]	6-log reduction[4] from raw sewage to recycled water	8.2-log reduction

Notes:

[1] Median – to be demonstrated during treatment plan validation

[2] As a default, the most resistant (or worst case virus) virus or protozoan should be used at each treatment step for calculating log reductions.

[3] Median removal, with a lower (critical) limit of 6-log reduction

[4] Median, with a lower (critical) limit of 5-log reduction

Microbial criteria are expressed as water quality targets for bacteria where target concentrations are measureable, and as treatment performance targets for viruses and protozoa. This is because direct measurement of target concentrations is impractical due to limitations in analytical techniques. Water quality criteria are not derived for helminths (parasitic worms) as helminth infections are not considered endemic in most parts of Australia, and it is considered that treatment processes that provide a significant proportion of protozoan removal by sedimentation and/or filtration would also effectively remove helminth eggs. These microbial criteria are applied at the end of the treatment process prior to recycled water entering the distribution system or being introduced into storage.

The presence of chemicals in recycled water at levels that could potentially pose a health risk is not anticipated for this scheme. According to EPA guidelines, chemicals entering the sewerage system are managed through trade waste control, substantially diluted with other wastewater, and generally removed or degraded by treatment processes. Due to this, the EPA has not established specific water quality objectives for chemicals.

Acceptable uses of Class A+ recycled water of the quality specified in Table 6-1 include:

- Irrigation of public open spaces such as parks and sport fields, where public access is unrestricted and any irrigation method is used.
- Domestic garden watering including vegetable gardens.
- Toilet flushing and washing machine use.
- General outdoor uses such as car washing, dust suppression, construction and wash down
- Filling water features and ponds that are not used for swimming.
- Use in cooling towers.
- Fire fighting and fire protection systems including hydrants and sprinkler systems.

Table 6-2 below outlines the considerations required for acceptable uses of Class A recycled water as outlined by the *GEM Dual pipe Water Recycling Schemes- Health and Environmental Risk Management (2005).*

Table 6-2, Considerations for dual pipe acceptable[1] uses

Potential Use	Environmental	Plumbing/ communication	Other
Residential			
Garden watering, including vegetables	*Risk Assessment*	*Controls required*	
Car washing	*Avoid run-off to storm water system*	*Controls required*	
General outdoor use (e.g. wash down, construction)	*Avoid run-off to storm water system*	*Controls required*	
Ornamental ponds/water features	*Management controls required*	*Controls required*	*Aesthetics*
Toilet flushing	-	*Controls required*	*Aesthetics*
Washing machines[2]	-	*Controls required*	*Public acceptance, aesthetics*
Commercial/industrial/municipal			
Irrigation	*Risk Assessment*	*Controls required*	-
Construction	*Avoid run-off to storm water system*	*Controls required*	-
Wash-down	*Avoid run-off to storm water system*	*Controls required*	-
Dust suppression	*Avoid run-off to storm water system*	*Controls required*	-
Cooling towers	-	*Controls required*	*Legionella control*[3]
Toilet/urinal flushing	-	*Controls required*	*Aesthetics*
Fire protection systems/hydrants	-	*Controls required*	

Notes:

[1] Uses are considered to be acceptable from a human health perspective

[2] Taps at the laundry trough should not be supplied with recycled water

[3] Under the *Building Act 1993* a specific risk management plan is required to control the risk of *Legionella* from cooling tower systems.

6.3 Operational Control and Preventative Measures

There are a number of potential health risks associated with the construction, operation and maintenance of a dual pipe supply system. The following key potential risks in relation to the distribution and reticulation of recycled water are identified and will be further detailed after final design and included in the Recycled Water Management Plan to be included in the IPART application for approval:

- Contamination of the drinking water supply system with recycled water due to cross-connections between two supplies
- Pathogen contamination from the use of sewer repair equipment during mains alteration and repair
- Pathogen contamination from the environment during mains alteration and repair
- Environmental impact due to burst mains and flushing events.

In controlling the risks associated with distribution and reticulation, it is anticipated that the following preventative measures will be implemented:

- Design and construction of the system in accordance with the *Water Supply Code of Australia* (WSA 03-2002, WSAA), including supplemental codes
- Protection of drinking water supply back up to the recycled water system using an approved registered air gap at the inlet to the recycled water storage or through the installation of a RPZ device on the drinking water supply back-up to the recycled water supply.
- Development of processes to ensure that:
  - The drinking water service pipe and drinking water meter into the property is only connected to the drinking water main in the street
  - The recycled water service pipe and recycled water meter into the property is only connected to the recycled water main in the street.
- Engagement of water main contractors with appropriate quality accreditation
- Regular auditing of contractors
- Fire hydrants carrying recycled water will be clearly marked and be identified in accordance with the fire services *Guidelines for the identification of Street Hydrants (1999)*
- Implementation of standard operating procedures for managing and maintaining the recycled water system
- Implementation of an appropriate scheduled maintenance program
- Implementation of protocols to ensure that sewer repair tools are not used to repair to recycled water main
- Flushing the recycled water systems after recharge

Key potential risks associated with plumbing and installations within the water user's property are identified below:

- Pathogen, chemical or physical contamination via backflow

- Pathogen, physical or chemical contamination from pipework failure below ground and backflow to the system
- Pathogen, physical or chemical contamination of the drinking water with recycled water due to cross connections.

The following preventative measures will be considered to control the risks identified above:

- Plumbing works will be undertaken in accordance with AS/NZS 3500:2003 – *National Plumbing and Drainage Code*, which is consistent with the Plumbing Industry Commission (PIC) *Recycled Water Plumbing Guide*
- Only licensed plumbers will be contracted to install the recycled water system, including appropriate backflow prevention on the recycled water service.
- Auditing of meter and backflow prevention installations
- Use of approved materials with appropriate watermarks and standard markings
- Separation of above ground recycled water and drinking water infrastructure by at least 100mm
- Separation of below ground recycled water and drinking water infrastructure by at least 300mm
- Use of purple identification tape for all below ground recycled water pipes
- Use of purple marking for all outdoor recycled water taps. Also ensure that these taps have a removable handle and are located at least 300mm from any drinking water tap
- Ensure that recycled water taps are not interchangeable with drinking water taps. To prevent drinking water taps from being installed on a recycled water outlet, tap inlets should have different sized threads
- Location of prohibition signs on all recycled water tap outlets no further than 150mm from the tap handle. These signs should clearly read "Do Not Drink"
- Use of purple coloured recycled water meters
- Ensure that recycled water meters are not interchangeable with drinking water meters. To prevent incorrect installation and transfer of meters, recycled and drinking water meters should have different threads
- All internal plumbing connections to the dual water supply system should be inspected by the PIL to ensure compliance with the PIC *Recycled Water Plumbing Guide 2005*. The main inspection points are:

  I. Connection from the recycled water meter to the house prior to backfilling

  II. Rough-in stage within the house

  III. Testing and commissioning (as per recycled water system commissioning process detailed in the PIC *Recycled Water Plumbing Guide 2005*)

- Advice will be provided to end water users to enable them to self-check that the drinking water outlets are connected to the drinking water supply
- An audit program will also be developed to inspect a percentage of properties for incorrect connections.

More specific operational hazards, as well as a more detailed and comprehensive Hazard Analysis and Critical Control Point (HACCP) framework will be developed and documented in the HEMP, which will be prepared as part of the IPART application.

