Public Works
NSW Water Solutions

Wingecarribee Shire Council

Integrated Water Cycle Management Strategy Issues Paper

Report Number: WSR - 16020

May 2017

WINGECARRIBEE SHIRE COUNCIL

A division of the Department of Finance, Services and Innovation

Public Works
NSW Water Solutions

Document Control

Version	Author	Reviewer	Approved for Issue	
			Name	Date
Draft 1	Jennifer Blaikie / Gareth Clemens	Glenn Fernandes	Glenn Fernandes	26/4/2016
Draft 2	Glenn Fernandes		Glenn Fernandes	12/5/2016
Final	Gareth Clemens	Glenn Fernandes	Glenn Fernandes	15/5/2017

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Executive Summary

Wingecarribee Shire covers an area of 2700 square kilometres and is situated approximately 100km southwest of Sydney. This area is known to tourists as the Southern Highlands of New South Wales. This Shire is an important catchment area for water supply to Sydney, Wollongong and the Northern Shoalhaven. Council has initiated the preparation of an Integrated Water Cycle Management Study to effectively integrate water supply, sewerage & stormwater services to achieve sustainable management of these services for Wingecarribee Shire Council (WSC).

This report provides a summary of the issues and all the outcomes from items 2 to 7 of the IWCM checklist (DPI Water, July 2014).

Water supply and sewerage schemes

The Wingecarribee Shire Water Supply System currently provides drinking water to Bowral, Mittagong, Moss Vale and Bundanoon towns, and Exeter, Sutton Forest, Aylmerton, Berrima, Robertson, Braemar, Willow Vale, Colo Vale, Hill Top, Yerrinbool, Burrawang, Balaclava and New Berrima villages. There are three water treatment plants in the system; Wingecarribee WTP, Bundanoon WTP and Medway WTP, which supply treated water to an estimated serviced population of over 40,000. Medway WTP has currently been mothballed due to a number of performance, operation, safety, water quality and operating cost issues. Its service area is now served by Wingecarribee WTP.

Council provides sewerage services to the towns of Bowral, Burradoo, Moss Vale Mittagong, Bundanoon, Hill Top, Robertson and Colo Vale and the villages of Berrima, New Berrima, Balaclava, Braemar, Welby, Willow Vale and Aylmerton. Council operates six sewage collection and treatment schemes: Berrima, Bowral, Bundanoon, Mittagong, Moss Vale and Robertson.

Population and Demographic projection

The Australian Bureau of Statistics (ABS) data, NSW Department of Planning's population strategy, and the demographic and housing study undertaken by SGS Economics and Planning were analysed to develop a Shire wide growth strategy for population projections. Council has adopted the SGS growth strategy as the basis for the Shire wide growth projection, with growth after the end of the projection to continue at the 2026 to 2031 projected rate. Under this projection, the percentage of the population served by the reticulated water supply schemes remains at about 91% and sewerage schemes goes from 77% to 79%.

Water Cycle Analysis and Projection

Wingecarribee Shire Council has previously commissioned the Water Supply System Master Plan (WSSMP) that outlines the peak day, average day and average annual customer water demands, and the projected non-revenue water (NRW) for Council's planned population growth and development until 2031. These results were reviewed and augmented by extending the forecasts to 2046 and estimating the projected unrestricted dry year demand.

The current average day demand, excluding non-revenue water, is estimated to be 10.27 ML/d with a peak day demand of 30.5 ML/d. A 25 percent increase in the peak day demand was noted in 2014 which could be attributed due the significant bushfires during that year.

The water demand was modelled on a monthly time scale to determine the annual unrestricted dry year demands. Allowing for the 2014/2015 non revenue water it is estimated that the dry year filtered water production for a 1 in 20 year summer would be about 4,990 ML/year.

The assessed Average Dry Weather Flow (ADWF) per Equivalent Person (EP) estimated for each sewerage scheme is provided in the Table below.

Average Dry Weather Flows per EP for each Sewerage Scheme

	Berrima	Bowral	Bundanoon	Mittagong	Moss Vale
ADWF (L/EP/day)	220	220	200	200	240

Water Service System Issues

The water service system issues at Wingecarribee Shire that have been identified through the analyses are outlined in the Table below.

Water Service System Issues at Wingecarribee Shire

Element	Issue	Issue Type	Comment
WTP Source management	By 2031 the PDD is predicted to be very close to the combined production capacities of Wingecarribee and Bundanoon WTPs.	System Capacity	The WSSMP suggests that the decision to permanently deactivate Medway WTP be held off until further investigations are undertaken.
WTP Source management	The WSSMP suggests that operational changes are required in order for Wingecarribee and Bundanoon WTPs to supply all of the system demand up to 2026.	System Capacity	
Security of Supply	Under the existing WTP supply area zoning, the Wingecarribee supply area PDD is predicted to exceed the WTP capacity by around 2031.	Capacity	This is without considering the additional roughly 25% increase in demand noted during the bushfires in 2014.
Security of Supply	Under the proposed revised supply area zoning, the Bundanoon WTP capacity is already exceeded by the Bundanoon supply area peak day demand.	Capacity	
Water treatment plant	The Drinking Water Management Plan risk assessment identified the need to confirm the chlorine contact time (C.t value) available at both WTPs	Performance	Computational fluid dynamic modelling is currently being undertaken to confirm the contact time available
Water distribution system	There are some areas in the reticulation where a chlorine residual of 0.2 mg/L is not achieved.	Regulatory	Council has identified a programme of work to improve the chlorine residual in the system.
Sampling and testing	It is noted that there is a discrepancy between the on-line and bench top test results for water quality.	Best Practice Management	Indicates that one or the other has not been calibrated correctly or the true reading is not within the range of the instrumentation

Element	Issue	Issue Type	Comment
Drinking water management plan	The dam water extraction and reticulation free chlorine have been identified as Critical Control Points (CCP). Based on the definition and role of a CCP these parameters are not considered as CCPs.	Best Practice Management	A review of the CCPs is suggested during the annual DWMS audit.
Water reticulation system	The WSSMP review identified a number of reservoirs that operate with relatively high differential head which presents a risk in meeting the supply pressure	Level of Service	WSSMP suggests installing regulating valves at these reservoir inlets
Water reticulation system	The WSSMP found that under the 2031 system demand Mt Gib and New Berrima have only marginally more than the 12 hours PDD storage required.	Level of Service	The WSSMP suggests that Council progress the secondary supply from Berrima WPS/Medway zone as a priority
Berrima Sewerage Scheme	A sewage detention time of about 10 hours at ADWF was calculated for pumping station BE1 which has the potential for septicity and odour generation.	Performance	
Sewerage pumping stations	Pumping station BE5 at Berrima, BW11 and Lift PS at Bowral, Hill Top at Mittagong and MV8 at Moss Vale all have an emergency storage of less than 2 hours under ADWF	Performance	Council has adopted a failure response time of one hour during working hours and two hours after hours. The PIRMP contains an incident response management plan to respond to sewage overflow incidents
Bowral STP	Regular exceedance of the 50th percentile limit of total nitrogen and some exceedances of the 90th percentile for total phosphorus.	Regulatory	
Bowral STP	The plant has a hydraulic design capacity of 14,600 EP based on a loading of 240 L/EP/d. The current estimated EP of about 15,000 exceeds the design capacity.	Capacity	Due to the lower estimated loading of 202 L/EP/d, it is expected that the hydraulic capacity of the plant will be exceeded at around 2030.
Bowral STP	The plant is currently operating past its capacity for biological loading.	Capacity	
Bowral STP	The plant is currently operating past its capacity for total nitrogen.	Capacity	
Mittagong STP	Exceeded 50th percentile concentration limit for total nitrogen.	Regulatory	

Element	Issue	Issue Type	Comment
Mittagong STP	The plant has a hydraulic design capacity of 14,000 EP based on a loading of 230 L/EP/d. The current estimated EP of about 16,500 exceeds the design capacity.	Capacity	Due to the lower estimated loading of 145 L/EP/d, it is expected that the hydraulic capacity of the plant will not be exceeded.
Mittagong STP	The plant is currently operating past its capacity for total nitrogen and total phosphorus.	Capacity	
Moss Vale Sewerage Scheme	A sewage detention time of about 6 and hours at ADWF was calculated for pumping station MV8 and MV12 respectively which has the potential for septicity and odour generation.	Performance	
Moss Vale STP	Exceedance of total load limits for nitrogen due to extra flows at the STP.	Regulatory	
Moss Vale STP	Exceedance of total daily volume limit due to inflow infiltration	Regulatory	
Moss Vale STP	The current estimated EP of 8,988 treated by the plant means that the plant is operating at its current design capacity of 9,000 EP. However if the MVEC has progressed as expected, then the current estimated EP is 11,212 which exceeds the design capacity of the plant.		The Moss Vale Enterprise Corridor (MVEC) development will need to be considered when determining the extent of any upgrade required.
Moss Vale STP	The biological/nutrient loading rates measured in the 2009 Influent Sewage Monitoring Report were lower than the STP design loading rates hence the biological / nutrient capacity of the plant is not expected to be exceeded until around 2018.	Regulatory	The MVEC development will need to be considered when determining the extent of the upgrade required.
NorBE	For each STP upgrade the GHD report concluded that even when options were considered where the effluent concentration limits were more stringent than expected for other catchment based plants, NorBE was not assured.	Regulatory	
Unserviced areas	Council has an on-site sewage management strategy but experience shortage of resources to undertake number of inspections required.	Best Practice Management	

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1 Introduction

1.1 Wingecarribee Shire LGA

Wingecarribee Shire Council is the local government authority for the Wingecarribee Shire of New South Wales, a region typically referred to as the Southern Highlands. It is located midway between Sydney and Canberra off the Hume Highway and covers an area of about 2,700 km^2 with a population of 47,584 people (as at 2014).

Wingecarribee Shire is largely rural, with urban areas in numerous towns and villages. Rural land is used largely for sheep and cattle grazing, with some timber production, fruit and vegetable growing, mining and viticulture. The Shire is an important water catchment area for Sydney Water and within the declared catchment of Sydney Water.

The main urban centres within Wingecarribee Shire are Bowral, Moss Vale, Mittagong and Bundanoon. As well, there are smaller villages including Hill Top, Yerrinbool, Colo Vale, Robertson, Berrima, New Berrima, Exeter, Burrawang, Penrose, Willow Vale, Alpine, Balaclava, Renwick, Wingello, Sutton Forest, Avoca, Fitzroy Falls and Balmoral Village.

Figure 1.1: Wingecarribee Shire LGA map

1.2 Urban Centres

The population of the main towns and villages within the Wingecarribee Shire are given in Table 1.1.

Table 1.1: 2011 Population in main urban centres

Town/Village	Population (2011)	Water Supply	Sewage System
Bowral	8,022	Wingecarribee	Bowral
Moss Vale	7,792	Wingecarribee	Moss Vale
Mittagong	5,722	Wingecarribee	Mittagong
Burradoo	2,555	Wingecarribee	Bowral
Hill Top	2,506	Wingecarribee	Mittagong
Robertson	1,849	Wingecarribee	Robertson
Colo Vale	1,719	Wingecarribee	Mittagong
East Bowral	1,581	Wingecarribee	Bowral
Yerrinbool	1,088	Wingecarribee	-
Welby	736	Wingecarribee	Mittagong
Willow Vale	668	Wingecarribee	Mittagong
Berrima	600	Wingecarribee	Berrima
New Berrima	542	Wingecarribee	Berrima
Bundanoon	2,420	Bundanoon	Bundanoon
Exeter	831	Bundanoon	-
Total	**38,631**		
Wingecarribee (LGA) Total	**44,395**		

2 Operating environment and levels of service

2.1 Operating environment

The delivery of urban water services including water supply, sewerage and stormwater services is subject to a number of legislative and regulatory requirements, guidelines, contractual obligations for delivery of services and other external and internal factors, collectively referred to as the operating environment. An IWCM issue will arise if there is a failure to meet the legal obligations or agreed levels of service in water supply and sewerage servicing including the following:

- Legislative and regulatory requirements (health requirements, WHS, EPA Licence)
- Levels of service targets (as agreed with customers)
- Contractual and agreed arrangements (e.g. Memorandum of Understanding (MoU))
- Best Practice Management criteria

The operating environment compliance situation is analysed in this section to identify the IWCM issues.

2.1.1 Regulatory and Contractual Compliance Requirements

Wingecarribee Shire Council operates several sewerage schemes under the authority of the Local Government Act, 1993. The residents outside the designated sewerage service areas are required to provide their own onsite sewerage management system.

This and a number of other legislations influence the way in which Council can provide the urban water and wastewater services and have specific implications for the operation of the schemes. The following table provides the details of the status of compliance with the legislative and regulatory requirements by the Council.

Table 2.1: Wingecarribee Shire Council Legislative requirements

Key Legislative Framework and their main purposes	Council current performance and future targets
Local Government Act (1993)	
This Act aims to provide the legal framework for an effective, efficient, environmentally responsible, and open system of Local Government including the provision, management and operation of water supply and sewerage works and facilities. It covers: • Section 60 - proposal approvals for water or sewage treatment works construction and for effluent and biosolids reuse • Section 61 - inspections of LWU dams and water and sewage treatment works • Section 64 - developer charges • Section 68 - provide an approval to applications to discharge trade waste to Council's sewerage system • Section 90 (2) – concurrence on liquid trade waste approvals • Section 428 – annual reporting	These Legislative and regulatory targets are generally met by Council. • Council has Section 60 approval for its water and wastewater systems operation. • Council has recycled water management systems in place for the Mittagong and Robertson reuse schemes. • Council has currently engaged NSW Public Works for preparation of Development Servicing Plans for Water Supply and Sewerage Services. • Council has a trade waste policy in place which outlines the approvals process for trade waste discharge.

Key Legislative Framework and their main purposes	Council current performance and future targets
Environmental Planning and Assessment Act (1979) (incl. the EPA Regulation 2000).	
This Act aims to encourage proper management of resources, the orderly use of land, the provision of services, and the protection of the environment. It covers: • Local Environmental Plans (LEP), Environmental Impact Statement (EIS), Reviews of Environmental Factors (REF)	These Legislative and regulatory requirements are generally met by Council.
Catchment Management Authorities Act 2003	
Promotes the coordination of activities within catchment areas. This Act has implications for the management of river quality and quantity. Requirement for ongoing management plan.	Council has a Catchment management plan in place for Bundanoon dam.
Soil Conservation Act (1938)	
This Act aims to manage the conservation of soil resources and farm water resources and the mitigation of erosion and land degradation.	These Legislative and regulatory requirements are generally met by Council.
Public Health Act (2010)	
This Act aims to promote, protect and improve public health; by providing safe drinking water to the community. It requires a Local Water Utility to have a Drinking Water Management Plan (DWMP) in place. The performance for Wingecarribee and Bundanoon water supply was checked by: - Reviewing the raw water quality received at the plant, - The performance of the plant against the critical control points - Review of the reticulated water quality	Outcomes of the assessment are provided in Section 7.1.2.
Fluoridation of Public Water Supplies Act (1957)	
This Act covers the addition of fluoride to public water supply under the NSW Fluoridation Code of Practice. Council need to ensure continuous compliance with the Code of Practice.	WSC's drinking water supply is fluoridated. The fluoride dose in the water is controlled through a Critical Control Point. Refer Section 7.1.2 for an assessment of this CCP.
Water Management Act (2000)	
This Act promotes the sharing of responsibility for the sustainable and efficient use of water between the NSW Government and water users and provides a legal basis to manage NSW water planning, allocation of water resources and water access entitlements.	Council has a current bulk water supply agreement with WaterNSW for the supply of water from Wingecarribee dam. Council also has a license to extract water from Bundanoon Creek and Medway Dam.
Protection of the Environment Operations Act (1997)	
This Act introduces an approach to protect the environment. It is a powerful tool for regulating sewerage schemes by local water utilities.	Council has an EPL License and a PIRMP for each STP. The performances against these licenses have been reviewed in Section 8.

Key Legislative Framework and their main purposes	Council current performance and future targets
Work Health and Safety Act 2011 and WHS Regulation 2011	
This Act has an objective to provide a consistent framework to secure the health and safety of workers and workplaces.	Council reviews Work Health and Safety issues through regular audits.
State Environmental Planning policy (Sydney Drinking Water Catchment) SEPP SDWC	
The SEPP SDWC requires that all proposed development in the Greater Sydney drinking water catchment to have a neutral or beneficial effect on water quality (NorBE) and this impacts Council's operations in a number of ways including: • On-site Wastewater Systems must be consistent with the Sydney Catchment Authority's 2012 guideline 'Design and Installation of On-site Wastewater Systems' in addition to the standard NSW Health requirements. • for Council sewerage schemes: more stringent effluent quality requirements and effluent reuse sites and disposal locations determined by proximity to water sources.	A review of the on site sewage management systems is provided in Section 9. Outcomes of NorBE assessments undertaken by GHD for the proposed STP upgrades are outlined in Section 8.2.
Dam Safety Act 1978	
Wingecarribee Council operates the Bundanoon and Medway Dams. Wingecarribee Dam is operated by WaterNSW. Welby and Robertson dams are not in operation.	Council has completed Dam Surveillance Reports for both these dams

2.2 Levels of Service

2.2.1 Level of Service targets and current performance

Levels of Service are defined by local water utilities as the standards required from the water and sewerage systems from the perspective of the individual customer. The LOS are targets which the Council aims to meet and are not intended as a formal customer contract.

The provision of the agreed levels of service to customers is dependent upon the efficient and effective running of the water supply and sewerage operations. To this end, Wingecarribee Shire Council implements a program of works and appropriate operation and maintenance procedures to meet the levels of service for the current and future customers. Council also identifies additional works required to bridge any gap between the existing and desired services.

It is Council's intent to adopt a process of continual monitoring and reporting to assess the current performance and target achievements. Details of Council's adopted level of service targets and current performance as set out in the Strategic Asset Management Plan 2016 are given in the following tables.

Table 2.2: Water Supply Levels of Service

Service Attribute	Service Objective	Performance Measure Process	Current Performance	Expected position in 10 years based on current LTFP
COMMUNITY LEVELS OF SERVICE				
Quality	Council will endeavour to ensure water supplied is in compliance with the physical and chemical parameters of Australian Drinking Water Guideline and is free from objectionable taste and odour	• Customer surveys and analysis of customer complaints. • Microbiological and Chemical water sampling • 'Department of Primary Industries (DPI) Water' performance reporting	• "Fairly satisfied" rating in the customer satisfaction survey • 100% compliance with microbiological and chemical testing • 5.6 customer complaints /1000 connections/year recorded in relation to water quality	• "Very satisfied" rating in the customer satisfaction survey • 100% compliance with microbiological and chemical testing • <4 customer complaints/1000 connections / year
	Eliminate the need for "boil water alerts" through providing appropriate water supply and treatment infrastructure and carrying out the necessary operation and maintenance activities	• Number of boil water alerts issued in performance reporting period. ('DPI Water' performance reporting.) • Operational and Maintenance plans implemented	• Nil • 10% completion of maintenance program	• Nil • 90% completion of maintenance program
	Maintains effective disinfection within the water distribution system (including a minimum free chlorine residual of 0.2mg/L)	• Percentage of samples satisfying the minimum free residual chlorine levels water network sampling	• 60% compliance with LWU Circular 18	• 100% compliance
Function	Pressure Provide pressures between 12 and 90m head of water in the reticulation system whilst conveying a minimum of 6 litres per minute per residential connection under normal conditions	• Percentage of connections complying with pressure and flow requirements. (Network modelling)	• 97% comply with pressure between 12 & 90m head • Average pressure shire wide 56m	• 100% compliance.

Service Attribute	Service Objective	Performance Measure Process	Current Performance	Expected position in 10 years based on current LTFP
	Response times to; Rectification of system failures (Time to have staff on site to commence rectification after notification) *Priority 1* - defined as failure to maintain continuity or quality of supply to a large number of customers or to a critical use at a critical time. • 1 hour (during working hours) • 2 hours (after working hours) *Priority 2* - defined as failure to maintain continuity or quality of supply to a small number of customers or to a critical user at a non-critical time. • 3 hour (during working hours) • 4 hours (after working hours) *Priority 3* - defined as failure to maintain continuity or quality of supply to a single customer. • One working day *Priority 4* - defined as a minor problem or complaint which can be dealt with at a time convenient to the customer and the water authority. • Within 2 weeks	• Customer surveys • Develop Conquest system to report time of request / failure and time onsite.	• "Fairly satisfied" rating in the customer satisfaction survey	• "Very satisfied" rating in the customer satisfaction survey

Service Attribute	Service Objective	Performance Measure Process	Current Performance	Expected position in 10 years based on current LTFP
	Catastrophe Any situation of this nature would prompt immediate action involving senior personnel and emergency services with the aim of containing and resolving the situation as quickly as possible			
	Interruptions to supply Planned – Domestic customers will receive 24 hours written notice and industrial customers will receive 7 days' written notice. Unplanned – Not to occur more than six times per year and not to last longer than 12 hours.	• Develop process for planned interruptions and include notification requirements • Develop Conquest system to report unplanned incidents and duration of interruption.	• Monitoring system is being developed	• Minimal non-compliance
	Customer complaints and inquiries of a general nature will be responded to: • Written complaint or inquiry within 10 working days • Personal complaint or inquiry within one working day	• Conquest requests system report • Random checking of recorded requests	• Monitoring system is being developed	• 100% of inquiries and complaints responded to within agreed LOS timeframes.
Capacity/ Utilisation	Water restrictions will be kept to a minimum	• Restrictions should not be applied for more than 5% of the time / year	• 100% compliance	• 100% compliance
	Provide more than 90% of peak day demand.	• Water Network Modelling Analysis	• More than 90% of peak day demand met	• 100% of peak day demand is met

Service Attribute	Service Objective	Performance Measure Process	Current Performance	Expected position in 10 years based on current LTFP
	Water for Fire Fighting will be available from reticulation fire hydrants for firefighting at a minimum flow of 10l/s 15m residual pressure	• Fire hydrants installed at 60m intervals in urban areas and 140m in rural areas. • Water network modelling analysis	• To be determined	• 100% of hydrants meet criteria
TECHNICAL LEVELS OF SERVICE				
Operations	Operation of Water Assets to ensure compliance with Australian Drinking Water Guidelines	• Operational activities are undertaken as per operational manuals / operational plans and Australian Drinking Water Guidelines • Operational tasks recorded and tracked in Conquest Maintenance Management System	• To be determined	• 100% operational tasks completed
Maintenance	To maintain assets to ensure they meet the required service standard	• Water Treatment Plant preventative maintenance program implemented • Reticulation preventative maintenance program implemented	• To be determined	• 100% of preventative maintenance tasks completed
Renewal	To renew assets to meet demand and agreed levels of service	• 10 year capital works plan completed • Annual Asset renewals completed	• 80% of projects completed	• 100% of projects completed within the Financial Year
Upgrade/ New	To upgrade and construct new assets to meet demand and agreed levels of service	• 10 year capital works plan completed • Annual Asset upgrade / construction works completed	• 80% of projects completed	• 100% of projects completed within the Financial Year

Table 2.3: Sewerage Services Levels of Service

Service Attribute	Service Objective	Performance Measure Process	Current Performance	Expected position in 10 years based on current LTFP
COMMUNITY LEVELS OF SERVICE				
Quality	Council will use its best endeavours to ensure safe and sustainable sewerage collection and disposal, as outlined by industry standards	• Customer surveys • Nutrient and pathogen effluent sampling (EPA licences) • Public Health Incidents – 'Department of Primary Industries (DPI) Water' performance reporting	• Data not available • 1 breach of EPA licence discharge conditions • 0	• "Very satisfied" rating in the customer satisfaction survey • 0 breaches of EPA licence discharge conditions • 0
Function	Frequency of system failures	• Recorded chokes and overflow ('DPI Water' performance report)	• 44 main breaks & chokes / 100km /y • 36 overflows / 100km/y	• <20 chokes / 100km /y • <10 overflow / 100km/y
	Response times to system failures (Time to have staff on site to commence rectification after notification) *Priority 1* - defined as "major failure to contain sewage within the sewer system or any problem affecting a critical user at a critical time". • 1 hour (during working hours) • 2 hours (after working hours) *Priority 2* - defined as 'minor failure to contain sewage within the sewer system or any problem affecting a critical user at a non-critical time'. • 3 hour (during working hours) • 4 hours (after working hours) *Priority 3* - defined as 'minor failure to contain sewage affecting a property	• Customer surveys and associated analysis • Develop Conquest system to report time of request / failure and time onsite.	• "Fairly satisfied" rating in the customer satisfaction survey	• "Very satisfied" rating in the customer satisfaction survey

Service Attribute	Service Objective	Performance Measure Process	Current Performance	Expected position in 10 years based on current LTFP
	or as bad odours'. • One working day			
	Customer complaints & inquiries of a general nature will be responded to: • Written complaint or inquiry within 10 working days • Personal complaint or inquiry within one working day	• Conquest requests system report • Random checking of Dataworks requests	• Monitoring system to be developed	• 100% of inquiries and complaints responded to within agreed LOS timeframes.
	Odour	• NOW performance reporting	• 1.1 complaints/1000prop	• <1 complaints/1000prop
Capacity/ Utilisation	Availability of Service: Council provide sewage collection and disposal services to local community	• Extent of area serviced within the defined service area. NOW performance report	• 99.6%	• 100%
TECHNICAL LEVELS OF SERVICE				
Operations	Operation of Sewer Assets to ensure compliance with Environmental Protection Agency licence requirements	• Operational activities are undertaken as per operational manuals / operational plans and Environmental Protection Agency licence requirements	• Conquest Maintenance Management System to be fully implemented to monitor progress	• 100% operational tasks completed
Maintenance	To maintain assets to ensure they meet the required service standard	• STP preventative maintenance program implemented • Reticulation preventative maintenance program implemented	• Conquest Maintenance Management System to be fully implemented to monitor progress	• 100% of preventative maintenance tasks completed
Renewal	To renew assets to meet demand and agreed levels of service	• Annual Asset renewal projects completed • Assets are maintained in a condition 3 or better	• 92% of renewal projects completed within the Financial Year • 95.4% of assets are in condition 3 or better	• 100% of renewal projects completed within the Financial Year • 97% of assets maintained to condition 3 or better
Upgrade/ New	To upgrade and construct new assets to meet demand and agreed levels of service	• Annual Asset upgrade / construction projects completed	• 86% of upgrade projects completed within the Financial Year	• 100% of projects completed within the Financial Year and within budget

3 Urban water services

3.1 Water Supply System Overview

The Wingecarribee Shire Water Supply System currently provides drinking water to Bowral, Mittagong, Moss Vale and Bundanoon towns and Exeter, Sutton Forest, Aylmerton, Berrima, Robertson, Braemar, Willow Vale, Colo Vale, Hill Top, Yerrinbool, Burrawang, Balaclava and New Berrima villages.

There are three water treatment plants in the system; Wingecarribee WTP, Bundanoon WTP and Medway WTP, which supply treated water to an estimated serviced population of over 40,000. The water supply service area is mapped in Figure 3.1.

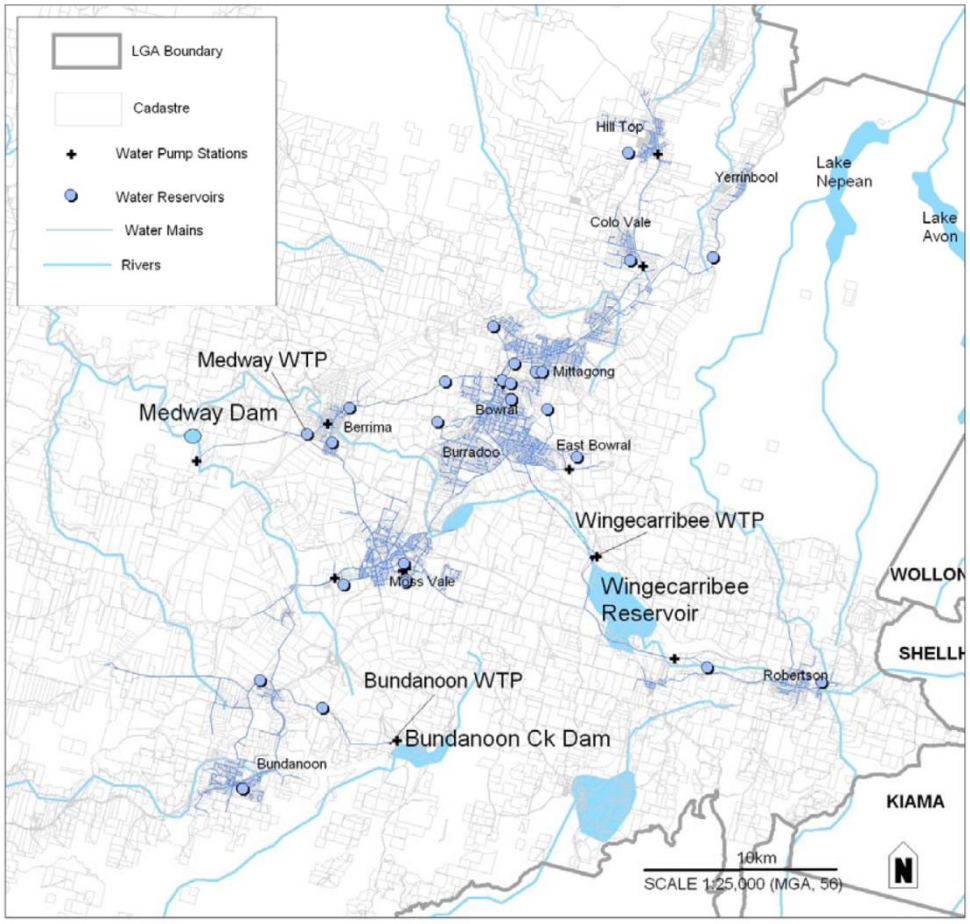


Figure 3.1: Wingecarribee Shire water supply service area

The Wingecarribee Water Supply Scheme consists of an intake and a water treatment plant near Wingecarribee Reservoir. The scheme services the majority of the urban areas in the Wingecarribee Shire. A schematic of the scheme with its service areas is provided in Appendix A.

The Bundanoon Water Supply Scheme is supplied with water sourced from Bundanoon Creek Dam which is fed by a raw water pump station and 1km rising main to Bundanoon Water Treatment Plant. The scheme services the areas of Bundanoon, Exeter and Sutton Forest. A schematic of the scheme with its service areas is provided in Appendix A.

The Medway Water Supply Scheme consists of an intake at Medway Dam, a raw water pump station, a 5.7 km rising main and a treatment plant at Medway. Medway WTP has currently been mothballed due to a number of performance, operation, safety, water quality and operating cost issues. When in use, it supplied water to Berrima, Hopewood, Welby, Gib, Gib North and Murchison reservoirs. Its service area is now served by Wingecarribee WTP.

3.2 Water catchments

Wingecarribee Shire sits on a major catchment divide, with the south east of the Shire in the Kangaroo River catchment, shown in Figure 3.2. The north-east of the shire drains into the Upper Nepean River catchment and the more populated middle and western areas of the Shire containing most of the towns and villages drain into the Warragamba catchment through the Wollondilly River, Wingecarribee River, Little River, Nattai River and Bargo River. Within these catchments lie the catchments that comprise the three water supply schemes, shown in Figure 3.3.

3.2.1 Wingecarribee Reservoir catchment

Wingecarribee Reservoir is about 10 kilometres south-east of Bowral on the Wingecarribee River (direct catchment 41 km^2.) The immediate catchment area around Wingecarribee Reservoir is mostly cleared farmland, with the communities of Robertson and Burrawang nearby. The upper reaches of Wingecarribee Reservoir contain an ancient peat swamp, a habitat for several endangered species. Wingecarribee Reservoir has a volume of approximately 24,000 ML.

The reservoir supplies the majority of the water used by Wingecarribee Shire, and is part of the Shoalhaven Scheme which during drought also tops up water supplies for Sydney and Goulburn. Most of the water in Wingecarribee Reservoir is transferred in from Lake Yarrunga and transferred via Bendeela Pondage and Fitzroy Falls Reservoir. Lake Yarrunga is mostly surrounded by thick bushland though the entire catchment includes large areas of farmland, national park, state forest, state recreation area and several sizeable towns spread over a vast catchment that extends south a significant distance past Braidwood, almost to Cooma.

Wingecarribee Reservoir is operated by WaterNSW and supplied to Wingecarribee Shire Council under a Bulk Water Supply Agreement. Council pays a monthly fixed availability charge and a volumetric charge (Table 3.1). WaterNSW undertakes a comprehensive program of raw water monitoring program, testing both water in storages and many sites in the catchment and works with Council to ensure that poor water quality events do not impact on the quality of water supplied to Council's customers, especially during summer algal blooms. The charges for the water supplied by WaterNSW are determined by the NSW Independent Pricing and Regulatory Tribunal (IPART). An IPART price review is currently underway with the draft determination for the 2015-16 price review scheduled to be released in March 2016 with the final to be released in June 2016.

Table 3.1: Bulk water purchases

Component	1/7/2010-30/6/2011	1/7/2011-30/6/2012	1/7/2012-30/6/2013	1/7/2013-30/6/2014	1/7/2014-31/12/2014*
Availability Charge ($/month)			20,783.50	21,443.51	22,369.78
Volumetric Charge ($/ML)	250.82	268.87	202.22	205.86	211.93
Water purchased	3,477	3,480	3,775	4,385	2,427
Total cost	872,101.14	935,667.60	1,012,782.50	1,160,018.22	782,791.47
Average cost per month	72,675.10	77,972.30	84,398.54	96,668.19	65,232.62

* July-December only due to amalgamation of Sydney Catchment Authority and State Water to form WaterNSW

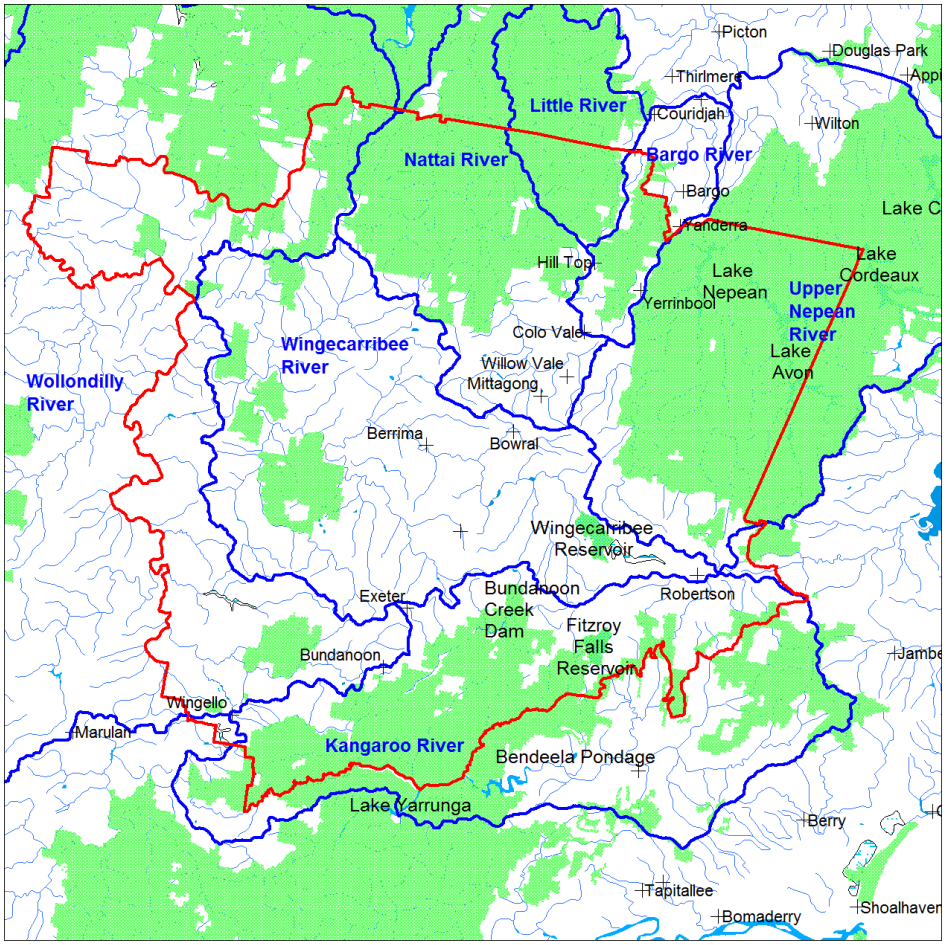


Figure 3.2: Water catchments of Wingecarribee Shire

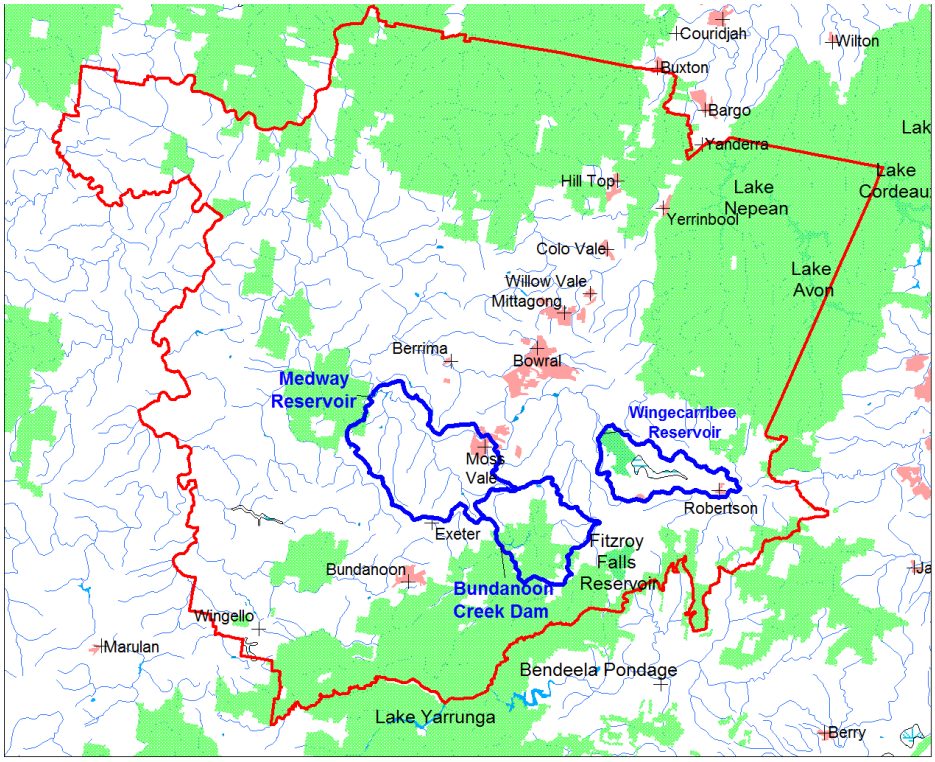


Figure 3.3: water supply catchments of Wingecarribee Shire

3.2.2 Bundanoon Creek Dam catchment

Bundanoon water supply sources water from Bundanoon Creek Dam. The dam is sited in a steep valley with the fringes of the lake mostly covered by thick vegetation, both in the Meryla State Forest and privately held land. The dam has a volume of approximately 2,000 ML.

Bundanoon Creek Dam is located 7km east of Exeter and has a catchment of 54 km^2. It drains into the Kangaroo River catchment, feeding Lake Yarrunga (catchment 5750 km^2 and impounded by Tallowa Dam), the primary water source utilised by Shoalhaven Water. Water from Lake Yarrunga is transferred via Bendeela Pondage and Fitzroy Falls Reservoir to Wingecarribee Reservoir.

3.2.3 Medway Dam catchment

The majority of the Medway Dam catchment has been cleared with a narrow strip of uncleared land around the edges of the lake. The catchment includes Sutton Forest, Werai and most of Moss Vale along with a stretch of the Hume Highway and the Berrima cement works.

3.3 Water treatment plants

Design capacities for Wingecarribee and Bundanoon water supply schemes are given in Table 3.2. Medway WTP has a design flow of 126 L/s and a design capacity of 8 ML/d.

Table 3.2: Water supply scheme capacities

Unit	Wingecarribee		Bundanoon	
	Design Flow (L/s)	Design Capacity	Design Flow (L/s)	Design Capacity
Raw Water Intake	500		130	
Raw Water Pumping Station	500		130	
Water Treatment Plant	500	42.00 ML/d	126.00	10.00 ML/d
Clear Water Pump	475 L/s		130	
Clear Water Tank	-	3.00 ML	-	0.156 ML

The process flow diagrams for Wingecarribee WTP and Bundanoon WTP are shown in Figure 3.4 and Figure 3.5 respectively. When in operation the Medway WTP used a conventional treatment system, consisting of flocculation, sedimentation, gravity sand filtration and disinfection.