6.4 Irrigation Only Recycled Water System

6.4.1 Hazard Identification

According to the *GEM: Use of Reclaimed Water (2003)* recycled water used for irrigation purposes have to be considered for the following pathogens for human health risk assessment:

- Helminths – intestinal nematodes such as *Taenia* which causes tapeworm in humans and *Ascaris* which causes roundworms in humans.
- Bacteria – such as those causing cholera, typhoid and shigellosis
- Protozoa – causing amoebiasis and giardiasis
- Viruses – such as those causing viral gastroenteritis or infectious hepatitis.

Given that recycled water for the WPW&SSP will originate from domestic sources, the health risk posed by chemical contaminants is typically less that that posed by pathogens. Metals and organic compounds tend to settle into the sludge stream and are then subject to management through the treatment process. For this reason, no guidance is provided for chemical contaminants in the *GEM: Use of Reclaimed Water (2003).*

Algal contamination of reclaimed water storage reservoirs may pose a risk to the adequate treatment and distribution of reclaimed water during bloom events. Blue-green algae may also pose a risk to human health through the production of toxins if water storage is not adequately managed. Humans coming into contact with recycled water containing high numbers of blue-green algae may be at risk of developing skin and eye infection and gastric upsets.

6.4.2 Risk Assessment

Under normal operation, recycled water used for irrigation purposes will be drawn from water stored in the storage dams. These storage dams are supplied by the treatment plant with water which meets the standards for dual pipe reticulation which are more stringent than those outlined above. Therefore water introduced into the storage dams should adhere to the criteria for Class A reclaimed water for unrestricted irrigation under the *GEM: Use of Reclaimed Water (2003).* However, there is a possibility of water contamination during storage as the dams are open to the natural environment. Therefore it cannot be certain that this irrigation water will remain Class A in quality.

6.4.3 Operational Control and Preventative Measures

Recycled water from the irrigation only system will only be used for open space irrigation of pasture, crops and playing fields. The potential level of exposure to recycled water determines the Class which is suitable for both urban and municipal reuse schemes. The potential level of exposure is influenced by a number of factors including:

- The distance from residential or public access areas
- The use of signing and/or fencing to restrict site access
- The irrigation method used; and
- The use of restricted watering times (e.g. watering at night time).

- Development of an Environmental Improvement Plan (EIP), which will be covered as part of the HEMP for the WPW&SSP.

- Restriction of public access during irrigation period and for a period of 4 hours after irrigation or until dry

- Appropriate signage in accordance with AS1319 – Safety Signs

- Implementation of monitoring and auditing programs.

These restrictions are proposed on the basis that spray irrigation will be used. Less control may be required if application methods such as sub-surface, trickle or micro-irrigation systems are used. However it will have to be demonstrated that public health will be adequately protected.

As with dual pipe reticulation, more specific operational hazards will be identified and outlined in the hazard control table in a Recycled Water Management Plan (RWMP). A more detailed HACCP framework specific to irrigation using recycled water will be developed and documented in the HEMP, which will be prepared separately to the IPART application.

6.5 Validation Requirements for Class A+ Dual Pipe Recycled Water

Validation is a critical component of the treatment process management to ensure that the targeted water quality objectives are achieved. Health Department validation and endorsement is required to ensure that the targeted water quality objectives outlined by the EPA are achieved for Class A+ recycled water for dual pipe use. DOH requires that individual processes within the treatment train are validated through the following methods:

- Considering data which already exists

- Specific on-site testing of full-scale or pilot systems

- On-site tracer studies

For the purposes of this WPW&SSP, existing data was considered to meet validation requirements and receive DOH endorsement. Specific on-site testing of the facility will be undertaken upon completion of construction to verify the validation requirements outlined at this stage. It is essential to demonstrate sufficient log removal achievements from each individual process with the treatment train. Demonstration of log removal from each process is explained in detail below.

6.5.1 Membrane Bioreactor (MBR)

According to DOH requirements, the capability of a secondary treatment process to reduce pathogens needs to be characterised over an extended period of time to consider seasonal variation, catchment inputs and process upset. Such testing typically occurs over a 12 month period. As such, the validation requirements for the MBR will not be considered at the works approval stage, instead target water quality criteria will be met through the Ultrafiltration, UV treatment and chlorination processes within the treatment train. Specific on-site testing of the MBR will be undertaken following construction of the treatment facility to validate the capability of this process if required.

6.5.2 Ultrafiltration membrane (UF)

DOH requires that validation reports for membrane filtration systems in support of log reduction claims be according to the guidance provided in the *USEPA Membrane Filtration Guidance Manual (2005)*. The Dow Omexell™ UF membrane (Model SFX2860) manufactured by Dow Water Solutions or equal will be selected to be used for the proposed AWT plants. This UF membrane model has been tested according to the *USEPA Membrane Filtration Guidance Manual (2005)* by MWH. The full testing report will need to be provided.

6.5.2.1 Virus Removal

- Challenge experiments with MS2 virus have shown that the log removal achieved by the membrane is in the range of 2.8 – 5.1 logs. MS2 virus removal was greater than 2.8 log, 95% of the time and greater than 3.0 log, 90% of the time.

- Virus log removal increased somewhat with increasing membrane specific resistance. Virus log removal at high-fouled conditions was greater than at mid fouled conditions and removal at mid-fouled conditions was greater than at low fouled conditions.

- Negative and positive control experiments with MS2 virus showed that the background level of MS2 in the feed water was negligible and that no virus was removed by the membrane system housing or piping.

6.5.2.2 Giardia and Cryptosporidium Removal

- In compliance with the LT2ESWTR, the *Cryptosporidium* and *Giardia* Log Removal Value (LRV) by the Dow Omexell UF membrane can be determined by conducting surrogate particulate challenge tests and verification of LRV by direct integrity tests.

- Challenging tests of the Omexell UF membrane, using 0.5 µm fluorescent latex microspheres (Duke Scientific), demonstrated that the Omexell UF membrane is capable of removing greater than 4.4-log of 0.5 µm particles, 95% of the time. These results verify that the Dow Omexell UF membrane can achieve greater than 4.0 log removal for *Cryptosporidium* and *Giardia*.

- Direct Integrity Test calculation method established the Upper Control Limit (UCL) as a pressure decay rate less than 0.14 psi per minute. The UCL is the highest pressure decay rate that verifies a minimum of 4.0 LRV for *Cryptosporidium* and *Giardia*. Dow defines the Quality Control Release Value (QCRV) for Omexell UF membrane is 0.14 psi per minute, which correlates with UCL.

- Pressure Decay Tests of non-damaged membranes, implemented on a daily basis during operation, were performed at a target initial applied pressure of 30 psi. All displayed less than 0.14 psi per minute decay rate.

Target organism	Removal credit
Giardia lamblia	4-log
Cryptosporidium	4-log
Virus	2.5 log

The operating and quality control values for the membrane system are presented in Table below.