Wingecarribee WTP was operated under EPA licence number 3187 until it was surrendered on 9 May 2001. Bundanoon WTP and Medway WTP were operated under EPA Licence numbers 2649 and 1800 respectively until both licenses were surrendered on 22 April 2002. In all cases the only licensed discharge was supernatant from the sludge lagoons. All at both WTPs, the supernatant from the sludge lagoons is now returned to the head of the plant/

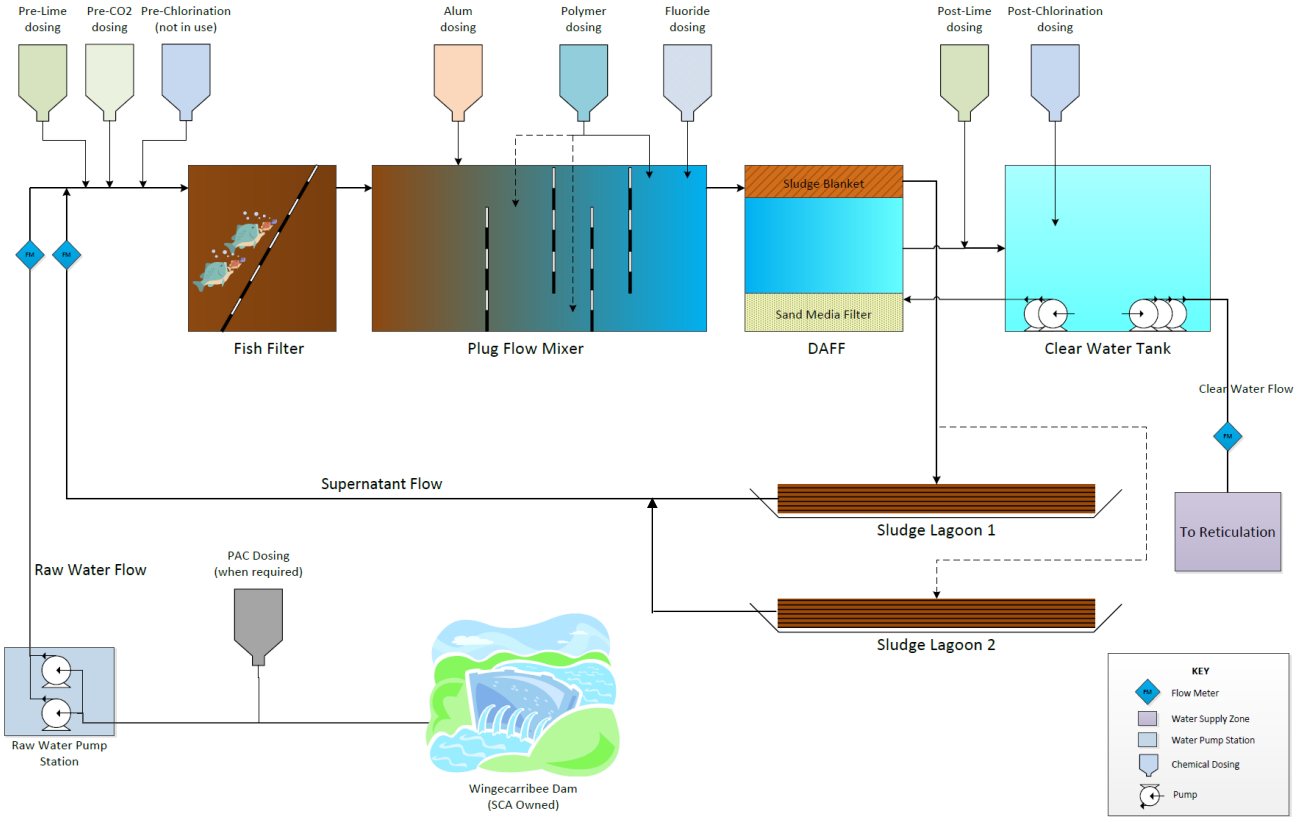


Figure 3.4: Wingecarribee water treatment plant schematic

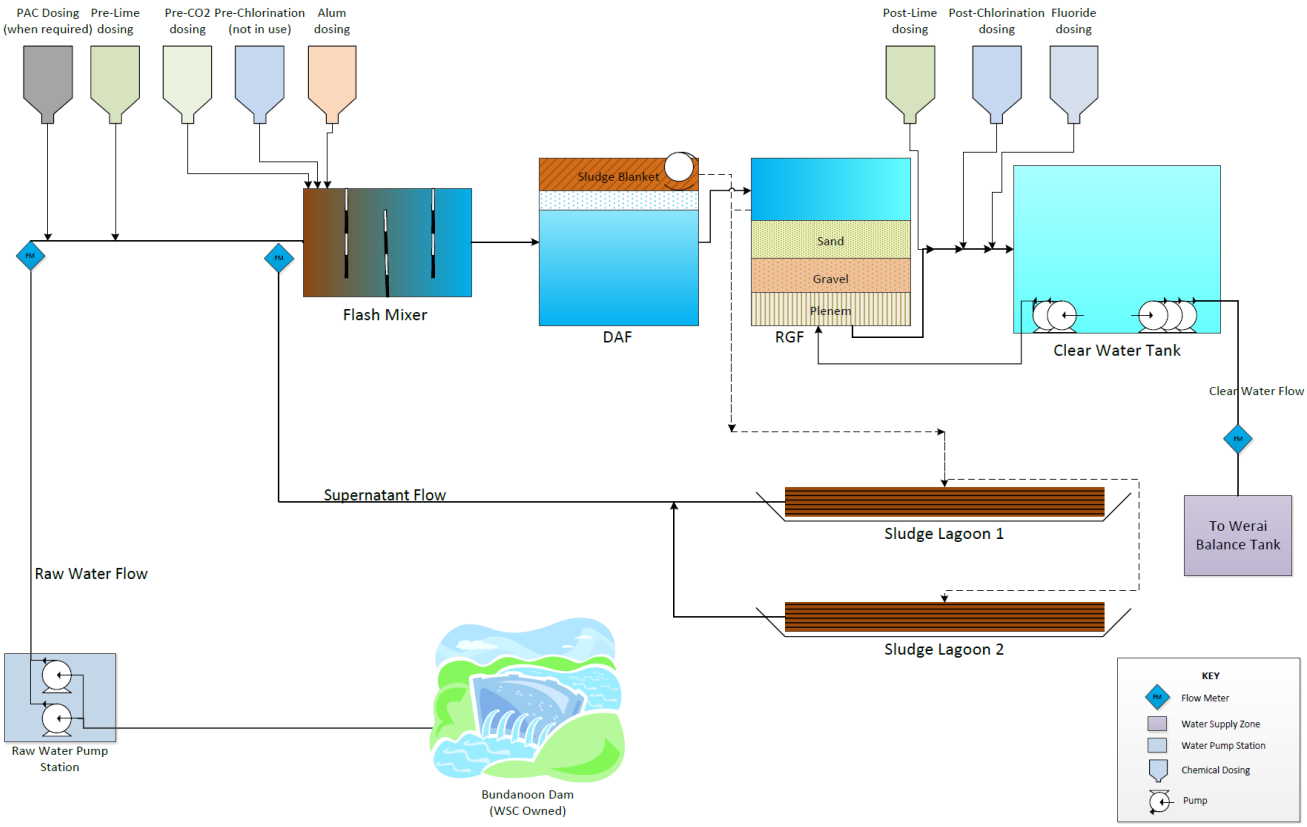


Figure 3.5: Bundanoon water treatment plant schematic

3.4 Water Distribution System

The Wingecarribee Shire water distribution system comprises thirty one treated water storages, ten booster pump stations and over 650 km of trunk, distribution and reticulation mains. The current capacity of Bundanoon WTP greatly exceeds the demands of the Bundanoon and Exeter reservoir zones, therefore Council has been considering supplying some of the areas around Moss Value and New Berrima from Bundanoon. In order to aid understanding, the areas that may be switched will be referred to as the Wingecarribee South water supply area. The reservoir sizes are given in Table 3.3.

Table 3.3: Wingecarribee and Bundanoon water supply scheme reservoir capacities

Wingecarribee		Wingecarribee South		Bundanoon	
Reservoir	**Size**	**Reservoir**	**Size**	**Reservoir**	**Size**
Berrima	0.46 ML	Blakes Hill	2.27 ML	Bundanoon (Large)	1.36 ML
Burrawang	3.30 ML	Hill Rd	10 ML	Bundanoon (Small)	2.5 ML
Colo Vale	0.68 ML	Hill Rd (high level)	0.68 ML	Exeter	4.55 ML
East Bowral	5.00 ML	New Berrima	0.59 ML	Werai Balance Tank	0.23 ML
Gib North	6.00 ML	Woodville Rd	2.29 ML		
Gib High	0.50 ML				
Hill Top	1.60 ML				
Hopewood	2.28 ML				
Kimberly	0.14 ML				
Murchison St	0.23 ML				
Oxley Dr (Concrete)	10 ML				
Oxley Dr (Steel)	2.28 ML				
Robertson	0.68 ML				
Soma Ave	1.24 ML				
Spencer	2.30 ML				
West Bowral	2.50 ML				
Welby	1.43 ML				
Willow Vale	10 ML				
Yerrinbool	1.20 ML				

3.5 Sewerage Schemes

3.5.1 Overview

Wingecarribee Shire Council operates six sewage collection and treatment schemes: Berrima, Bowral, Bundanoon, Mittagong, Moss Vale and Robertson. The sewage scheme service area is mapped in Figure 3.6.

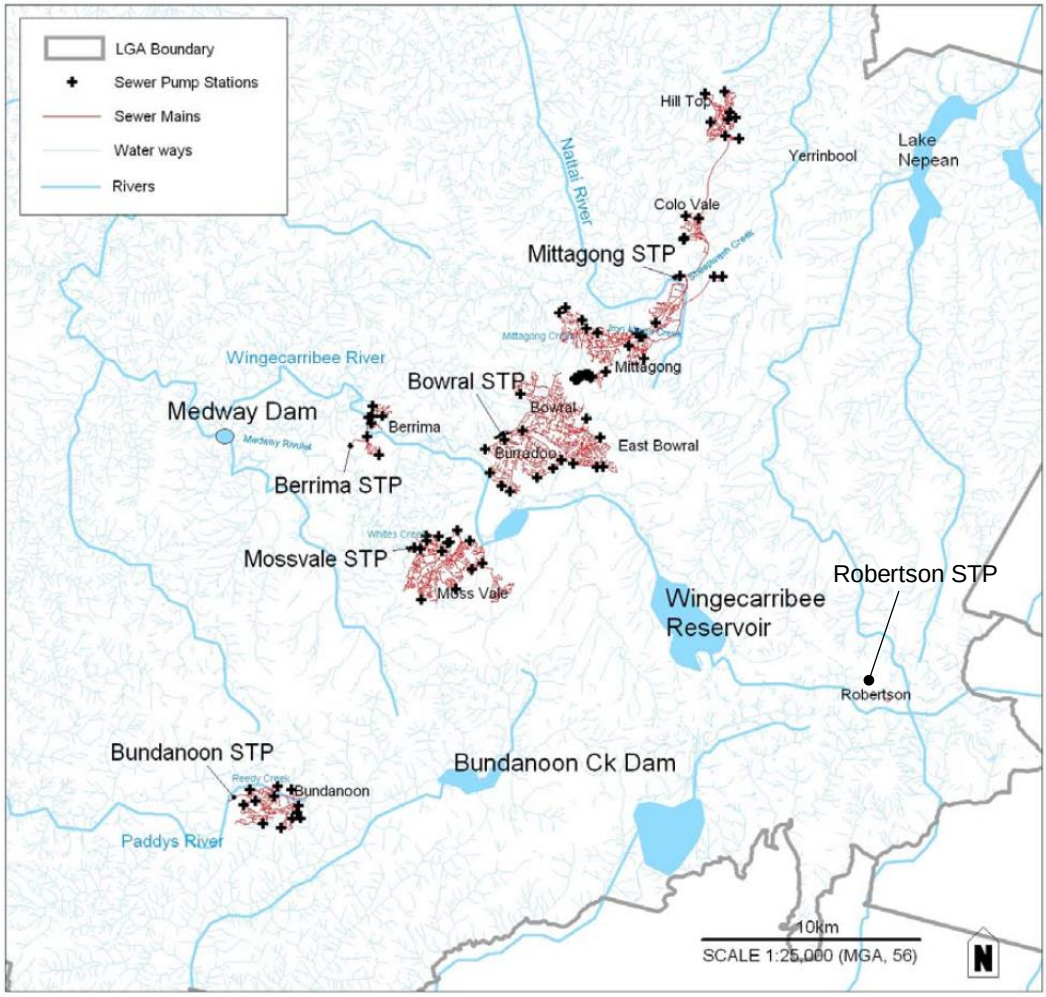
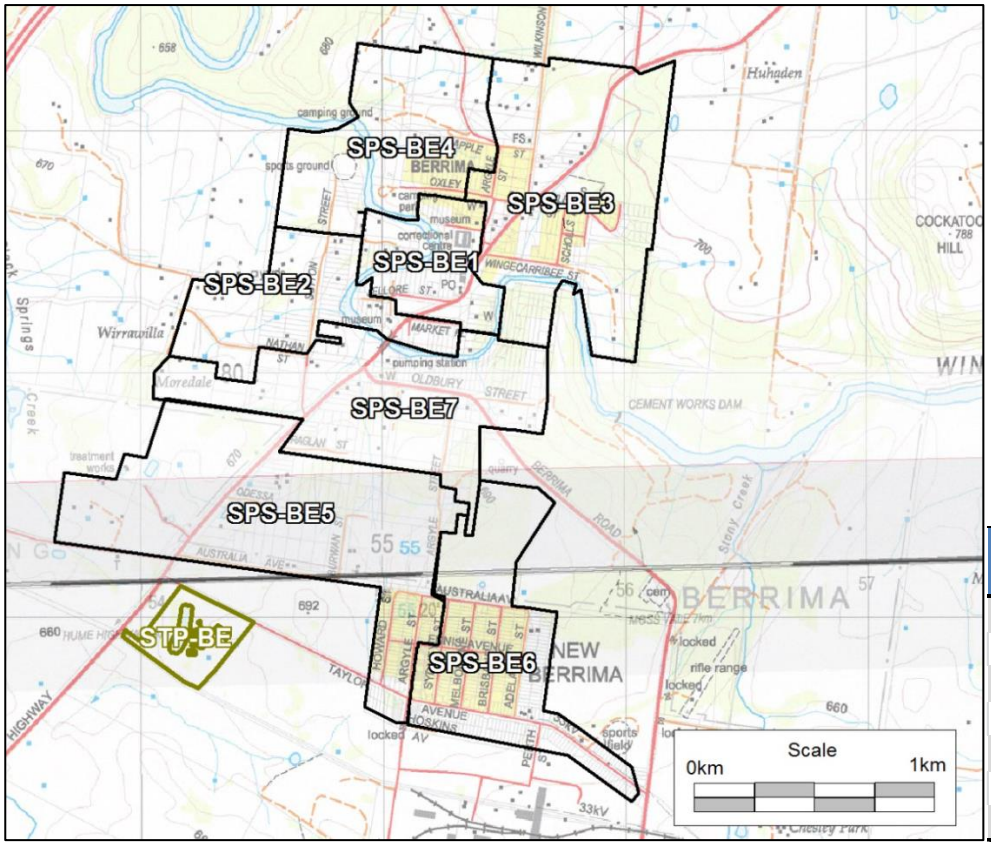


Figure 3.6: Wingecarribee Shire sewerage service area (Robertson scheme not shown)

3.5.2 Berrima Sewerage Scheme

Berrima STP is located approximately 2 km south-west from the centre of Berrima and services the smaller residential lots in Berrima and New Berrima. Many larger lots (5000 m^2 and up) are not serviced. The system is serviced by a conventional gravity sewerage system, comprising seven (7) pump stations.

Plant inflows are directed to the STP inlet works via a single pump station (SPS-BE5). A pump hierarchy diagram can be found in Appendix B.



SPS	Pump rate (L/s)
BE1	10
BE2	5
BE3	5
BE4	5
BE5	20
BE6	5
BE7	5

Figure 3.7: Berrima Sewerage Scheme

STP Description

Berrima STP is a 2,000 EP capacity STP that utilizes a Pasveer channel for secondary treatment and chemical phosphorous removal to treat sewage. Effluent is discharged to Oldbury Creek. Details on process unit capacities are given in Table 3.4.

A process flow diagram for Berrima STP can be found in Appendix C.

Table 3.4: Berrima STP - Process Units and Capacities

Process Unit	Capacity
STP Design Capacity	
Design Population	2,000 EP
ADWF	0.48 ML/d (5.6 L/s) @ 240 L/EP/d
PDWF	2 x ADWF (11.1 L/s)
PWWF	7 x ADWF (38.9 L/s)
1 x P2000 Pasveer channel (including screening)	2,000 EP
Chemical dosing consisting of:	
Liquid alum for P removal	Alum storage tank
1 x catch pond	Capacity: 530 m^3 1 days detention at ADWF
1 x effluent detention pond	Capacity: 16,000 m^3 30 days retention at ADWF
2 x sludge lagoons	Effective volume: 570 m^3 each Fill time: 6 months each

Process Unit	Capacity
1 x Sludge Drying Bed	Approx total area: 1,000 m^2 Divided into six sections
Biosolids Management	Stabilisation grade B of biosolids is targeted for all WSC STPs. Council has a biosolids management plan. Currently biosolids from each plant are used at Moss Vale STP to remediate the site.
Effluent Management	Effluent is discharged to Oldbury Creek

License requirements and non-compliances

The EPA licence for this site (number 3575) specifies monitoring of:

1. Volume of effluent discharged to Oldbury Creek, this is limited to a maximum of 1,300 kL/day
2. Quality of effluent discharged
3. Quantity of influent. Flows less than or equal to 38 L/s must be fully treated by screening, activated sludge treatment (including biological Nitrogen removal), chemical dosing for phosphorus removal and tertiary ponding. Flows over 38 L/s may be treated through extended aeration and ponding.

Recent non-compliances are summarised in Table 3.5.

Table 3.5: Berrima Sewerage Non-compliances

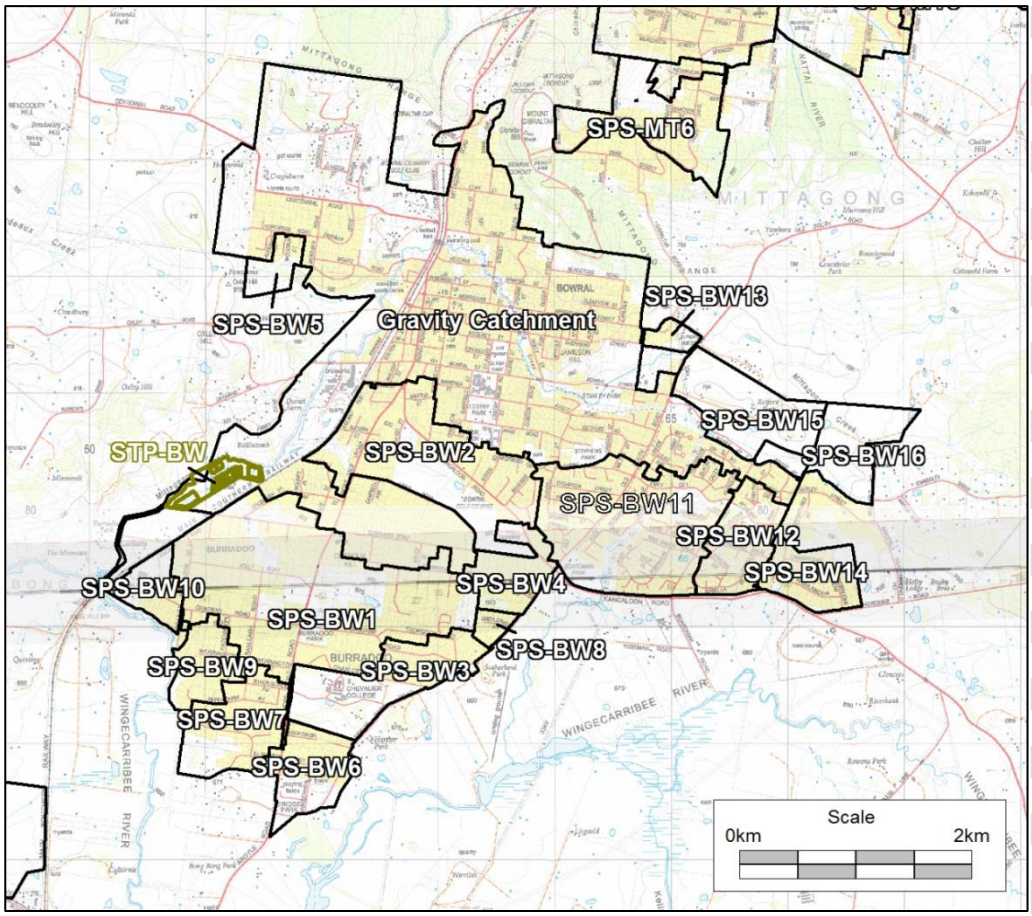
Year starting	Type of non-compliance
1 May 2014	The 100 percentile limit of pH was not met due to algal bloom. Algal bloom is occasional occurrence in the tertiary pond. However the council will investigate possible remedial measures in the 15/16 financial year
1 May 2013	Exceedance of the daily volume limit due to high rainfall resulting in higher inflows to the plant Failed to supply annual return Statement of Compliance details relevant to Pollution Incident Response Management Plan (PIRMP)
1 May 2012	Exceedance of daily volume due to high rainfall in the catchment (on 4 occasions)
1 May 2011	Daily volume limit exceeded during reporting period due to high rainfall. (on 14 occasions)
1 May 2010	pH limit exceeded due to algae growth. Daily volume limit exceeded.

3.5.3 Bowral Sewerage Scheme

Bowral STP is located approximately 2 km from the centre of Bowral. The plant receives sewage from development within the area of Bowral, East Bowral and Burradoo. The system is serviced by a conventional gravity sewerage system, and sewage flows are delivered to the STP through two trunk gravity mains from Bowral and a trunk rising main from Burradoo.

The plant inflows are directed to a lift pump station prior to the inlet works. Sewage overflows greater than lift pump station capacity, or in the event of power failure, are diverted from the lift pump station into the storm detention pond, which subsequently overflows directly to Mittagong Rivulet.

A pump hierarchy diagram can be found in Appendix B.



SPS	Pump rate (L/s)
BW1 Pump 1	50
BW1 Pump 2	50
BW2 Pump 1	10
BW2 Pump 2	10
BW3 Pump 1	10
BW3 Pump 2	10
BW4 Pump 1	5
BW4 Pump 2	5
BW5 Pump 1	5
BW5 Pump 2	5
BW6 Pump 1	10
BW6 Pump 2	10
BW7 Pump 1	5
BW7 Pump 2	5
BW8 Pump 1	< 5
BW8 Pump 2	< 5
BW9	5
BW10	5
BW11 Pump 1	50
BW11 Pump 2	50
BW12 Pump 1	30
BW12 Pump 2	30
BW13 Pump 1	< 5
BW13 Pump 2	< 5
BW14 Pump 1	5
BW14 Pump 2	5
BW15	< 5
Lift PS Pump 1	280
Lift PS Pump 2	280
Lift PS Pump 3	280

Figure 3.8: Bowral Sewerage Scheme

STP Description

Bowral STP is a 14,600 EP capacity STP that Bowral STP is a 14,600 EP capacity STP that utilizes one IDEA reactor and two Pasveer channels for secondary treatment and chemical phosphorus removal to treat sewage. The effluent is filtered and disinfected via a UV unit prior to discharge to Wingecarribee River. Some treated effluent from the STP is currently reused at the STP.

A process flow diagram for Bowral STP can be found in Appendix C.

Table 3.6: Bowral STP – Process Units and Capacities

Process Unit	Capacity
STP Design Capacity	
Design Population	14,600 EP
ADWF	3.46 ML/d (40 L/s) @ 240 L/EP/d
DDWF	3 x ADWF (120 L/s)
DWWF	7 x ADWF (280 L/s)
1 x sewage lift PS	280 L/s. Max of 340 L/s Inflow excess of 280 L/s diverted to storm detention pond

1 x inlet works with screening No grit removal	Step screen capacity: 380 L/s
1 x storm detention pond	Capacity: 17,000 m^3 5 days at ADWF
1 x IDEA reactor	10,600 EP
2 x P2000 Pasveer channel	2,000 EP each
Chemical dosing consisting of: Liquid alum for P removal Caustic dosing	 Alum storage tank: 22.5 kL (two months storage) Caustic storage tank: 22.5 kL (30 days storage)
1 x catch pond	Capacity: 1,357 m^3 9.4 hours storage at ADWF
2 x cloth media filters	Maximum capacity: 135 L/s
1 x UV disinfection unit	Design flow (full UV treatment): 55 L/s Maximum (partial treatment) flow: 135 L/s
2 x sludge lagoons	Effective volume: 5.5 ML each Fill time: 8 month each
4 x sludge drying beds	Management area: 2 large – approx. 1,450m^2 each, 2 small – approx. 600m2 each Average sludge depth: 200 mm
Onsite effluent reuse system, consisting of: 1 x recycled water storage tank 1 x effluent lift pump (tank top up) 2 x pressure pumps (duty/standby)	 35 kL Capacity: 7 L/s at 5 m head Capacity: 0.5 L/s at 15 m head
Biosolids Management	Stabilisation grade B of biosolids is targeted for all WSC STPs. Council has a biosolids management plan. Currently biosolids from each plant are used at Moss Vale STP to remediate the site.
Effluent Management	Effluent is discharged to Wingecarribee River Some treated effluent currently reused at the STP

License requirements and non-compliances

The EPA licence for this site (number 1749) specifies monitoring of:

1. Volume of effluent discharged to Wingecarribee River, wet weather discharge to Mittagong Creek and discharge to effluent utilisation area. This is limited to a combined maximum of 14,700 kL/day
2. Quality of effluent discharged and ambient water quality upstream and downstream of the effluent discharge point on the Wingecarribee River
3. Flow between tertiary filters and the UV disinfection unit

Table 3.7: Bowral sewerage non-compliances

Year starting	Type of non-compliance
1 May 2014	Exceed 50%ile limit for Total Nitrogen & 90%ile for Total Phosphorus due to heavy periods of prolonged rainfall.

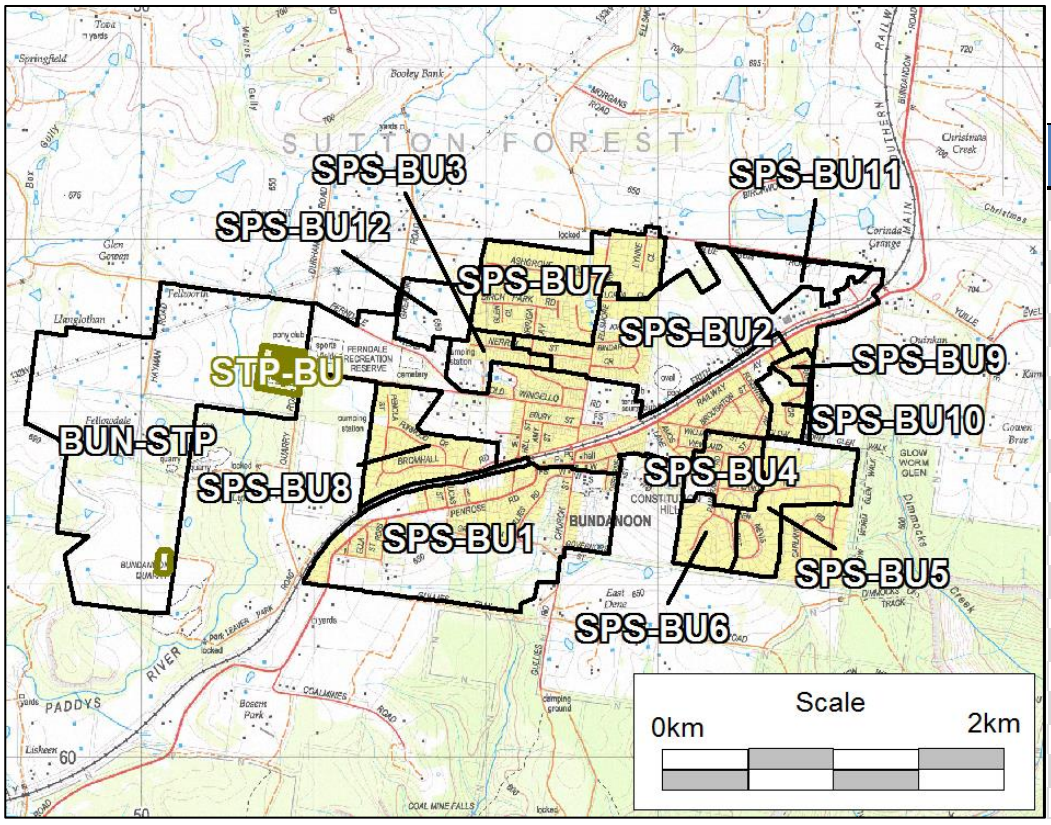
Year starting	Type of non-compliance
1 May 2013	Exceedance of the 50 percentile concentration limit for total nitrogen due to high loadings at the treatment plant Failed to supply annual return Statement of Compliance details relevant to Pollution Incident Response Management Plan (PIRMP)
1 May 2012	Exceedance of the 50 percentile concentration limit for Nitrogen due to potentially high concentration of loadings being received at the plant.
1 May 2011	50 percentile Nitrogen concentration limit exceeded, perhaps due to high loadings being received at the plant and 90 percentile Total Phosphorus concentration limit exceeded limit for various reasons (on 6 occasions) Exceedance of load limits for Total Suspended Solids (Enclosed Waters) due to high flows being received at the plant, system failure and solids build up. Various actions taken to prevent recurrence. Daily volume limit exceeded due to periods of high consistent rainfall (on 4 occasions)
1 May 2010	Exceeded 50 percentile concentration limit for Total Nitrogen Exceeded 90 percentile concentration limit for Total Phosphorus

3.5.4 Bundanoon Sewerage Scheme

Bundanoon sewerage scheme serves the community of Bundanoon. The system is serviced by a conventional gravity sewerage system, comprising eleven (11) pump stations. The main gravity trunk feeds directly to the STP, located 1.75 km from Bundanoon town centre.

All sewage gravitates into the reception chamber of the inlet works via the trunk main. Flow greater than the inlet works capacity overflows to the storm detention pond, which can then overflow to Reedy Creek during extreme flow events.

A pump hierarchy diagram can be found in Appendix B.



SPS	Pump rate (L/s)
BU1	27
BU2	31
BU3 Pump 1	7
BU3 Pump 2	7
BU4	15
BU5 Pump 1	13
BU5 Pump 2	13
BU6 Pump 1	13
BU6 Pump 2	2
BU7 Pump 1	4
BU7 Pump 2	1
BU8	2
BU9 Pump 1	2
BU9 Pump 2	1
BU10 Pump 1	6
BU10 Pump 2	2
BU11 Pump 1	16
BU11 Pump 2	2
BU12 Pump 1	7
BU12 Pump 2	1

Figure 3.9: Bundanoon Sewerage Scheme

STP Description

Bundanoon STP has a design capacity of 5,400 EP and is comprised of an IDEA reactor and Pasveer channel for secondary treatment, cloth media filters, UV disinfection, and chemical phosphorous removal. All sewage gravitates into the reception chamber of the inlet works via the trunk main. Treated effluent is discharged to Reedy Creek, and some is recycled for use in irrigating a sports fields and agricultural land.

A process flow diagram for Bundanoon STP can be found in Appendix C.

Table 3.8: Bundanoon STP – Process Units and Capacities

Unit	Capacity
STP Design Capacity	
Design Population	5,400 EP
ADWF	1.14 ML/d (13.2 L/s) @ 210 L/EP/d
DDWF	3 x ADWF (39.4 L/s)
DWWF	7 x ADWF (92.4 L/s)
PWWF	8.5 x ADWF (112.2 L/s)
1 x inlet works with screening and grit removal	Max inflow = 128.4 L/s Inflow from sewage main in excess of 112 L/s diverted to detention pond
1 x storm detention pond	Capacity: 7,200 m^3 6.3 days storage at ADWF
1 x IDEA reactor	3,400 EP
1 x P2000 Pasveer channel	2,000 EP
Chemical dosing, consisting of:	
Liquid alum for P removal	Alum storage tank: 30 kL
Liquid lime for pH correction	Lime slurry tank: 200 L
1 x catch/balance pond	Balance volume: 368 m^3 Catch volume: 470 m^3
2 x cloth media filters	Maximum capacity: 60 L/s
1 x UV disinfection unit	Design flow (full UV treatment): 60 L/s Maximum (partial treatment) flow: 302 L/s
2 x sludge lagoons	Effective volume: 2,150 m^3 each Fill time: 6 months each
4 x sludge drying beds	Management area: 1,590 m^2 each Maximum depth of storage: 350 mm
Onsite effluent reuse system, consisting of:	
1 x reclaimed water storage tank	117 kL
1 x effluent low lift PS	Capacity: 45 L/s
1 x VSD pressure pump for on-site reuse	Capacity: 0.5 to 3.0 L/s at 55 m head
1 x turbine pump for off-site agricultural reuse	Capacity: 45 L/s
Biosolids Management	Stabilisation grade B of biosolids is targeted for all WSC STPs. Currently biosolids from each plant are used at Moss Vale STP to remediate the site.

Unit	Capacity
Effluent Management	Treated effluent is discharged to Reedy Creek, Some effluent is recycled for use in irrigating a sports fields at Ferndale reserve and agricultural land.

License requirements and non-compliances

The EPA licence for this site (number 2436) specifies monitoring of:

1. Volume of effluent discharged to Reedy Creek and discharge to the two effluent utilisation areas at the sports field and agricultural area. This is limited to a combined maximum of 9,500 kL/day, including a maximum of 220 kL/day and 3,900 kL/day at the sports field and agricultural area respectively.
2. Quality of effluent discharged and ambient water quality upstream and downstream of the effluent discharge point on Reedy Creek.
3. Flow at the inlet channel of the STP

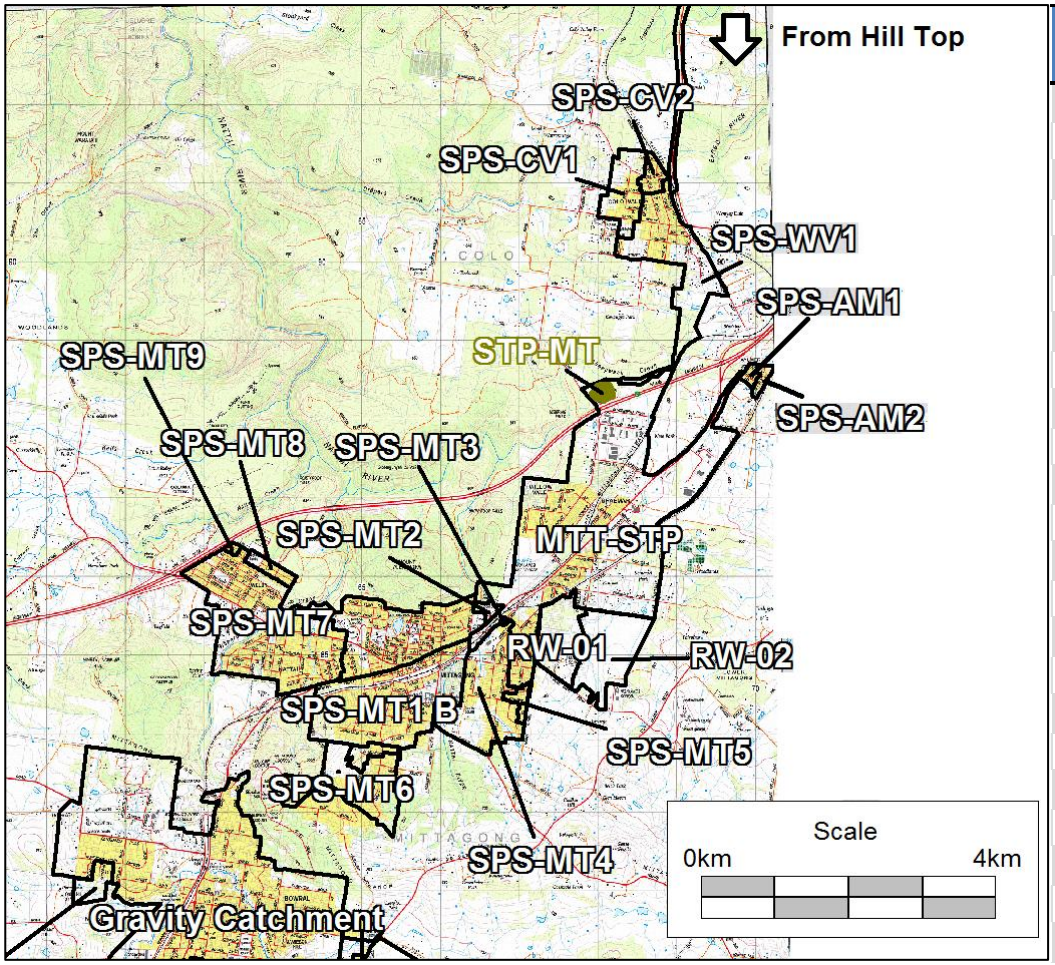
Table 3.9: Bundanoon sewerage non-compliances

Year starting	Type of non-compliance
1 May 2014	None
1 May 2013	Failure to supply annual return Statement of Compliance details relevant to Pollution Incident Response Management Plan (PIRMP)
1 May 2012	None
1 May 2011	None
1 May 2010	Exceedance of pH limit

3.5.5 Mittagong Sewerage Scheme

Mittagong STP receives sewage from development within the areas of Mittagong, Willow Vale, Braemar, Hilltop, Colo Vale and Aylmerton. The system is serviced by a conventional gravity sewerage system, comprising nineteen (19) pump stations. Sewage is delivered to the STP inlet works via a single pump station (Willow Vale 1 SPS).

A pump hierarchy diagram can be found in Appendix B.



SPS	Pump rate (L/s)
AM1	10
AM2	10
AM3	10
CV1	10
CV2	10
HT1	35
HT2	10
HT3	10
HT4	10
HT5	10
HT6	10
HT7	10
HT8	30
MT1	200
MT2	10
MT3	10
MT4	10
MT5	10
MT6	10
MT7	30
MT8	10
MT9	10
WV1	320

Figure 3.10: Mittagong Sewerage Scheme

STP Description

The Mittagong STP currently has a design capacity of 14,000 EP and utilizes two IDAL reactors for secondary treatment, chemical phosphorus removal and UV disinfection to treat sewage.

There is no storm diversion before the main reactors (diversion occurs post IDALs) and the process has been designed to hydraulically cater for a peak flow of 7 x ADWF. Treated effluent is discharged into Mittagong Creek, with some effluent reused at the Highlands Golf Course. In high flow events the storm detention pond will overflow to Sheepwash Creek.

A process flow diagram for Mittagong STP can be found in Appendix C.

Table 3.10: Mittagong STP – Process Units and Capacities

Unit	Capacity
STP Design Capacity	
Design Population	14,000 EP
ADWF	3.18 ML/d (36.8 L/s) @ 230 L/EP/d
DDWF	3.5 x ADWF (129 L/s)
DWWF	7.3 x ADWF (269 L/s)
1 x sewage lift PS (Willow Vale 1)	355 L/s for 2-3 minutes. Approximately 64 starts per day
1 x inlet works with screening (No grit removal)	Max inflow = 355 L/s

Unit	Capacity
2 x IDAL reactors with selector	14,000 EP Flow above 5.7 ADWF receive insufficient aeration Flows above 7 ADWF are diverted to wet weather storage HRT in selector at PDWF: approx 1 hr
Chemical dosing, consisting of: Liquid alum for P removal	 3 x Alum storage tanks: 54 kL total
1 x storm detention pond	Capacity: 22,000 m^3 77 hours storage at design flow (7 x ADWF)
1 x balance tank	Capacity: 465 kL 3.5 hours at ADWF
1 x secondary clarification pond	Capacity: 3.5 ML 255 days sludge storage
2 x UV disinfection units	Design flow (full UV treatment): Maximum (partial treatment) flow: 190 L/s
4 x sludge lagoons	Effective volume: 2,638 m^3 each Fill time: 3 months each
6 x Disused sludge drying beds (currently Geotubes® replacing drying beds)	Management area: 533 m^2 each
Biosolids Management	Stabilisation grade B of biosolids is targeted for all WSC STPs.
Effluent Management	Treated effluent is discharged into Mittagong Creek Some effluent is reused at the Highlands Golf Course.

License requirements and non-compliances

The EPA licence for this site (number 10362) specifies monitoring of:

1. wet weather overflow volumes and quality of effluent released into Sheepwash Creek
2. volume and quality of effluent discharged into Iron Mines Creek (measured at the treated effluent pumping station). This is limited to 23,000 kL/day.

Recent non-compliances are summarised in Table 3.11.

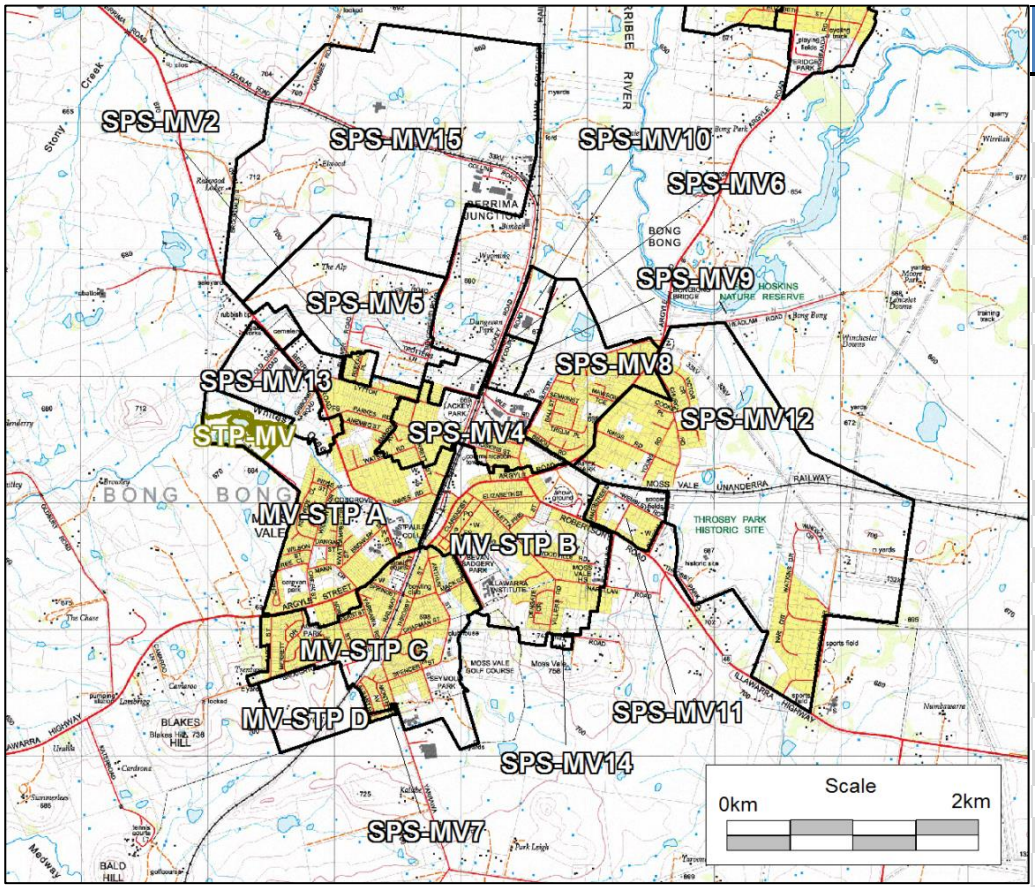
Table 3.11: Mittagong sewerage non-compliances

Year starting	Type of non-compliance
1 May 2014	Exceeded 50 percentile concentration limit for Nitrogen (total) due to potentially high concentration loadings being received at the plant.
1 May 2013	Failure to supply annual return Statement of Compliance details relevant to Pollution Incident Response Management Plan (PIRMP)
1 May 2012	None
1 May 2011	None
1 May 2010	Exceedance of pH limit
1 May 2009	Daily volume limit exceeded at EPA Point 1 due to high rainfall in catchment 6-8/2/10 and 15/2/10. Plant upgrade commissioned giving significant increase in process capacity and utilisation of STP lagoon storage (on 2 occasions) Failure to sample at required frequency EPA Pt 2 - due to use of treated effluent stored in tertiary dam for plant augmentation project only 11 samples obtained. Non-compliance with 90% concentration limit for ammonia.

3.5.6 Moss Vale Sewerage Scheme

Moss Vale STP plant receives sewage from development within the area of Moss Vale. The system is serviced by a conventional gravity sewerage system, comprising twelve (12) pump stations. The main gravity trunk feeds directly to the STP, located approximately 2 km from the centre of Moss Vale.

A pump hierarchy diagram can be found in Appendix B.



SPS	Pump rate (L/s)
MV2 Pump 1	3
MV2 Pump 2	3
MV4 Pump 1	14
MV4 Pump 2	52
MV5 Pump 1	30
MV5 Pump 2	30
MV6 Pump 1	4
MV6 Pump 2	4
MV7 Pump 1	8
MV7 Pump 2	7
MV8 Pump 1	20
MV8 Pump 2	17
MV9 Pump 1	3
MV9 Pump 2	3
MV10 Pump 1	4
MV10 Pump 2	7
MV11 Pump 1	13
MV11 Pump 2	13
MV12 Pump 1	17
MV12 Pump 2	17
MV13 Pump 1	3
MV13 Pump 2	3
MV14	2
MV15	2

Figure 3.11: Moss Vale Sewerage Scheme

STP Description

Bowral STP has a design capacity of 9,000 EP and utilizes two IDEA reactors for secondary treatment, chemical phosphorus removal and UV disinfection to treat sewage. Treated effluent is discharged to Whites Creek.

During storms, sewage is diverted from the inlet works to the wet weather storage ponds (2 in series), which is then returned to the plant when inflow subsides. There is an emergency overflow from the second storage pond directly to the Whites creek.

A process flow diagram for Moss Vale STP can be found in Appendix C.

Table 3.12: Moss Vale STP – Process Units and Capacities

Unit	Capacity
STP Design Capacity	
Design Population	9,000 EP
ADWF	2.2 ML/d (25 L/s) @ 240 L/EP/d
DDWF	2 x ADWF (50 L/s)
DWWF	13.2 x ADWF (332 L/s)

Unit	Capacity
1 x inlet works with screening and grit removal	Max inflow = 333 L/s Inflow excess of 175 L/s diverted to storm detention pond post screening
2 x storm detention pond	Capacity: 2,400 m^3 and 17,300 m^3 9 days storage at ADWF
2 x IDEA reactors	9,000 EP
Chemical dosing, consisting of: Liquid alum for P removal	 2 x Alum storage tanks: 25 kL each
1 x catch pond	Capacity: 2,100 m^3 1 day storage at ADWF
1 x UV disinfection unit	Design flow (full UV treatment): 25.5 L/s Maximum (partial treatment) flow: 88 L/s
2 x sludge lagoons	Effective volume: 1,530 m^3 each Fill time: 8 months each
4 x sludge drying beds	Management area: 550 m^2 each Maximum depth of storage: 300 mm
Biosolids Management	Stabilisation grade B of biosolids is targeted for all WSC STPs.
Effluent Management	Treated effluent is discharged to Whites Creek.

License requirements and non-compliances

The EPA licence for this site (number 1731) specifies monitoring of:

1. Volume of effluent discharged to Whites Creek and wet weather discharge from the storm balance pond. This is limited to a combined maximum of 8,400 kL/day
2. Quality of effluent discharged and ambient water quality upstream and downstream of the effluent discharge point on Whites Creek
3. Total volume at the weir structure adjacent to the inlet works

Recent non-compliances are summarised in Table 3.13.

Table 3.13: Moss Vale sewerage non-compliance

Year starting	Type of non-compliance
1 May 2014	The load limit of total Nitrogen exceeded due to high rainfall experienced in the catchment throughout the year. Currently Moss Vale STP is operating around the capacity of its design dry weather flow and augmentation is planned in the near future. Ammonia Nitrogen exceeded to 2.1 due to high rainfall experienced in the catchment throughout the year. Currently Moss Vale STP is operating around the capacity of its design dry weather flow and augmentation is planned in the near future. Volume/mass limit exceeded due to high rainfall experienced in the catchment throughout the year. Currently Moss Vale STP is operating around the capacity of its design dry weather flow and augmentation is planned in the near future.
1 May 2013	Exceedance of the daily volume limit due to high rainfall and groundwater levels (on 2 occasions) Failed to suppy details required in annual return Statement of Compliance for Pollution Incident Response Management Plan (PIRMP)
1 May 2012	Exceedance of the daily volume limit due to periods of high rainfall that increased the water table & reduced capacity within the reticulation system. Exceedance of load limit for Nitrogen (total) due to extra flows because of urban development, storm water inflow & rain infiltration.

Year starting	Type of non-compliance
1 May 2011	Daily volume limits exceeded due to high consistant rainfall (on 19 occasions) Exceeded 100 percentile concentration limit of 15 for Nitrogen (total) Exceedance of load concentration limits for Total Nitrogen due to extra flows due to development, storm water & infiltration.
1 May 2010	Daily volume limit exceeded (on 4 occasions)
1 May 2009	Exceedance of limits of Nitrogen, due to extra flows at STP due to development, storm water inflow & infiltration. Undergoing assessment on dry & wet weather flow analysis, to ascertain effects of wet weather periods. Non-compliance for 100% limit for Nitrogen (total) (on 3 occasions) Non-compliance of condition for continuous measurement of volume (on 2 occasions)

3.5.7 Robertson Sewerage Scheme

Robertson lies in the immediate catchment of Wingecarribee Reservoir. Due to the importance of the Wingecarribee Reservoir as a water source for the Wingecarribee Shire and the downstream Warragamba Dam, WSC found it necessary to sewer Robertson in 2012 to reduce the risk of contamination from on-site sewage management systems.

The raw sewage generated by the town gravitates to a single sewage pumps station (SPS 1) and pumped to Robertson STP. The high quality treated effluent is transferred via a 15 kilometre effluent transfer main to a purpose built 47 million litre storage dam in Glenquarry where it is then used for pasture irrigation on 42 hectares of agricultural land.

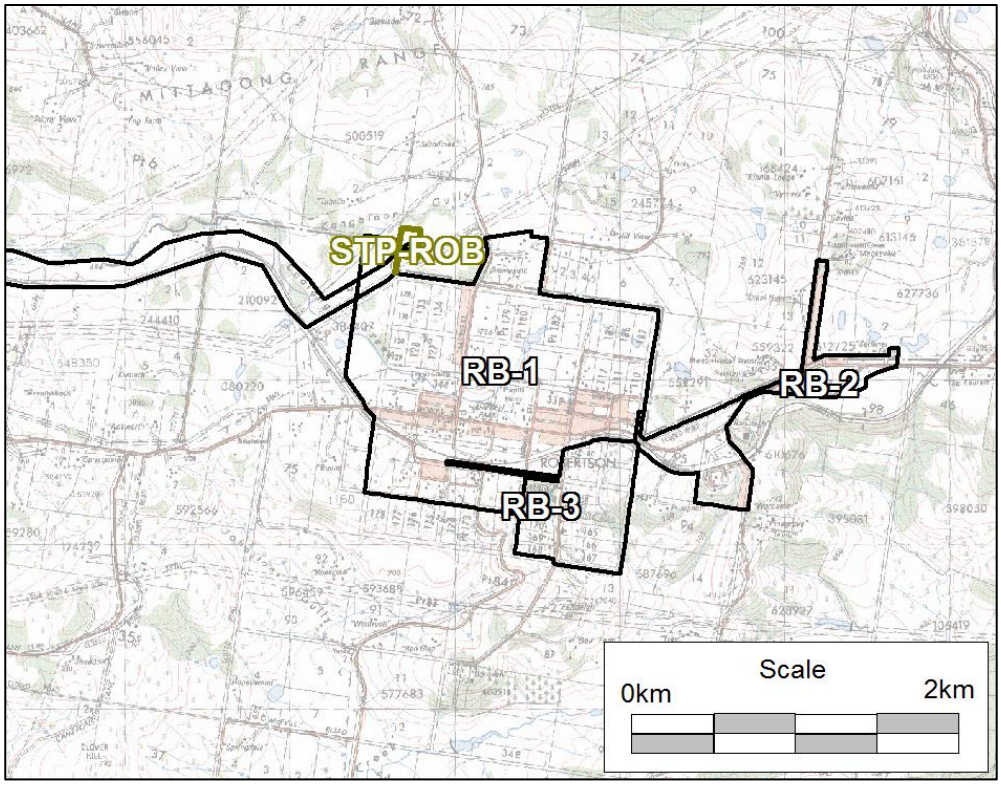


Figure 3.12: Robertson Sewerage Scheme

STP Description

The Robertson STP utilizes Siemens BioNutre activated sludge process for secondary treatment followed by filtration in a membrane operating system. Treated water then undergoes UV disinfection before being transferred to the agricultural reuse scheme.

A process flow diagram for Bundanoon STP can be found in Appendix C.

Table 3.14: Robertson sewerage key components

Unit	Capacity
STP Design Capacity	
Design Population	2,000 EP
ADWF	0.42 ML/d (4.86 L/s)
DDWF	3.5 x ADWF (17.0 L/s)
1 x inlet works with screening and grit removal	Max inflow = 17 L/s
1 x Bioreactor (BioNutre), consisting of a three-stage aeration process followed by a post anoxic reactor	2000 EP Capacity: 17 L/s
2 x Membrane Operating System (MOS)	2000 EP 2 tanks per unit. Tank volume: 19.5 kL
Chemical dosing, consisting of:	
Liquid alum for P removal	20 kL
Liquid caustic for alkalinity and pH control	20 kL
Membrane cleaning chemicals (sulphuric acid, citric acid, sodium hypochlorite, sodium metabisulphite)	1.5 kL per chemical
Sodium acetate for carbon supplement	1,300 L
1 x UV disinfection unit	Design flow (full UV treatment): 17 L/s
1 x sludge tank	30 kL
1 x centrifuge for sludge dewatering	5 m3 /h
1 x filtrate tank	60 kL
2 x Reclaimed water pump (duty-standby)	3 L/s at 3 m head
Reclaimed water storage dam (off-site)	47 ML
Biosolids Management	Stabilisation grade B of biosolids is targeted for all WSC STPs.
Effluent Management	All effluent is transferred to 47 ML storage dam in Glenquarry for use in agricultural irrigation

License requirements and non-compliances

The EPA licence for this system (number 20205) specifies monitoring of the volume and quality of wet weather releases to the Wingecarribee River. Given the proximity of the system to Wingecarribee Reservoir, the system has been designed to operate without overflow with full treatment for all flows and it is expected that all of the flows will be reused in most years. There are no annual volume limits for wet weather discharges and no load based licensing fees are levied for this system. The system has operated for two complete reporting years and in this time, no non-compliances have been recorded.

3.6 Urban stormwater

Wingecarribee Shire Council developed a “Stormwater Management Plan – 2010 to 2031” in order to manage stormwater quality, stormwater quantity, stormwater related assets, and stormwater aspects of new developments.

Council is in the process of updating their stormwater asset management system to shift to a more pro-active approach to stormwater asset management. In order to plan and budget for future

requirements of the stormwater system, Council has implemented a Developer Servicing Plan (DSP) to collect funds for the provision and replacement of stormwater infrastructure from new developments.

Stormwater Harvesting

Council undertakes stormwater harvesting from the East Bowral wetlands for use on the East Bowral playing fields as well as using water from Lake Alexandra for irrigation of the surrounding landscaping.

3.7 Asset replacement costs

The current replacement costs for water and sewerage assets are given in Table 3.15 and Table 3.16 respectively. These tables are taken from Wingecarribee Shire Council's Strategic Asset Management Plan 2016. Values as of 30 June 2015.

Service Lines ($44M) are the sewer property connections that council own and maintain. These are the lines that run from the sewer main to the property boundary trap. Water services ($33.7M) are the water connections that council own and maintain. These are the lines that run from the water main to the individual property water meter.

Table 3.15: Current replacement cost for water assets

Asset Category	Replacement Cost $000	Residual Value $000	Depreciable Amount $000	Depreciated Replacement Cost $000	Annual Depreciation Expense $000
Treatment Plants (incl. Mitta Depot)	40,455	5,948	34,506	23,830	540
Reservoirs (incl. Telemetry)	37,736	3,340	34,396	19,571	360
Pump Stations	12,640	511	12,129	4,586	185
Dams	20,550	7,536	13,014	11,217	168
Mains	85,289	8,519	76,770	54,791	845
Hydrants	22,929	0	22,929	11,908	355
Valves	17,423	0	17,423	9,230	271
Meters	5,065	0	5,065	3,284	185
Water Services	33,773	0	33,773	22,650	546
Bulk Meters	654	16	638	512	20
Urban Filling Station	233	0	233	187	7
Total	**276,745**	**25,871**	**250,874**	**161,766**	**3,483**

Table 3.16: Current replacement cost for sewerage assets

Asset Category	Replacement Cost $000	Residual Value $000	Depreciable Amount $000	Depreciated Replacement Cost $000	Annual Depreciation Expense $000
Pump Stations	28,259	2,961	25,298	20,030	637
Gravity Mains	60,281	12,048	48,233	48,016	487
Rising Mains	9,887	1,977	7,910	8,767	89
Valves	1,226	0	1,226	972	28
Vents	906	0	906	398	7
Access Chambers	44,217	8,375	35,841	31,620	450
Service lines	44,044	4,404	39,640	27,210	583
Treatment Works (incl. Telemetry)	70,831	19,410	51,421	57,958	1,181
Total	**259,650**	**49,175**	**210,475**	**194,971**	**3,463**

3.8 Current price signals

Based on Wingecarribee Shire Council's water and sewerage charges 2015/16, the recent pricing details are summarised in the tables below:

Table 3.17: Wingecarribee Shire Council water and sewerage fees and charges

Wingecarribee Shire Council fees and charges	Residential	Non-residential
Water Access Charge	$0.43 per day	$0.43 per day (20 mm) up to $24.23 per day (150 mm)
Water Consumption Charge	$1.78 per kL up to 616 kL $2.67 per kL for over 616 kL	$1.78 per kL
Sewerage Access Charge	$2.07 per day	$1.70 per day (20 mm) up to $95.85 per day (150 mm)
Sewerage Usage Charge		$1.33 per kL water consumed
Typical Residential Bill	Water - $502 (2014/15) Sewerage - $739 (2014/15)	
Typical Developer Charge	Water - $6,480 (2014/15) Sewerage - $8,250 (2014/15)	

3.9 Liquid Trade Waste Policy

Wingecarribee Shire Council's current Liquid Trade Waste Policy was adopted on 22 June 2011 with a review scheduled for 2016. Details of fees and charges are given in Table 3.18.

Table 3.18: Wingecarribee Shire Liquid Trade Waste Fees and Charges

Type of Fee	Fee/Charge (2015/16)
Application fee	
Category 1	$47.85
Category 2 & 2S	$155.65
Category 3	$342.65
Annual trade waste fee	
Category 1 (includes exempt low risk business)	$56.10
Category 2 & 2S	$174.35
Category 3	$591.80
Pre-treatment device inspection fee per approved device	$100.00
Trade waste usage charge	
Trade Waste Usage (with appropriate pre-treatment)	$1.82 per kL
Trade Waste Usage (without appropriate pre-treatment)	$16.06 per kL
Trade Waste Reinspection Fee	
Category 1 (includes exempt low risk business	$56.10
Category 2 & 2S	$83.93
Category 3	$165.33

Type of Fee	Fee/Charge (2015/16)
On-site Receival area waste fee	
Septic Effluent	$2.37 per kL
Septage	$25.63 per kL
Portable Toilet	$17.49 per kL

This policy divides liquid trade waste discharges into Concurrence Classification A, B, C and S based on DPI Water's Trade Waste Regulation Guidelines. The procedure for approval is governed by Chapter 7 of the Local Government Act and is subject to the Local Government Regulation 2005.

Septic waste receivers

Currently septic waste is received only at Berrima STP. About 10 kL of septic waste is received at the Berrima STP per day by private contractors. All contractors that discharge septic waste at the STP have current approvals.

4 Population and development

4.1 Shire population

In order to understand the historical population trends in the Shire and develop a growth strategy for the future, the following information was analysed:

- Census data from the Australian Bureau of Statistics (ABS)
- Department of Planning's population strategy for the region
- Demographic and housing study undertaken by SGS Economics and Planning

ABS Census Data

The ABS undertakes the Census of Population and Housing every 5 years and calculates the Estimated Resident Population (ERP) as of 30 June each year (released in March of the subsequent year). The ERP is corrected for a number of factors that can cause the Census results to be inaccurate and is revised about two years after a census is undertaken to account for the results of the Census. The recent ERP and Basic Community Profile (BCP) census populations for the Shire are summarised in Table 4.1.

Table 4.1: Historical population growth

Population	Year	1996	2001	2006	2011	2014
ERP	Population	37,988	42,384	43,532	46,126	47,584
	Equivalent annual growth rate over previous period		2.21%	0.54%	1.16%	1.04%
BCP	Population	36,777	40,840	41,868	43,947	
	Equivalent annual growth rate over previous period		2.12%	0.50%	0.97%	

Department of Planning Population Strategy

Wingecarribee Shire Council and the NSW Department of Planning regularly commission population and growth strategies to ensure that sufficient land is released and that provisions can be made to build new infrastructure to service the community.

The "New South Wales State and Local Government Area Population, Household and Dwelling Projections: 2014 Final" for the period 2011 to 2031 provides the following information for WSC:

- population growth starting at 0.68% and decreasing to 0.34%
- essentially static proportion of dwellings occupied
- an increasing percentage of the population living in non-private dwellings (this is likely to be due to the aging of the population)
- decreasing household size from 2.46 to 2.27

Wingecarribee Demographic and Housing Study

Council engaged SGS Economics and Planning (SGS) to prepare a demographic and housing study, to help Council make informed decisions about accommodating demand for housing over the next 20 years. This study was completed in May 2012. This study showed population growth starting at 0.86% per year, increasing to 0.94% per year and then decreasing to 0.83% per year

The historical population data and the projections from the above three sources are graphed in Figure 4.1 (the data is included in Appendix D, section D.1). The data was extrapolated using the growth rates to cover a thirty year projections for the IWCM study.

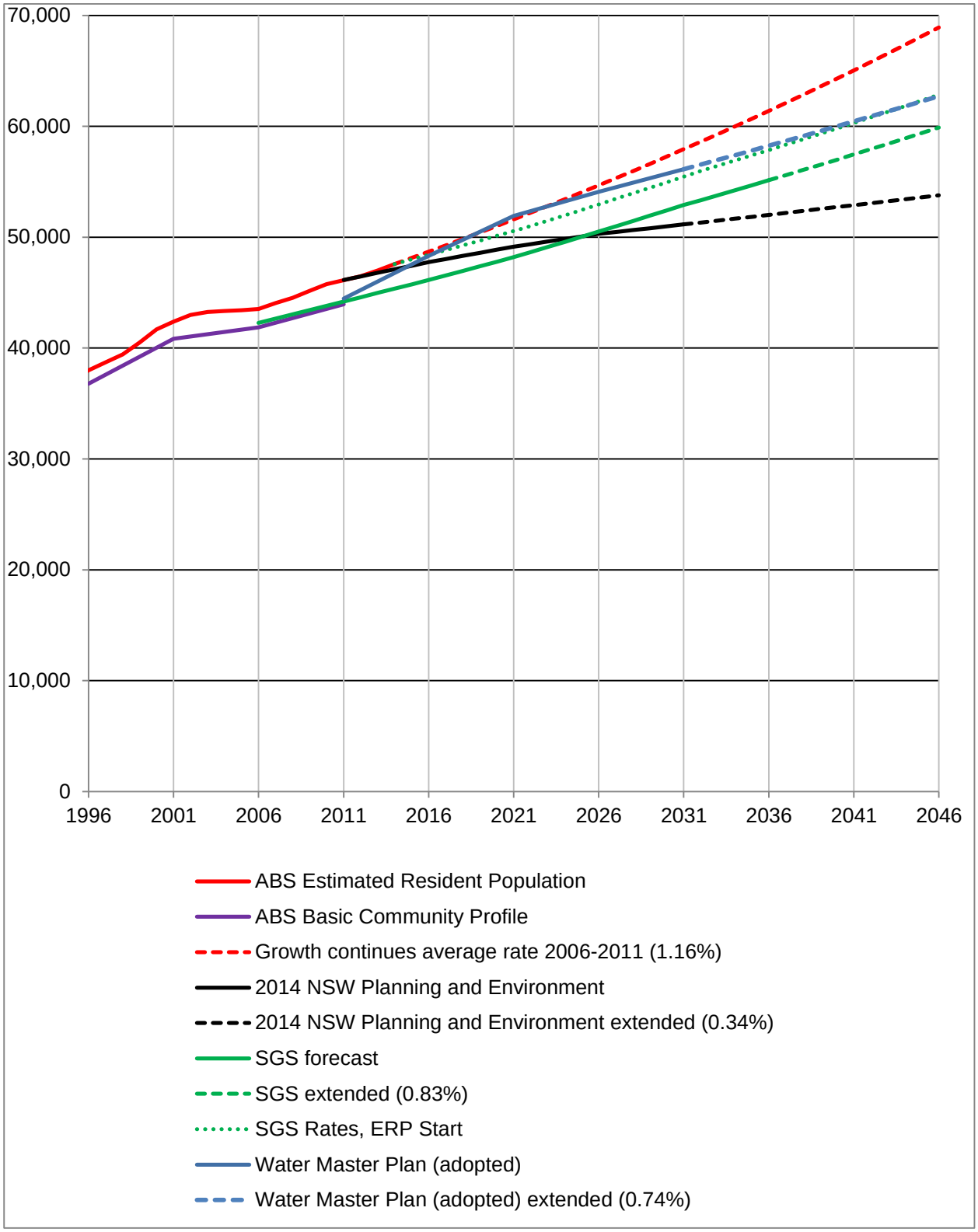


Figure 4.1: Shire wide population growth scenario comparison

This information was discussed with Council's Strategic Planners and Council has adopted the Water Master Plan growth strategies and statistics as the basis for the Shire wide growth projection, with growth after the end of the projection to continue at the 2026 to 2031 projected rate. Under this projection, the percentage of the population served by the reticulated water supply schemes remains at about 91% and sewerage schemes goes from 77% to 79%.

4.2 Service area growth

Council provided a number of datasets with information on service area growth:

- Water Supply System Master Plan (WSSMP) with population spatial distribution of the residential and non-residential growth areas that are expected to be developed up until 2031.
- Growth areas GIS Layer, this layer includes land releases and subdivisions from about 1990 onwards, the vast majority of which have been substantially developed or completely developed, therefore it is assumed that all potential development listed in this layer has been checked and accounted for in the WSSMP.

The SGS spatial distribution was adopted for the population and service area growth up to 2031, with the additional capacity of 171 lots at Retford Park in Bowral. An additional potential of about 1,500 lots was also included, on Council's request, at the Chelsea Gardens/Coomungie Urban Release area in Moss Vale, even though Council has not taken a final decision on this development.

Since Council has no further information on the service area growth beyond 2031, the following assumptions were used for the projection from 2032 to 2046:

- population growth continues at the 2026 to 2031 shire wide growth rate of 0.74% per year,
- non-private dwelling population remains stable at the 2031 percentage
- household size remains stable at the 2031 rate
- percentage of dwellings occupied remains stable at the 2031 rate
- spatial distribution of growth for water supply and sewerage schemes remains at the 2031 distribution proportion.

The serviced population and dwellings for each water supply and sewerage scheme are provided in Table 4.2, Table 4.3, Table 4.4 and Table 4.5.

The SGS spatial distribution was used for population and dwelling growth at the reservoir and sewer catchment level and hence these projections are only available up to 2031. The growth for each reservoir zone is included in Appendix D, section D.2 and the growth for each sewage catchment is included in Appendix D D.3.

There are two major events that attract tourists to the Shire. Tulip Time in Corbett Gardens runs from 13th September to 25th September and the Brigadoon in Bundanoon which takes place in August. Council advice is that the peak tourist season is during the Tulip festival when the population increases by about 20 percent.

Table 4.2: Serviced permanent population projection – water supply zones

Water Scheme	2011 Census	2011 Census + WSSMP Growth					Forecast extension		
		2011	2016	2021	2026	2031	2036	2041	2046
Wingecarribee	28,197	28,197	30,955	32,640	33,697	34,719	36,027	37,383	38,791
Wingecarribee South	8,475	8,475	9,045	10,309	11,214	12,092	12,547	13,020	13,510
Bundanoon	3,685	3,685	3,900	4,115	4,224	4,251	4,411	4,577	4,750
Total Serviced	**40,357**	**40,357**	**43,900**	**47,064**	**49,135**	**51,062**	**52,985**	**54,980**	**57,050**
Unserviced	4,103	4,103	4,410	4,857	4,962	5,072	5,263	5,461	5,667
Total	**44,460**	**44,460**	**48,310**	**51,920**	**54,097**	**56,134**	**58,248**	**60,441**	**62,717**

Table 4.3: Serviced residential dwelling projection – water supply zones

	2011 Census	2011 Census + WSSMP Growth					Forecast extension		
		2011	2016	2021	2026	2031	2036	2041	2046
Wingecarribee	12,637	12,637	14,331	15,405	16,056	16,655	17,175	17,796	18,529
Wingecarribee South	3,695	3,695	4,045	4,851	5,409	5,923	6,108	6,328	6,589
Bundanoon	1,904	1,904	2,036	2,173	2,240	2,256	2,327	2,411	2,510
Total serviced	**18,236**	**18,236**	**20,412**	**22,429**	**23,706**	**24,834**	**25,609**	**26,535**	**27,628**
Unserviced	2,170	2,170	2,358	2,644	2,708	2,773	2,859	2,962	3,084
Total	**20,406**	**20,406**	**22,770**	**25,073**	**26,414**	**27,606**	**28,468**	**29,497**	**30,712**

Table 4.4: Serviced permanent population projection – sewerage schemes

Sewer Scheme	2011 Census	2011 Census + WSSMP Growth					Forecast extension		
		2011	2016	2021	2026	2031	2036	2041	2046
Berrima	861	861	861	914	1,046	1,046	1,085	1,126	1,168
Bowral	11,583	11,583	12,370	13,315	13,893	14,352	14,893	15,454	16,036
Bundanoon	2,451	2,451	2,480	2,512	2,542	2,569	2,665	2,766	2,870
Mittagong	11,086	11,086	13,045	13,772	14,220	14,857	15,417	15,997	16,599
Moss Vale	6,609	6,609	7,170	8,347	9,121	9,886	10,258	10,645	11,045
Robertson	1,519	1,519	1,531	1,544	1,555	1,565	1,624	1,685	1,749
Total serviced	**34,109**	**34,109**	**37,457**	**40,404**	**42,376**	**44,275**	**45,942**	**47,672**	**49,467**
Unserviced	10,351	10,351	10,853	11,517	11,721	11,859	12,305	12,769	13,250
Total	**44,460**	**44,460**	**48,310**	**51,920**	**54,097**	**56,134**	**58,248**	**60,441**	**62,717**

Table 4.5: Serviced residential dwelling projection – sewerage schemes

	2011 Census	2011 Census + WSSMP Growth					Forecast extension		
		2011	2016	2021	2026	2031	2036	2041	2046
Berrima	362	362	362	396	477	477	492	510	531
Bowral	5,484	5,484	5,967	6,570	6,926	7,195	7,420	7,688	8,005
Bundanoon	1,252	1,252	1,270	1,290	1,308	1,324	1,366	1,415	1,473
Mittagong	4,660	4,660	5,863	6,327	6,603	6,975	7,193	7,453	7,760
Moss Vale	2,976	2,976	3,320	4,071	4,548	4,996	5,152	5,338	5,558
Robertson	680	680	688	695	702	708	731	757	788
Total serviced	**15,414**	**15,414**	**17,470**	**19,349**	**20,565**	**21,676**	**22,353**	**23,161**	**24,115**
Unserviced	4,992	4,992	5,300	5,723	5,849	5,930	6,115	6,336	6,597
Total	**20,406**	**20,406**	**22,770**	**25,073**	**26,414**	**27,606**	**28,468**	**29,497**	**30,712**

4.3 Equivalent Population

The equivalent population (EP) for residential properties was calculated using the population for each residential property provided in the Infoworks sewer model for each sewerage scheme. Note for Berrima the population was not given, so each residential property was multiplied by the household size and occupancy ratio for Berrima to obtain a population estimate. It is understood that these models were prepared in 2015 and therefore it is expected that the population and flow data would be from the 2013/14 period. The results are given in Table 4.6.

Table 4.6: 2014 Residential EP

	Berrima	Bowral	Bundanoon	Mittagong	Moss Vale
Household Size (ABS 2011 Census)	2.4	2.3	2.2	2.3	2.4
2014 Res EP - Infoworks	826	12,165	2,515	10,944	7,486

The methodology used to estimate the non-residential EP is provided below:

- The Average Dry Weather Flow (ADWF) for 2014 was estimated for each sewerage scheme (refer to Section 6.2 Table 6.1). The ADWF comprises of a residential and a non-residential flow component.
- For each scheme, the non-residential flow component was obtained from the sum of the 'trade flow' in the Infoworks model. The residential flow component was then calculated as the difference between the estimated ADWF and the non-residential flow component
- The calculated residential flow component was divided by the 2014 residential EP for the scheme (refer to Table 4.6) to obtain the average dry weather flow per residential EP.
- The non-residential flow component was divided by the flow per residential EP to obtain the total non-residential EP for the scheme.

This methodology also enabled the EP values to be assigned to each sewer catchment in the Infoworks model. The total ET for each scheme was calculated by dividing the total EP by the household size.

The calculation of non-residential EP for all the schemes based on the above methodology is provided in Table 4.7.

Table 4.7: Calculated non-residential EP for the sewerage schemes

	Berrima	Bowral	Bundanoon	Mittagong	Moss Vale
Estimated 2014 ADWF (kL/day)	220	3,200	500	2,400	2,100
Flow from Non-res (kL/d) – Infoworks	42	517	19	462	86
Flow from Res (kL/d)	178	2,683	481	1,938	2,014
Hydraulic loading (L/EP/d)	215	221	191	177	269
2014 Non res EP	197	2,345	100	2,607	590
2014 Total EP	1,022	14,510	2,615	13,551	8,076
2014 Total ET	426	6,309	1,189	5,892	3,365

4.4 Serviced Population Projection

The sewerage scheme serviced population for each scheme was projected using the following methodology:

- The residential EP for each scheme grows by the increase in population given in Table 4.4.
- The non-residential EP is projected to grow at a constant rate of 0.25% per annum which was used in the STP Capacity Assessment and Upgrade Options Report prepared by GHD.

- The Moss Vale Enterprise corridor comes on-line from 2016 with a water demand starting at 1.1 ML/d and increasing by 0.2 ML/d every year for the next 15 years. This is based on advice from Council. In accordance with the above methodology 90 percent of this demand is expected to flow to the Moss Vale STP.

The summary of the residential population, non-residential EP and total EP for each sewerage scheme are provided in Table 4.8. The Infoworks model for the Robertson sewerage scheme was not available and hence the total EP for this scheme has not been calculated.

Table 4.8: Serviced Equivalent Population projection – sewerage schemes

Sewer Scheme	EP	2011 Census + WSSMP Growth				Forecast extension		
		2016	2021	2026	2031	2036	2041	2046
Berrima	Residential	826	879	1,011	1,011	1,050	1,091	1,133
	Non-residential	387	392	397	402	407	412	417
	Sub total	1,212	1,270	1,407	1,412	1,456	1,502	1,549
Bowral	Residential	12,480	13,425	14,003	14,462	15,003	15,564	16,146
	Non-residential	2,362	2,392	2,422	2,452	2,483	2,514	2,546
	Sub total	14,842	15,817	16,425	16,914	17,486	18,078	18,692
Bundanoon	Residential	2,527	2,559	2,589	2,616	2,712	2,813	2,917
	Non-residential	96	97	99	100	101	102	104
	Sub total	2,623	2,656	2,687	2,716	2,813	2,915	3,020
Mittagong	Residential	11,727	12,454	12,902	13,539	14,099	14,679	15,281
	Non-residential	2,320	2,349	2,379	2,409	2,439	2,470	2,501
	Sub total	14,047	14,804	15,281	15,948	16,538	17,149	17,782
Moss Vale	Residential	7,711	8,888	9,662	10,427	10,799	11,186	11,586
	Non-residential	593	600	608	615	623	631	639
	Sub total	8,303	9,488	10,269	11,042	11,422	11,816	12,224
Moss Vale + MVEC	Residential	7,711	8,888	9,662	10,427	10,799	11,186	11,586
	Non-residential	5,218	9,808	14,441	19,073	19,081	19,089	19,097
	Sub total	12,928	18,696	24,103	29,500	29,880	30,275	30,683

The residential EP has been obtained from the Infoworks model and therefore does not match up exactly with the population numbers in Table 4.4. The differences, however, are not significant.

5 Water demand projections

Wingecarribee Shire Council has previously commissioned the WSSMP and this was reviewed and updated in March 2015 (Focused Asset Services). This document outlines the peak day, average day and average annual customer water demands and the projected non-revenue water (NRW) for Council's planned population growth and development until 2031. These results have been augmented by extending the forecasts to 2046 and estimating the projected unrestricted dry year demand.

5.1 Average day demand

The WSSMP used records from the 2012 calendar year. The average daily water demand for this period is summarised in Table 5.1.

Table 5.1: Average daily water demands in 2012

Category	ADD (ML/day)
Non-residential	2.11
Residential	8.16
Total revenue water	**10.27**
Non-revenue water	2.09
Total production	**12.37**
Non-revenue water %	16.9%

These total production figures agree with the production information provided by Council. The water demands for 2012 were approximately 8% below average for the period 1/7/2008 to 30/6/2015, though only 2% below average once 2013/2014 was excluded. Therefore the average day demands from the WSSMP are considered reasonable.

5.2 Peak day demand

The WSSMP used the maximum production data from the three water treatment plants to estimate the peak day demand. This corresponded to about 30.5 ML/d. It used a peaking factor of 2 from the WSA code for the non-residential PDD. The residential PDD was then calculated as the difference, while maintaining the non-revenue water constant. The calculations are summarised in Table 5.2.

Table 5.2: Peak daily demand calculations

Category	ADD (ML/day)	PDD (ML/day)	Ratio
Non-residential	2.11	4.23	2
Residential	8.16	24.17	2.96
Total revenue water	**10.27**	**28.4**	**2.77**
Non-revenue water	2.09	2.09	1
Total production	**12.37**	**30.49**	**2.46**
Non-revenue water %	16.9%	6.9%	

A review of the peak daily demand calculations is provided below:

- The peaking factor of 2 for the non-residential demand, taken from the WSA code, is considered reasonable.

- The total PDD of 30.5 ML/d is 2.3% below that recorded on 8/2/2009, and NRW was comparable (17% in 2008/2009 compared to 18% in 2012/2013).
- The total PDD is 25.4% below that recorded on 15/1/2014, recorded on a 35.5 ^{o}C day in the middle of a significant fire season summer.

Therefore the peak day demand is considered appropriate for periods without significant bushfires. If the infrastructure strategy is based on the PDD of 30.5 ML/d then an alternate strategy would need to be determined to provide capacity to combat bushfires.

The filtered water production data was analysed to determine the peak demand persistence, the results are summarised in Figure 5.1 and Table 5.3.

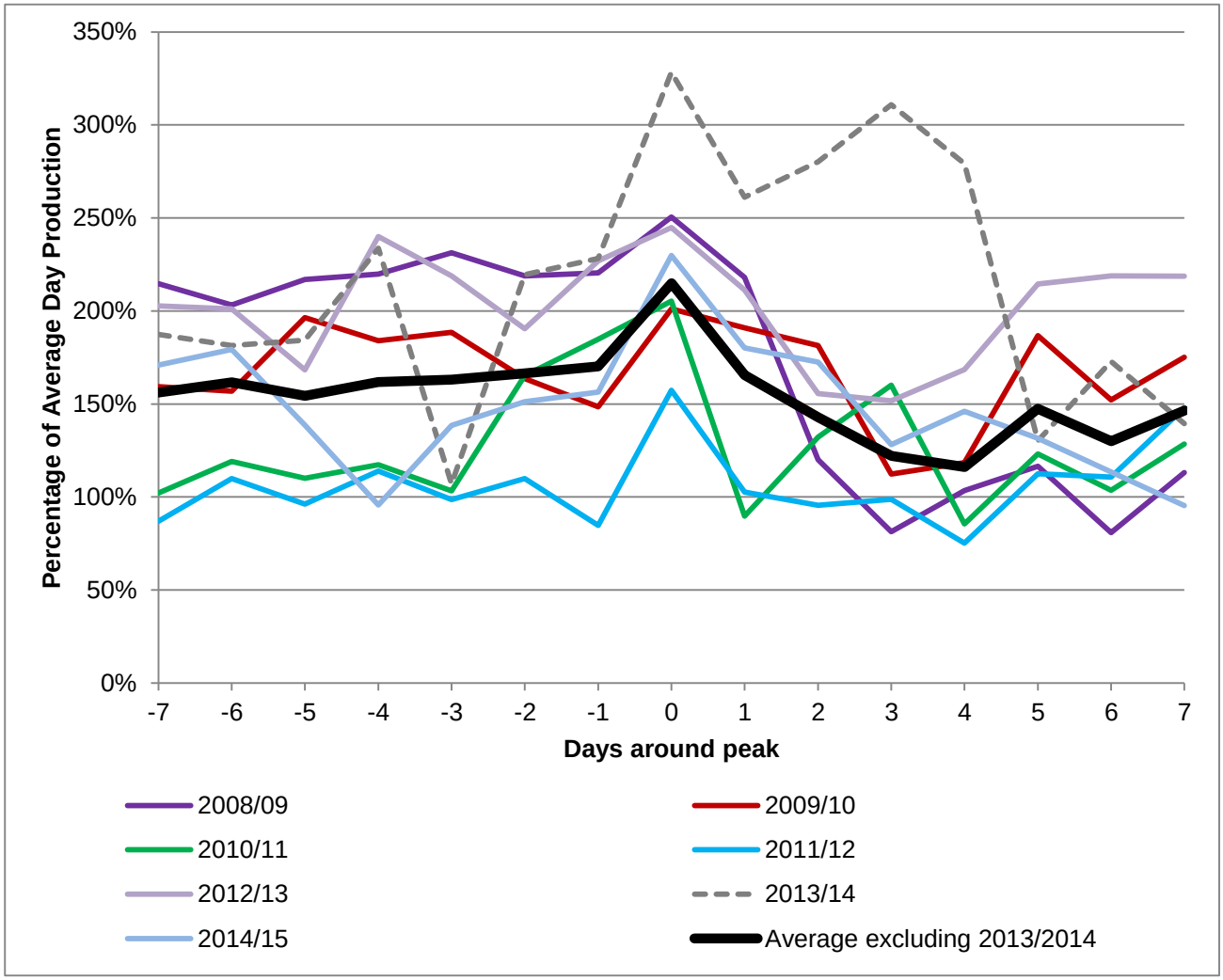


Figure 5.1: Demand before, during and after the peak day

Table 5.3: Peak demand persistence

Day	Days before							Peak day	Days after						
	7	6	5	4	3	2	1		1	2	3	4	5	6	7
Percentage of peak day demand*	73	75	72	75	76	78	79	100	77	67	57	54	69	60	68

*data from 2013/2014 has been excluded

5.3 Historical and current water production

The historical water production data was analysed to ascertain the influence of:

- growth, including the increased water efficiency of dwelling built under BASIX
- climate
- non-revenue water.

The water demand was modelled on a monthly time scale. It was very noticeable that the water demand in 2013/2014 was much higher than could be accounted for by the climate at the time, this could potentially be attributed to the severe bush fire season. Therefore the modelled demand was optimised for the periods 1/7/2008 to 30/06/2013 and 1/7/2014 to 30/6/2015 and the period from 1/7/2013 to 30/6/2014 was excluded.

Irrigation demand was the main factor used in the model. Attempts were made to improve the model's fit through the use of other factors including:

- Shire population
- percentage of dwellings that were built after the implementation of BASIX
- pricing
- a general efficiency factor (both linear and cumulative).

These factors did not improve the correlation between modelled and actual demands sufficiently and so these factors were not included in the final model.

Based on the final model, it is estimated that there is a climate dependent demand equivalent to 177 ha of irrigated area and a climate independent demand of 8.87 ML/day. The estimated current (2014/2015) demands (revenue water) are:

- average annual demand of 4,053 ML/year which compares with the estimated 4,515 ML/year in the WSSMP
- average daily metered demand of 11.1 ML/day, which compares with 10.27 in Table 5.1
- The 95th percentile dry year metered demand is 4,355 ML/year (107.4% of the average).