Table 6-3, System Operating & Quality Control Parameters

Operating parameter	Maximum value
Flux[1] (corrected to 200^{C})	60 gfd
Trans membrane pressure (TMP)	30 psi

Turbidity Performance Standards	0.1 NTU based on 95% of monthly measurements; Not to exceed 0.5 NTU
Quality Control Release Value (QCRV)	0.10 psi/min
Upper Control Limit (UCL)[2]	0.14 psi/min

6.5.2.3 Ultraviolet disinfection (UV)

The DOH requires that the approach used to validate UV treatment equipment is consistent with those outlined in the USEPA Ultraviolet Disinfection Guidance Manual for the final Long term 2 enhanced surface water treatment rule (LT2ESWTR) (2006). In general UV is effective for Cryptosporidium but not so for viruses. Using the methodology outlined in the USEPA guidelines, it was determined that a starting UV dose of 40mJ/cm2 is sufficient to claim 4-log inactivation credit for Cryptosporidium and a 0.5-log inactivation for adenovirus. During operation of the UV treatment process, a dose calculated dose approach dose monitoring strategy will be implemented to monitor UV dose based on flow-rate, UV intensity, UVT and lamp status to ensure that adequate dosage is administered.

6.5.2.4 Chlorination

The approach used to validate log reductions based on chlorination system is consistent with those outlined in the *USEPA Disinfection Profiling and Benchmarking Guidance Manual (1999).* The total Contact Time (CT) of chlorine was calculated using flow rates, storage volumes and baffling factors within the treatment system. It will be monitored through the measurement of the appropriate residual (i.e. free or combined chlorine, depending on the method of chlorination) at a level that corresponded to the validated detention time for the system. Using the CT, predicted water temperature and pH, it was possible to estimate log removal for both Cryptosporidium and virus removal based on residual chlorine concentrations. Chlorination is more effective in virus removal than Cryptosporidium removal and it was determined that a residual concentration of 0.01mg/L will result in an estimated 4-log reduction of viruses and 0.2-log reduction of Cryptosporidium.

The validation of the chlorination system will be covered in detail within the RWQMP which will need to include the following information:

- Details on the CT control system and whether it will calculate CT on line and compare with the target value
- Details on chlorine residual monitoring and alarm systems
- Operation and supply cut off information should chlorine residuals fall below critical limits
- Monitoring procedures for flow, temperature, pH and ammonia
- Minimum tank volumes
- Equipment maintenance and testing procedures
- Details on equipment design.

7 Managing Environmental Impacts and Risks

The potential environmental impacts and risks have been addressed from a strategic level in this document. During the next stage of the project as part of the IPART approval process this will be expanded through the preparation of site specific Environmental Management Plans (EMPs) for each zone within the scheme. The EMPs will include evaluation of site specific site, soil, environmental and land use constraints to ensure the scheme is developed with minimal environmental impacts and risks. Irrigation management plans will also be developed for all irrigation areas in the scheme.

High level environmental assessment has been undertaken in this investigation to demonstrate how from a strategic level the strategy has been developed to minimise environmental impacts and risks. A large number of risk control measures have been incorporated into the design of the strategy.

This assessment was undertaken using a Hazard Identification methodology similar to that used in risk assessment and HACCP processes that will follow in later stages of the project as required by the national guidelines for water recycling and other risk management standards. This approach was also adopted as it is a structured, easy to follow and transparent process.

The management of health risks associated with recycled water usage are addressed in more detail in Section 6 of this report.

A summary of the environmental hazards, potential impacts and the preliminary control and monitoring measures for each major component of the proposed scheme are presented in the following tables. These will be expanded during the next phase of the project.

Table 7-1 provides the preliminary hazard assessment for the pressure sewerage network. It can be seen from Table 7-1 the majority of hazards relate to management of inflows and the prevention of overflows and uncontrolled discharges of raw sewage to the environment.

Table 7-1: Preliminary environmental hazards assessment for the pressure sewerage system

Scheme Component	Potential Hazard	Potential Impacts	Preliminary Control/Monitoring Measures
Pressure sewerage collection system	Pump failure	Uncontrolled release of raw sewage to environment.	Duty and standby pumps. Pump failure monitoring. 24 hours storage in pump wells.
	Pipe failure/ leakage	Uncontrolled release of raw sewage to environment.	Fusion welded PE pipe with PN 16 rating with minimum 600 mm cover. Flow monitoring throughout the network. Additional controls may be provided in high risk areas of the network like creek and road crossings.
	Power Outage	Uncontrolled release of raw sewage to environment.	24 hours storage in pump wells.
	Fats and oils blockage	Uncontrolled release of raw sewage to environment.	Pressure mains designed to achieve scouring velocities. Trade waste agreements with commercial customers. Education and awareness for residential customers.
Pressure	Foreign object	Uncontrolled release of	Grinder pumps macerate sewage into fine slurry before entering

Scheme Component	Potential Hazard	Potential Impacts	Preliminary Control/Monitoring Measures
sewerage collection system (cont'd)	blockage	raw sewage to environment.	the pressure sewer network. Pressure mains designed to achieve scouring velocities. Large foreign objects that result in failure of pump unit will raise alarm so operator can rectify. Fault will occur close to source so education and awareness can occur, and if required penalties enforced.
	Stormwater infiltration	Uncontrolled release of diluted sewage to environment. Overload WWTP.	Water-tight pressure sewerage network will have no infiltration downstream of pump wells. Gravity sewer lines upstream of pump wells will be of UPVC rubber ring construction. Flow monitoring throughout the network and at the treatment plant to monitor wet weather peaking factors. Pump hours run monitoring at each pump well to enable tracing wastewater production & infiltration to its source.
	Ground water infiltration	Overload WWTP.	Water-tight pressure sewerage network will have no infiltration. Flow monitoring throughout the network and at the treatment plant.
	Excessive wastewater generation	Overload WWTP.	Flow monitoring throughout the network and at the treatment plant. Pump hours run monitoring at each pump well to enable tracing of wastewater generation to its source. Wastewater Management Plan required at development application stage for all major land release areas to demonstrate compliance.
	Trade waste discharges	Contamination of recycled water supply with metals, chemicals and salts	Trade waste agreement for all commercial and industrial customers. If required individual industrial/commercial customers will provide onsite pre-treatment. Trade Waste Management Plan required to be submitted at development/building application stage for all industrial tenants to demonstrate compliance. Only one industrial/commercial lot per package pump station to enable more accurate monitoring of trade waste discharges.
	Noise	Noise impacts on nearby residents leading to complaints	Pressure package pump stations are below ground and use submersible pumps with low noise.
	Odour	Odour impacts on nearby residents leading to complaints	Network design to minimise detention times. Where detention times are greater than 4 hours, oxidizing agents will be dosed at appropriate points into the network. Package pump units will be vented through the upstream gravity pipes to house vent stacks to minimise odour production at package pump units.
	Aesthetics	Aesthetic impacts on nearby residents	Pressure package pump station is located below ground with minimal aesthetic impact.

Scheme Component	Potential Hazard	Potential Impacts	Preliminary Control/Monitoring Measures
		leading to complaints	

Table 7-2 shows the preliminary hazard assessment for the MBR plant. The major hazards with the MBR plant relate to managing raw sewage inflows, ensuring reliable operation, managing waste products and ensuring amenity impacts on nearby residents.

Table 7-2: Preliminary environmental hazards assessment for the MBR plant.