Allowing for 14.55% NRW (the 2014/2015 NRW), it is expected that the unrestricted dry year filtered water production for a 1 in 20 year summer would be approximately 4,990 ML/year.

Using this model the demand for the year 2003, (estimated to be a 1 in 11 year event), was estimated to be 4,300 ML. DPI Water's performance monitoring data reports that the 2003/04 revenue water was 4,500 ML. The difference between the modelled estimate and the actual water supplied is about 4% which is a good validation of the model.

During 2013/2014 unusually high demands were recorded which were probably related to bushfires. It is estimated that the monthly demand increased by up to 47% and continued to be exceptionally high right through to the end of June with the average additional water demand being 21% (compared to a 1 in 20 year dry year being about 7.4% additional).

Unit demands

The unit demands developed for the WSSMP express demand for each customer category in terms of litres per person living in the serviced area per day. The information used was obtained from the DPI Water performance report and therefore uses the same customer categories:

- residential
- commercial / industrial
- farmland
- institutional (hospitals, schools, nursing homes, goal)
- public parks, gardens and ovals.

The reliability of DPI Water's performance monitoring reports depends on the accuracy and consistency of the data supplied by Councils. For Wingecarribee Shire Council, the data is expected to be reliable as the data collection and processing procedures are externally audited on a regular basis.

The annual total metered water consumption for each customer category is graphed in Figure 5.2.

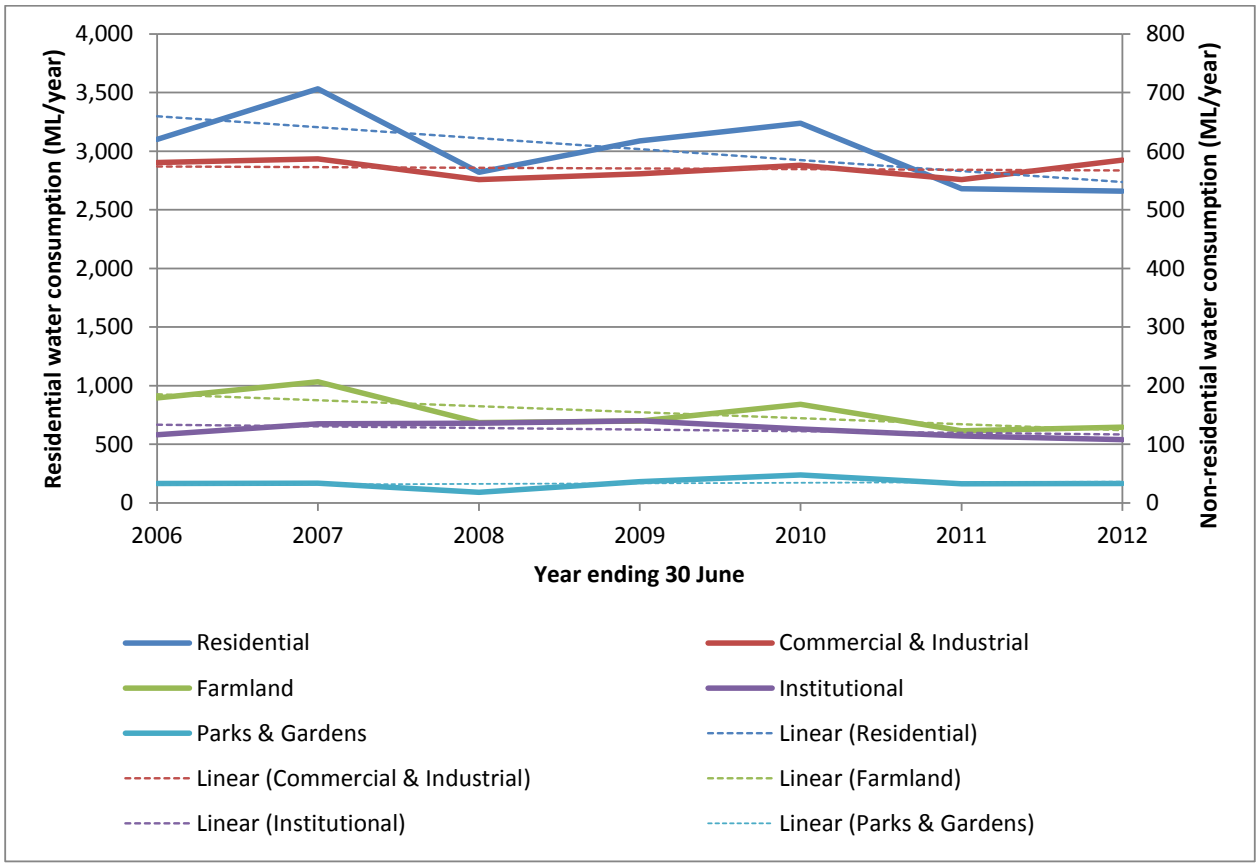


Figure 5.2: Annual metered demand by customer category

As can be seen in Figure 5.2:

- residential demands have been falling (while the population has been increasing, see Figure 4.1), with the 2012 demand 86% of the 2006 demand
- farmland demands have been decreasing, with the 2012 demand at 72% of the 2005 demand
- commercial and industrial demands have been relatively consistent, with a variance of less than ±3.3%
- parks and gardens demands are relatively low and highly variable, with demands between 55% and 143% of the average with no significant overall trend.

WSSMP presents unit water demands for each user category in terms of litres per person living in the serviced area per day. The problem with this approach is that while the serviced population has increased by 5.5% over the period of the analysis, the demands for each non-residential category have either been falling or stable. Therefore there is little evidence for correlating non-residential demands (especially farmland demands) with population growth.

The WSSMP presents a range of unit water demands:

- Low = 250 L/person/day equal to lowest figure over reporting period
- Moderate = 280 L/person/day equal to the average figure over the reporting period
- High = 330 L/person/day equal to the highest figure over the reporting period.

The estimated demands in the WSSMP per person include residential use, non-residential use and non-revenue water and are the same for all areas and year. Therefore the distribution of the growth in water demands may be skewed towards residential areas and away from non-residential use centres. Also the drop in water demand due to both BASIX and the general availability of more efficient appliances has not been accounted for. The NRW is projected to remain unchanged, regardless of the change in service area or loss reduction strategies.

5.4 Forecast water demand and production

The peak day demand and average day demand forecasts for 2013 to 2031 have been sourced from the WSSMP and extended using the expected population growth in each water supply area.

The un-restricted dry year demand projection has been undertaken by scaling the average day demand by the 2014 dry year to average year ratio (1.074).

The Peak Day and Annual water production has been estimated by accounting for the non revenue water which is currently estimated to be 2.1 ML/d or 767 ML/year.

The treatment plant losses have averaged 8% of production over the last four years, therefore raw water extraction is estimated as 108% of filtered production.

Table 5.4: Water demand, production and extraction

		2012	2016	2021	2026	2031	2036	2041	2046
Metered Demand	Average day (ML/day)	10.29	12.45	14.49	16.18	17.83	18.59	19.37	20.18
	Peak day (ML/day)	28.44	33.15	37.52	40.90	44.17	46.27	48.44	50.70
	Average year (ML/year)	3,756	4,544	5,289	5,906	6,508	6,784	7,070	7,366
	Dry year ML/year)	4,034	4,881	5,680	6,343	6,990	7,286	7,593	7,911
Filtered Production	Average day (ML/day)	12.39	14.55	16.59	18.28	19.93	20.69	21.47	22.28
	Peak day (ML/day)	30.54	35.25	39.62	43.00	46.27	48.37	50.54	52.80
	Average year (ML/year)	4,522	5,311	6,055	6,672	7,274	7,550	7,836	8,133
	Dry year ML/year)	4,857	5,704	6,503	7,166	7,813	8,109	8,416	8,735
Raw Extraction	Average day (ML/day)	13.38	15.71	17.92	19.74	21.52	22.34	23.19	24.06
	Peak day (ML/day)	32.98	38.07	42.79	46.44	49.97	52.24	54.59	57.03
	Average year (ML/year)	4,884	5,736	6,540	7,206	7,856	8,154	8,463	8,783
	Dry year ML/year)	5,246	6,160	7,024	7,739	8,438	8,757	9,089	9,433

The WSSMP provides peak day demand projections on a reservoir zone level. As Council does not have detailed development strategies beyond the end of the WSSMP, the long term demand and production growth has been estimated only on supply area (Wingecarribee, Wingecarribee South and Bundanoon) basis. These forecasts are contained in Appendix E. It has been assumed that the proportional split between supply areas is the same for dry years as it is for peak days, for example if 10% of the peak day demand occurs in the Bundanoon supply area, then 10% of the dry year demand occurs in the same area.

5.5 Impact of climate variability on water demand

Future irrigation demands that are likely to occur due to enhanced climate variability were modelled to assess the likely impact on future water demands, production requirements and extraction. Based on the modelling undertaken to estimate the dry year demand, it is currently estimated that in the current climatic conditions, irrigation currently contributes to between 14% and 26% of the metered demand, this is comparatively low for NSW.

The impact expected future climate was estimated based on the CSIRO estimates discussed in Appendix F, using the:

- estimated 2020-2039 seasonal average change in rainfall
- middle of the range of estimated seasonal evapotranspiration.

The volume of irrigation water required is expected to increase between 8 and 16%. This will result in:

- average annual water demands increasing by 0.4%
- dry year water demands increasing by 2.4%, this is expected to increase the dry year filtered water extraction in 2046 by around 204 ML/year
- the ratio of dry year to average year water demands increasing from 7.4% to 9.7%.

While the estimated increase in dry year water demands is comparatively small when compared to the errors involved in estimating the future water demand (for example the likely variance in actual population and industrial growth), the bigger concern is the likely increase in the average number of days with extreme to catastrophic bushfire risk.

6 Sewer flow projections

6.1 Historical sewage flows

The historical daily and monthly average STP influent flows in conjunction with site rainfall records are shown in the following graphs. Data is from the period of May 2013 to April 2014. No effluent flow data is available for any of the STPs.

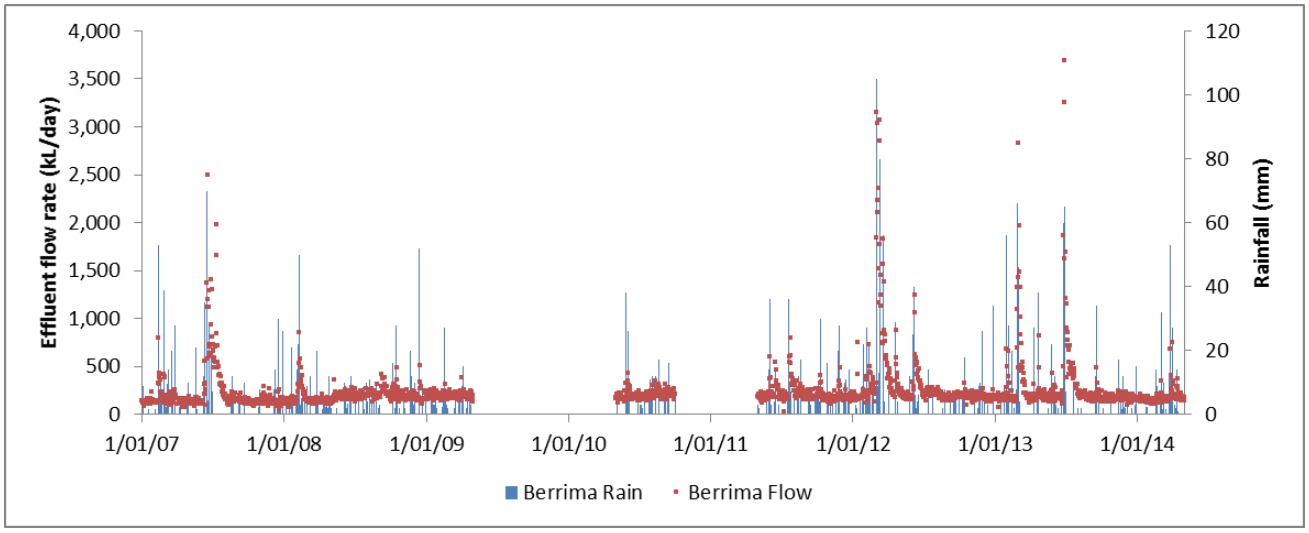


Figure 6.1: Daily STP Inflow and rainfall for Berrima STP

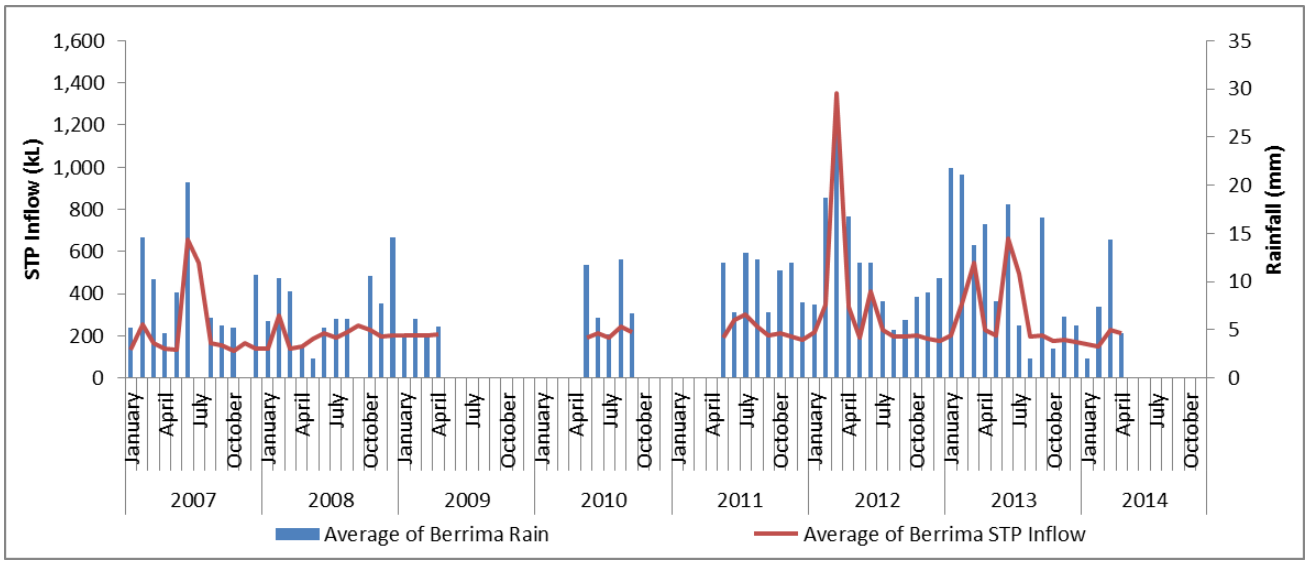


Figure 6.2: Monthly Average STP Inflow and rainfall for Berrima STP

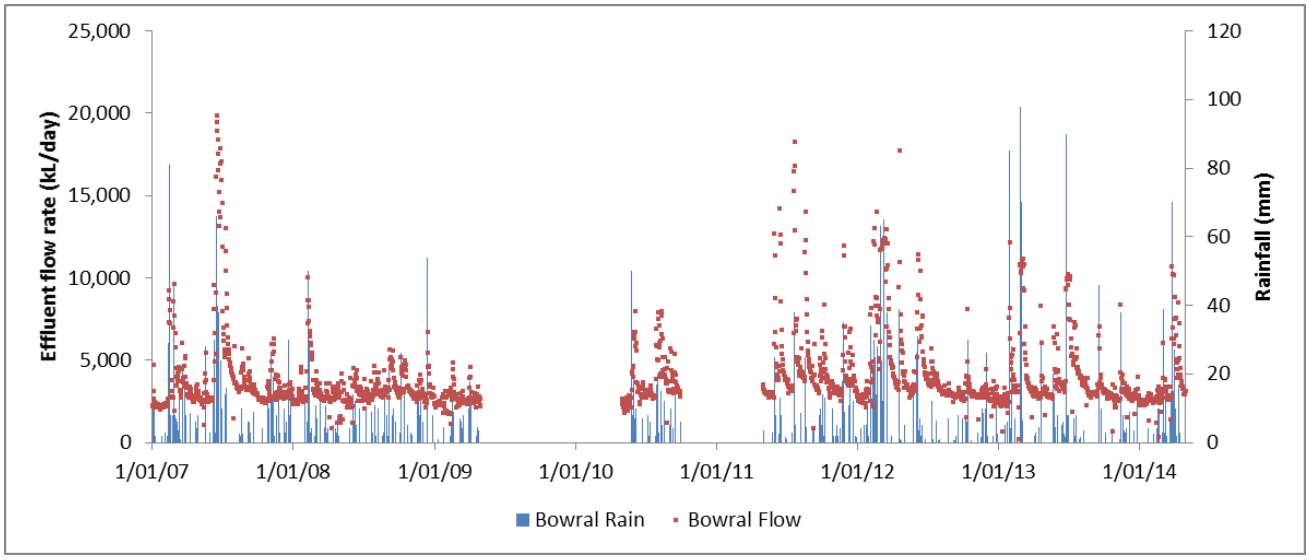


Figure 6.3: Daily STP Inflow and rainfall for Bowral STP

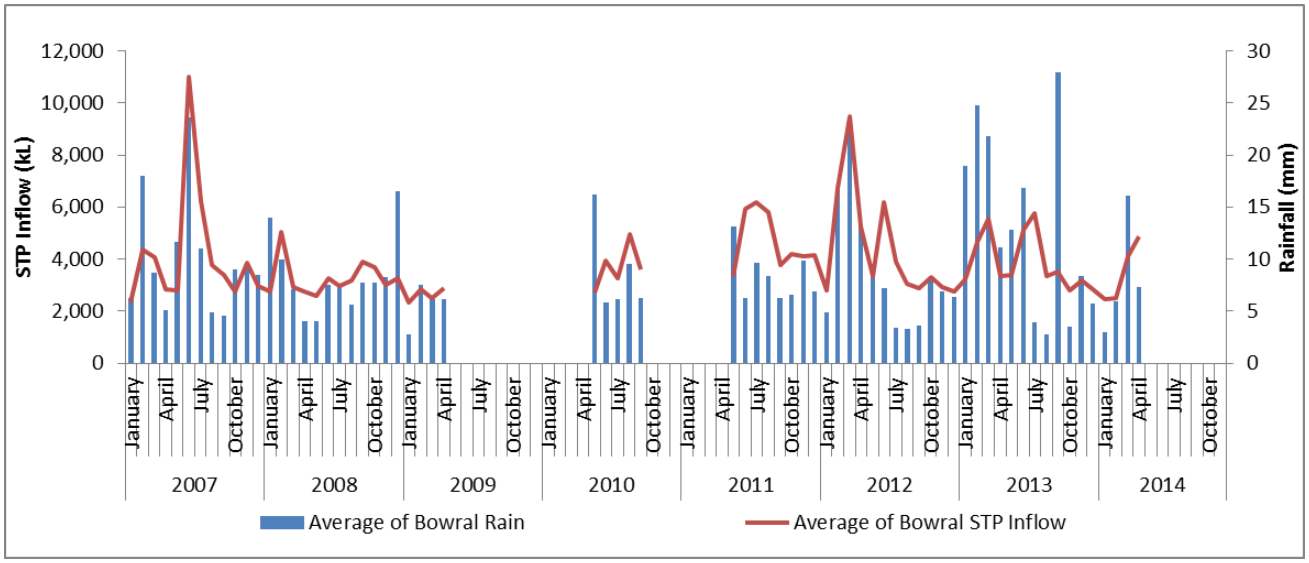


Figure 6.4: Monthly Average STP Inflow and rainfall for Bowral STP

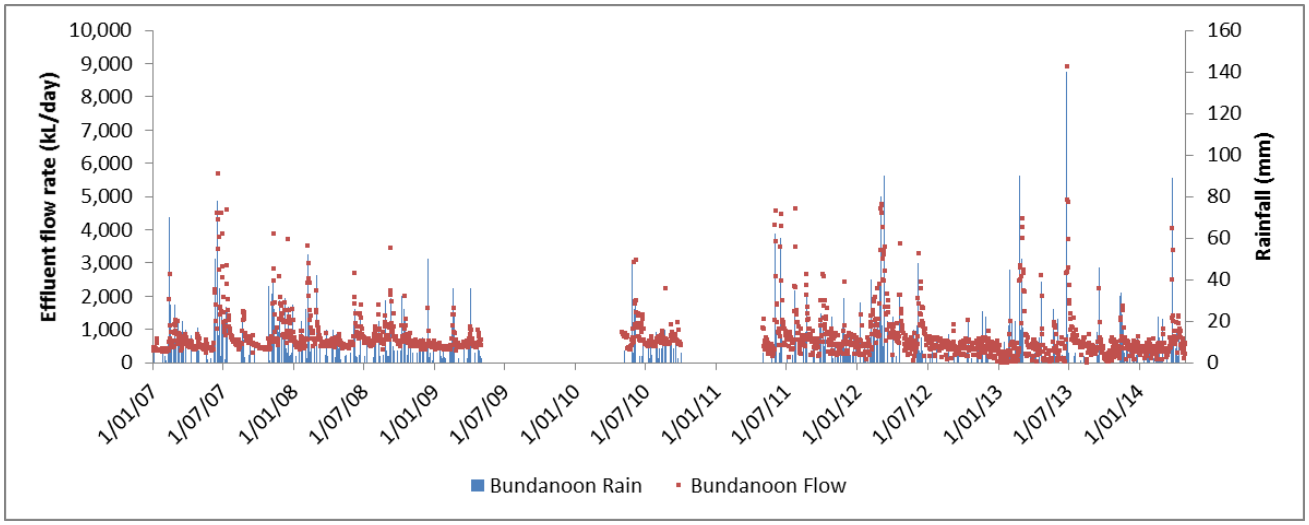


Figure 6.5: Daily STP Inflow and rainfall for Bundanoon STP

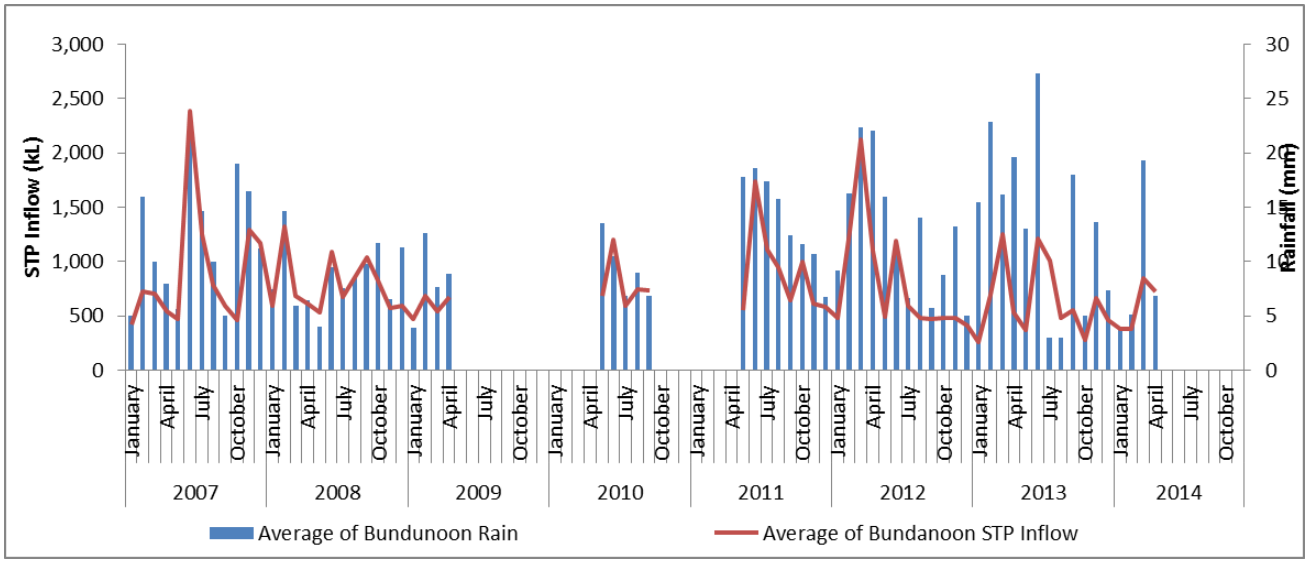


Figure 6.6: Monthly Average STP Inflow and rainfall for Bundanoon STP

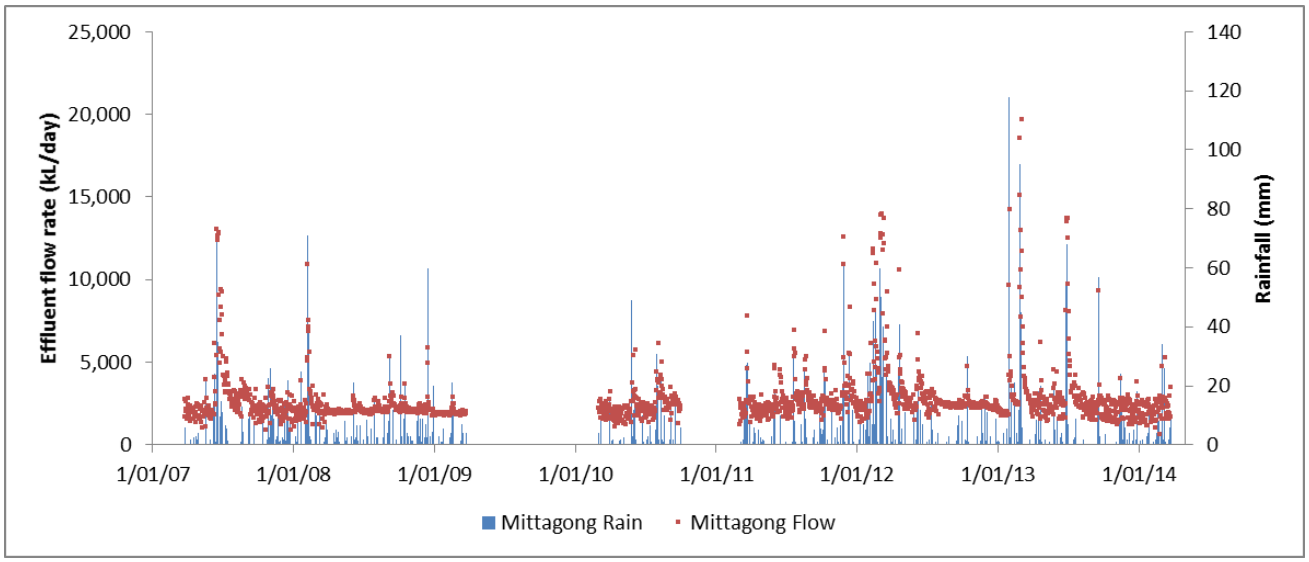


Figure 6.7: Daily STP Inflow and rainfall for Mittagong STP

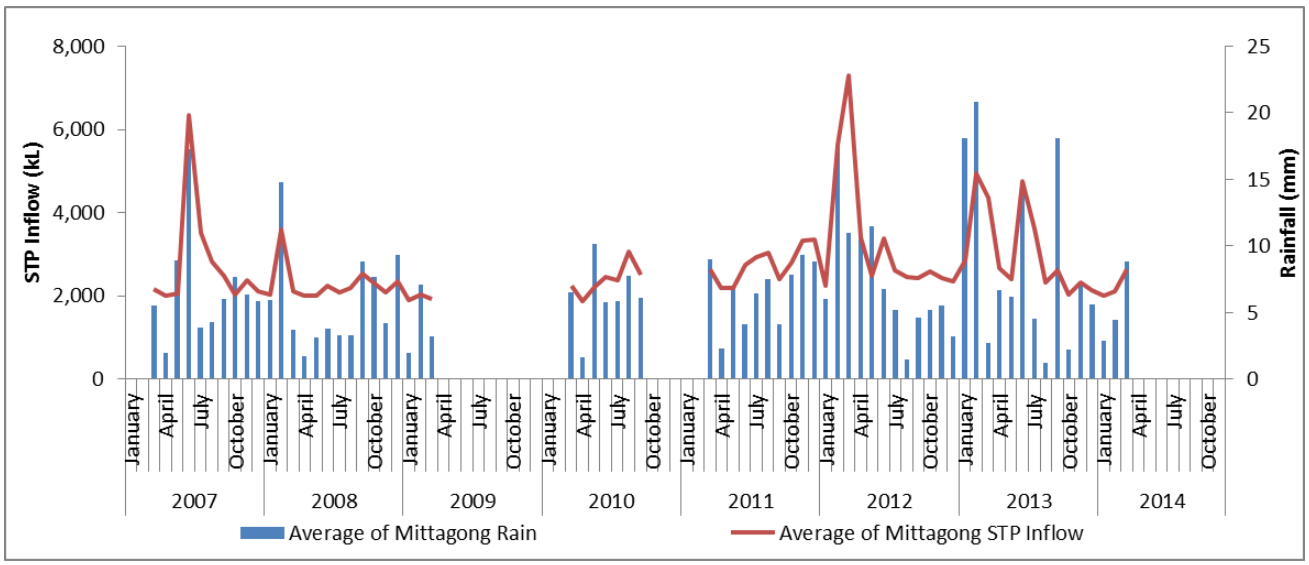


Figure 6.8: Monthly Average STP Inflow and rainfall for Mittagong STP

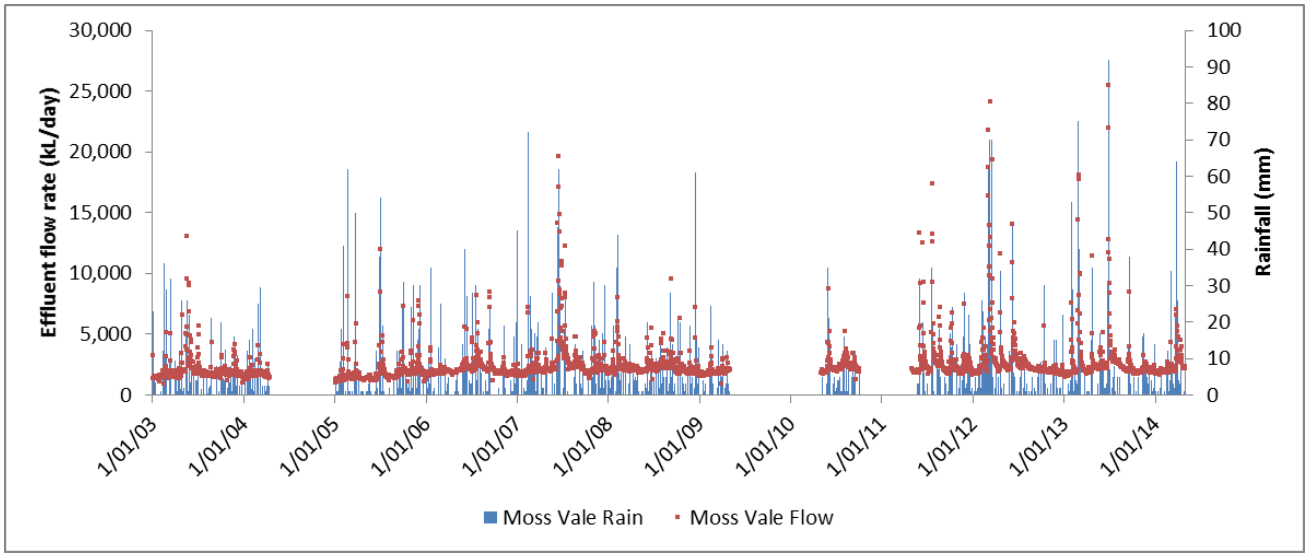


Figure 6.9: Daily STP Inflow and rainfall for Moss Vale STP

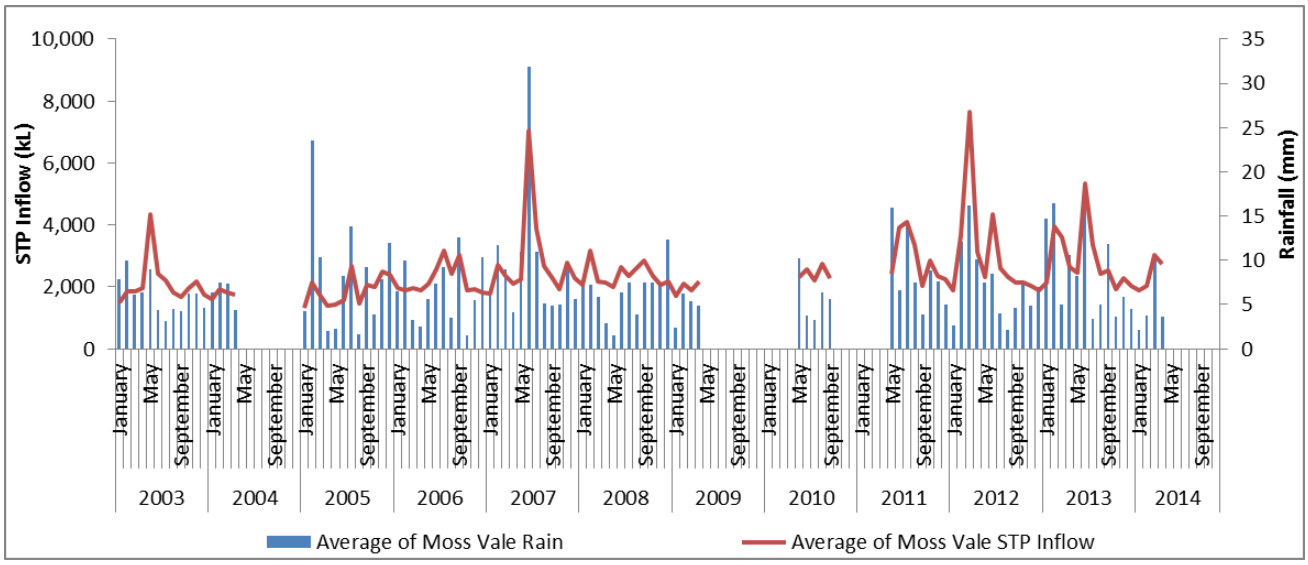


Figure 6.10: Monthly Average STP Inflow and rainfall for Moss Vale STP

6.2 Sewer system flow forecast

The sewer system loads were estimated in terms of equivalent connected residential property and equivalent persons in Section 4.3.

The following capacity assessment uses plant data from January 2007 to May 2014, with gaps as can be seen in the above figures (Moss Vale data begins in 2003.). This data was provided as daily STP influent flow rate. No data on the instantaneous influent flow is available, so the diurnal peaking factor (also called the 'r value') and hence the peak dry weather flow is calculated using the methodology in the sewer design manual.

Actual Average Dry Weather Flow (ADWF)

Daily flow data was analysed to estimate the average dry weather flow, maximum dry day flow and maximum wet day flow. A dry day was taken as a day in which that day, the five preceding days and the two following days were all not wet days. A wet day was any day with >2mm rainfall. For years where a full year of data is available, the dry weather flows were averaged to obtain ADWF.

The ADWF values obtained are compared in Table 6.1 to values provided in the STP Investigations report by GHD, and those obtained from the 72-hour composite sampling analysis undertaken by

Council in January 2017. It is noted that on average the ADWF in January has been around 85% of the ADWF for the year, which is why the values from the 72 hour monitoring are relatively low.

Table 6.1: Actual ADWF calculations (all values in kL/d)

		Berrima	Bowral	Bundanoon	Mittagong	Moss Vale
This IWCM	**2007**	200	3,053	521	2,296	2,471
	2008	203	2,777	560	2,054	2,009
	2012	224	3,222	490	2,428	2,185
	2013	213	3,145	372	2,387	2,181
GHD Study	**2005**		2,915		2,095	
	2006		2,452		1,977	2,037
	2007		2,743		2,057	2,074
	2008		2,676		2,013	2,029
	2009		2,454		1,889	2,045
	2010					
	2011		3,554		2,310	2,094
	2012		3,096		2,420	2,215
	2013		2,961		2,357	2,043
	2014		2,538		2,109	1,942
72-hr sampling	**Jan 2017**		2,715		1,829	1,780

The adopted 2014 ADWF is shown in Table 6.2 which is used in EP calculations (see Section 4.3). The calculated 2014 hydraulic loading from Table 4.7 is also shown, along with the adopted hydraulic loading used in flow projections. population of 7,170 in Table 4.4.

Table 6.2: Adopted ADWF and Hydraulic Loading

	Berrima	Bowral	Bundanoon	Mittagong	Moss Vale
Adopted 2014 ADWF (kL/day)	220	3,200	500	2,400	2,100
2014 Hydraulic Loading (L/EP/day)	215	221	191	177	269
Adopted Hydraulic Loading (L/EP/day)	220	220	200	200	240

The calculated 2014 hydraulic loading for Moss Vale is considered to be high. Council has advised that the percentage of non-residential EP to total EP of 7% is lower than expected. It has been decided that the Infoworks model has attributed some non-residential flow as residential flow which has led to the high residential hydraulic loading. A standard industry value of 240 L/EP/day has been adopted for the Moss Vale hydraulic loading.

Impact of seasonal variations on ADWF

The monthly ADWF was reviewed for the data range available to assess the impact of seasonal variations. Council advised that the peak tourist season is during the months of September/October with the summer period being the off-peak season. The population generally increases by about 20 percent during the peak season. The monthly ADWF is for the data range available is graphically presented with the monthly rainfall in Figure 6.11.

It is noted from the data that the ADWF in the peak season of September and October is comparable to the months of July and May, which have similar rainfall, even though a 20 percent increase in population is expected. It is also noted that the off-peak season is generally a wet period when the inflow to the STP is expected to be higher.

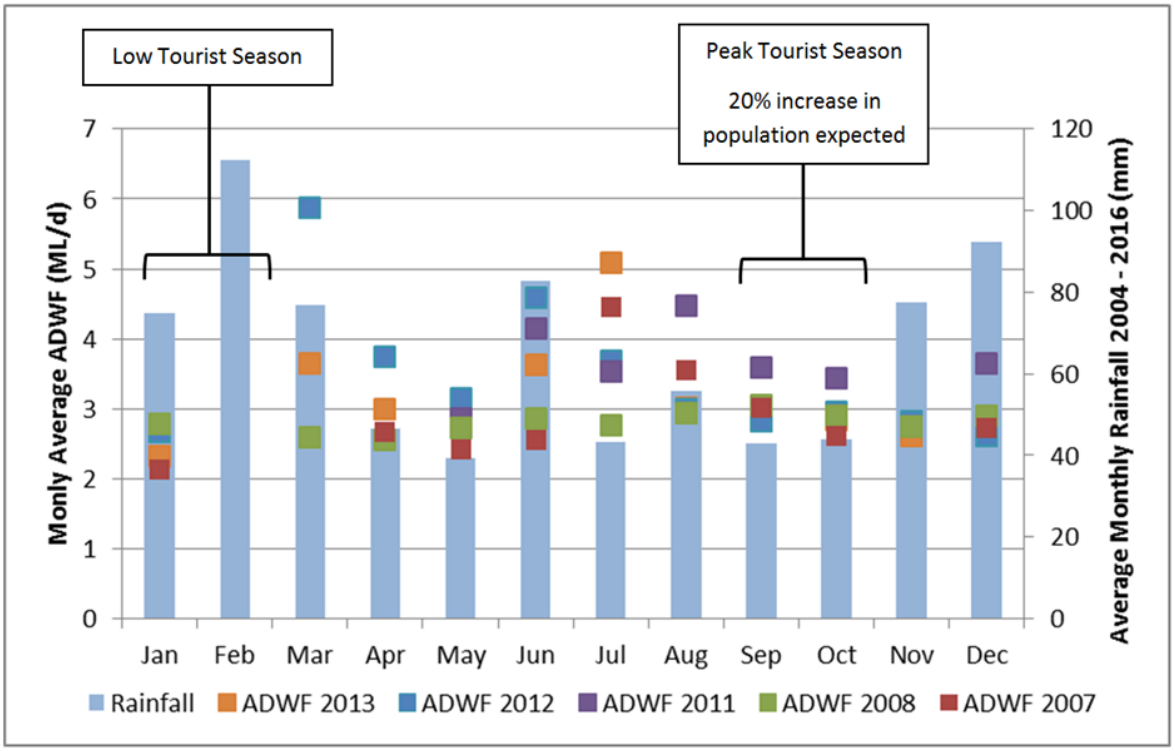


Figure 6.11: Seasonal Variation of ADWF

Peak Dry Weather Flow

An actual peak dry weather flow was estimated by calculating the peaking factor from ET using formulas in the sewer design manual. The r values for Moss Vale, Mittagong and Bowral were compared to those that were determined by 72 hour testing in the 2015 GHD STP Investigations reports. These values are given in Table 6.3.

Table 6.3: Actual PDWF calculations

		Berrima	Bowral	Bundanoon	Mittagong	Moss Vale
IWCM	EP (2016)	1,212	14,842	2,623	15,365	8,303
	ET (2016)	631	6,453	1,192	6,680	3,460
	r (calculated)	2.4	1.8	2.2	1.8	2.0
GHD	r		2.3		2.1	2.0
IWCM	PDWF (L/s)	6	71	13	51	48

Peak Wet Weather Flow

No actual instantaneous PWWF data is available for any of the sewage schemes within Wingecarribee Shire.

The method in the sewer design manual to calculate PWWF is to calculate the Storm Allowance (SA) from ET, then add that to PDWF.

$$SA = 0.058\ L/s * ET$$

Table 6.4: Calculated PWWF

		Berrima	Bowral	Bundanoon	Mittagong	Moss Vale
IWCM	EP (2016)	1,212	14,842	2,623	15,365	8,303
	ET (2016)	631	6,453	1,192	6,680	3,460
	SA (L/s)	36.6	374.3	69.2	387.5	200.7
	PWWF (L/s)	42.9	444.9	82.1	438.6	248.6
	PWWF/ADWF	5.1	7.4	6.1	5.5	8.4

It is possible that the PWWF could be higher based on higher rainfall scenarios. Council embarked on a programme to assess the performance of the sewerage systems within the Shire. Overflow performance of the systems was assessed for both the existing loads and also for the forecast loads in the year 2030. The results of the assessment are provided in Section 8. A review of this assessment is suggested based on the ADWF estimated in this study.