Scheme Component	Potential Hazard	Potential Impacts	Preliminary Control/Monitoring Measures
MBR Treatment System	Excessive inflows	Overload WWTP. Uncontrolled release of process water to environment.	Inlet balance tank sized to absorbs peak dry weather flows. Integrated control system restricts inflows from the pressure sewer network when the MBR balance tank is full, thus utilizing storage within the network. MBR peak design capacity includes 20% safety factor to cater for infrequent peak day events that may occur. Flow monitoring throughout the network and at the treatment plant. Pump hours run monitoring at each pump well to enable tracing of wastewater generation to its source.
	Power outage	Treatment plant failure	24 hours emergency storage in upstream system. Standby power generation for critical components and alarms systems.
	Tank/pipe failure	Uncontrolled release of process water to environment.	Stainless steel tanks used for all treatment tanks. Treatment tanks located inside treatment plant building. Earth containment bund downstream of treatment plant site will be used as a further safeguard for treatment plants located adjacent to sensitive receptors.
	Mechanical/ electrical failure	Uncontrolled release of process water to environment. Non-compliant effluent quality.	Duty and standby equipment for critical elements of the MBR. Online failure detection monitoring with alarms for critical mechanical/electrical items. Online monitoring with alarms for critical process parameters. Maintain stock of critical spare parts for the scheme. Standard design and use of common across all zones will assist with maintaining spare parts stock.
	Process upset	Non-compliant effluent quality	MBR process is robust with high MLSS and membrane provides physical barrier. Online monitoring with alarms for critical process parameters. Remote log in and operation to allow monitoring and control of system when operator not onsite. Routine effluent quality monitoring. 20% additional peak capacity can be utilized for re-treatment of stored non-compliant water if required.

Scheme Component	Potential Hazard	Potential Impacts	Preliminary Control/Monitoring Measures
	Screenings management	Vermin vectors for disease Offsite impacts if inappropriately managed.	Stored in dewatered state in an appropriate container that prevents vermin access. Removed from site by licensed waste contractor. Off-site disposal at an approved solid waste management facility.
MBR Treatment System (cont'd)	Chemicals Management	Potential impacts if inappropriately managed	Chemical storages to be constructed as per relevant guidelines. All chemical storages are located inside the treatment plant building to be protected from the climatic effects. Chemical storages to be located within bunded area with capacity to store >110% of the stored chemical volume. Quality assurance procedures will be developed for accepting chemical deliveries to ensure mixing incompatible chemicals does not occur. Chemical dosing equipment will include online monitoring to minimise chemical usage.
	Waste activated sludge	Potential odour. Vermin vectors for disease. Offsite impacts if inappropriately managed.	Waste activated sludge production is expected to be about 1-2% of wastewater flows at 13,000 mg/L TSS. Waste activated sludge will be temporarily stored onsite before removal by licensed contractor to the nearest approved management facility. Waste sludge will be stored in aerobic conditions to minimise odour and assist with sludge stabilisation and volume reduction. Sludge removal from each WWTP is expected to occur every 1 to 2 weeks.
	Membrane chemical cleaning waste	Potential impacts if inappropriately managed. Process upset.	Membrane chemical clean in place (CIP) waste will consist of acid, alkaline and chlorine contaminated water. CIP wastewater will be stored, neutralised and returned to the inlet tank for recirculation through the plant (where this does not result in process upset). Where CIP waste recirculation will result in process upset this water will be removed from site by a licensed contractor for disposal at the nearest approved facility.
	Noise	Noise impacts on nearby residents leading to complaints	Minimum buffer of 100 metres to residential dwellings. Aerator blowers, pumps and other noise emitting items are located in the treatment plant building. Noise controls on specific items and on the treatment plant building to ensure noise thresholds are achieved.
	Odour	Odour impacts on nearby residents leading to complaints	Minimum buffer of 100 metres to residential dwellings. MBR located in treatment plant building. Tanks will be ducted to activated carbon filters in building vents stacks. Deodorizing sprays will be installed on building vent stack outlets.

Scheme Component	Potential Hazard	Potential Impacts	Preliminary Control/Monitoring Measures
	Aesthetics	Aesthetic impacts on nearby residents leading to complaints	Minimum buffer of 100 metres to residential dwellings. MBR located in treatment plant building. Building will be appropriately located within the landscape with vegetation screening.

Table 7-3 outlines the preliminary hazard assessment for the AWTP. The environmental risk of this item is generally low, however the public health risks associated with the AWTP are high given the reuse of Class A recycled water, and this is discussed further in Section 6.

Management of brine waste from the side stream reverse osmosis process is probably the most significant environmental hazard relating to the AWTP. Once the scheme becomes operational use of the RO side stream will be minimised based on actual salt concentrations and downstream risks.

Other hazards like management of chemicals and noise and odour impact are similar to those already described for the MBR as both are located within the treatment plant building.

Table 7-3: Preliminary environmental hazards assessment for the AWTP.

Scheme Component	Potential Hazard	Potential Impacts	Preliminary Control/Monitoring Measures
Advanced Water Treatment Plant	Power outage	Inability to supply recycled water	Potable water top-up of Class A+ recycled water supply tank, with appropriate backflow prevention measures. Gravity overflow from MBR permeate tank to the wet weather storage in case power failure is restricted to AWTP only.
	Mechanical/ electrical failure	Inability to supply recycled water. Potential uncontrolled overflow from MBR permeate tank.	Duty and standby equipment for critical elements. Online failure detection monitoring with alarms for critical mechanical/electrical items. Online monitoring with alarms for critical process parameters like turbidity, trans-membrane pressure, pH, chlorine residual, UV transmission etc. Maintain stock of critical spare parts for the scheme. Standard design and standard components will assist in maintaining spare parts stock. Class A+ recycled water supply tank provides 24 hours storage and includes potable water top-up, with appropriate backflow prevention measures. Gravity overflow from MBR permeate tank to the wet weather storage. This is addressed as part of the Recycled Water Management Plan process with HACCP during the IPART approval, as discussed in Section 9.
	Process upset/failure	Supply of non-compliant recycled water to dual reticulation system	Online monitoring with alarms for critical process parameters like turbidity, trans-membrane pressure, pH, chlorine residual, UV transmission etc. Plant designed with automatic shut down to prevent supply of recycled water if non-compliance detected. Non-compliant Class A+ recycled water can be diverted to wet weather storage for re-treatment. Class A+ recycled water supply tank provides 24 hours storage and includes potable water top-up, with appropriate backflow prevention measures. This is addressed as part of the Recycled Water Management Plan process with HACCP during the IPART approval, as discussed in Section 9.
Advanced Water Treatment Plant (cont'd)	RO Brine waste	Potential impacts if inappropriately managed.	RO system designed with a recovery rate of 0.85 to minimise brine waste volume. Brine waste stored in evaporation pond to reduce volume. Pond constructed as a turkey nest dam with polyethylene liner. Peak brine waste production will be during periods of irrigation demand, hence high evaporation.

Scheme Component	Potential Hazard	Potential Impacts	Preliminary Control/Monitoring Measures
			Following extended wet weather excess diluted brine waste will be transported offsite by licensed waste contractor to an approved facility, or where permitted based on total salt load/concentration, blended with water from the wet weather storage for land irrigation.
	Tank/pipe failure	As per MBR	As per MBR
	Chemicals Management	As per MBR	As per MBR
	Membrane CIP waste	As per MBR	As per MBR
	Noise	As per MBR	As per MBR
	Odour	As per MBR	As per MBR
	Aesthetics	As per MBR	As per MBR

Table 7-4 outlines the preliminary hazard assessment for the Class A+ recycled water supply system. Risks relating to human health are dealt with in Section 6.

Many of the environmental hazards associated with the use of Class A+ recycled water relate to the long term nutrient and salt loads and impacts on soil and vegetation. However given the high quality of water these are not expected to be significant from an environmental perspective.