6.3 Forecast sewer system flow

Future ADWF, PDWF and PWWF were estimated by using the adopted unit loadings given in Table 6.2. The future STP sewage loading projections are shown in Table 6.5.

Table 6.5: Projected ADWF and PDWF

Scheme		2016	2021	2026	2031	2036	2041	2046
Berrima STP	EP	1,212	1,270	1,407	1,412	1,456	1,502	1,549
	ET	631	662	733	736	758	782	807
	ADWF (kL/d)	267	279	310	311	320	331	341
	r	2.4	2.4	2.4	2.4	2.4	2.4	2.4
	PDWF (L/s)	8	8	9	9	9	9	9
Bowral STP	EP	14,842	15,817	16,425	16,914	17,486	18,078	18,692
	ET	6,453	6,877	7,141	7,354	7,603	7,860	8,127
	ADWF (kL/d)	3,265	3,480	3,614	3,721	3,847	3,977	4,112
	r	1.8	1.8	1.8	1.8	1.8	1.8	1.8
	PDWF (L/s)	70	74	77	79	81	83	86
Bundanoon STP	EP	2,623	2,656	2,687	2,716	2,813	2,915	3,020
	ET	1,192	1,207	1,222	1,234	1,279	1,325	1,373
	ADWF (kL/d)	525	531	537	543	563	583	604
	r	2.2	2.2	2.2	2.2	2.2	2.2	2.2
	PDWF (L/s)	14	14	14	14	14	15	15
Mittagong STP	EP	14,047	14,804	15,281	15,948	16,538	17,149	17,782
	ET	6,108	6,436	6,644	6,934	7,191	7,456	7,731
	ADWF (kL/d)	2,809	2,961	3,056	3,190	3,308	3,430	3,556
	r	1.9	1.8	1.8	1.8	1.8	1.8	1.8
	PDWF (L/s)	60	63	65	68	70	72	75
Moss Vale STP	EP	8,303	9,488	10,269	11,042	11,422	11,816	12,224
	ET	3,460	3,953	4,279	4,601	4,759	4,924	5,094

Scheme		2016	2021	2026	2031	2036	2041	2046
	ADWF (kL/d)	1,993	2,277	2,465	2,650	2,741	2,836	2,934
	r	2.0	1.9	1.9	1.9	1.9	1.9	1.9
	PDWF (L/s)	45	51	55	59	60	62	64
Moss Vale STP + Moss Vale Enterprise Corridor (MVEC)	EP	12,928	18,696	24,103	29,500	29,880	30,275	30,683
	ET	5,387	7,790	10,043	12,292	12,450	12,615	12,784
	ADWF (kL/d)	3,103	4,487	5,785	7,080	7,171	7,266	7,364
	r	1.9	1.8	1.8	1.7	1.7	1.7	1.7
	PDWF (L/s)	68	94	119	143	144	146	148

6.4 Climate Variability

The NSW Office of Environment and Heritage commissioned the CSIRO to investigate the likely change in rainfall in NSW. It is projected that the extreme rainfall (defined as a 1 in 40yr 1 day rainfall event) will change in intensity by up to +12% by 2030 and up to 10% by 2070, the key results from this study are summarised in Appendix F.

6.5 Biological and Nutrient Loading

Existing biological loading data

Biological loading rates for Bowral, Mittagong and Moss Vale are given in the GHD reports. However, the composite sampling results for Bowral, Moss Vale and Mittagong (in Table 2-10, Table 2-6, and Table 2-7 in the respective GHD reports) do not appear to be an accurate representation of the dry weather raw sewage strength to these plants. The BOD, COD and SS levels are unusually low for dry weather flow sewage. Median total BOD levels are approximately 20 – 35 % of typical design domestic BOD levels. Equivalent SS and COD are also very low. P levels are approximately 50% of expected TP levels. Ammonia nitrogen levels are within expected ranges, however it should be noted that ammonia levels for Bowral and Mittagong, where samples were collected downstream of the supernatant return were 20% greater than Moss Vale, where samples were collected upstream of the supernatant return.

The abovementioned discrepancies may be due to possible deficiencies (subject to confirmation from GHD) in the composite sampling methodology. These include:

1. The composite sampling methodology does not indicate if monitoring of the hydraulic inflow was concurrently undertaken. This would have enabled the calculation of the equivalent mass inflow for the various parameters at the various periods of the diurnal cycle from which the average daily load/concentration can be can determined.
2. It seems that samples were collected in a single container instead of the 24 sample bottles in most automatic samples. These would have allowed samples to be assessed based on diurnal periods. It would also provide an indication of when insufficient samples may have been collected by the sampler.
3. Possible incorrect location of sampling point. Photos should have been included in the report of the sampling points. It is possible that samples may have been collected where complete mixing or short circuiting may have been occurring. The sampling probe may have had a blockage resulting in filtration of relevant solids.

Additionally the low strength sewage determined in the composite sampling results could also be attributed to wet weather inflow during the sampling period.

For these reasons, should an STP upgrade be desired it is recommended that a new 72 hour composite sampling analysis of the raw sewage be undertaken to confirm the suitability of the design parameters. This will reduce overall risk and avoid over (or under) investment.

Predicted biological loading

The biological loading rates used for future projections are given in Table 6.6.

Table 6.6: Actual Biological Loading Rates (g/EP/day)

Nutrient	Bowral	Berrima	Bundanoon	Mittagong	Moss Vale
Biochemical Oxygen Demand (BOD)	60.0	60.0	58.0	42.8	45.0
Total Kjeldahl Nitrogen (TKN)	12.5	12.5	14.8	16.9	11.9
Total Phosphorus (TP)	3.0	3.0	2.9	2.5	2.0

The loading rates for Moss Vale and Mittagong come from the 2009, 72 hour sewage monitoring reports by NSW Water Solutions. Due to wet weather that occurred during testing loading is slightly lower than what would be expected on a dry day.

The loading rates for Bundanoon come from the results of a 2001 72 hour monitoring that is included in the 2004 Bundanoon Sewage Concept Design by NSW Water Solutions.

For Berrima and Bowral STP, standard loads from the Public Works 1984 “Manual of Practise – Sewage Treatment Plant Design” have been adopted.

For the design biological and nutrient loading of the existing plants, the capacities for Bowral, Mittagong and Moss Vale are taken from the GHD STP Capacity Assessment Reports. The Bundanoon biological load design criteria are taken from the 2004 Bundanoon Sewage Concept Design by NSW Water Solutions. The above mentioned nitrogen loadings are all Total Nitrogen. The BOD loading for Berrima is taken from the Berrima STP O&M Manual, while the loading for TKN and TP use Public Works standard values.

7 Water System Capacity and Performance Assessment

7.1 Headworks Secure Yield

A headworks secure yield analysis was undertaken to provide updated secure yield estimates for Bundanoon's water supply headworks system in accordance with DPI Water's draft "*Assuring future urban water security, Assessment and Adaption guidelines for NSW local water utilities*".

The secure yield estimates for Bundanoon Dam only (ie without supply from the Wingecarribee Reservoir) for the main cases examined for the climate experienced over the last 120 years or so and with projected 1^{o}C climate warming is provided in .

Table 7.1: Bundanoon dam secure yield estimates

Bundanoon Gross dam Storage Size (ML)	EFR releases (ML/d)	Secure Yield (ML/a)	
		Historic climate	1^{0}C Climate Warming
2046	Up to 1	1,967	1,965

Modelling was also undertaken to estimate transfers required from the Wingecarribee Reservoir to meet a nominated future demand of 9,433 ML/a with the aim to maximise the use of Bundanoon Dam and thus minimise the use of transfers from the Wingecarribee Reservoir. the results are summarised below:

- On occasions all the daily demand can be met from Bundanoon Dam, however there are times when all the daily demand needs to be met from the Wingecarribee Reservoir.
- For the modelled historic climate, 64 to 62% of demand on average could be supplied from the Bundanoon Dam storage while 36 to 38% of demand on average would need to be supplied from the Wingecarribee Reservoir.
- For the modelled 1oC warming scenarios, 55 to 48% of demand on average could be supplied from the Bundanoon Dam storage while 45 to 52% of demand on average would need to be supplied from the Wingecarribee Reservoir.

7.1.1 Raw Water Quality

Wingecarribee Shire Council has existing control measures to monitor the raw water quality at both Water Treatment Plants. This includes daily sampling and testing of temperature, pH, turbidity, apparent colour, manganese (soluble and total) and ammonia. Turbidity, pH and temperature are monitored online and by daily bench test.

Based on historical water quality data, the raw water turbidity generally fluctuates between 5 and 20 NTU at Wingecarribee WTP and between 2 and 15 NTU at Bundanoon WTP. This raw water turbidity range has no impact on the effective performance of the treatment process at both WTPs. Filtered water turbidity remains below the CCP target level at both WTPs even during high turbidity events.

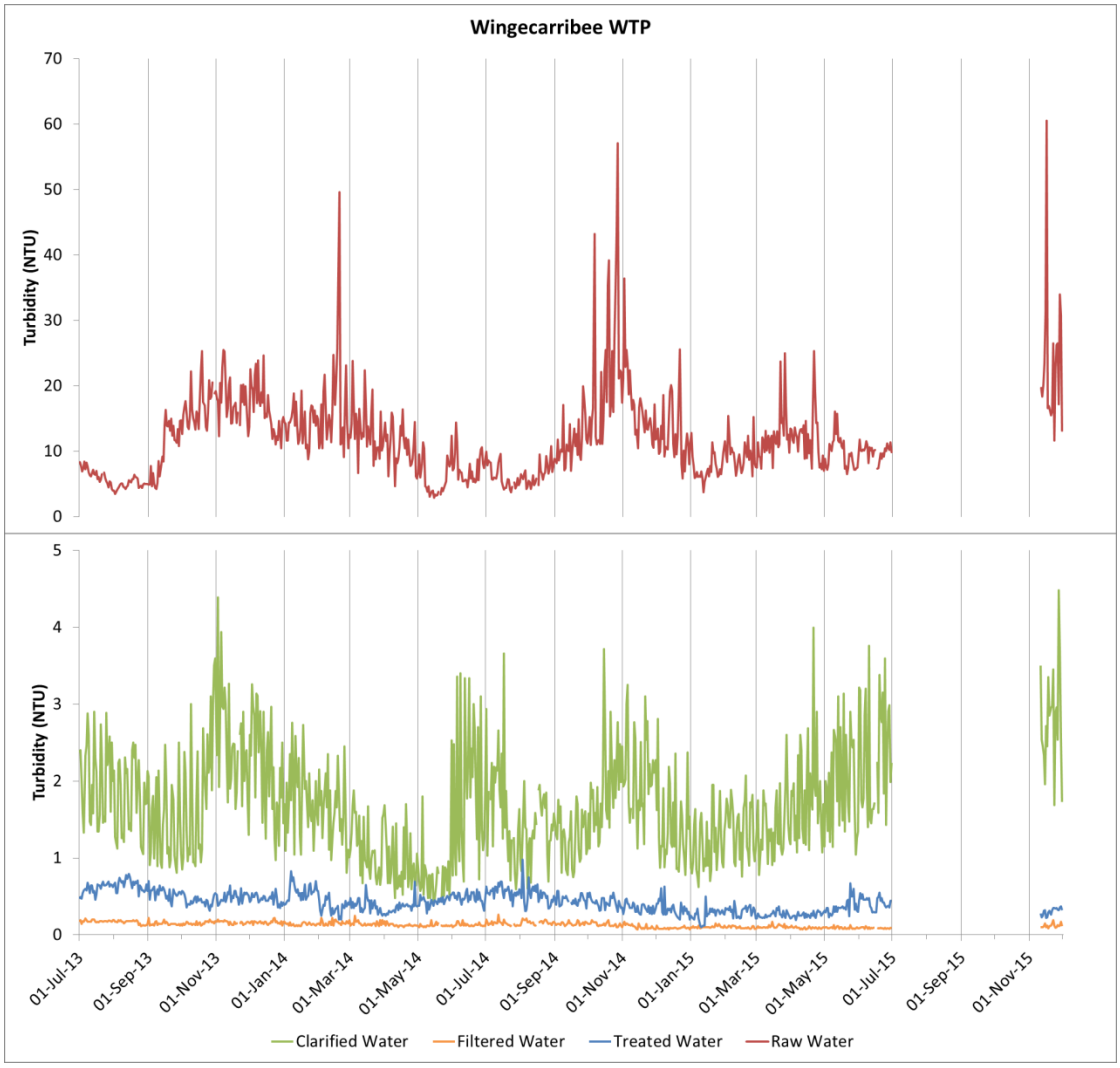


Figure 7.1: Wingecarribee WTP – effect of raw water turbidity on treated water turbidity

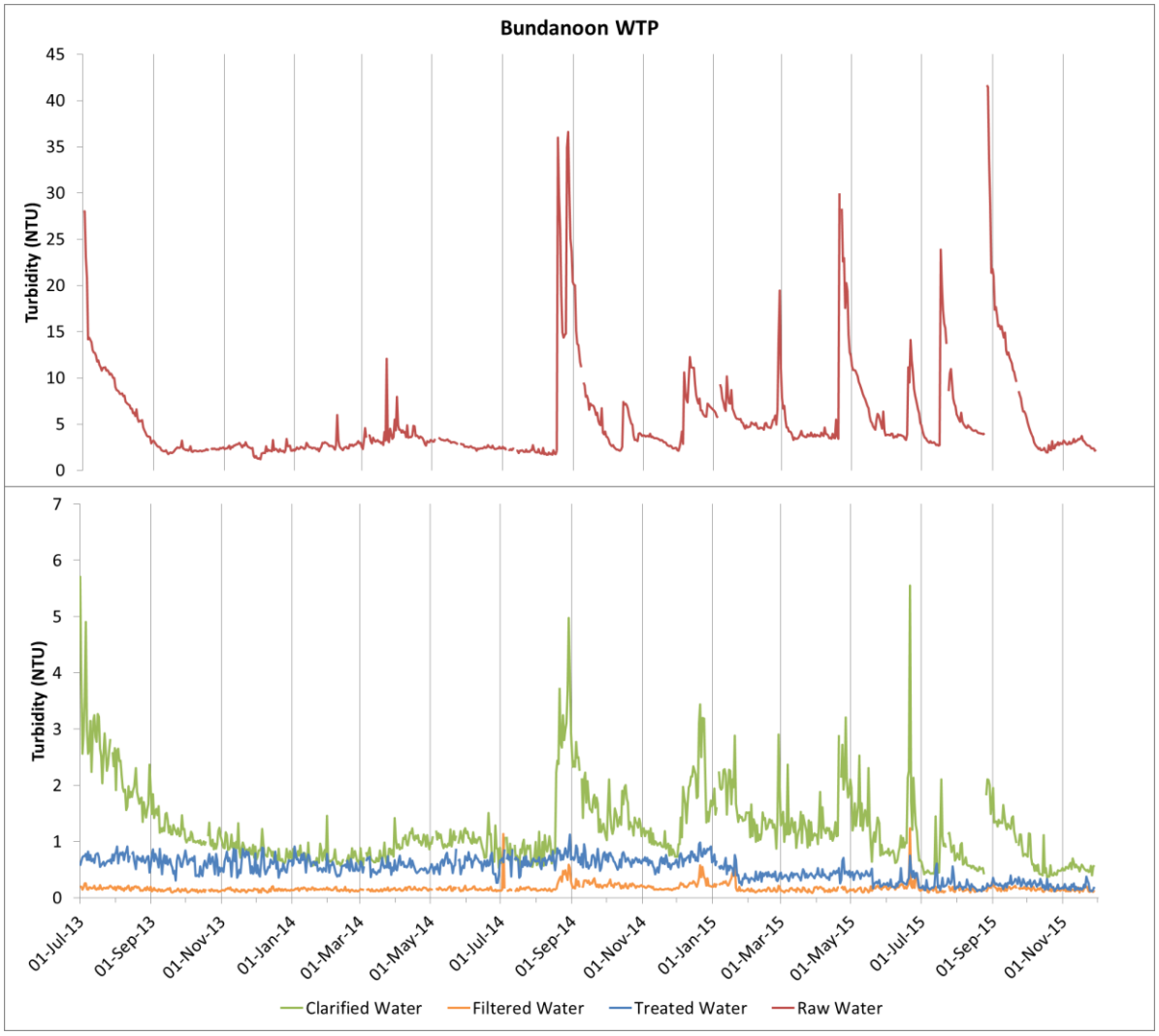


Figure 7.2: Bundanoon WTP – effect of raw water turbidity on treated water turbidity

7.1.2 Water Treatment

WSC's Drinking Water Management System defines 6 Critical Control Points (CCP) at both Wingecarribee and Bundanoon WTP. These CCPs are summarized in Table 7.2 and data is shown in Figure 7.3 to Figure 7.6.

Based on the definition and role of a Critical Control Point the 'Dam Water Extraction Turbidity' and 'Distribution System Free Chlorine' are not considered CCPs. A review of the identified CCPs is suggested.

Table 7.2: WSC Critical Control Point Summary

System	CCP ID	Control Point	Hazard	Control Parameter	Target	Alert Level	Critical Limit
Wingecarribee	W1	Dam Water Extraction	All pathogens	Turbidity	<10 NTU	>20 NTU	>30 NTU
	W2	Filtration	All pathogens	Turbidity	<0.2	>0.4	>0.5
	W3	Fluoridation	Fluoride over dosing or Under dosing	Fluoride	1 mg/L	<0.9 mg/L or >1.1 mg/L	>1.5 mg/L at any time, <0.9 mg/L for more than 72 hours
	W4	Disinfection	All Pathogens	Free Chlorine	1.5 mg/L	1.2 mg/L	0.9 mg/L
	W5	Reservoirs	All pathogens and all chemicals	Reservoir integrity	No breach of integrity	Any sign of integrity breach	Evidence of contamination
	W6	Distribution	All pathogens	Free Chlorine	>0.3mg/L	<0.2 mg/L	</=0.1 mg/L
System	**CCP ID**	**Control Point**	**Hazard**	**Control Parameter**	**Target**	**Alert Level**	**Critical Limit**
Bundanoon	B1	Dam water Extraction	All pathogens	Turbidity	<10 NTU	>20 NTU	>30 NTU
	B2	Filtration	All pathogens	Turbidity	<0.2	>0.4	>0.5
	B3	Fluoridation	Fluoride over dosing or Under dosing	Fluoride	1 mg/L	<0.9 mg/L or >1.1 mg/L	>1.5 mg/L at any time, <0.9 mg/L for more than 72 hours
	B4	Disinfection	All Pathogens	Free Chlorine	1.5 mg/L	1 .2mg/L	0.9 mg/L
	B5	Reservoirs	All pathogens and all chemicals	Reservoir integrity	No breach of integrity	Any sign of integrity breach	Evidence of contamination
	B6	Distribution	All pathogens	Free Chlorine	>0.3mg/L	<0.2 mg/L	</=0.1 mg/L
Target	This is where you want your system to be operating. Try to maintain levels equal to or greater quality the required value.						
Alert Level	First indication your system may have a problem or a potential problem. Increase monitoring and refer to CCP management plans.						
Critical Limit	At this limit you have lost control of your system. As a matter of urgency refer to CCP management plans and try to remediate problem.						

For data from 549 days measured between 1 July 2013 and 30 November 2015, the number of days containing an instance of the alert or critical limit for the CCPs being breached is given in Table 7.3.

Table 7.3: Count of days with alert or critical limit breaches 2015

System	Control Point	Sample count	Under		Over	
			Alert Limit*	Critical Limit	Alert Limit*	Critical Limit
Wingecarribee WTP	Raw Water Turbidity	Online 743 Bench 744	-	-	Online 50 Bench 11	Online 13 Bench 0
	Filtered Water Turbidity	Online 745 Bench 745	-	-	Online 0 Bench 0	Online 0 Bench 0
	Treated Water free chlorine	Online 746 Bench 748	Online 0 Bench 0	Online 2 Bench 2	-	
	Treated Water fluoride	Online 0 Bench 750	Bench 27	Bench 1	Bench 154	Bench 0
Bundanoon WTP	Raw Water Turbidity	Online 225 Bench 868	-	-	Online 9 Bench 9	Online 6 Bench 8
	Filtered Water Turbidity	Online 194 Bench 867	-	-	Online 0 Bench 6	Online 1 Bench 7
	Treated Water free chlorine	Online 868 Bench 879	Online 72 Bench 13	Online 51 Bench 1	-	
	Treated Water fluoride	Online 0 Bench 882	Bench 4	Bench 0	Bench 175	Bench 0

* the number for alert limit breach does not include instances that were also a critical limit breach

It is noted that there is a discrepancy between the on-line and bench top readings, indicating that one or the other has not been calibrated correctly or the true reading is not within the range of instrumentation. This is more noticeable for the treated water free chlorine for Bundanoon WTP. Since the number of bench sample data available was significantly greater than the online data, the graphs are plotted using the bench data.

Both WTPs perform quite well and are operated in a way that alert limit breaches are controlled so that the critical limit is not breached. Raw water turbidity critical limits are occasionally breached, however this cannot be changed by plant operation and it is recommended that this be removed as a CCP in future reviews.

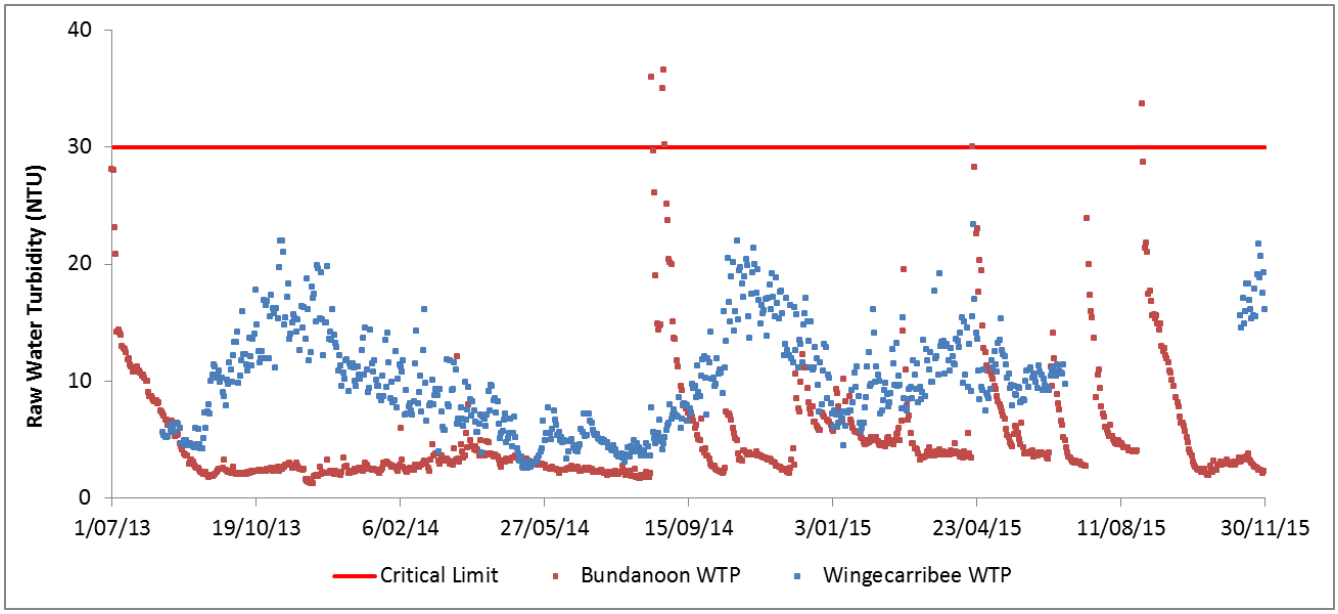


Figure 7.3: Raw Water Turbidity and CCP Critical Limit

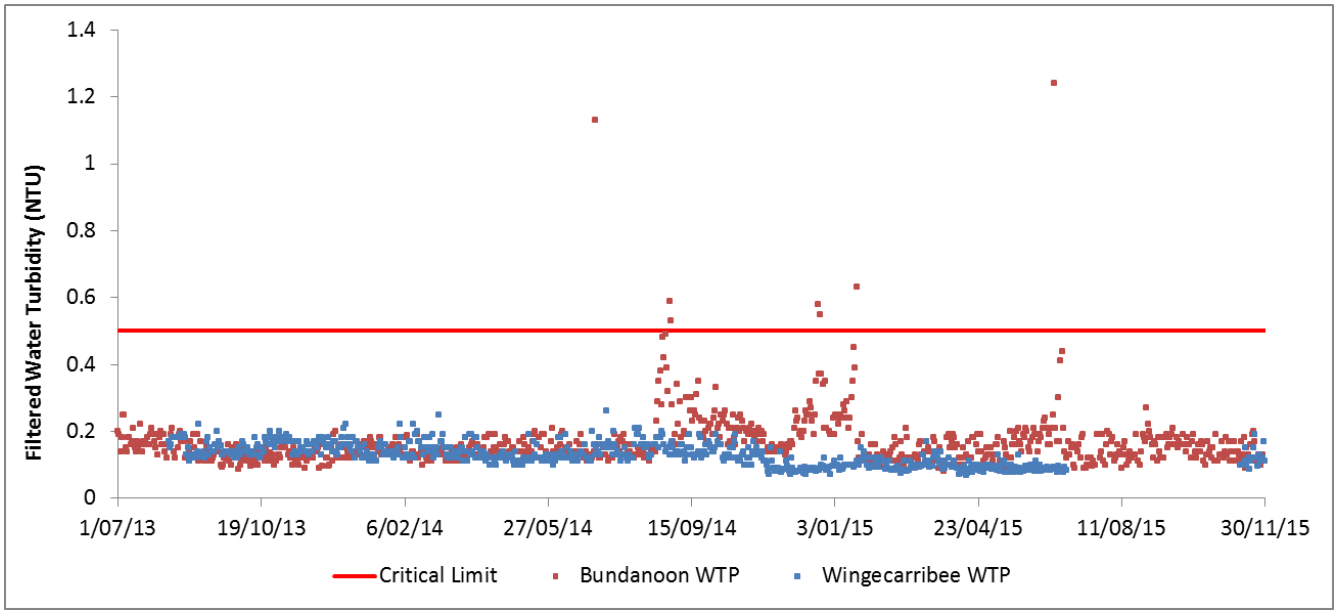


Figure 7.4: Filtered Water Turbidity and CCP Critical Limit

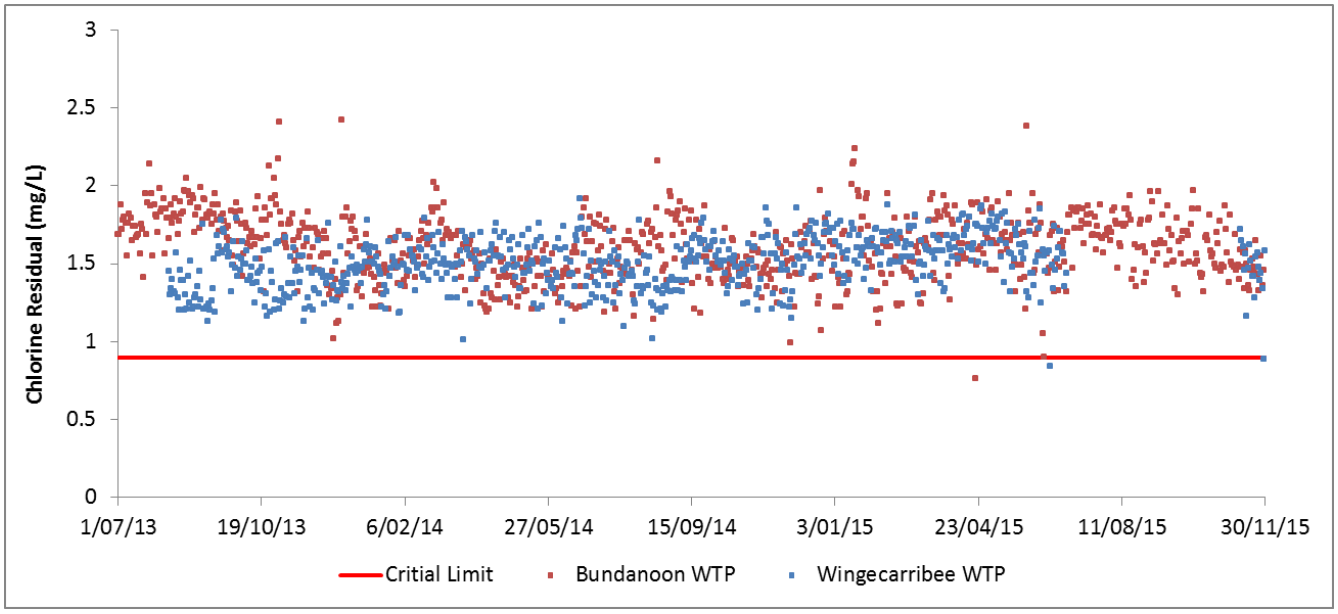


Figure 7.5: Treated Water Chlorine Residual and CCP Critical Limit

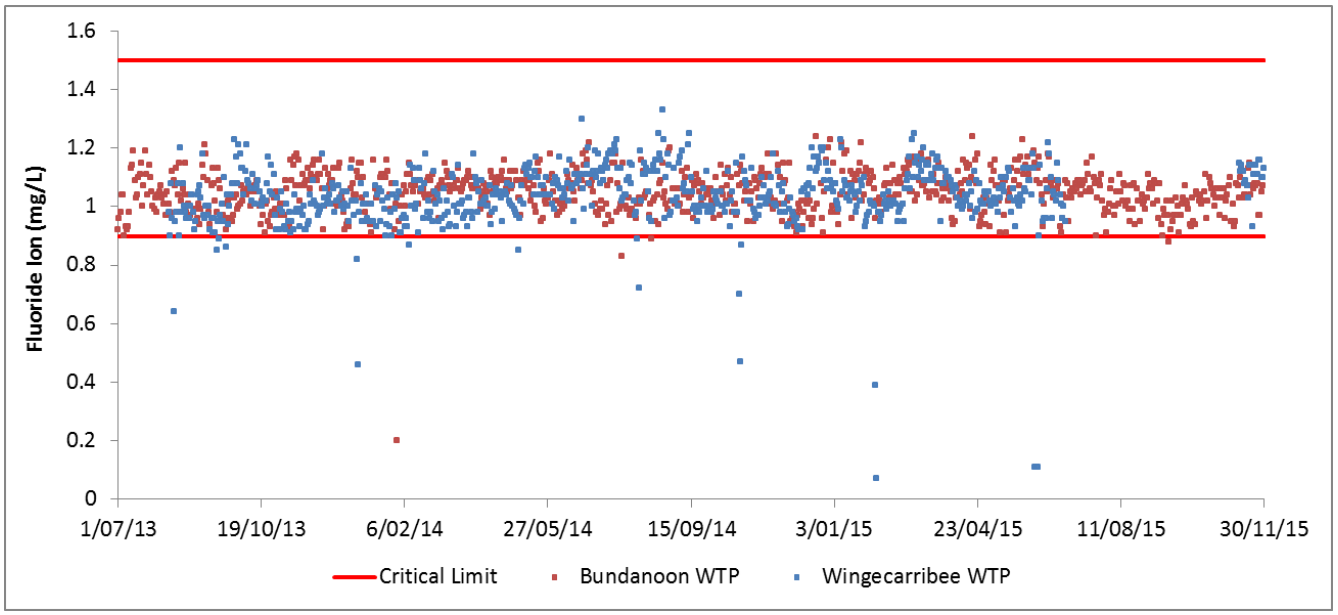


Figure 7.6: Treated Water Fluoride Concentration and CCP Critical Limits[1]
1 - lower critical limit defined as 72 hours below limit

7.1.3 Potable Water Reticulation

Water Quality

The free chlorine concentration of the reticulated potable water from 2012 to 2015 was reviewed, with results summarized in Table 7.4. The chlorine residual was frequently under the limit of the ADWG, which has been identified in addressing compliance with LWU Circular 18 and systems to improve compliance have been put in place.

Table 7.4: Free chlorine measured in reticulation

System	Date, year from	Mean	Minimum	% below guidline value 0.2 mg/L
Bundanoon	2012	0.52	0.02	36%
	2013	0.57	0.02	38%
	2014	0.18	0.01	74%
	2015	0.21	0	68%
Wingecarribee	2012	0.44	0.02	38%
	2013	0.41	0.01	44%
	2014	0.38	0.01	47%
	2015	0.21	0	34%

Table 7.5: Turbidity measured in reticulation

System	Date, year from	Mean	Maximum	% failing guideline value of minimum 5 NTU
Bundanoon	2012	0.05	0.05	0%
	2013	0.13	0.2	0%
	2014	0.28	0.5	0%
	2015	0.32	1	0%
Wingecarribee	2012	0.22	0.6	0%
	2013	0.61	4	0%
	2014	0.29	1	0%
	2015	0.43	1	0%

Compliance with LWU Circular 18

As of 10/06/2015 Council has addressed all requirements of LWU Circular 18. The Circular specifies the requirements for the following three barriers are assessed to assure integrity and safety of the water supply system.

Barrier 1: Effective Disinfection

All WTP's have had theoretical C.t and t5 calculations carried out and based on that data have had parameters set for flow, level, chlorine, pH and temperature. Computational Fluid Dynamic (CFD) modelling is currently being conducted on all three clear water tanks to confirm the theoretical desk top calculations.

The WTP Operators are trained and deemed competent in the requirement to ensure that adequate disinfection has been carried out and the requirement to maintain parameters within operating limits and escalate any deviations.

A free chlorine residual >0.5mg/L in maintained prior to the first customer, as can be seen from the CCP assessment in Section 7.1.2.

Barrier 2: Distribution System Integrity

All thirty of Wingecarribee Shire Council's reservoirs are inspected on a monthly schedule by operational staff to ensure that:

- The reservoir roofs are secured from entry by birds, animals, vermin and windborne contaminants.
- Rain water cannot enter into the reservoir (i.e. no leaking roof or holes in the reservoir wall or gaps around the openings on the roof).
- Roof is adequately drained especially near the openings and landings. The roof should extend beyond the reservoir wall.
- All inspection hatches are closed and locked at all times.
- The reservoir site and roof are secured from unauthorised access
- Review the reservoir maintenance standard operating procedure to ensure they are sound and fit for purpose.

Over the last five years numerous access hatches, access platforms, internal ladders, ridge capping and drainage projects have been carried out and completed to ensure reservoir integrity is maintained.

Barrier 3: Maintain a Free Chlorine Residual in the Water in the Distribution System

Council has identified some areas in the reticulation where a chlorine residual of 0.2 mg/L is not achieved. Council has installed a number of re-chlorination units and have a programme of work to carry out the following to improve the chlorine residual throughout the system.

- Computational Fluid Dynamic modelling of clear water tanks
- Water main cleaning (ice pigging)
- Zone management to improve water turnover and water age
- Additional re-chlorination units at service reservoirs
- Renew and replacement of sample facilities to ensure representative sampling locations and sample integrity is maintained

7.1.4 Treated Water Reticulation

The 2015 *Wingecarribee Shire Council System Master Planning Review* was commissioned to examine the performance of the Wingecarribee Shire Council water supply system performance under existing and future demands out to 2031 (in line with Council population forecasts). The objectives of the study have been expanded to include investigations into a range of operational and system management issues.

The *Wingecarribee Shire Council System Master Planning Review* identified a range of Hydraulic issues in the current water system:

Reservoir Fill Rates

A number of reservoirs operate with relatively high head differentials between the upstream system and the operating level in the reservoir. This can lead to a high head drop across the inlet valve or a high flow rate within the feeder main and a corresponding high head loss in this main. Both situations present undesirable risks to meeting Standard of Service (SoS) targets. To manage these risks, the Master Planning Review suggests that WSC consider installing solenoid controlled diaphragm type (or similar construction and operation) regulating valves at the inlets to these reservoirs.

The reservoirs that were identified as requiring investigation and further action are Yerrinbool, Willow Vale, Welby, Spencer St, Berrima and Balmoral.

Reservoir Storage Issues

The Master Planning Review analysed the storage capacity of all reservoirs and found that under the 2031 system with proposed upgrades, all reservoirs can maintain at least 12 hours PDD storage at their lowest operating level.

Mt Gib Reservoir zone has only marginally more than 12 hours PDD storage at 2031 conditions and the zone has relatively little future growth located in it suggesting that PDD storage is currently an issue.

New Berrima zone has only 17 hours storage however it is one of the most remote reservoirs. This will be an issue until the alternate supply from the Berrima zone is provided. This provides an alternate feed and makes the reservoir supply much more reliable. It is suggested on this basis that Council progress the secondary supply from Berrima WPS / Medway zone as a priority.

WTP Source Management

With three water treatment plants available, Council has flexibility in how different zones receive water supply. Council intends to strategically manage the operation of its three WTP in order to achieve the best cost and risk management outcomes.

By 2031, the PDD is predicted to be very close to the combined production capacities of Wingecarribee WTP and Bundanoon WTP. The issue is however that Wingecarribee WTP has a relatively small balancing storage in relation to the WTP throughput and it can be difficult to physically pump the continuous maximum WTP production rate into the system. The model has shown that under various conditions it is actually possible to do this however it is suggested that the decision to permanently deactivate Medway WTP be held off until further investigation can be undertaken into issues such as:

- Peak Day Demand persistence
- Final development level and demand of MEZ
- Unification of major site growth targets with actual population growth

The modelling results do however indicate that Wingeecarribee WTP and Bundanoon WTP could supply all of system demand up to 2026 assuming:

- Variable speed control is implemented at Wingecarribee WTP (completed)
- A transfer PRV from the Exeter zone to the Moss Vale system is provided at Oldbury Rd PRV (to be delivered in 2016/17 financial year)
- Evan's Lane WPS is upgraded to a duty of 110 L/s @ (completed)

7.2 Headworks Capacity

A time series graph showing the historical and projected peak day demand super-imposed with the design capacity of the existing treatment works for the Wingecarribee and Bundanoon schemes is provided in Figure 7.7.

As described in Section 5.6 of the *2015 System Master Planning Review*, it is proposed that Bundanoon WTP be used to supply the Moss Vale system which is currently serviced by Wingecarribee WTP. The projected PDD for these proposed supply areas are given in Figure 7.8.

Under the existing WTP supply area zoning, the Wingecarribee supply area PDD is predicted to exceed the WTP capacity by around 2031.

Under the proposed revised supply area zoning supplying Moss Vale from Bundanoon, the Bundanoon WTP capacity is already exceeded by the Bundanoon supply area peak day demand.

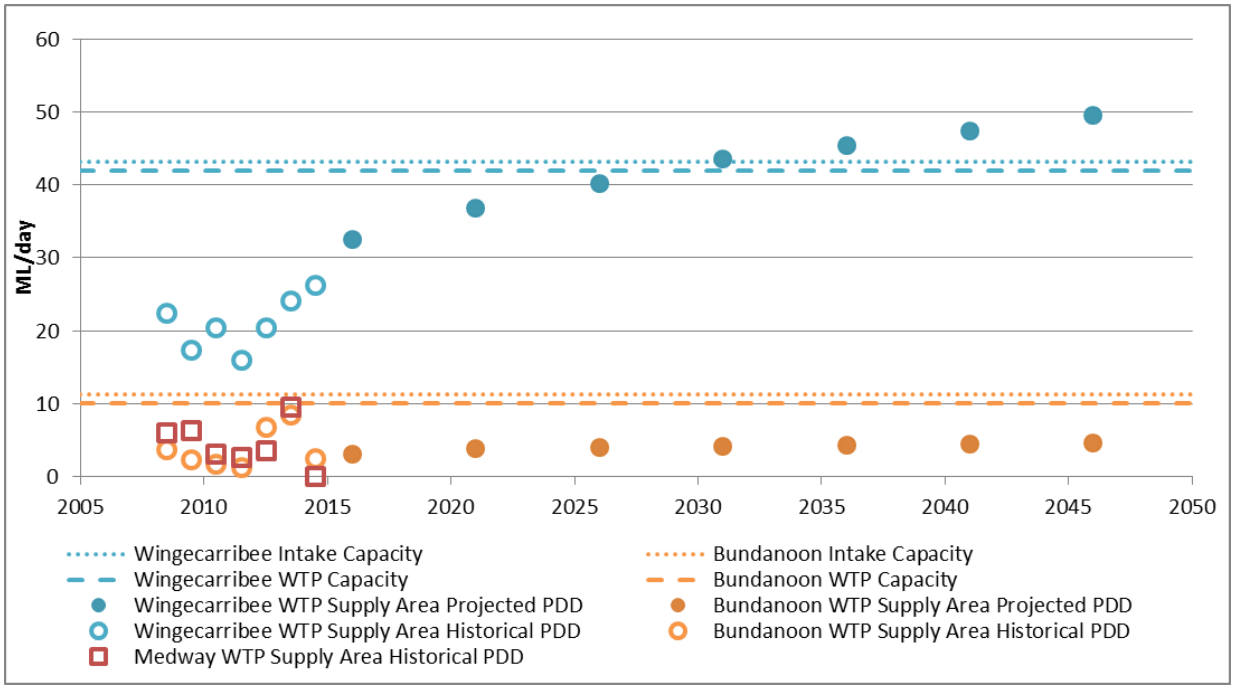


Figure 7.7: System Capacity and Projected Peak Day Demand – Existing Zoning

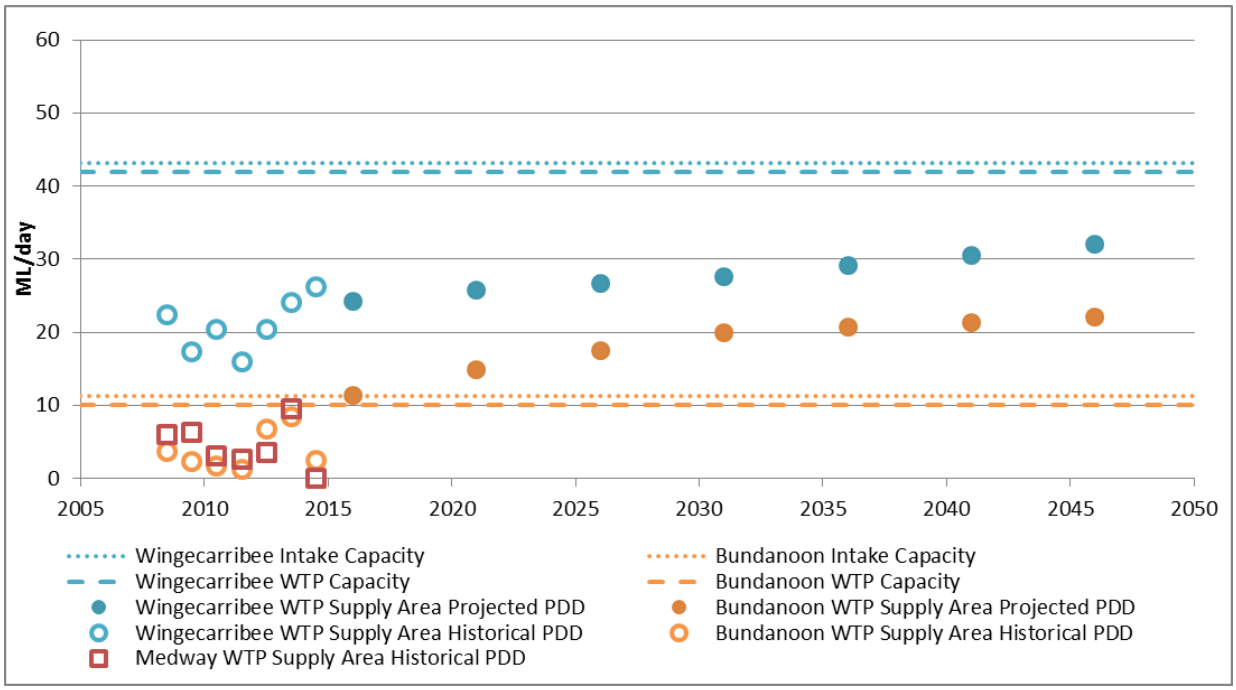


Figure 7.8: System Capacity and Projected Peak Day Demand – Proposed Zoning

7.3 Performance against LOS Targets

A review of the performance against the LOS Targets has been provided in Table 2.2.