Hazards relating to pipe and tank failure are also not likely to pose a significant risk given the high quality water and infrequent nature of such failure events and standard control measures.

Table 7-4: Preliminary environmental hazards assessment for the Class A+ recycled water system.

Scheme Component	Potential Hazard	Potential Impacts	Preliminary Control/Monitoring Measures
Class A+ recycled water supply system	Nutrient loading	Nutrient accumulation in soil and transport to groundwater	Low nutrient concentrations of TN <7 mg /L, TP <0.25 mg/L Low average irrigation rate of 0.7 mm/day, or 2.6 ML/ha/yr, due to high rainfall area. Low nutrient loading rates of 18 kg TN/ha/yr and 0.7 kg TP/ha/yr are lower than plant uptake rates. MEDLI modelling of the scheme indicated no significant nutrient impacts, See Appendix 6.
Class A+ recycled water supply system (cont'd)	Salt loading	Increase salinity of soil and soil water	Salinity not expected to be significant issue given the high rainfall. Salts that may accumulate during extended dry weather would be flushed through the soil profile during the frequent high rainfall events. MEDLI modelling of the scheme with a TDS of 1500 mg/L indicated no significant salt impacts on plant growth, See

Scheme Component	Potential Hazard	Potential Impacts	Preliminary Control/Monitoring Measures
			Appendix 6. Class A plus recycled water receives 30% side stream RO treatment to maintain TDS below 500 mg/L. Salt load controls on trade waste discharges.
	Soil sodicity and effluent SAR	Degrading of soil structure from excess sodium	SAR of recycled water expected to be low 2.6 – 4.5 based on data from operational SOLO WATER sites in Appendix 4. Urban irrigation areas will generally consist of blended landscaping soils. Landscape soil specification may be required for new developments. Salt load controls on trade waste discharges.
	Chlorine residual	Impacts on soil biota and vegetation	Maintain a chlorine residual >0.2 and <2 mg/L.
	Over irrigation	Contamination of surface water and groundwater.	Monitoring of recycled water usage at each lot to identify high volume users. Education and awareness and recycled water use agreements to inform behaviour. High quality Class A+ recycled water with low nutrients. Development areas to be designed with appropriate downstream stormwater quality controls capable of treating for soluble nutrients, e.g. bioretention system and wetlands.
	Pipe failure	Uncontrolled release of Class A+ recycled water to environment	High quality Class A+ recycled water
	Tank failure	Uncontrolled release of Class A+ recycled water to environment	High quality Class A+ recycled water
	Water quality decline in storage & reticulation	Supply of non-compliant Class A+ recycled water	Recycled water tank includes recirculation and chlorine monitoring and dosing system to maintain a free chlorine residual of >0.6 mg/L and <2 mg/L. Health risks are discussed more in Section 6.
	Inappropriate uses of recycled water	Public health impacts	Recycled water use agreement with all customers. Class A+ recycled water quality. Health risks are discussed more in Section 6.

Table 7-5 shows the preliminary hazard assessment for the Class A recycled water agricultural irrigation system. The main hazards with agricultural irrigation system relate to the long term nutrient and salt loads and the impact on soil, groundwater and vegetation. Given the high quality water, with appropriate irrigation management procedures the impacts are not expected to be significant.

Table 7-5: Preliminary environmental hazards assessment - Class A irrigation recycled water system.

Scheme Component	Potential Hazard	Potential Impacts	Preliminary Control/Monitoring Measures
Class A recycled water agricultural irrigation supply system	Nutrient loading	Nutrient accumulation in soil and transport to groundwater	Low nutrient concentrations of TN <10 mg /L, TP <0.3 mg/L Low average irrigation rate of 0.7 mm/day, or 2.6 ML/ha/yr, due to high rainfall area. Nutrient loading rates of 26 kg TN/ha/yr and 0.8 kg TP/ha/yr are lower than plant uptake rates. MEDLI modelling of the scheme indicated no significant nutrient impacts, See Appendix 6.
	Salt loading	Increase salinity of soil and soil water	Salinity not expected to be significant issue given the high rainfall. Salts that may accumulate during extended dry weather would be flushed through the soil profile during the frequent high rainfall events. MEDLI modelling of the scheme with a TDS of 1500 mg/L indicated no significant salt impacts on plant growth, See Appendix 6. Recycled water salinity likely to be <1000 mg/L. Salt load controls on trade waste discharges.
	Soil sodicity and effluent SAR	Degrading of soil structure from excess sodium	SAR of recycled water expected to be low 2.6 – 4.5 based on data from operational SOLO WATER sites in Appendix 4. Salt load controls on trade waste discharges. Detailed geotechnical investigations will occur during the IPART approval process to determine soil ESP in irrigation areas. If required an ongoing lime application regime will be developed for the irrigation areas.
	Chlorine residual	Impacts on soil biota and vegetation	Maintain a chlorine residual >0.6 and <2 mg/L.
	Over irrigation	Contamination of surface water and groundwater.	Irrigation scheduling based on soil water deficit. Avoid irrigation during or shortly after rain events. Maximum daily application rates will be set for each irrigation area and controlled by irrigation controller. This will be defined in more detail during the IPART approval process. Flow monitoring on all irrigation areas.
	Pipe failure	Uncontrolled release of Class A recycled water to environment	Appropriate construction standards and identification/ signage to minimise the risk of failure due to agricultural machinery. Given the high quality of recycled water infrequent pipe breakages are not likely to result in significant impacts.
	Water quality decline in the wet weather storage	Supply of non-compliant Class A recycled water	High quality MBR permeate discharged into the wet weather storage has low nutrient concentrations and chlorine residual. Algae growth will be managed in the wet weather storage by mixing, aeration and high water quality inputs. Monitoring water quality in the wet weather storage and if required recycled water will be polished on supply.

Scheme Component	Potential Hazard	Potential Impacts	Preliminary Control/Monitoring Measures
Class A recycled water agricultural irrigation supply system (cont'd)	Wet weather storage leakage and inflows	Groundwater contamination	Constructed with a polyethylene liner to prevent seepage. Constructed as turkey nest dam to avoid stormwater inflows.
	Wet weather storage dam failure	Uncontrolled release of stored recycled water to environment	To be constructed away from areas of high flood velocity. Top of bank to be a minimum of 500 mm above Q100 flood level to avoid inundation. Bank stabilisation to prevent erosion.
	Overflows from wet weather storage	Uncontrolled release of stored recycled water to environment	Effluent irrigation areas and wet weather storage sized to achieve less than one overflow event every 2 years on average. This accounts for <1% of total wastewater generation. Overflows from the wet weather storage will be avoided by the following protocol: - If storage >85% full increase irrigation rates - If storage >95% full allow irrigation during wet weather - If storage >99% full daily wastewater inflows will receive full treatment in the AWTS and RO to enable release to local stormwater systems

8 Operational & Monitoring Requirements

8.1 MBR Operation and Maintenance

A draft Operation and Maintenance ("O&M") manual will be prepared by the operator for the MBR plant. The O&M manual will be prepared and finalised during the commissioning phase. The O&M manual will provide a range of standard operating features including daily run checks. The following is an example standard operating procedure for daily run checks on the MBR plant by the operators:

Daily Maintenance
1. FILL OUT SYTEM LOG SHEET AND VERIFY THAT THE OPERATING SETTINGS ARE NORMAL.
2. VISUALLY CHECK ALL SYSTEMS, INCLUDING ALL CHEMICAL STORAGE CONTAINERS AND CHEMICAL PIPING SYSTEMS, AS WELL AS ALL UNIT PIPING, PRESSURE AND FLOW INSTRUMENTS, SAMPLE TAPS AND FITTINGS, TUBING AND TANKS AND REPAIR AS NECESSARY.
3. COLLECT SAMPLE FROM AND MEASURE MLSS CONTENT. IF MLSS EXCEEDS 12,000MG/L SOME OF THE SLUDGE FROM THE BOTTOM OF THE MBR MUST BE REMOVED.
4. VISUALLY INSPECT THE AIR DISTRIBUTION IN THE MBR AND PERFORM AERATOR WASH PROCEDURE IF UNEVEN AIR DISTRIBUTION IS OBSERVED.

8.2 AWT Plant Operation and Maintenance

A draft O&M manual will be prepared by the operator for the advanced water treatment plant (AWTP). This will comprise O&M manuals for each component of the AWTP including the ultra-filtration (UF) unit, the Reverse Osmosis (RO) unit, the ultraviolet (UV) lamps and the chlorine dosing unit.

The O&M manuals will include information such as systems start-up, regular cleaning and maintenance schedules, parts replacement requirements, scheduled maintenance requirements, emergencies procedures, etc.

The O&M manual will be prepared and finalised during the commissioning phase. Refer to table 8.1 below.

8.3 Pressure Sewerage Operation and Maintenance

The O&M manual for the pressure sewerage system will be prepared by the operator and finalised during the commissioning phase. Refer to Table 8.1.

8.4 Monitoring Program

The following monitoring programs will be incorporated into standard environmental and operating procedures for the schemes:

- Sewage flows (daily) and quality (quarterly) discharged to the MBR;
- MBR and AWT Recycled Water Quality – online monitoring (pH, O_2, turbidity, TP, Electrical conductivity) linked to automatic control system of the plant assures Class A equivalent quality.

- MBR and AWT Recycled Water Quality checks by NATA laboratory testing (pH, BOD, SS, TP, TN, turbidity, electrical conductivity, TDS, cations, SAR, alkalinity, chloride, sulphate, E.Coli);
- Water quantity and water quality of recycled water discharges to water ways.
- Sludge volumes discharge to waste collection vehicle;
- Volumes of brine generated from the RO plants;
- Monitoring of recycled water dams;
- Soil monitoring on irrigation areas. To be outlined in the section of the HEMP dealing with recycled water irrigation.

8.5 Monitoring Requirements

Monitoring of the system will occur to ensure the scheme is operating as intended with no unacceptable environmental or public health impacts. A minimum of one to two years' worth of background environmental monitoring will be undertaken prior to scheme operation to gain a more detailed understanding of the existing environmental conditions.

Verification and validation monitoring will be undertaken for the recycled water treatment and supply systems to ensure the required classes of recycled water are achieved on an on-going basis. This will be developed as part of the recycled water management plan incorporating HACCP that will occur during the IPART approval process; this is discussed more in Section 6.

A summary of the monitoring requirements of the scheme is presented below in Table 8-1. These will be expanded into more detailed site specific management plans for each zone in the scheme during the IPART approval process.

Table 8-1 Summary of monitoring requirements for the Pottsville Strategy.

Scheme Component	Preliminary Monitoring Requirements
Pressure sewerage network	- Flow monitoring in major branch lines and at treatment plant - Hours run and number of starts monitoring - Failure detection monitoring with alarm - Pump well Level monitoring with high level alarm
MBR and AWTS online monitoring	- Treatment process validation monitoring - Online monitoring critical process parameters like DO, turbidity, trans-membrane pressure, pH, chlorine residual, total phosphorous, electrical conductivity, failure detection with alarms. - Flow monitoring across the MBR, AWTS, RO, wet weather storage - Water level monitoring in critical tanks, the wet weather storage and RO brine disposal pond. - Daily treatment plant operational tasks and checklists.
Class A recycled water supply system	- Treatment process validation monitoring for Class A recycled water. - Class A recycled water quality monitoring including nutrients, salts - Online monitoring of residual chlorine in the supply tank - Flow monitoring throughout the network and at each lot

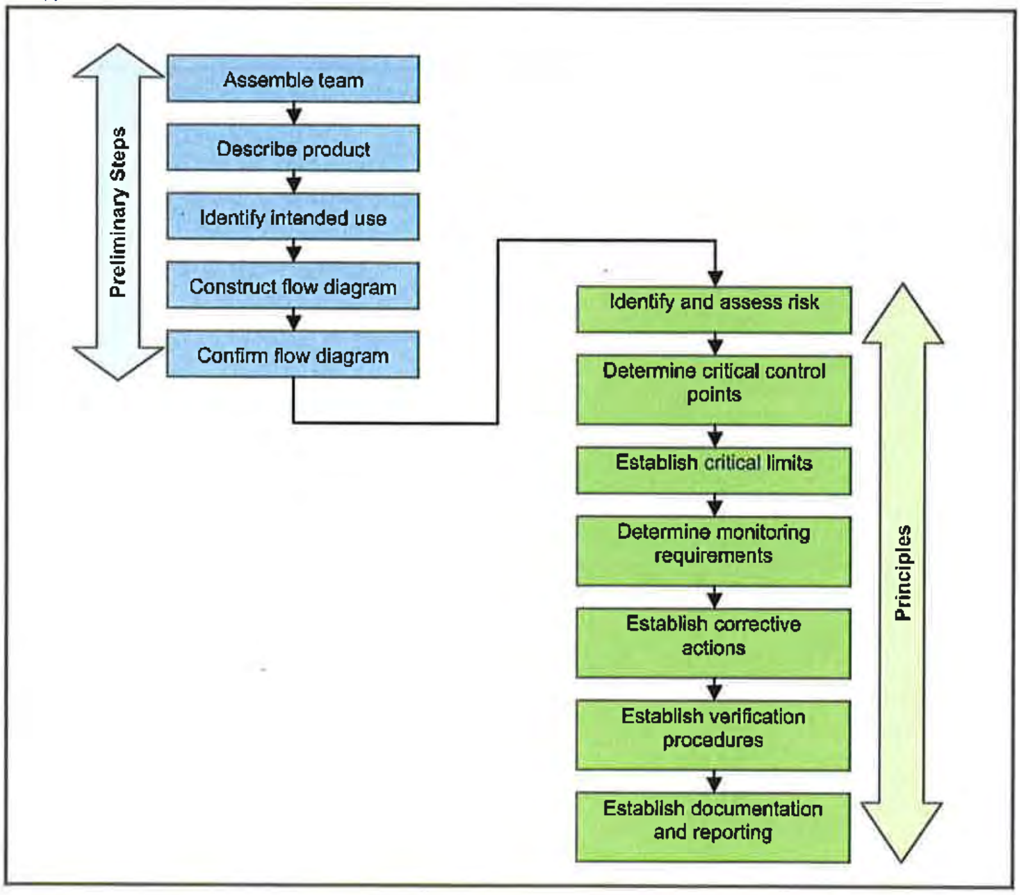
	- Soil quality and vegetation monitoring for high volume recycled water users in each zone - Surface water and groundwater quality monitoring
Class A recycled water agricultural irrigation supply system	- Treatment process validation monitoring for Class A recycled water - Class A recycled water quality monitoring including nutrients, salts - Flows to each irrigation area and total supplied from wet weather storage - Rainfall monitoring - Soil moisture monitoring - Soil quality monitoring - Surface water and groundwater quality monitoring - Vegetation monitoring

9 Contingency Planning

9.1 HACCP Analysis of the Treatment System

The HACCP approach has recently been adopted in the water industry to ensure the safe and sustainable production of recycled water. This is demonstrated in the Victorian *Safe Drinking Water Act 2003*, the *Australian Drinking Water Guidelines (2004* and the *WHO Guidelines for Drinking Water Quality*. The HACCP framework is made up of 12 steps - five preliminary steps and seven principles. These are outlined Figure 9-1 below.