8 Sewerage Scheme Capacity and Performance Assessment

8.1 Sewer Catchment Performance

Council's sewerage systems include 73 pumping stations. Following a review of the pumping hierarchy a selected number of pump stations were identified for a performance assessment. These are listed in Table 8.1. The results of the assessment are provided in the following Sections.

Table 8.1: Pump stations identified for performance assessment

Scheme	Pump Station	Contributing Pump Stations
Berrima	SPS-BE1	1,2,3,4
	SPS-BE5	1,5,6,7
Bowral	SPS-BW1	1,3,4,6,7,8,9,10
	SPS-BW2	2
	SPS-BW3	3,4,8
	SPS-BW6	6,7,9
	SPS-BW11	11,12,14
	Bowral Lift PS	All
Bundanoon	SPS-BU1	1
	SPS-BU2	2,7,11
	SPS-BU4	4,5,6
Mittagong	Colo Vale SPS 2	Colo Vale 1 and 2
	Hill Top PS	Hill Top 1 to 8
	Frankland St PS	Joadga St, Frankland St
	Aylmerton SPS 1	Aylmerton 1 and 2
	Mittagong SPS 1	Joadga St, Frankland St, Swimming Pool, Nero St, Mittagong PS
	Willow Vale PS 1	All
Moss Vale	SPS-MV4	4,6
	SPS-MV5	5
	SPS-MV8	8,9,10
	SPS-MV12	12

8.1.1 Odour/Septicity Potential

Septicity is generally considered to be a risk when detention in a rising main is greater than 4 hours. Detention times in the rising mains for the selected pump stations was calculated using formula in the NSW Public Works Sewer Pumping Station Design Manual. The results for all selected pump stations are given in Table 8.2 and expanded upon in Appendix G.1.

This is particularly noticeable for the pump stations BE1 in Berrima, BW3, BW6 and BW11 in Bowral, BU1 in Bundanoon, and MV4, MV8 and MV12 in Moss Vale. Many of these have longer than average rising main lengths.

Table 8.2: Detention Time in the rising main of selected sewer pumping stations

Scheme	Pump Station	Pump rate (L/s)	Rising main length (m)	Combined run time for SPS (hrs/day)		Detention Time (hrs)	
				Dry Weather	Wet Weather	Dry Weather	Wet Weather*
Berrima	SPS-BE1	10	1,104	1.35	4.73	10.05	2.87
	SPS-BE5	20	1,033	nd	nd	0.00	0.00
Bowral	SPS-BW1	50	387	2.15	8.85	1.23	0.30
	SPS-BW2	10	374	1.35	6.08	3.71	0.82
	SPS-BW3	10	502	1.14	4.70	5.70	1.38
	SPS-BW6	10	692	2.13	7.42	4.10	1.18
	SPS-BW11	50	1,415	2.82	8.38	4.94	1.66
Bundanoon	SPS-BU1	27	651	0.63	5.35	5.43	0.64
	SPS-BU2	31	461	0.72	4.90	1.91	0.28
	SPS-BU4	15	231	0.73	2.43	3.29	0.99
Mittagong	Colo Vale SPS 2	10	161	4.65	12.08	0.24	0.09
	Hill Top PS	35	129	3.81	9.25	0.36	0.15
	Frankland St PS	30	593	2.00	8.53	1.46	0.34
	Aylmerton SPS 1	10	672	7.37	13.78	0.35	0.19
	Mittagong SPS 1	200	402	1.67	8.18	1.24	0.25
	Willow Vale PS 1	320	15	2.48	11.02	0.28	0.06
Moss Vale	SPS-MV4	14	467	1.36	9.60	5.58	0.79
	SPS-MV5	30	516	0.64	4.59	2.34	0.33
	SPS-MV8	20	1,341	2.57	12.32	5.69	1.19
	SPS-MV12	17	1,680	3.50	20.76	6.08	1.02

8.1.2 Emergency Storage Capacity

The available storage volumes within the identified pumping stations are provided in Table 8.3, and expanded upon in Appendix G.2. Depending on the reason that the pump station fails, it will continue to receive flow from gravity only or from gravity plus other pump stations.

It should be noted that Council has adopted a Priority 1 system failure response time Level of Service of one hour during working hours and two hours after hours. The available storage at ADWF for the majority of pump stations is sufficient to cover for this response time to failures. However for certain pump stations including BW11 and the Lift PS at Bowral, Hill Top and Frankland St PS at Mittagong and MV8 at Moss Vale, the storage volume available is not sufficient to allow for the 2 hour failure response time.

It should also be noted that if a failure occurs just before the evening peak dry weather flow period the available storage reduces by half, as the flowrate is doubled (PDWF ~ 2 x ADWF), to one hour which will also not allow for the afterhours failure response time.

Table 8.3: Selected sewage pumping station storage volumes

Scheme	Pump Station	Operating Volume	Emergency Storage Volume	Time to fill Emergency Storage Volume	
				Gravity Only	Gravity + Pumped
Berrima	SPS-BE1	1.3	5.7	8.3	2.1
	SPS-BE5	1.3	4.8	3.0	0.6
Bowral	SPS-BW1	5.0	25.1	2.7	1.4
	SPS-BW2	4.8	43.7	4.8	4.8
	SPS-BW3	3.5	19.8	12.2	5.3
	SPS-BW6	1.4	9.5	7.3	1.9
	SPS-BW11	9.0	15.8	0.7	0.5
	Bowral Lift PS	31.8	43.4	0.4	0.4
Bundanoon	SPS-BU1	5.3	20.5	6.4	6.4
	SPS-BU2	10.9	97.1	35.7	16.9
	SPS-BU4	1.2	3.3	3.6	1.6
Mittagong	Colo Vale SPS 2	0.5	8.1	2.6	2.6
	Hill Top PS	1.4	22.8	1.2	1.2
	Frankland St PS	18.9	21.8	1.5	1.5
	Aylmerton SPS 1	0.5	7.6	5.7	5.7
	Mittagong SPS 1	30.2	62.8	3.0	1.8
	Willow Vale PS 1	38.0	146.3	4.6	1.6
Moss Vale	SPS-MV4	8.1	26.1	4.0	3.8
	SPS-MV5	2.7	17.4	4.8	4.8
	SPS-MV8	3.8	7.8	1.0	1.0
	SPS-MV12	2.7	19.9	2.5	2.5

8.1.3 Overflow performance

In response to Department of Environment and Climate Change (DECC) licensing requirements for sewerage systems (PRP 100), Council embarked on a programme to assess the performance of the sewerage systems within the Shire. Overflow performance of the systems was assessed for both the existing loads and also for the forecast loads in the year 2030.

Following consultation during the assessment Council proposes a 1 in 5 year ARI containment standard for all systems, apart from Bowral where a 1 in 1 year ARI containment standard is proposed. The results for the sewerage schemes are summarised below.

For Berrima the results of the study indicated that only two minor overflows would occur under a 10 year ARI event. No overflows are predicted to occur under a 5 year ARI event. To carry out augmentation works to meet the 1:10 ARI event would result in only minor environmental improvements.

Under dry weather conditions the Bowral system appears to be in reasonably sound condition with hydraulic capacities generally sufficient for both existing and future dry weather flows. Under wet weather conditions the modelling results indicate a large number of possible overflows at the year

2030, however, there are only five significant locations that will contribute 50% of the predicted flow volumes.

Within the Bundanoon system storm overflows occur only through pumping station capacity/storage issues at pumping stations 1,2,4,7 and 8.

The Mittagong system performs relatively well with the modelling results predicting 18 overflows in the ten year period under present conditions and 20 overflows under 2030 conditions. Constructed overflows at pumping stations do not activate at all during the 10 year period. All overflows emanate from manholes.

For the Moss Vale system assessment found that the hydraulic model of the existing system predicts overflows only occur as a result of a 1:5 year ARI flow event. Overflows were predicted to occur at 22 locations across the system and the total volume of overflow discharged from the system was 2.9ML. A similar result was predicted for the year 2030.

8.2 STP Performance

Time series graphs showing the projected EP growth with the STP design capacity are provided for each STP. All STPs were designed using typical design hydraulic loadings of 240 L/EP/day.

In 2015 GHD completed three capacity assessment and future upgrade strategy investigations for Bowral, Mittagong and Moss Vale STPs. The aim of these investigations was to develop strategies for the long term operation of Council's STPs which can then be included in Council's Asset Management Plans and incorporated into future long term financial plans. The outcomes and conclusions of these reports are given for the Bowral, Mittagong and Moss Vale STPs.

8.2.1 Berrima Sewerage Scheme

Figure 8.1 shows the projected EP growth in Berrima. It is estimated that the current load of 1,212 EP is below the 2,000 EP design capacity of the STP.

For the assessed hydraulic loading of 220 L/EP/day in this study (see Table 6.2), the functional hydraulic capacity of the STP is increased to 2,180 EP. At this capacity the STP hydraulic capacity will not be exceeded in the 30 year planning period.

The Berrima STP is also expected to remain within its biological/nutrient design capacity up to and beyond 2046, as shown in Figure 8.2. This is assuming that actual loading is equal to or less than standard design values.

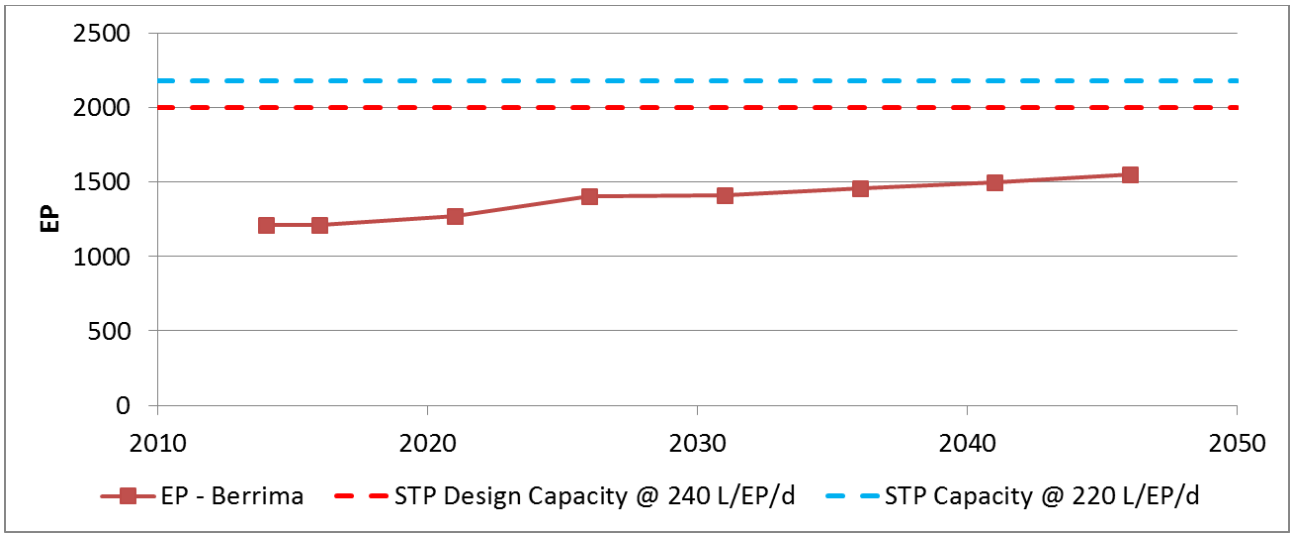


Figure 8.1: Berrima STP - projected EP growth and STP hydraulic capacity

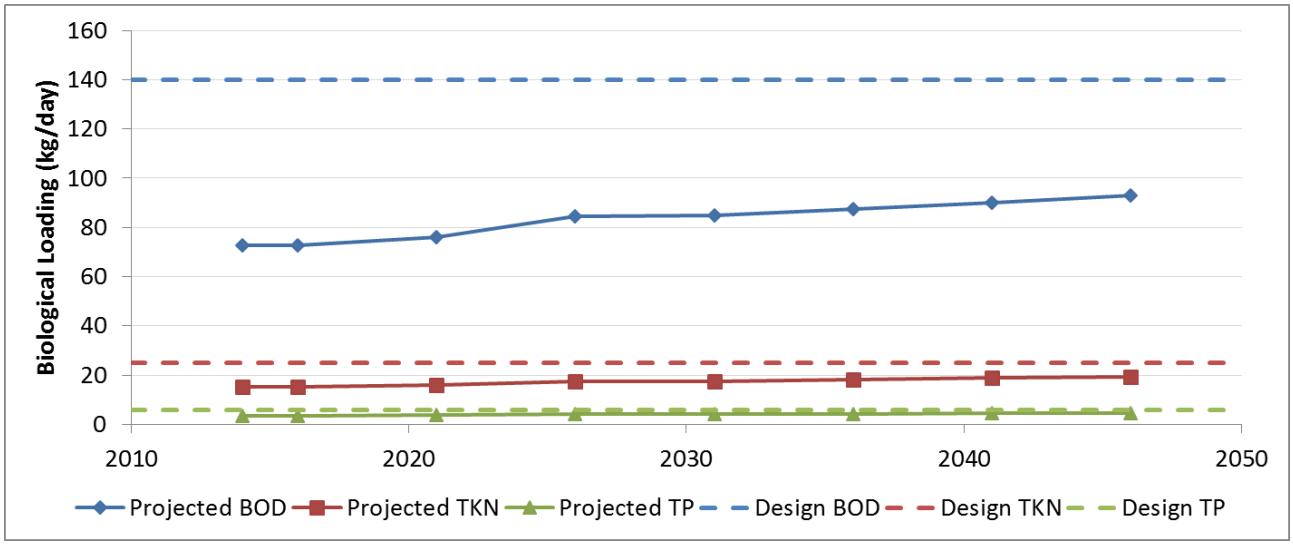


Figure 8.2: Berrima STP - projected biological loading and plant capacities

8.2.2 Bowral Sewerage Scheme

Figure 8.3 shows the projected EP growth in Bowral. The current estimated EP treated by the plant of 14,842 is already past the plant's design capacity of 14,600 EP.

For the assessed hydraulic loading of 220 L/EP/day in this study (see Table 6.2), the functional hydraulic capacity of the STP is increased to 15,930 EP. At this capacity it is estimated that the STP hydraulic capacity will not be exceeded until around 2021.

The Bowral STP is also expected to be currently operating past its biological/nutrient design capacity, as shown in Figure 8.4. This is assuming that actual loading is equal to or less than standard design values.

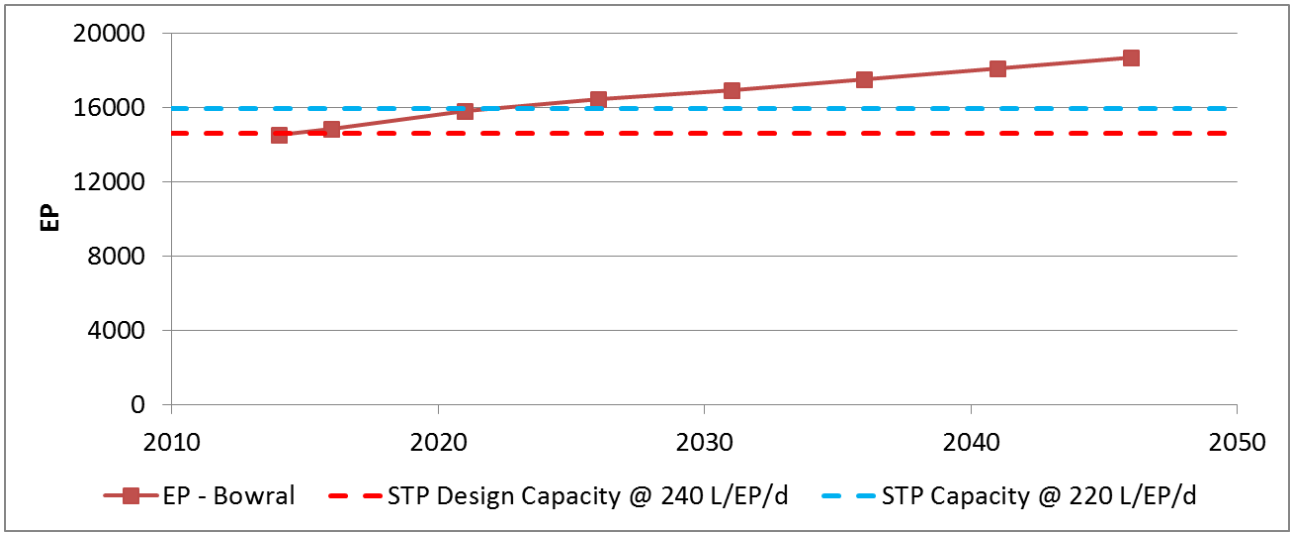


Figure 8.3: Bowral STP - projected EP growth and STP hydraulic capacity

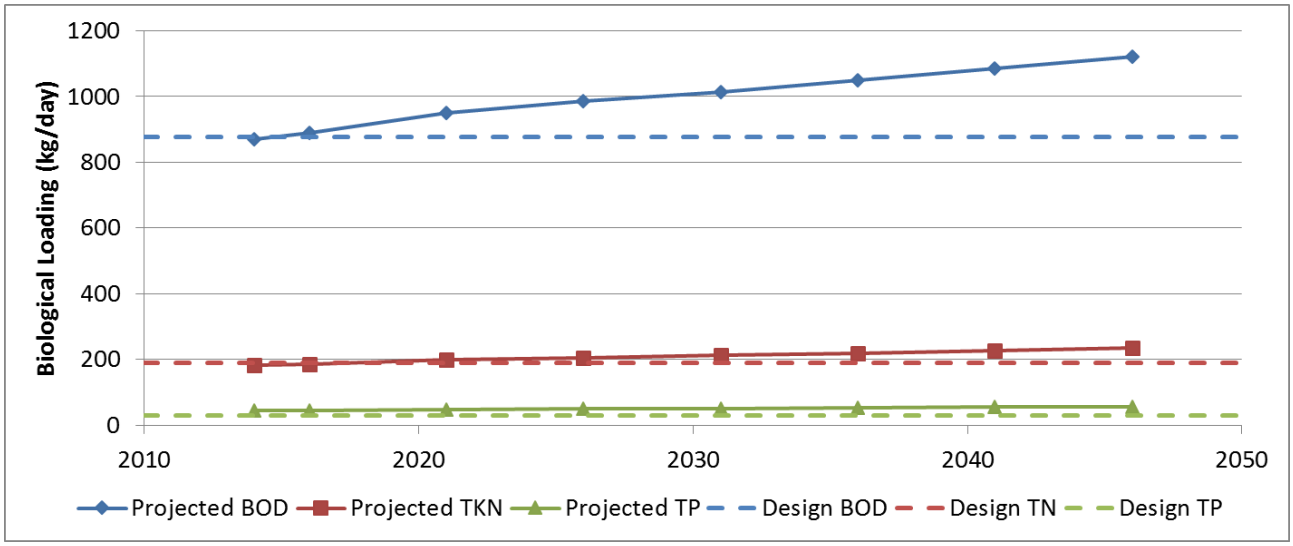


Figure 8.4: Bowral STP - projected biological loading and plant capacities

Major Conclusions from GHD Report

The major conclusions regarding the Bowral STP load and capacity are:

- The STP is very lightly loaded in terms of COD and BOD. In other words, there is very little carbon available. This will present significant nutrient removal issues at the treatment plant, due to biological nutrient removal requiring carbon for microbial growth.
- The plant is failing to meet the long term 50%ile licence limit for total nitrogen, however is comfortably meeting the 90%ile target. All other parameters are currently meeting licence conditions.
- The inlet works have been designed to divert flows is excess of 280L/s to the wet weather storage pond. This arrangement will result in licence breach in periods when the wet weather storage pond overflows to the environment. The existing EPL stipulates flows up to 344L/s must be screened before discharging to the environment.
- The rated capacity of the secondary treatment system (IDEA) is insufficient to treat the stated design loads. The combined IDEA-Pasveer capacity is insufficient to treat the current flows.
- The catch pond is currently not operating efficiently due to full STP shut-down being required monthly to undertake cleaning tasks.
- The tertiary filtration and UV disinfection systems are performing as specified and have sufficient capacity for future growth.

NorBE conclusions demonstrate:

- Bowral STP is already performing with effluent concentrations comparable or lower than other treatment plants within the Sydney Drinking Water Catchments.
- Even when options were considered where the effluent concentration limits were more stringent than expected for other catchment based plants, NorBE was not assured.
- A NorBE for phosphorus would be attained at 0.1 mg/L, which is 50% lower than typically licenced.
- Any move to achieving this neutral outcome needs to be balanced with the additional alum cost, the operational difficulty of optimising the alum treatment and the toxic effect of the discharge of excess alum.
- An increase in nitrogen is expected which may increase aquatic vegetation growth, but is not expected to significantly alter the waterway function.

- The issues of a lack of industrial clients and a high rainfall climate are two challenges to mitigating the discharge through partial reuse.
- The susceptibility of the waterway to low flow conditions supports the maintaining of the discharge to the river at neutral or beneficial concentrations.
- NorBE assessment indicates that partial NorBE can be achieved by implementing recycled water schemes, however it is acknowledged that Council's potential scope for such schemes is limited for Bowral STP catchment.

8.2.3 Bundanoon Sewerage Scheme

Figure 8.5 shows the projected EP growth in Bundanoon. It is estimated that the current load of 2,623 EP is below the 5,400 EP design capacity of the STP.

For the assessed hydraulic loading of 200 L/EP/day in this study (see Table 6.2), the functional hydraulic capacity of the STP is increased to 6,400 EP. At this capacity the STP hydraulic capacity will not be exceeded in the 30 year planning period.

The Bundanoon STP is also expected to remain within its biological/nutrient design capacity up to and beyond 2046, as shown in Figure 8.6Figure 8.2. This is assuming that actual loading is equal to or less than standard design values.

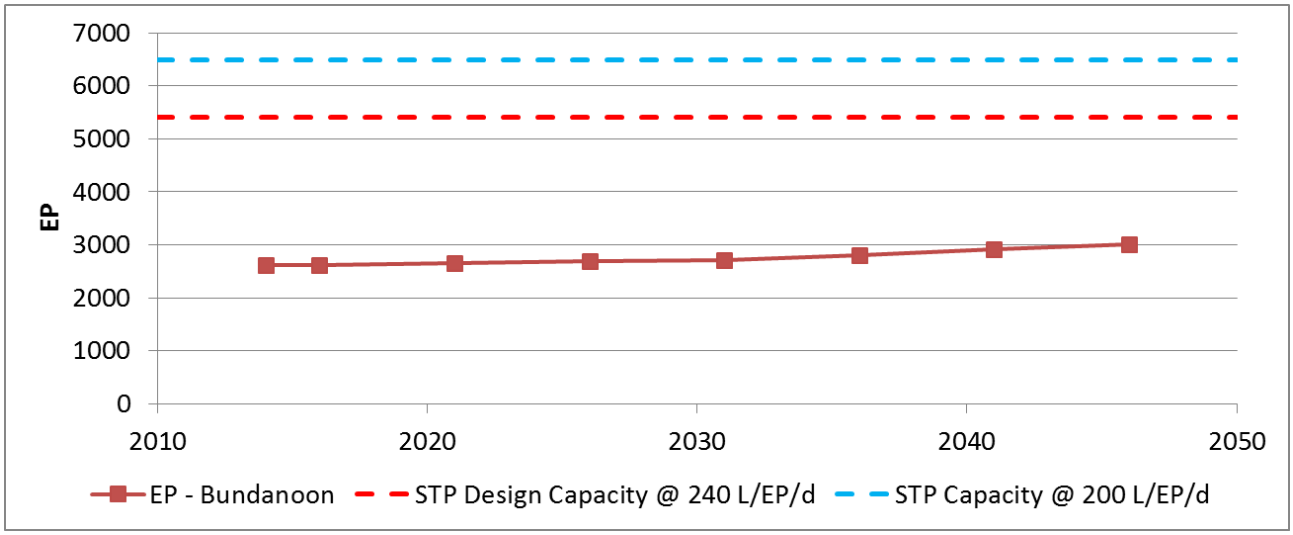


Figure 8.5: Bundanoon STP - projected EP growth and STP hydraulic capacity

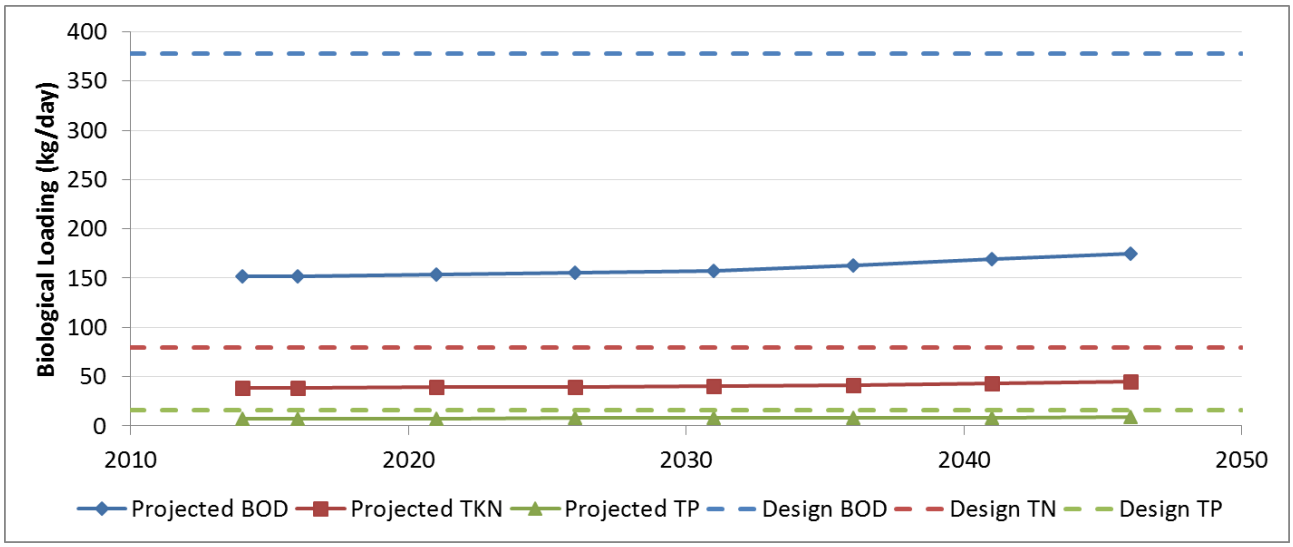


Figure 8.6: Bundanoon STP - projected biological loading and plant capacities

8.2.4 Mittagong Sewerage Scheme

Figure 8.7.shows the projected EP growth in Mittagong. The current estimated EP treated by the plant of 14,047 is already past the plant's design capacity of 14,000 EP.

For the assessed hydraulic loading of 200 L/EP/day in this study (see Table 6.2), the functional hydraulic capacity of the STP is increased to 16,800 EP. At this capacity it is estimated that the STP hydraulic capacity will not be exceeded until around 2039.

The STP is currently operating within the capacity for BOD loading due to the low BOD loading measured in the 2009 Influent Sewage Monitoring Report. The Sewage Monitoring Report also measured TKN and ammonia nitrogen (NH_3-N) concentrations that were in the high strength range of domestic wastewater quality, and thus the plant is currently operating past its capacity for Nitrogen loading. This is shown in Figure 8.8.

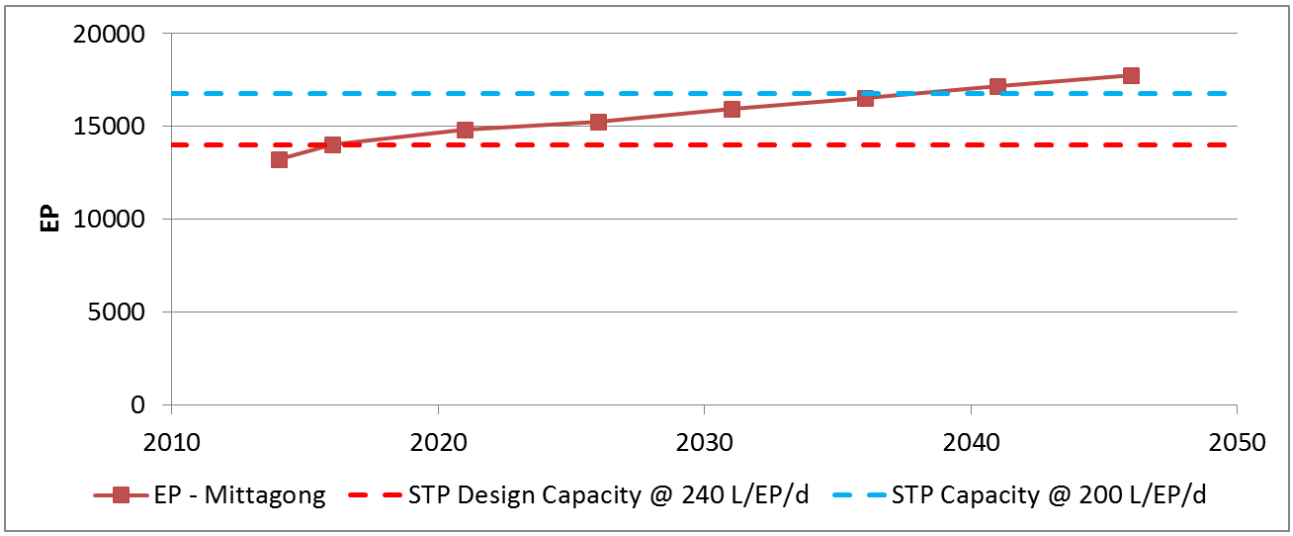


Figure 8.7: Mittagong STP - projected EP growth and STP hydraulic capacity

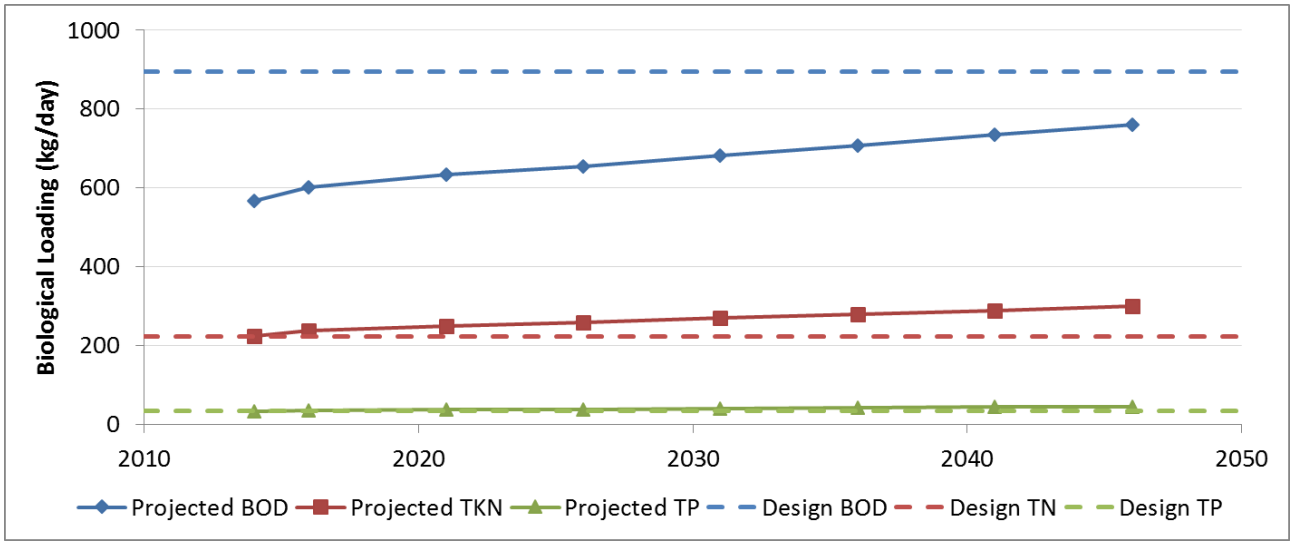


Figure 8.8: Mittagong STP - projected biological loading and plant capacities

Major Conclusions from GHD Report

The major conclusions regarding the Mittagong STP load and capacity are:

- The STP is very lightly loaded in terms of COD and BOD. In other words, there is very little carbon available. This will present significant nutrient removal issues at the treatment plant, due to biological nutrient removal requiring carbon for microbial growth.

- The plant is currently meeting all licence conditions, with the possible exception of maximum effluent flow discharge. Existing EPL flow conditions should be confirmed prior to undertaking further works.
- The inlet works design is not efficient for step screen operation, due to the intermittent very high flows experienced at the STP as a result of Willow Vale 1 Pump Station operation. While there is some theoretical spare capacity in the screening system, the nature of the pump station operation creates operation issues for the screen, and screenings capture rates are considered very low.
- Wet weather storage bypass occurs post-IDEA tanks, and therefore the full hydraulic flow must be passed through the reactors before being diverted. This arrangement fails to provide any protection to the reactors during periods of very high flows, and should be modified such that wet weather bypass occurs post inlet screens.
- The rated capacity of the secondary treatment system (IDEA) is sufficient to treat the design loads, and should be sufficient until 2021 if population growth is as per the supplied predictions. Secondary treatment capacity is limited by the decanter hydraulic capacity, specifically maximum throughput. Bypassing the reactors in peak wet weather flow will alleviate this problem.
- The UV disinfection systems are performing as specified and have sufficient capacity for future growth, subject to the capacity of future effluent pump station upgrades.

NorBE conclusions demonstrate:

- Mittagong STP is already performing with effluent concentrations comparable to other treatment plants within the Sydney Drinking Water Catchments. Even when options were considered where the effluent concentration limits were more stringent than expected for other catchment based plants, NorBE was not assured.
- A NorBE for phosphorus cannot be attained, even at 0.1 mg/L, which is 50% lower than typically licenced, although water quality objectives would be met. Note that any move to operating at 0.1 mg/L phosphorus needs to be balanced with the additional alum cost, the operational difficulty of optimising the alum treatment and the toxic effect of the discharge of excess alum.
- An increase in nitrogen is expected which may increase aquatic vegetation growth, but is not expected to significantly alter the waterway function.
- The issues of a lack of industrial clients and a high rainfall climate are two impediments to mitigating the discharge through partial reuse.
- The susceptibility of the waterway to low flow conditions supports the maintaining of the discharge to the river at neutral or beneficial concentrations

8.2.5 Moss Vale Sewerage Scheme

Figure 8.9 shows the projected EP growth in Moss Vale under the scenarios with and without the MVEC development contributing to the STP load. The Moss Vale Enterprise Corridor (MVEC) estimated to have contributed an estimated 4,625 EP to the sewage load in 2016 and an additional approximately 915 EP every year until 2031.

The current estimated EP treated by the plant is 12,298 with the MVEC or 8,303 EP without the MVEC. Including the load from the MVEC the 9,000 EP capacity of the plant is already exceeded. Without the load from the MVEC, the STP capacity is estimated to not be exceeded until around 2020.

Including the load from the MVEC, the biological / nutrient capacity of the plant is not expected to be exceeded until around 2018, shown in Figure 8.10. This is despite the plant capacity being exceeding in terms of EP because the biological / nutrient loading rates measured in the 2009 Influent Sewage Monitoring Report are lower than the STP design loading rates,

If the MVEC is not included, plant's biological nutrient loading is not expected to exceed the design capacity in the next 30 years, shown in Figure 8.11.

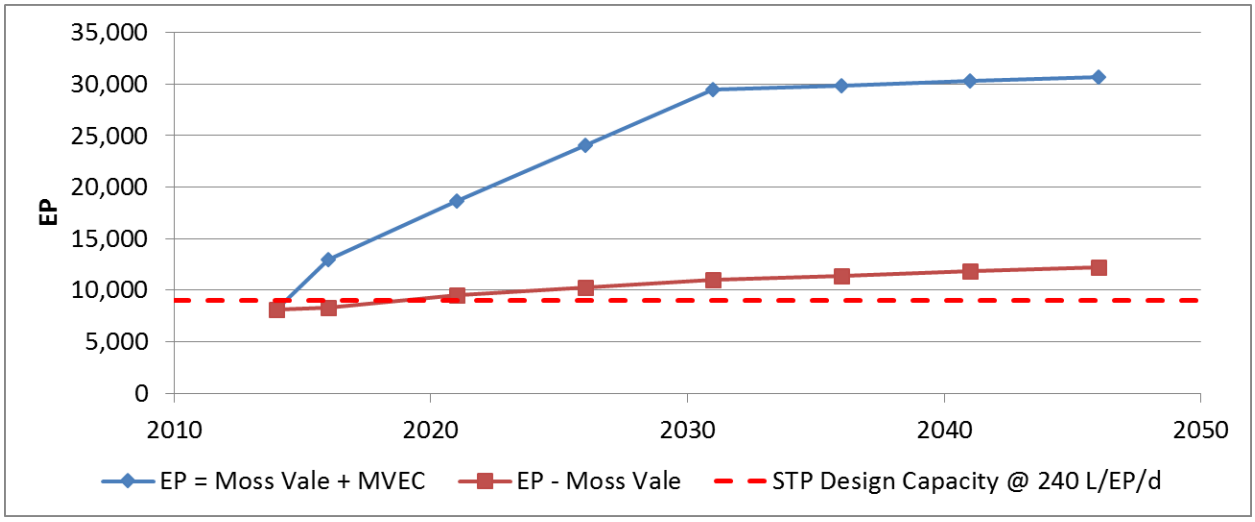


Figure 8.9: Moss Vale STP + MVEC - projected EP growth and STP hydraulic capacity

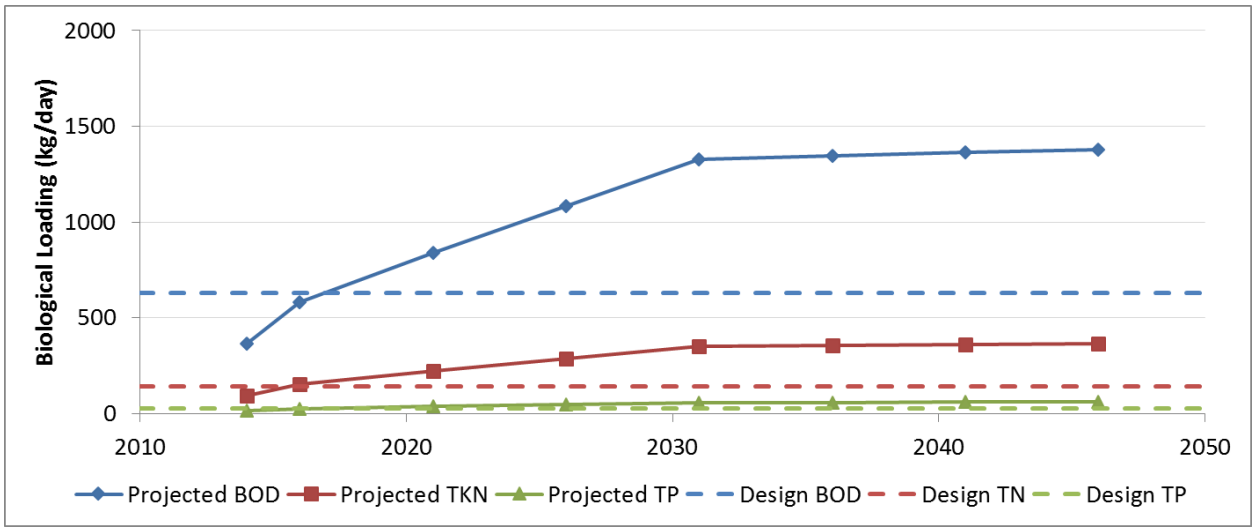


Figure 8.10: Moss Vale STP - projected biological loading and plant capacities (with MVEC)

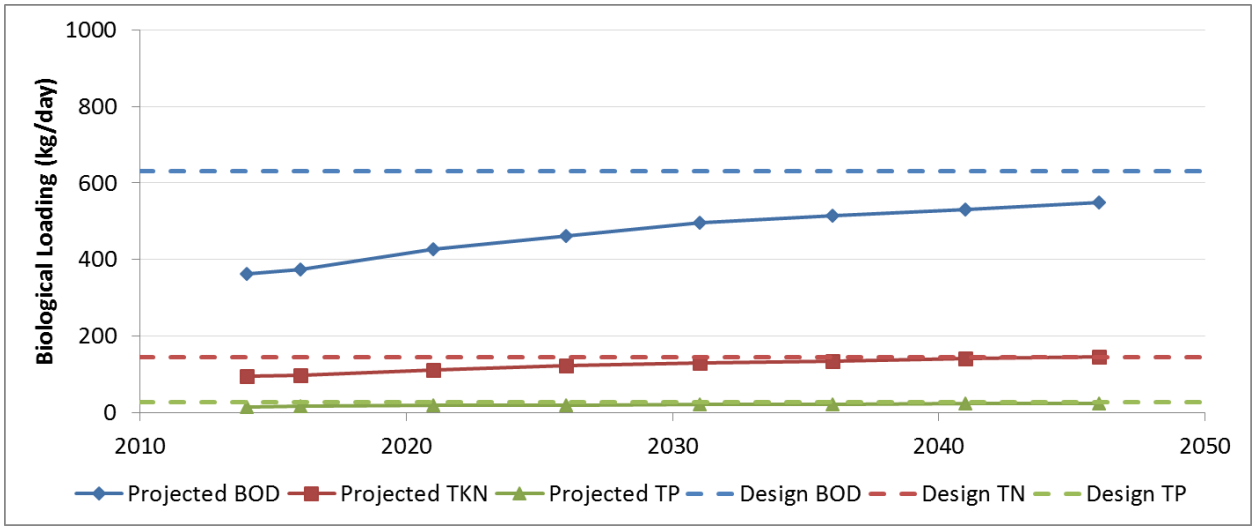


Figure 8.11: Moss Vale STP - projected biological loading and plant capacities (without MVEC)

Major Conclusions from GHD Report

The major conclusions regarding the Moss Vale STP load and capacity are:

- The STP is generally very lightly loaded in terms of COD and BOD, nutrients and solids, with all parameters approximately 20 to 50% less than the original design loads. The raw sewage is therefore considered very dilute. This has little impact on treatment with the exception of the COD to nutrient ratio which will dictate the nutrient removal performance of the system.
- The STP operates under the original EPL conditions, and licence conditions are much more lenient than most STPs operate under. The plant is typically meeting all licence parameters and performing within the expected ranges. In recent years there has been one incidence of exceeding the TN maximum licence (in 2011). It is not expected that the maximum concentration for TN will be reached very often given the level of process stability being achieved.
- The existing inlet works is nearing the end of its design life mechanically and electrically, and requires replacement as well as upgrading the capacity.
- The rated capacity of the secondary treatment system (EATs) is sufficient to treat the stated design loads. The plant is nearing capacity now and is expected to exceed that capacity within the next year, due to forecasted catchment growth.
- The UV disinfection system is performing well considering the age of the facility. It has sufficient capacity to treat the current flows only, and will need to be upgraded to meet future flows.