Figure 9-1: HACCP Approach



A contingency and emergency response plan will be prepared during the construction and commissioning stage of the MBR and Advanced Water Treatment Plant, which will be designed in line with the HACCP approach. A hazard analyses workshop will be held with the treatment plant operators, during the commissioning phase of the plant, as part of the initial operator training. Potential incidents and environmental and public health risks will be identified in the form of a hazard control table, which will document appropriate mitigation measures, procedures and emergency readiness (equipment and staff training). Final measures and procedures associated with these risks will be implemented at commencement of commissioning and operation. Hazards have been identified for recycled water collection, treatment, storage and end use. The hazard control table has been developed to identify actions and controls which will aid in mitigating risk and reduce the likelihood of their occurrence during production, supply and use of recycled water. This table documents the following information as part of the hazard analysis procedure; it will be developed further as part of the contingency and emergency response plan workshop:

- Identification of hazards and associated hazardous events at each step in the water treatment and use process.

- Identification of the likelihood and consequence of each of these hazards

- Determination of the risk and significance of each hazardous event (i.e. likelihood multiplied by consequence)

- Identification of control measures for each hazardous event. This can include system input management, physical barriers, monitoring standard operating procedures and education.

- Personal responsible for carrying out control measures.

The qualitative risk analysis matrix framework from the Australian Drinking Water Guidelines (NHMRC 2004) was used in assessing the risk of each hazard. This framework is outlined in the table below:

Table 9-2: Qualitative risk analysis matrix: Level of risk (NHMRC 2004)

Likelihood	Consequence				
	1. Insignificant – Insignificant impact, little disruption to normal operation, low increase in normal operation costs	**2. Minor** – Minor impact for small population, some manageable operation disruption, some increase in operation costs.	**3. Moderate** – Minor impact for large population, significant modification to normal operation but manageable, operation costs increased, increased monitoring.	**4. Major** – Major impact for small population, systems significantly compromised and abnormal operation if at all, high level of monitoring required	**5. Catastrophic** – Major impact for large population, complete failure of systems.
A. Almost Certain – Is expected to occur in most circumstances	Moderate	High	Very High	Very High	Very High
B. Likely – Will probably occur in most circumstances	Moderate	High	High	Very High	Very High
C. Possible - Might occur or should occur at some time	Low	Moderate	High	Very High	Very High
D. Unlikely – Could occur at some time	Low	Low	Moderate	High	Very High
E. Rare – May occur only in exceptional circumstances	Low	Low	Moderate	High	High

Specific key areas subject to emergency planning are outlined in the remainder of this section.

9.2 Spills Management

An overview of the function of the pressure sewer system, including spill prevention, controls, monitoring and alarms, was outlined in earlier in this report. This section provides the following summary of spills management measures employed at the scheme.

- **Raw sewerage overflows from the gravity and pressure sewer system:** Spill prevention will be undertaken through duty/standby pump in each pump well, telemetry controlled alarm systems to monitor high level in pump well, pump failure and power failure, Pressure sewers fusion welded and rated well above the peak system pressure and 24hr emergency storage capacity in the pump well in the event of failure

- **Sewerage (treated or untreated) from the MBR plant:** Spill prevention will be undertaken through high level alarm in the influent tank including pump well shut down, high level alarm in the plant screening unit including pump well shut down and spill prevention by inclusion of adequate freeboard above the high level alarm.

- **Overflows from the recycled water storage dams:** Spill prevention will be undertaken as overflows from the recycled water storages only expected to occur during significant rainfall events when dilution high and risk of algal blooms minor.

- **Chemical spill control measures:** Spill prevention measures include all chemicals being stored in appropriately sized bund areas in accordance with EPA regulations and spilled chemicals removed and disposed by EPA licensed contractor. Spill control kits will also be implemented in easy to access areas. Operations staff will be regularly trained on spill control measures and incidents will be reported and monitored. MSDS's of all chemicals will be kept up to date and filed at the chemical storage location and at the operations manager's office.

9.3 Algal Management

There is the possibility of algal growth occurring in the recycled water storage dams. Algal growth will be controlled by a water quality management program implemented by the onsite site manager. These measures will include the following:

- Regular inspection program for early detection of algal growth;

- Isolation of algal laden water to prevent discharges to water ways;

- Mechanical aeration/mixing of dam contents to breakup stratification.

The site manager will activate an emergency response plan (including general notification, response and reporting procedures) in the event of any algal bloom occurring with the potential for overflow to a water way or with the potential for human contact.

9.4 Exposure of Humans to Irrigation Recycled Water

Class A recycled water that is used for irrigation within the development sites is treated to a level that allows for unrestricted non-potable water use. In the event that humans are accidentally exposed (sprayed) with recycled water the very low pathogen levels in the Class A+ recycled water should be sufficient to prevent any human health risk.

Any reported human exposure events will be dealt with as part of the contingency and emergency response plan.

9.5 Emergency and Incident Management

Emergency response procedures will be identified through the HACCP process and will be included in the Schemes operation manual. A corrective action plan will be developed through the hazard analysis workshop to implement the following objectives during emergencies and incidents:

- Bringing processes back under control as soon as possible

- Dispose of any unsafe water before it is exposed to humans or the environment

- Generate improvement plans to avoid the recurrence of critical limits & Monitoring Requirements

10 Summary and Conclusions

10.1 Schemes Analysis

This Strategy outlines four (4) preferred schemes based on their geographical location and efficiency. These schemes are outlined in the plans contained in Appendix 1 and are described as follows:

10.1.1 Zone 1 - Tanglewood

Tanglewood comprises an existing zoned area to the north of Pottsville and the west of Bogangar.

This area has been included largely due to its isolation from any other urban areas and the significant constraints in connecting with the existing Hastings Point Wastewater Treatment Plant which is the existing strategy for the servicing of Tanglewood. A stand-alone scheme is recommended for this area and alternative STP plant locations and irrigation areas shown in Appendix 1. Detailed consideration will need to be given within the design phase to ensure that STP locations are accessible in flood events (1 in 100 year immunity and access) and that buffering is addressed to adjoining future residential areas. Potable water will be supplied from the existing TSC system via an existing 150mm rising main. A booster pump will need to be installed to provide supply to the onsite potable water storage tank located at the new WWTP site off peak. Pressure & flow will be maintained by a variable speed pump set located at the new WWTP and connected to the new reticulation system which runs through the development. Recycled water (Purple Pipe) system will be installed for domestic reuse throughout the development thus reducing the potable water demand by 60%.

The use of a stand-alone treatment and disposal system at Tanglewood also provides the opportunity to connect other areas, where viable, to the existing Hastings Point WWTP service area.

10.1.2 Zone 2 - Seabreeze North (Kings Land) and Seabreeze West

This zone comprises the future release areas identified as Seabreeze North and Seabreeze West. This zone sits between Koala Beach and Seabreeze Estate and to the west of the Pottsville Village area.

This zone will be supplied with a Sewer mining solution only. This will reduce the flow to the Hastings Point STP. The implementation of a Sewer Mining solution in this zone would allow for the treatment of the wastewater to Class A+ standard to be used for domestic reuse throughout the new lots on the developments.

Again, detailed consideration will need to be given within the design phase to ensure that the AWT & WWTP location is accessible in flood events (1 in 100 year immunity and access) and that buffering is addressed to adjoining future residential areas.

10.1.3 Zone 3 - Pottsville Employment, RTA, Springfield, Jacksons, Pottsville Industrial, Dunloe (Tagget) and Dunloe (PDC)

This zone comprises significant areas of future employment lands as identified in the Tweed Urban and Employment Lands Release Strategy and sits largely within the area bounded by the Pottsville Industrial area to the south and Pottsville Mooball Road and Cudgera Creek Road. This zone also comprises the northern areas of the Dunloe Residential release area, namely those lands in the ownership of both Tagget and Pottsville Development Corporation (PDC). All of these areas have been identified within the Tweed Urban and Employment Lands Release Strategy.

This area may take some considerable time to develop given the area of land involved. The area also benefits from its proximity to agricultural lands to the north of the area and a potential flood free STP site and storage locations.

Whilst separated by Pottsville Mooball Road, these lands are effectively adjoining and therefore are able to realise efficiencies through co-development of necessary infrastructure. Potential STP, Storage and irrigation areas have been identified in the central portion of the zone and within the proposed Industrial footprint (see Appendix 1). These options could be pursued in the shorter term, however it is noted that whilst a plant could potentially be located in the Industrial footprint, cooperation between landowners will need to be considered with respect to the siting of both storage and the undertaking of irrigation. In this regard both a short and long term irrigation option has been identified, therefore also allowing the gradual development of this zone over a number of years.

Potable water will be supplied from the existing TSC system at a 60% demand rate due to recycled water (Purple Pipe) being provided for domestic reuse throughout the zone.

10.1.4 Zone 4 - Dunloe Park (Petersen)

This area comprises the majority of the identified residential release areas and comprises all of those lands to the south of the Dunloe (PDC) landholding.

This area, like the Dunloe (PDC and Tagget areas) is constrained by potential STP, Storage and Irrigation opportunities within the development footprint and therefore a site to the south of the identified release areas and to the south of an existing low ridge separating proposed residential and existing agricultural area has been identified for both STP and storage location. The Dunloe (Petersen) zone enjoys good access to irrigation and reuse opportunities to the south, inclusive of the possible use of high quality recycled water in operations associated with the existing Dunloe Sands facility to the south of the site. The identified STP and storage location also enjoys strong visual buffering to the proposed STP location from future residential areas.

Again, detailed consideration will need to be given within the design phase to ensure that the STP location is accessible in flood events (1 in 100 year immunity and access) and that buffering is addressed to adjoining future residential areas.

10.2 Conclusions

With the Pottsville locality identified within both the Far North Coast Strategy and the Tweed Urban and Employment Lands Release Strategy 2009, attention is now drawn to the regions ability to service this forecast growth, which is seen as essential for the much needed employment opportunities that this growth presents.

It was identified that future urban growth in Pottsville, Hastings Point, Cabarita Beach and Tanglewood would traditionally be dependent on the upgrade of the wastewater treatment plant and off site effluent management system at Hastings Point WWTP. It was highlighted however that there are genuine concerns that augmentation of this plant is not viable and accordingly, the provision of essential sewerage infrastructure remains an issue which limits the ability to affect the urban expansion that has been identified for the Pottsville Locality.

Accordingly, TSC along with several key landowners in the Pottsville locality are the key stakeholders in this strategy. Developing an alternative decentralized strategy for servicing the highlighted areas with water supply and sewerage services. This report is the culmination of a detailed investigation into the viability of the decentralised option, which if endorsed by TSC, will trigger application for approval of private water utility schemes by the Independent Pricing and Regulatory Tribunal (IPART).

The continued use of this strategy and its relevance to the planning process is best described in the table below:-

Stage 1	***Stage 2***	***Stage 3***
Strategy Preparation & Adoption	*Rezoning Proposal*	*Development Application*

by Council and Stakeholders	(Planning Proposal)	
• *Commitment to environmental and engineering standards* • *Identification of potential irrigation areas and STP locations* • *Identification of applicable demand from future development areas* • *Identification of key constraints and alternatives*	• *Undertake further investigation of environmental and land constraints in order to demonstrate irrigation areas are capable of supporting development of the land – preliminary only* • *Refinement of applicable demand from future development areas based on detailed site analysis and yield (master planning required).* • *Identification and preliminary design of STP location, access and serviceability* • *Preparation of a Voluntary Planning Agreement between Council and Proponents that commits to the provision of necessary infrastructure inclusive of cost apportionment, timing of IPART approvals and relevant engineering and environmental investigations (VPA to be exhibited with rezoning proposal)*	• *Evidence of compliance with the terms of the VPA* • *Evidence of IPART application being made (can be run concurrent with Development Application)* • *Evidence of IPART approval to be provided prior to development consent being granted* • *Evidence of commercial agreements with respect to areas required for irrigation*

It is envisaged that this strategy (being effectively Stage 1) will give fabric to the ongoing steps outlined in Stages 2 & 3 that will ultimately lead to the suitable servicing of future development areas.

More specifically this report has:

- Identified the areas and future developments included under the proposed TCWWS and the future boundaries of the private water utility's operations;
- Provided an overview of the proposed schemes in the Zones identified and the main infrastructure requirements like wastewater treatment plants, effluent irrigation areas and wet weather storages required for each;
- The strategy also provides a potential alternative to the existing strategy that connects the existing urban zoned land at Tanglewood to the Hastings Point Wastewater Treatment Plant.
- Provided preliminary locations for main infrastructure items giving consideration to high level environmental, technical and social constraints;
- Described the proposed effluent management and recycled water use strategy and demonstrated how this will be sustainable through allocation of sufficient areas for effluent irrigation and wet weather storages;
- Documented the recycled water quality targets based on the intended end uses of recycled water and sustainable loading rates for nutrients and salts;

- Described the robustness of the decentralised wastewater treatment system and how the system will achieve the required recycled water quality targets;

- Described how the public health risks associated with recycled water usage will be managed for the scheme through the recycled water management plan and HACCP processes;

- Described how the potential and actual environmental impacts of the scheme will be managed;

- Provided an overview of the IPART approval process and future investigations required.

This report has shown that the decentralised private water utility model or similar is based around the principles of integrated water management and ecological sustainability, and that this solution provides a raft of benefits to the community and the environment.

APPENDIX – 1

Concept Irrigation and STP Areas

APPENDIX – 2

Typical WWTP Layout Designs

Sample Only

APPENDIX – 3

Tweed Coast Waste Water Strategy

Schematic Overview

APPENDIX – 4

Sample only of Operational Water Quality Data from Existing Sites

APPENDIX – 5

Pressure Sewerage Network Information (Conceptual)

APPENDIX – 6

Overview of Water & Nutrient Balance Modelling using MEDLI

APPENDIX – 7

IPART: Combined Application Form – Network Operator and Retail Supplier

APPENDIX – 8

Zoned area Cost Estimates ex. Power & Irrigation Systems and Types