NorBE conclusions demonstrate:

- Moss Vale STP is already performing with effluent concentrations comparable to other treatment plants within the Sydney Drinking Water Catchments, despite having less stringent compliance targets.
- Even when options were considered where the effluent concentration limits were more stringent than expected for other catchment based plants, NorBE was not assured.
- A NorBE for phosphorus cannot be attained beyond 2026, even at 0.1 mg/L, which is 50% lower than typically licenced, although water quality objectives would be met. Note that any move to operating at 0.1 mg/L phosphorus needs to be balanced with the additional alum cost, the operational difficulty of optimising the alum treatment and the toxic effect of the discharge of excess alum.
- An increase in nitrogen is expected which may increase aquatic vegetation growth, but is not expected to significantly alter the waterway function.
- The issues of a lack of industrial clients and a high rainfall climate are two impediments to mitigating the discharge through partial reuse.
- The susceptibility of the waterway to low flow conditions supports the maintaining of the discharge to the river at neutral or beneficial concentrations

9 Unserviced communities

A summary of the unserviced communities within the Wingecarribee Shire is provided in Table 9.1.

Table 9.1: Unserviced Communities

Town	Current Services	2001 EP*	2011 Census			
			Community		Surrounding Rural area	
			Dwellings	People	Dwellings	People
Balmoral	None	165	140	314	4	20
Burrawang	Water	235	159	245	111	174
Exeter	Water	369	277	527	129	229
Fitzroy Falls	None	<200	32	52	85	167
Kangaloon	None	<200				
Penrose	None	169			124	234
Sutton Forest	Water	218	44	92		
Wingello	None	264	172	383		
Yerrinbool	Water	927	366	1024	25	77

*CH2MHILL. 2001. Sydney Catchment Authority: Review of Catchment Sewerage Needs

Servicing small communities

Penrose and Wingello were surveyed in 2014 and 73% of responses received were not in favour of new water or waste water services. A similar survey in Balmoral Village in 2015 found that 51% of responses were not in favour. Following each survey, Council voted unanimously to defer the matter for five years and re-analyse the community needs in 2019 and 2020 respectively.

There are at least 5,000 On-site Sewage Management Systems (OSMS) across the Shire consisting of septic tanks or aerated systems. The process of installing an OSMS requires approval to install and approval to operate from Council. An ‘Approval to Operate’ license is granted for a period of two, three or five years.

Council has an ‘On-site Sewage Management Strategy’ adopted in 200 and last reviewed in 2014. Council maintains a register of all OSMS’. Council have indicated that they do experience shortage of resources to undertake the number of inspections required.

A summary of the review of the on-site sewage management systems (OSMS) for the unsewered villages in provided in Table 9.2.

Table 9.2: Summary of review of on-site sewage management systems in villages

Villages	Approximate number of OSMS	Typical risk rating assigned to OSMS	General soil type	Features
Burrawang	143	Low-Moderate	Clay loam	Deep soils aid system performance
Wingello	130	Low	Sandy clay loam	Below average failure rate
Penrose	100	Low	Sandy soil	Below average failure rate
Exeter	266	Moderate-High	Medium to heavy clay	Poor permeability of soils can be limiting

Villages	Approximate number of OSMS	Typical risk rating assigned to OSMS	General soil type	Features
Sutton Forest	132	Moderate	Medium clay	A number of older systems evident
Yerrinbool	256	Moderate	Sandy medium clay	Limited land area available for effluent disposal on many property's. High concentration of systems.
Medway	27	Moderate	Medium clay	A number of older systems evident
Balmoral	83	Moderate	Sandy clay	Shallow soils
Fitzroy Falls	72	Moderate	Medium clay	High rainfall area
Wildes Meadow	94	Moderate	Medium clay	A number of older systems evident
East Kangaloon	22	Low-Moderate	Light clay	Soils relatively suited to on-site disposal.

10 Water service system issues

The Wingecarribee Shire water service system issues that have been identified through the analysis, are outlined in Table 10.1.

Table 10.1: Water Service System Issues at Wingecarribee Shire

Element	Issue	Issue Type	Comment
WTP Source management	By 2031 the PDD is predicted to be very close to the combined production capacities of Wingecarribee and Bundanoon WTPs.	System Capacity	The WSSMP suggests that the decision to permanently deactivate Medway WTP be held off until further investigations are undertaken.
WTP Source management	The WSSMP suggests that operational changes are required in order for Wingecarribee and Bundanoon WTPs to supply all of the system demand up to 2026.	System Capacity	
Security of Supply	Under the existing WTP supply area zoning, the Wingecarribee supply area PDD is predicted to exceed the WTP capacity by around 2031.	Capacity	This is without considering the additional roughly 25% increase in demand noted during the bushfires in 2014.
Security of Supply	Under the proposed revised supply area zoning, the Bundanoon WTP capacity is already exceeded by the Bundanoon supply area peak day demand.	Capacity	
Water treatment plant	The Drinking Water Management Plan risk assessment identified the need to confirm the chlorine contact time (C.t value) available at both WTPs	Performance	Computational fluid dynamic modelling is currently being undertaken to confirm the contact time available
Water distribution system	There are some areas in the reticulation where a chlorine residual of 0.2 mg/L is not achieved.	Regulatory	Council has identified a programme of work to improve the chlorine residual in the system.
Sampling and testing	It is noted that there is a discrepancy between the on-line and bench top test results for water quality.	Best Practice Management	Indicates that one or the other has not been calibrated correctly or the true reading is not within the range of the instrumentation
Drinking water management plan	The dam water extraction and reticulation free chlorine have been identified as Critical Control Points (CCP). Based on the definition and role of a CCP these parameters are not considered as CCPs.	Best Practice Management	A review of the CCPs is suggested during the annual DWMS audit.

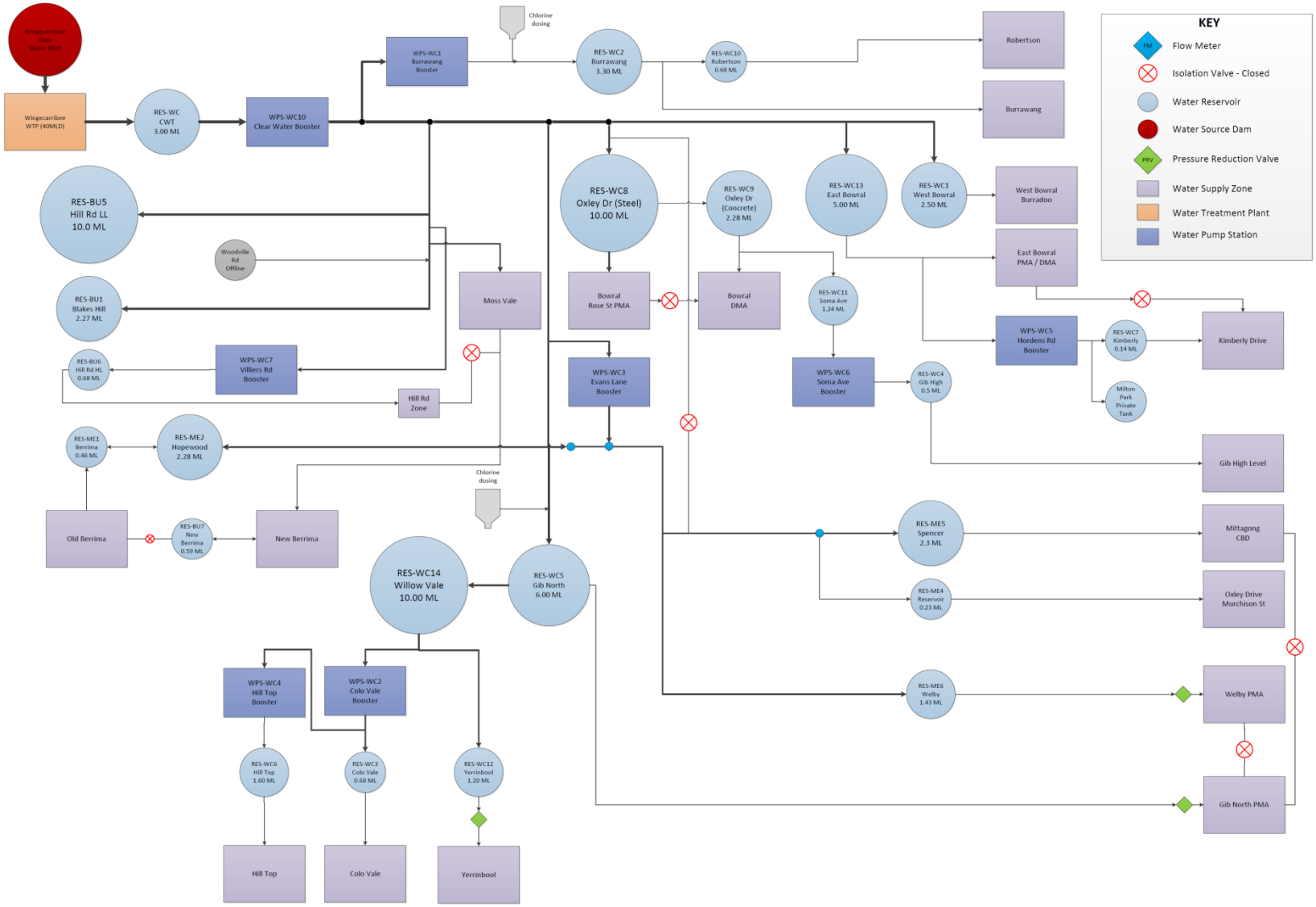
Element	Issue	Issue Type	Comment
Water reticulation system	The WSSMP review identified a number of reservoirs that operate with relatively high differential head which presents a risk in meeting the supply pressure	Level of Service	WSSMP suggests installing regulating valves at these reservoir inlets
Water reticulation system	The WSSMP found that under the 2031 system demand Mt Gib and New Berrima have only marginally more than the 12 hours PDD storage required.	Level of Service	The WSSMP suggests that Council progress the secondary supply from Berrima WPS/Medway zone as a priority
Berrima Sewerage Scheme	A sewage detention time of about 10 hours at ADWF was calculated for pumping station BE1 which has the potential for septicity and odour generation.	Performance	
Sewerage pumping stations	Pumping station BE5 at Berrima, BW11 and Lift PS at Bowral, Hill Top at Mittagong and MV8 at Moss Vale all have an emergency storage of less than 2 hours under ADWF	Performance	Council has adopted a failure response time of one hour during working hours and two hours after hours. The PIRMP contains an incident response management plan to respond to sewage overflow incidents
Bowral STP	Regular exceedance of the 50th percentile limit of total nitrogen and some exceedances of the 90th percentile for total phosphorus.	Regulatory	
Bowral STP	The plant has a hydraulic design capacity of 14,600 EP based on a loading of 240 L/EP/d. The current estimated EP of about 15,000 exceeds the design capacity.	Capacity	Due to the lower estimated loading of 202 L/EP/d, it is expected that the hydraulic capacity of the plant will be exceeded at around 2030.
Bowral STP	The plant is currently operating past its capacity for biological loading.	Capacity	
Bowral STP	The plant is currently operating past its capacity for total nitrogen.	Capacity	
Mittagong STP	Exceeded 50th percentile concentration limit for total nitrogen.	Regulatory	
Mittagong STP	The plant has a hydraulic design capacity of 14,000 EP based on a loading of 230 L/EP/d. The current estimated EP of about 16,500 exceeds the design capacity.	Capacity	Due to the lower estimated loading of 145 L/EP/d, it is expected that the hydraulic capacity of the plant will not be exceeded.

Element	Issue	Issue Type	Comment
Mittagong STP	The plant is currently operating past its capacity for total nitrogen and total phosphorus.	Capacity	
Moss Vale Sewerage Scheme	A sewage detention time of about 6 and hours at ADWF was calculated for pumping station MV8 and MV12 respectively which has the potential for septicity and odour generation.	Performance	
Moss Vale STP	Exceedance of total load limits for nitrogen due to extra flows at the STP.	Regulatory	
Moss Vale STP	Exceedance of total daily volume limit due to inflow infiltration	Regulatory	
Moss Vale STP	The current estimated EP of 8,988 treated by the plant means that the plant is operating at its current design capacity of 9,000 EP. However if the MVEC has progressed as expected, then the current estimated EP is 11,212 which exceeds the design capacity of the plant.		The Moss Vale Enterprise Corridor (MVEC) development will need to be considered when determining the extent of any upgrade required.
Moss Vale STP	The biological/nutrient loading rates measured in the 2009 Influent Sewage Monitoring Report were lower than the STP design loading rates hence the biological / nutrient capacity of the plant is not expected to be exceeded until around 2018.	Regulatory	The MVEC development will need to be considered when determining the extent of the upgrade required.
NorBE	For each STP upgrade the GHD report concluded that even when options were considered where the effluent concentration limits were more stringent than expected for other catchment based plants, NorBE was not assured.	Regulatory	
Unserviced areas	Council has an on-site sewage management strategy but experience shortage of resources to undertake number of inspections required.	Best Practice Management	

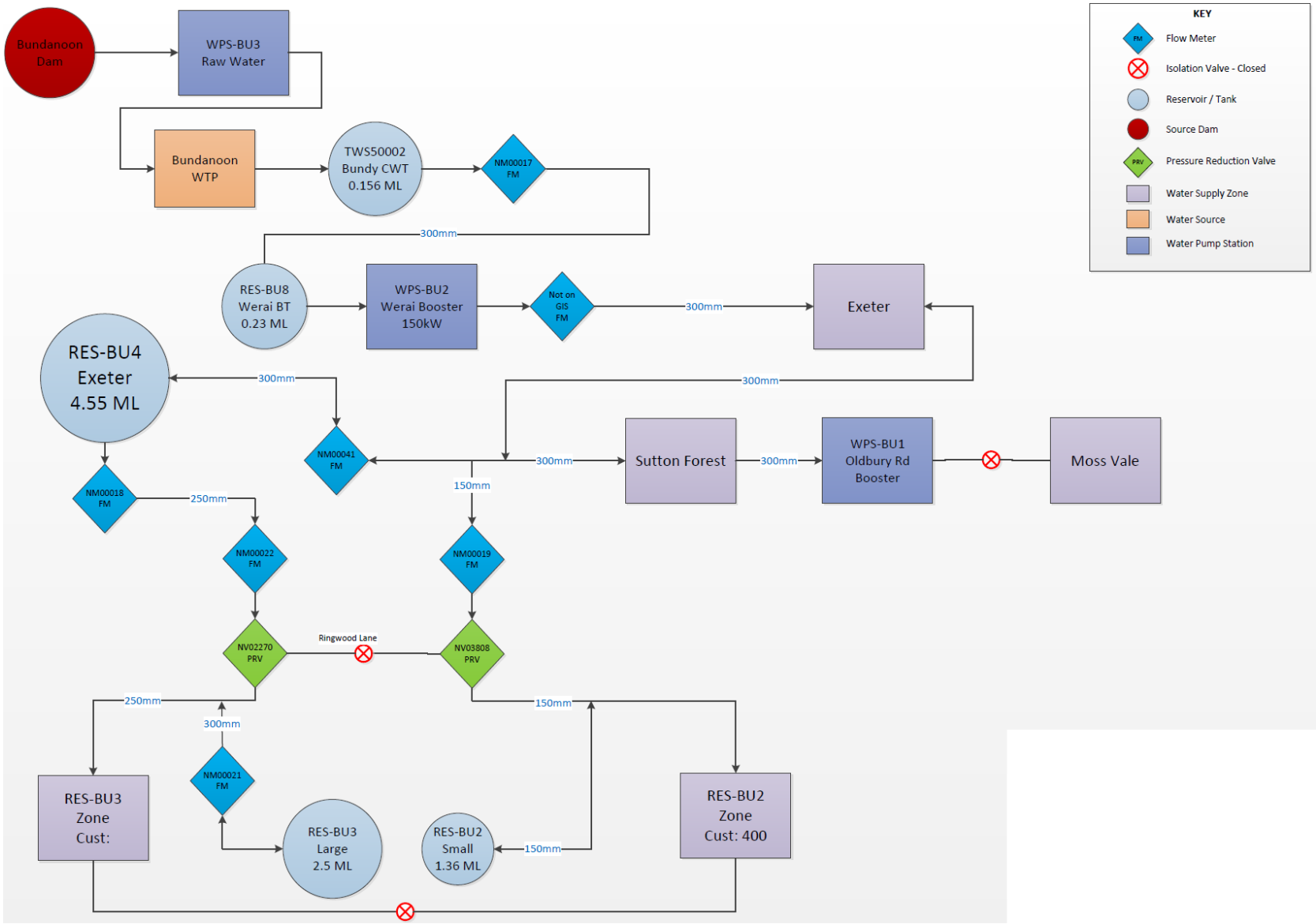
Appendices

Appendix A : Water Supply Scheme Schematic

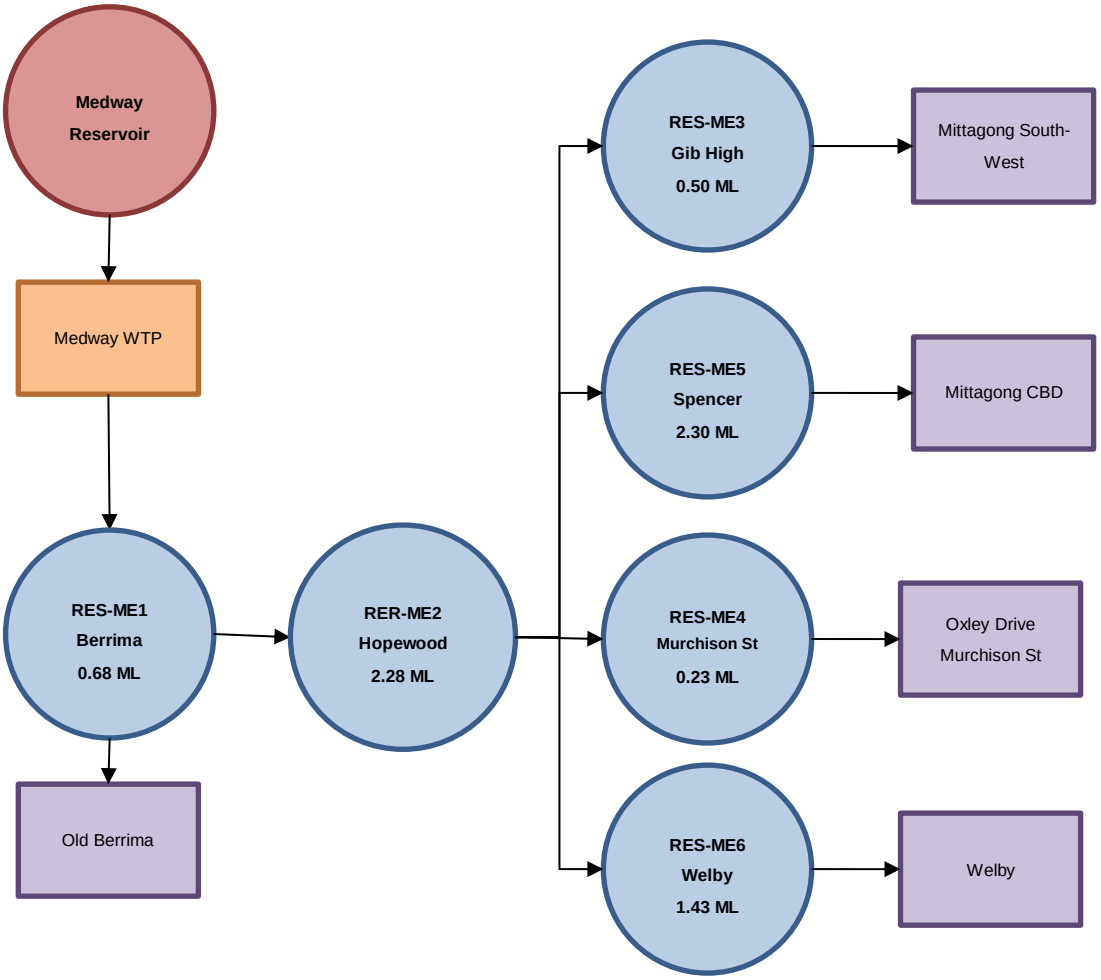
A.1 Wingecarribee WTP water supply scheme



A.2 Bundanoon WTP water supply scheme

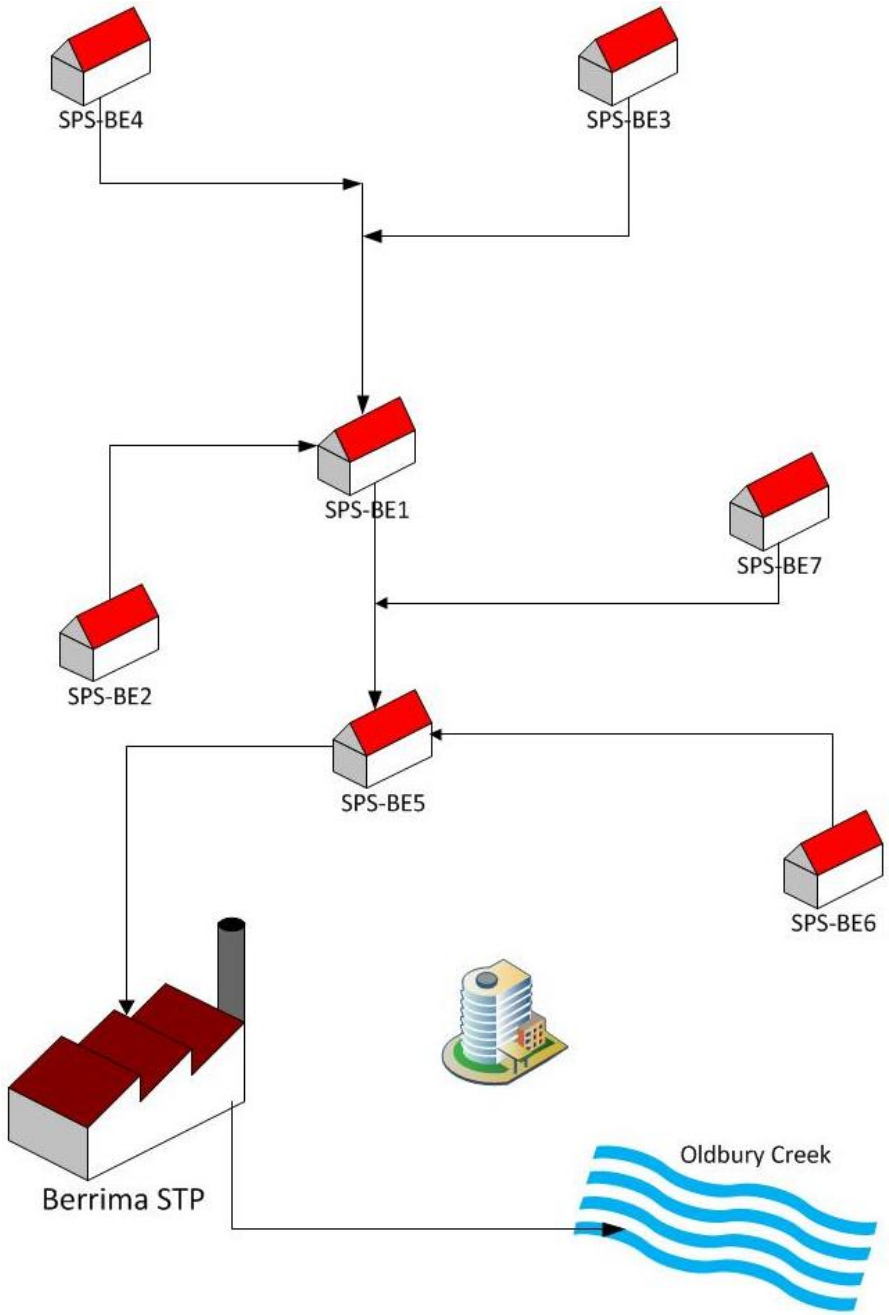


A.3 Medway WTP water supply scheme

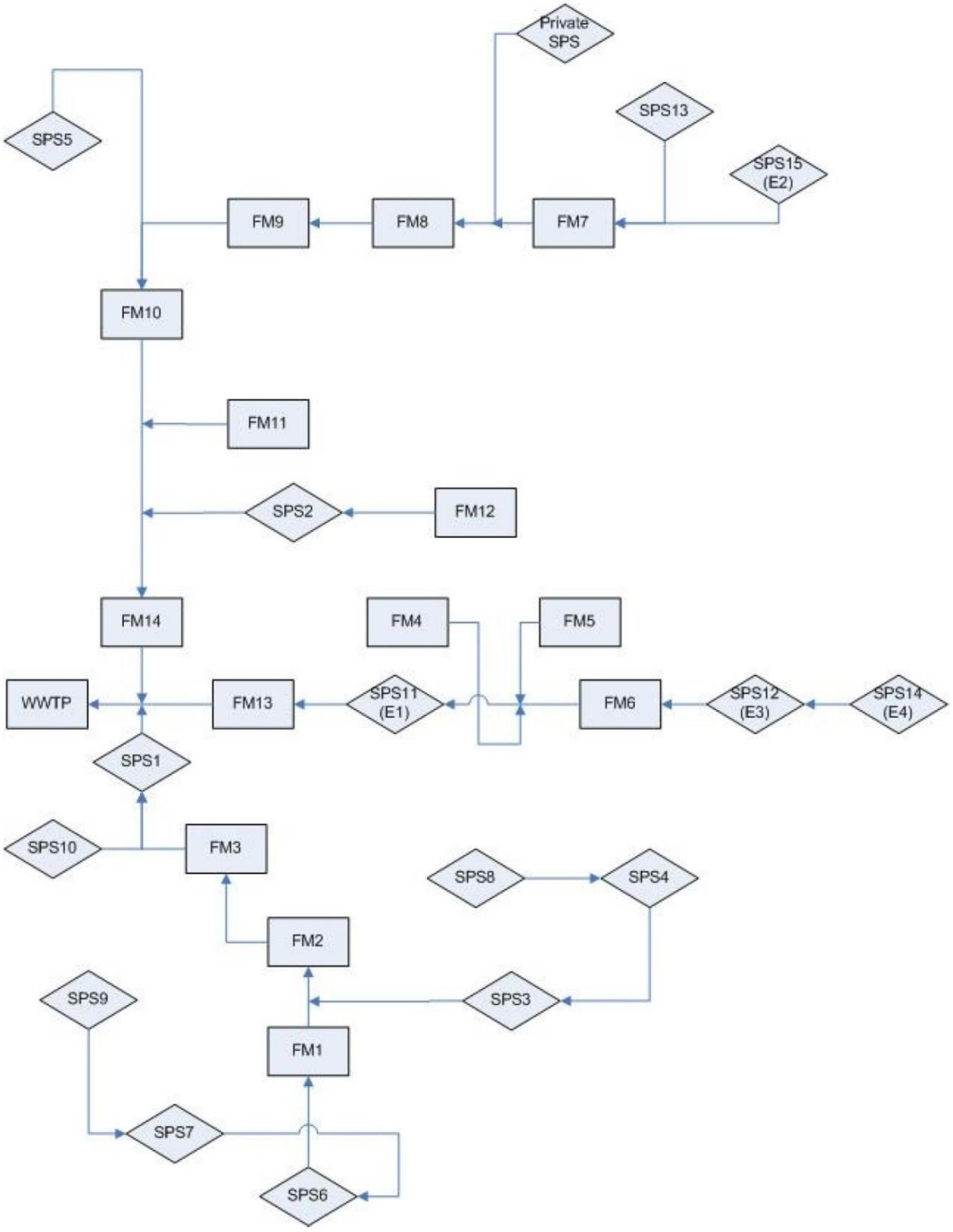


Appendix B : STP Pump Hierarchy Diagrams

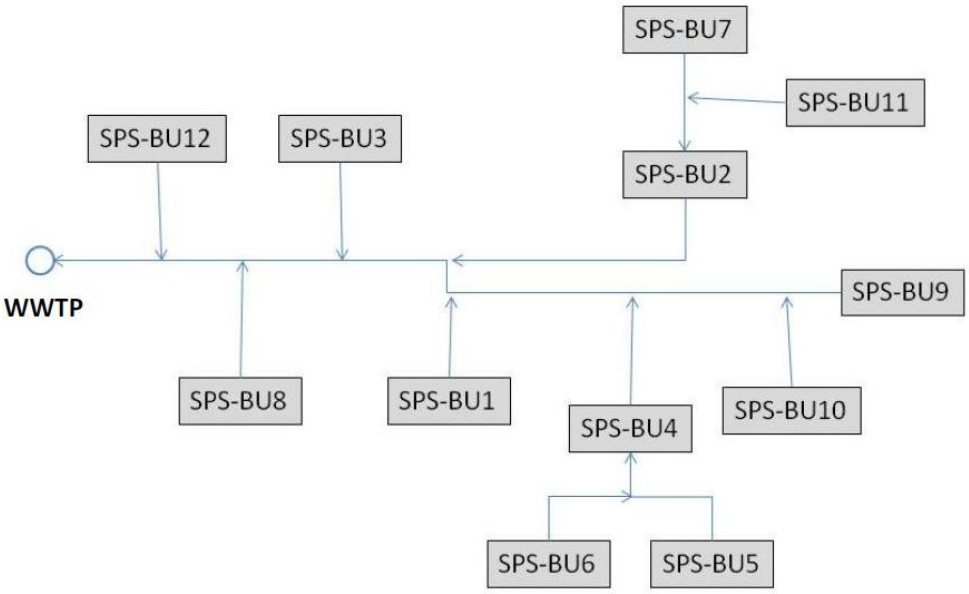
B.1 Berrima STP



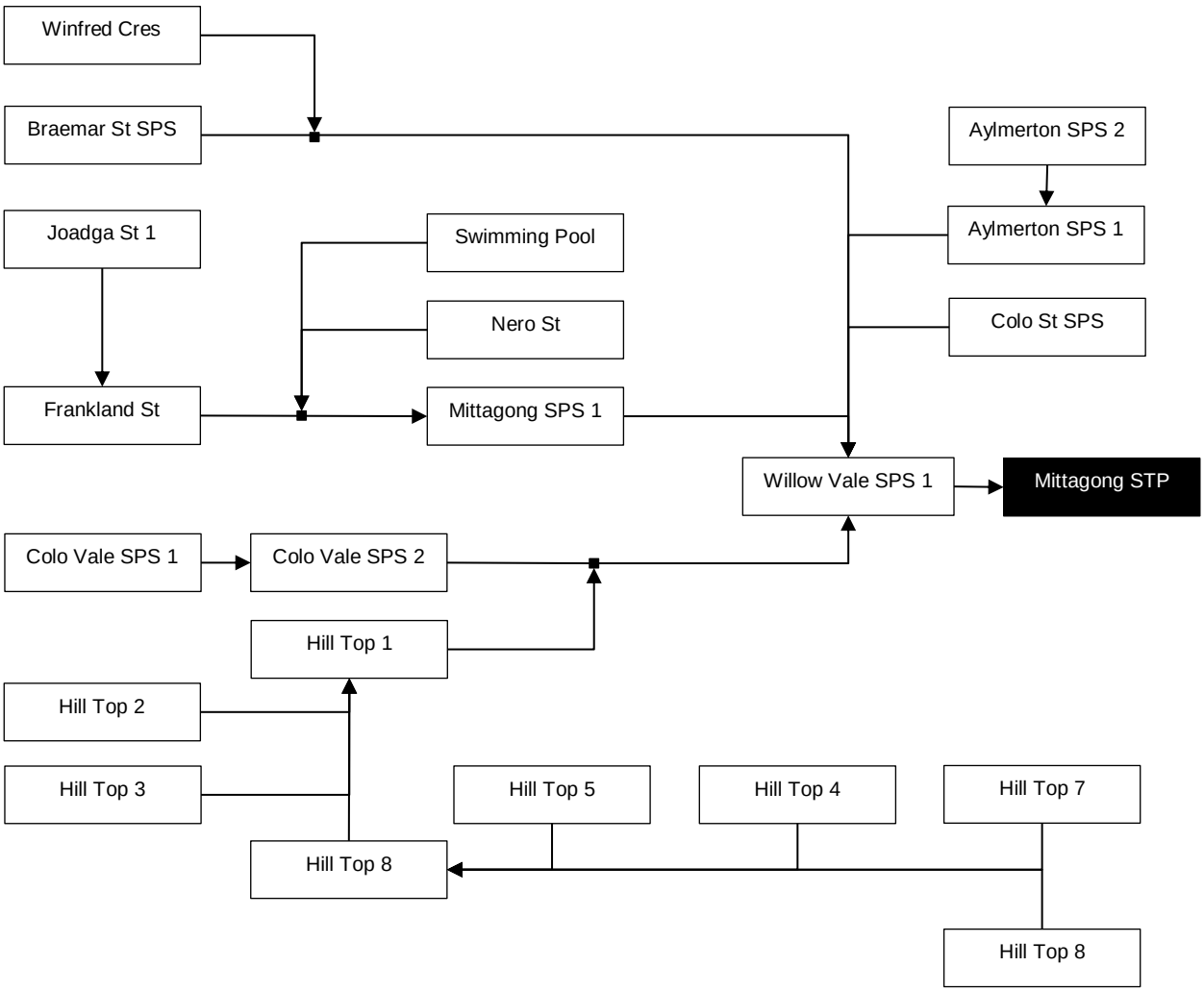
B.2 Bowral STP



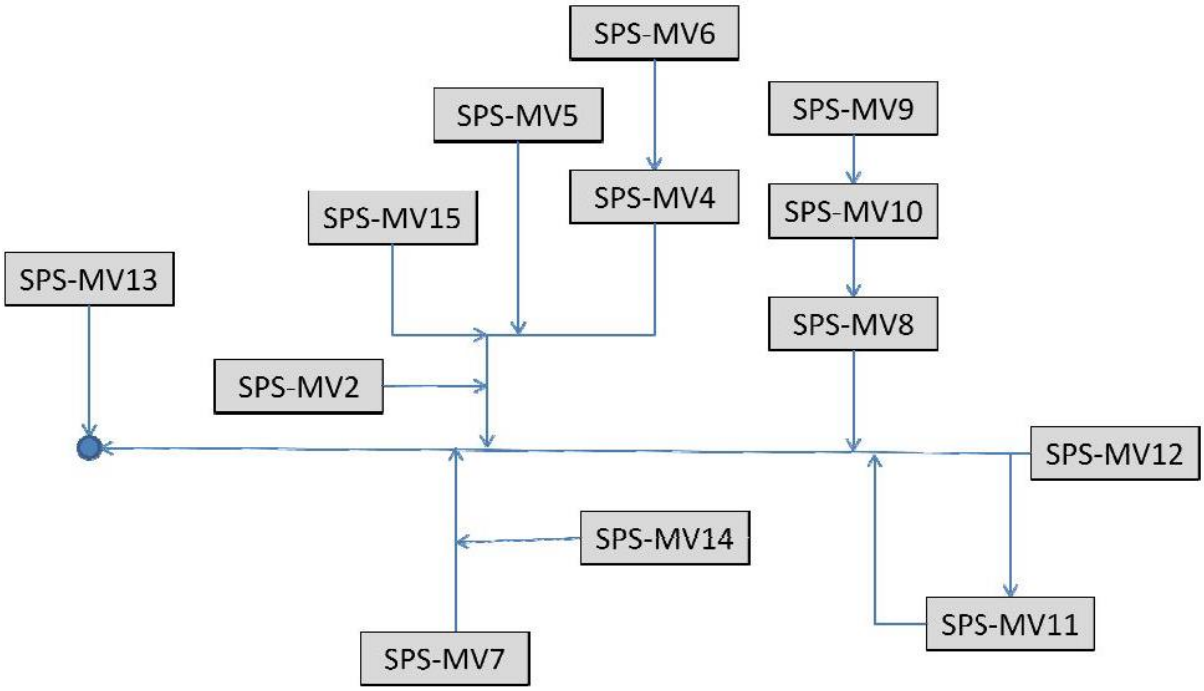
B.3 Bundanoon STP



B.4 Mittagong STP

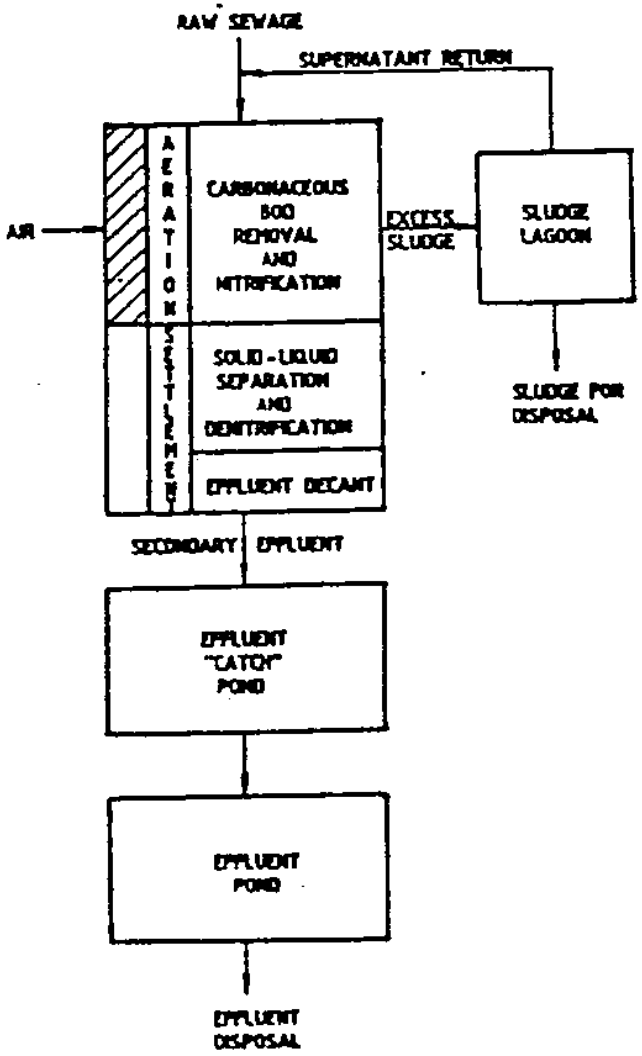


B.5 Moss Vale STP

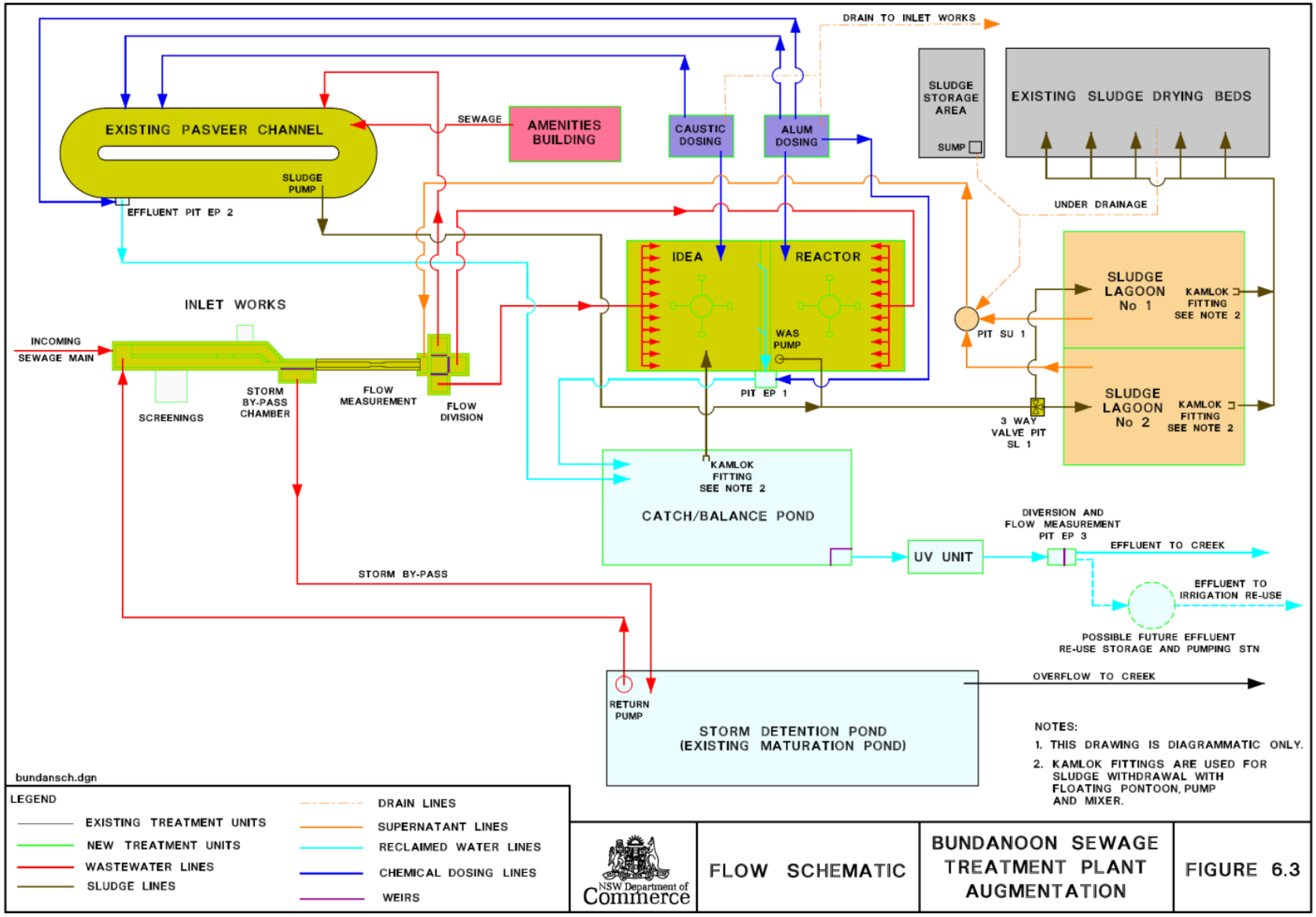


Appendix C : STP Process Flow Diagrams

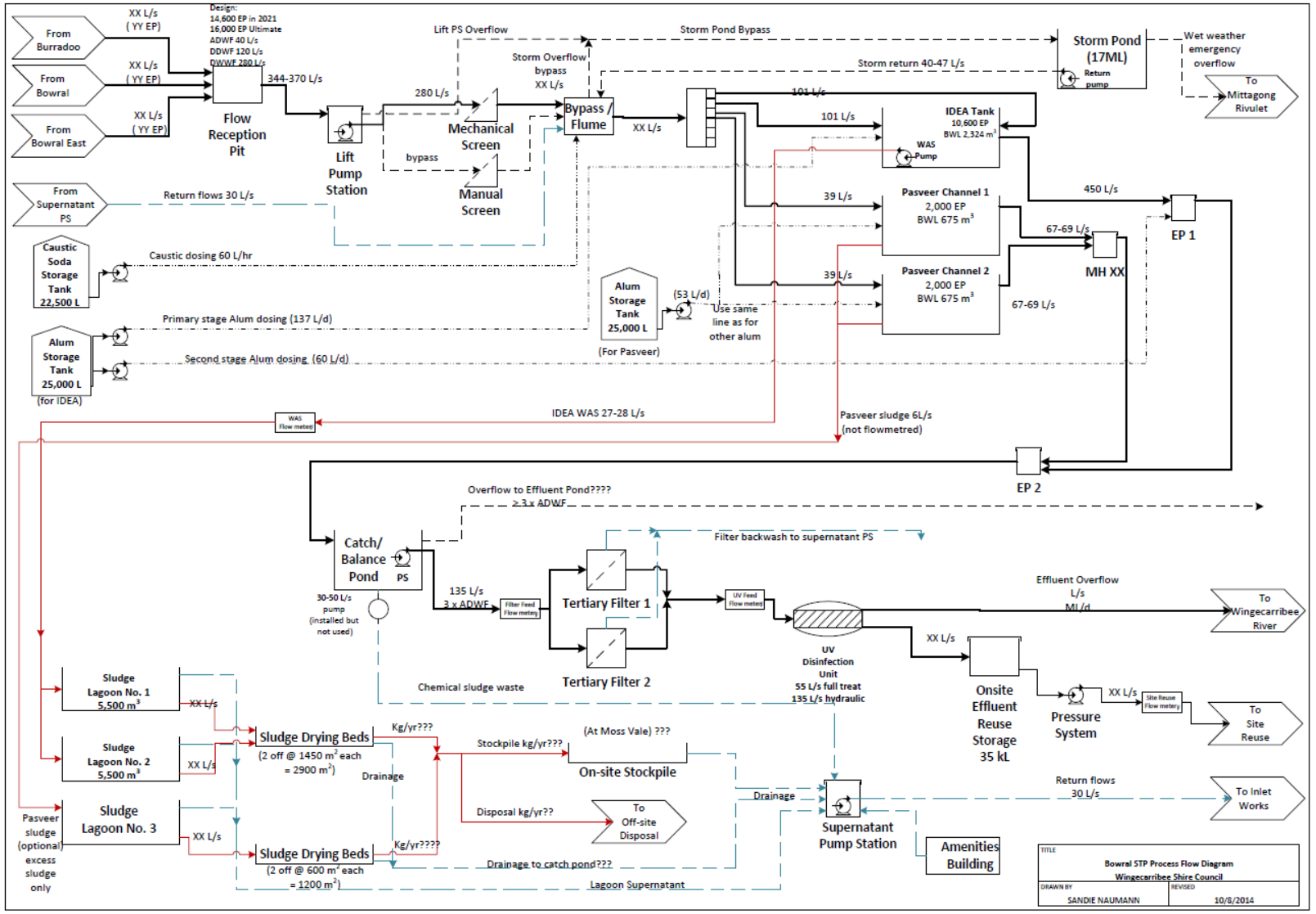
C.1 Berrima STP Process Flow Diagram



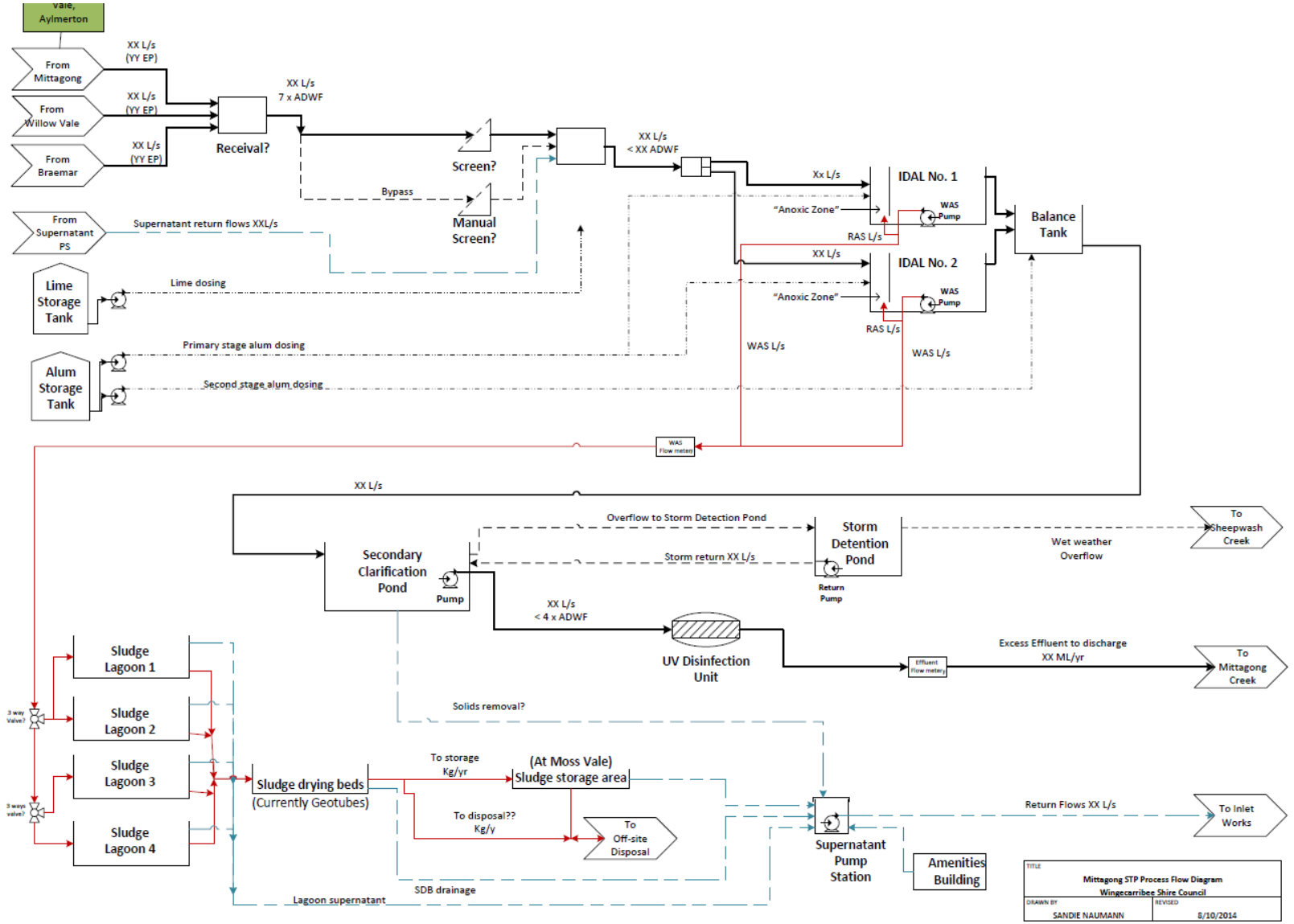
C.2 Bundanoon STP Process Flow Diagram



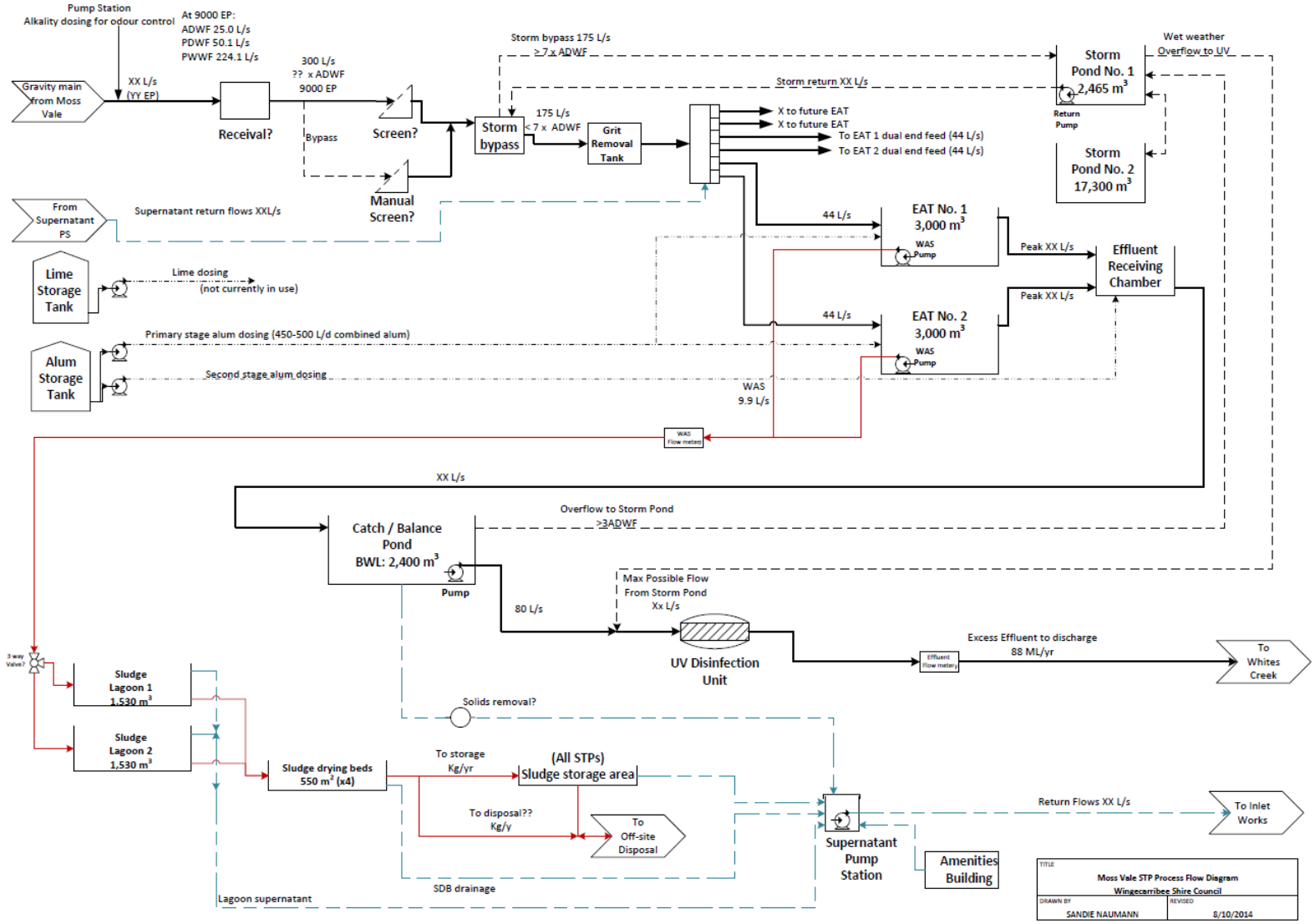
C.3 Bowral STP Process Flow Diagram



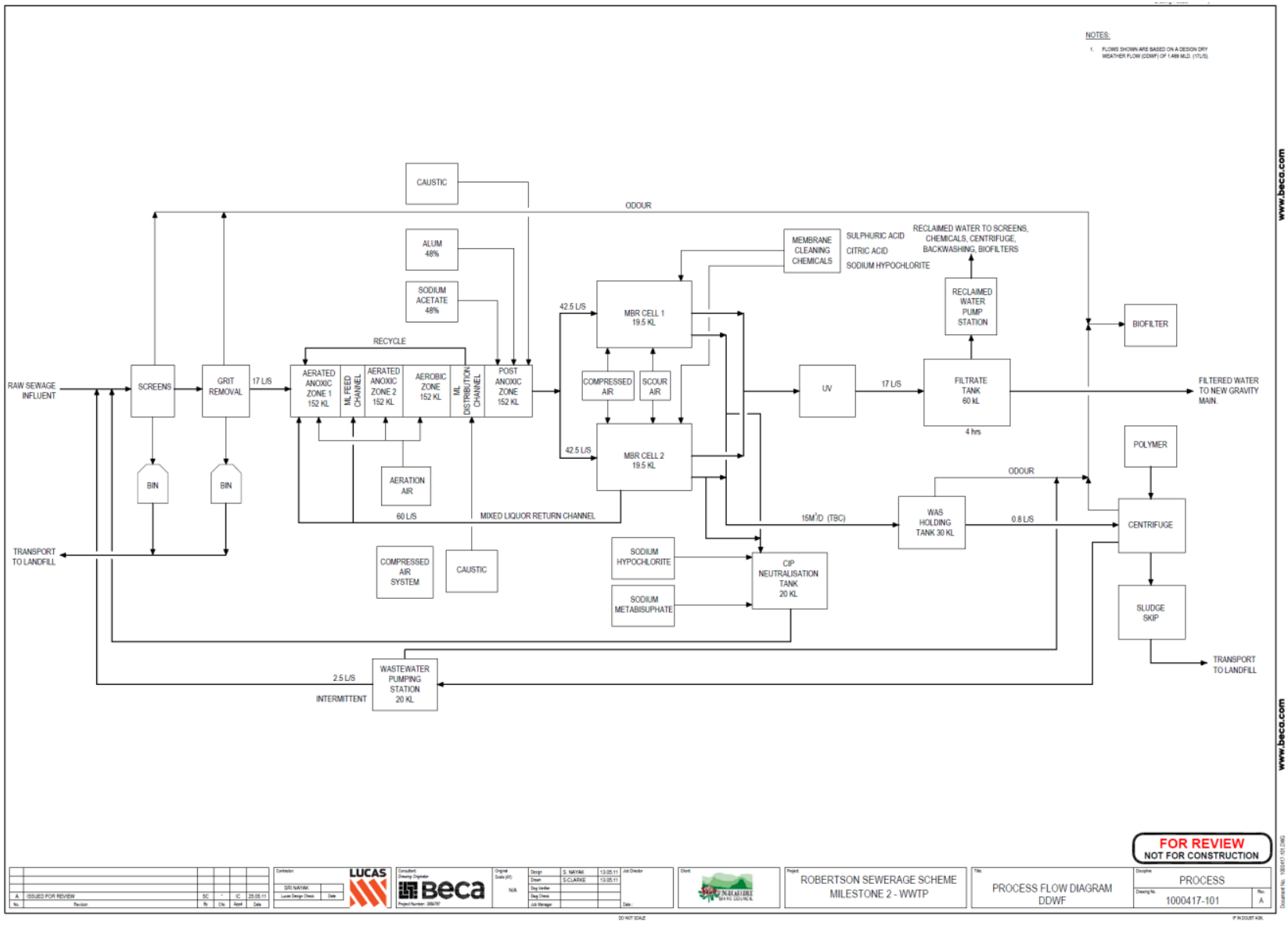
C.4 Mittagong STP Process Flow Diagram



C.5 Moss Vale STP Process Flow Diagram



C.6 Robertson STP Process Flow Diagram



Appendix D Population Projections

D.1 Annual Population Projections

Year	ERP	BCP	2006-2011 growth	NSW Planning & Environment	WSC Growth Planning Calculations V5	SGS
1996	37,988	36,777				
2001	42,384	40,840				
2006	43,532	41,868				42,273
2011	46,126	43,947		46,150	44,460	44,203
2012	46,487			46,466	45,205	44,585
2013	47,005			46,783	45,962	44,969
2014	47,584		47,584	47,103	46,732	45,358
2015			48,138	47,426	47,514	45,749
2016			48,699	47,750	48,310	46,144
2017			49,266	48,027	49,011	46,549
2018			49,840	48,305	49,723	46,958
2019			50,420	48,585	50,445	47,370
2020			51,007	48,867	51,177	47,786
2021			51,601	49,150	51,920	48,205
2022			52,202	49,378	52,348	48,659
2023			52,810	49,607	52,780	49,117
2024			53,425	49,837	53,215	49,580
2025			54,047	50,068	53,654	50,047
2026			54,677	50,300	54,097	50,518
2027			55,313	50,469	54,498	50,986
2028			55,957	50,638	54,903	51,458
2029			56,609	50,808	55,310	51,935
2030			57,268	50,979	55,721	52,416
2031			57,935	51,150	56,134	52,901
2032			58,610	51,322	56,551	53,341
2033			59,293	51,494	56,970	53,784
2034			59,983	51,667	57,393	54,231
2035			60,682	51,840	57,819	54,682
2036			61,388	52,014	58,248	55,136
2037			62,103	52,189	58,680	55,594
2038			62,826	52,364	59,115	56,056
2039			63,558	52,540	59,554	56,522
2040			64,298	52,716	59,996	56,992
2041			65,047	52,893	60,441	57,465
2042			65,804	53,071	60,889	57,943
2043			66,571	53,249	61,341	58,425
2044			67,346	53,428	61,796	58,910
2045			68,130	53,607	62,255	59,400
2046			68,924	53,787	62,717	59,893

D.2 Serviced population and dwelling projection – reservoir zone

Reservoir Zone	Population						Dwellings					
	2011 Census	2011 Census + WSSMP Growth					2011 Census	2011 Census + WSSMP Growth				
		2011	2016	2021	2026	2031		2011	2016	2021	2026	2031
Braemar	2,874	2,874	4,019	4,679	4,734	4,805	1,240	1,240	1,943	2,364	2,398	2,439
NV00384	30	30	30	30	30	30	14	14	14	14	14	14
NV03656	56	56	56	56	56	56	22	22	22	22	22	22
RES-ME1	395	395	395	395	395	395	175	175	175	175	175	175
RES-ME2	812	812	950	952	952	952	370	370	455	456	456	456
RES-ME3	111	111	111	111	111	111	45	45	45	45	45	45
RES-ME4	207	207	207	207	207	207	89	89	89	89	89	89
RES-ME5	2,396	2,396	2,628	2,645	2,738	2,772	1,099	1,099	1,241	1,252	1,310	1,330
RES-ME6	818	818	991	991	1,185	1,308	331	331	437	437	557	629
RES-WC1	1,401	1,401	1,635	1,754	1,781	1,894	657	657	801	876	893	959
RES-WC2	1,752	1,752	1,764	1,777	1,788	1,798	835	835	843	850	857	863
RES-WC3	1,726	1,726	1,726	1,726	1,818	1,973	656	656	656	656	713	803
RES-WC4	340	340	340	340	340	340	169	169	169	169	169	169
RES-WC5	1,185	1,185	1,528	1,577	1,599	1,853	546	546	756	788	801	950
RES-WC6	2,341	2,341	2,342	2,344	2,345	2,346	873	873	874	875	875	876
RES-WC7	98	98	98	98	98	98	67	67	67	67	67	67
RES-WC8	3,965	3,965	4,434	4,901	5,310	5,467	2,188	2,188	2,476	2,774	3,026	3,118
RES-WC9	1,181	1,181	1,181	1,181	1,213	1,320	568	568	568	568	588	651
RES-WC10	237	237	237	237	237	237	140	140	140	140	140	140
RES-WC12	1,272	1,272	1,272	1,272	1,272	1,272	464	464	464	464	464	464
RES-WC13	3,102	3,102	3,102	3,102	3,102	3,121	1,224	1,224	1,224	1,224	1,224	1,235
WINGE WTP	1,898	1,898	1,909	1,997	2,116	2,180	865	865	872	928	1,001	1,039
WINGE WTP EB	0	0	0	270	270	270	0	0	0	172	172	172
WPS-WC8	180	180	180	180	180	180	70	70	70	70	70	70

Reservoir Zone	Population						Dwellings					
	2011 Census	2011 Census + WSSMP Growth					2011 Census	2011 Census + WSSMP Growth				
		2011	2016	2021	2026	2031		2011	2016	2021	2026	2031
BUN_WTP	90	90	90	90	90	90	51	51	51	51	51	51
Hill Rd HL	506	506	506	506	506	666	263	263	263	263	263	357
RES-BU1	4,459	4,459	5,020	6,194	6,880	7,157	2,005	2,005	2,349	3,098	3,521	3,683
RES-BU2	759	759	788	820	849	876	421	421	439	459	477	493
RES-BU3	1,785	1,785	1,785	1,785	1,785	1,785	879	879	879	879	879	879
RES-BU4	1,051	1,051	1,237	1,420	1,499	1,499	553	553	667	784	833	833
RES-BU5	1,891	1,891	1,891	1,891	1,891	1,917	710	710	710	710	710	725
RES-BU7	658	658	668	754	885	913	271	271	277	332	413	429
RES-BU9	781	781	781	784	872	1,174	376	376	376	378	432	609
Unserviced	4,103	4,103	4,410	4,857	4,962	5,072	2,170	2,170	2,358	2,644	2,708	2,773
Total	44,460	44,460	48,310	51,920	54,097	56,134	20,406	20,406	22,770	25,073	26,414	27,606

D.3 Serviced population and dwelling projection – sewage catchment

Sewer catchment	Population						Dwellings					
	2011 Census	2011 Census + WSSMP Growth					2011 Census	2011 Census + WSSMP Growth				
		2011	2016	2021	2026	2031		2011	2016	2021	2026	2031
BER-STP	46	46	46	46	46	46	25	25	25	25	25	25
SPS-BE1	129	129	129	129	129	129	42	42	42	42	42	42
SPS-BE2	3	3	3	3	3	3	3	3	3	3	3	3
SPS-BE3	58	58	58	58	58	58	33	33	33	33	33	33
SPS-BE4	58	58	58	58	58	58	30	30	30	30	30	30
SPS-BE5	125	125	125	125	125	125	51	51	51	51	51	51
SPS-BE6	421	421	421	421	421	421	169	169	169	169	169	169
SPS-BE7	21	21	21	74	97	97	9	9	9	43	57	57
Berrima new	0	0	0	0	108	108	0	0	0	0	67	67

Sewer catchment	Population						Dwellings					
	2011 Census	2011 Census + WSSMP Growth					2011 Census	2011 Census + WSSMP Growth				
		2011	2016	2021	2026	2031		2011	2016	2021	2026	2031
BWL-STP D	4,757	4,757	5,219	5,693	6,034	6,175	2,330	2,330	2,613	2,916	3,126	3,208
SPS-BW1	912	912	912	912	924	1,067	379	379	379	379	387	470
SPS-BW10	85	85	85	85	85	119	45	45	45	45	45	65
SPS-BW11 B	2,633	2,633	2,633	2,633	2,633	2,633	1,106	1,106	1,106	1,106	1,106	1,106
SPS-BW12	800	800	800	800	800	800	264	264	264	264	264	264
SPS-BW13	85	85	85	85	85	85	39	39	39	39	39	39
SPS-BW14	175	175	175	175	175	175	64	64	64	64	64	64
SPS-BW15	0	0	0	270	270	270	0	0	0	172	172	172
SPS-BW2	1,099	1,099	1,190	1,273	1,423	1,546	761	761	817	870	962	1,034
SPS-BW3	202	202	378	390	403	403	106	106	214	222	230	230
SPS-BW4	234	234	234	234	281	281	108	108	108	108	137	137
SPS-BW5	70	70	70	70	70	70	30	30	30	30	30	30
SPS-BW6	115	115	115	115	115	115	53	53	53	53	53	53
SPS-BW7	274	274	276	276	290	290	131	131	132	132	141	141
SPS-BW9	142	142	142	164	164	164	68	68	68	82	82	82
Bowral new	0	0	56	141	141	141	0	0	35	88	88	88
Bowral new 2	0	0	0	0	0	19	0	0	0	0	0	11
BUN-STP	602	602	631	663	692	719	300	300	318	338	356	372
SPS-BU1	350	350	350	350	350	350	208	208	208	208	208	208
SPS-BU10	34	34	34	34	34	34	19	19	19	19	19	19
SPS-BU12	123	123	123	123	123	123	66	66	66	66	66	66
SPS-BU2	306	306	306	306	306	306	145	145	145	145	145	145
SPS-BU3	70	70	70	70	70	70	33	33	33	33	33	33
SPS-BU4	129	129	129	129	129	129	75	75	75	75	75	75
SPS-BU5	104	104	104	104	104	104	61	61	61	61	61	61
SPS-BU6	88	88	88	88	88	88	46	46	46	46	46	46
SPS-BU7	336	336	336	336	336	336	163	163	163	163	163	163
SPS-BU8	175	175	175	175	175	175	71	71	71	71	71	71
SPS-BU9	134	134	134	134	134	134	65	65	65	65	65	65

Sewer catchment	Population						Dwellings					
	2011 Census	2011 Census + WSSMP Growth					2011 Census	2011 Census + WSSMP Growth				
		2011	2016	2021	2026	2031		2011	2016	2021	2026	2031
Hill Top	64	64	64	64	64	64	32	32	32	32	32	32
MTT-STP	1,928	1,928	2,488	2,582	2,582	2,582	837	837	1,181	1,241	1,241	1,241
RW-01	0	0	9	18	26	51	0	0	5	11	16	31
RW-02	35	35	611	1,168	1,215	1,261	13	13	367	722	751	778
SPS-AM1	113	113	113	113	113	113	48	48	48	48	48	48
SPS-AM2	54	54	54	54	54	54	28	28	28	28	28	28
SPS-CV1	254	254	254	254	254	254	93	93	93	93	93	93
SPS-CV2	255	255	255	255	255	255	95	95	95	95	95	95
SPS-HT1	670	670	670	670	670	670	257	257	257	257	257	257
SPS-HT2	132	132	132	132	132	132	58	58	58	58	58	58
SPS-HT3	176	176	176	176	176	176	61	61	61	61	61	61
SPS-HT4	359	359	359	359	359	359	148	148	148	148	148	148
SPS-HT6	84	84	84	84	84	84	27	27	27	27	27	27
SPS-HT7	506	506	506	506	506	506	179	179	179	179	179	179
SPS-HT8	305	305	306	308	309	310	116	116	117	118	118	119
SPS-MT1 A	1,296	1,296	1,475	1,501	1,569	1,857	613	613	723	740	781	950
SPS-MT1 B	1,320	1,320	1,505	1,518	1,565	1,565	567	567	681	689	718	718
SPS-MT4	573	573	573	573	573	573	258	258	258	258	258	258
SPS-MT5	88	88	88	88	88	88	38	38	38	38	38	38
SPS-MT6	390	390	390	390	390	390	173	173	173	173	173	173
SPS-MT7	1,667	1,667	2,046	2,075	2,243	2,340	711	711	944	962	1,066	1,123
SPS-MT8	120	120	120	120	146	172	56	56	56	56	72	87
SPS-MT9	52	52	52	52	52	52	21	21	21	21	21	21
SPS-WV1	645	645	645	645	727	881	231	231	231	231	281	372
Mittagong new	0	0	3	3	3	3	0	0	2	2	2	2
Mittagong new 2	0	0	65	65	65	65	0	0	40	40	40	40

Sewer catchment	Population						Dwellings					
	2011 Census	2011 Census + WSSMP Growth					2011 Census	2011 Census + WSSMP Growth				
		2011	2016	2021	2026	2031		2011	2016	2021	2026	2031
MV-STP A	1,754	1,754	1,822	2,432	2,669	2,697	775	775	817	1,206	1,352	1,368
MV-STP B	882	882	882	990	1,035	1,457	432	432	432	501	529	776
MV-STP C	1,678	1,678	1,678	1,705	1,784	1,823	831	831	831	848	897	920
MV-STP D	0	0	391	485	485	485	0	0	240	300	300	300
SPS-MV11	194	194	194	194	194	194	70	70	70	70	70	70
SPS-MV13	60	60	60	60	60	60	22	22	22	22	22	22
SPS-MV14	8	8	8	8	8	8	9	9	9	9	9	9
SPS-MV15	9	9	9	9	9	9	0	0	0	0	0	0
SPS-MV2	147	147	147	147	147	147	51	51	51	51	51	51
SPS-MV4	656	656	656	659	758	758	311	311	311	313	374	374
SPS-MV5	347	347	347	347	347	347	116	116	116	116	116	116
SPS-MV6	78	78	78	78	78	78	25	25	25	25	25	25
SPS-MV8	796	796	796	796	796	822	334	334	334	334	334	349
Moss Vale and Berrima	0	0	0	0	0	0	0	0	0	0	0	0
Moss Vale new	0	0	102	437	751	1,000	0	0	63	276	470	616
RB-1	1,137	1,137	1,149	1,162	1,173	1,183	465	465	473	480	487	493
RB-2	76	76	76	76	76	76	57	57	57	57	57	57
RB-3	68	68	68	68	68	68	23	23	23	23	23	23
Robertson	238	238	238	238	238	238	135	135	135	135	135	135
Unserviced	10,351	10,351	10,853	11,517	11,721	11,859	4,992	4,992	5,300	5,723	5,849	5,930
Total	44,460	44,460	48,310	51,920	54,097	56,134	20,406	20,406	22,770	25,073	26,414	27,606

Appendix E Detailed water demand splits

E.1 Total demand and production projections

Average day

		Flow (ML/day)							
Demand Category		**2012**	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2046**
Existing	Commercial	2.11	2.11	2.11	2.11	2.11	2.11	2.11	2.11
	Residential	8.18	8.18	8.18	8.18	8.18	8.18	8.18	8.18
Future	Infill Growth	0.00	0.62	1.24	1.82	2.36	2.36	2.36	2.36
	Industrial (MVEC)	0.00	1.11	2.21	3.32	4.43	4.43	4.43	4.43
	Major Development Site	0.00	0.43	0.75	0.75	0.75	0.75	0.75	0.75
	Long-term growth	0.00	0.00	0.00	0.00	0.00	0.76	1.54	2.35
Total Demand		**10.29**	**12.45**	**14.49**	**16.18**	**17.83**	**18.59**	**19.37**	**20.18**
NRW		2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10
Total Production		**12.39**	**14.55**	**16.59**	**18.28**	**19.93**	**20.69**	**21.47**	**22.28**
Service Area Extension		0.14	0.16	0.41	0.46	0.52	0.52	0.52	0.52
Total		**10.43**	**12.61**	**14.90**	**16.64**	**18.35**	**19.11**	**19.89**	**20.70**

Peak day

		Flow (ML/day)							
Demand Category		**2012**	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2046**
Existing	Commercial	4.23	4.23	4.23	4.23	4.23	4.23	4.23	4.23
	Residential	24.21	24.21	24.21	24.21	24.21	24.21	24.21	24.21
Future	Infill Growth	0.00	1.74	3.45	5.06	6.56	6.56	6.56	6.56
	Industrial (MVEC)	0.00	1.77	3.54	5.31	7.08	7.08	7.08	7.08
	Major Development Site	0.00	1.20	2.09	2.09	2.09	2.09	2.09	2.09
	Long-term growth	0.00	0.00	0.00	0.00	0.00	2.10	4.27	6.53
Total Demand		**28.44**	**33.15**	**37.52**	**40.90**	**44.17**	**46.27**	**48.44**	**50.70**
NRW		2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10
Total Production		**31**	**35**	**40**	**43**	**46**	**48**	**51**	**53**
Service Area Extension		0.39	0.45	1.13	1.29	1.44	1.44	1.44	1.44
Total		**28.83**	**33.60**	**38.65**	**42.19**	**45.61**	**47.71**	**49.88**	**52.14**

Average year

		Flow (ML/year)							
Demand Category		**2012**	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2046**
Existing	Commercial	770	770	770	770	770	770	770	770
	Residential	2,986	2,986	2,986	2,986	2,986	2,986	2,986	2,986
Future	Infill Growth	0	226	453	664	861	861	861	861
	Industrial (MVEC)	0	405	807	1,212	1,617	1,617	1,617	1,617
	Major Development Site	0	157	274	274	274	274	274	274
	Long-term growth	0	0	0	0	0	276	562	858
Total Demand		**3,756**	**4,544**	**5,289**	**5,906**	**6,508**	**6,784**	**7,070**	**7,366**
NRW		767	767	767	767	767	767	767	767
Total Production		**4,522**	**5,311**	**6,055**	**6,672**	**7,274**	**7,550**	**7,836**	**8,133**
Service Area Extension		51	58	150	168	190	190	190	190

Dry year

		Flow (ML/year)							
Demand Category		**2012**	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2046**
Existing	Commercial	827	827	827	827	827	827	827	827
	Residential	3,207	3,207	3,207	3,207	3,207	3,207	3,207	3,207
Future	Infill Growth	0	243	486	713	925	925	925	925
	Industrial (MVEC)	0	435	866	1,301	1,737	1,737	1,737	1,737
	Major Development Site	0	169	294	294	294	294	294	294
	Long-term growth	0	0	0	0	0	296	603	922
Total Demand		**4,034**	**4,881**	**5,680**	**6,343**	**6,990**	**7,286**	**7,593**	**7,911**
NRW		823	823	823	823	823	823	823	823
Total Production		**4,857**	**5,704**	**6,503**	**7,166**	**7,813**	**8,109**	**8,416**	**8,735**
Service Area Extension		55	63	161	180	204	204	204	204

E.2 Reservoir zone peak day demand projection

	Reservoir Zone	Demand (ML/day)					% Change 2012-2031
		2012	2016	2021	2026	2031	
Wingecarribee	Balmoral	0.14	0.45	0.51	0.58	0.64	357%
	Berrima	0.3	0.3	0.3	0.3	0.3	0%
	Bowral	9.63	10.18	10.96	11.4	11.77	22%
	Burrawang	1.17	1.18	1.19	1.2	1.21	3%
	Colo Vale	1.04	1.04	1.04	1.11	1.23	18%
	Gib North	1.09	1.27	1.31	1.33	1.53	40%
	Hill Top	1.33	1.33	1.33	1.34	1.34	1%
	Hopewood	0.84	0.95	0.95	0.96	0.96	14%
	Kimberly Drive	0.13	0.13	0.13	0.13	0.13	0%
	Mt Gib	0.52	0.52	0.52	0.52	0.52	0%
	Murchison	0.21	0.21	0.21	0.21	0.21	0%
	Robertson	0.1	0.1	0.1	0.1	0.1	0%
	Spencer St	1.73	1.99	2	2.08	2.1	21%
	Welby	0.5	0.64	0.64	0.79	0.88	76%
	Willow Vale	2.31	3.33	3.93	3.97	4.03	74%
	Yerrinbool	0.69	0.69	0.69	0.69	0.69	**0%**
	Sub-total	**21.73**	**24.31**	**25.81**	**26.71**	**27.64**	**27%**
Wingecarribee South	Blakes Hill	1.17	1.61	1.98	2.26	2.45	109%
	Hill Road High Level	0.36	0.36	0.36	0.36	0.46	28%
	Moss Vale	3.38	5.2	7.53	9.56	11.41	238%
	New Berrima	0.37	0.38	0.45	0.55	0.57	54%
	Woodville	0.69	0.69	0.69	0.76	0.99	43%
	Sub-total	**5.97**	**8.24**	**11.01**	**13.49**	**15.88**	**166%**
Bundanoon	Bundanoon	1.68	1.7	2.35	2.46	2.57	53%
	Exeter	1.21	1.35	1.5	1.56	1.56	29%
	Sub-total	**2.89**	**3.05**	**3.85**	**4.02**	**4.13**	**43%**
Total		**30.6**	**35.6**	**40.7**	**44.2**	**47.7**	56%

E.3 Water supply area peak day demand (ML/day)

		2012	2016	2021	2026	2031	2036	2041	2046
Supply Areas	Wingecarribee	21.73	24.31	25.81	26.71	27.64	29.07	30.55	32.08
	Wingecarribee South	5.97	8.24	11.01	13.49	15.88	16.38	16.89	17.43
	Bundanoon	2.89	3.05	3.85	4.02	4.13	4.30	4.49	4.67
	Total	**30.59**	**35.60**	**40.67**	**44.22**	**47.65**	**49.75**	**51.92**	**54.18**
Existing Zoning	Wingecarribee WTP	27.70	32.55	36.82	40.20	43.52	45.44	47.44	49.51
	Bundanoon WTP	2.89	3.05	3.85	4.02	4.13	4.30	4.49	4.67
Proposed Zoning	Wingecarribee WTP	21.73	24.31	25.81	26.71	27.64	29.07	30.55	32.08
	Bundanoon WTP	8.86	11.29	14.86	17.51	20.01	20.68	21.38	22.10

E.4 Water supply area dry year demand projection

		2012	2016	2021	2026	2031	2036	2041	2046
Supply Areas	Wingecarribee	3450	3895	4127	4328	4532	4738	4951	5172
	Wingecarribee South	948	1320	1761	2186	2604	2669	2738	2809
	Bundanoon	459	489	616	651	677	702	727	753
	Total	**4857**	**5704**	**6503**	**7166**	**7813**	**8109**	**8416**	**8735**
Existing Zoning	Wingecarribee WTP	4398	5215	5888	6514	7136	7407	7689	7981
	Bundanoon WTP	459	489	616	651	677	702	727	753
Proposed Zoning	Wingecarribee WTP	3450	3895	4127	4328	4532	4738	4951	5172
	Bundanoon WTP	1407	1809	2376	2838	3281	3371	3465	3563

Appendix F Projected Climate Change

F.1 Climate Change in the Hawkesbury Nepean

Table 2. Current and Projected Climate Change in the Hawkesbury-Nepean Catchment			
	Present (1990)[1]	Projected Change	
		2030	2070
Temperature			
Average	Katoomba: 9 – 23°C[2] Moss Vale: 12 – 26°C[2] Richmond: 17 – 29°C[2]	+0.2 – +1.6°C	+0.7 – +4.8°C
No. Days below 0°C	Sydney: 0	Sydney: 0	Sydney: 0
No. Days above 35°C	Sydney: 3	Sydney: 4 – 6	Sydney: 4 – 18
No. Days above 40°C	Sydney: 0	Sydney: 0 – 1	Sydney: 0 – 4
Rainfall			
Annual Average	Katoomba: 1,399 mm Moss Vale: 973 mm Richmond: 801 mm	-7 – +7%	-20 – +20%
Extreme Rainfall[3]		-3 – +12%	-7 – +10%
Evaporation		+1 – +8%	+2 – +24%
No. Droughts per decade[4]	3	2–5	1–9
Extreme Winds		-5 – +8%	-16 – +24%
No. Fire Days[5]	Richmond: 12	Richmond: 12 – 14	Richmond: 10 – 19

1 Present day conditions for temperature and rainfall represent long-term averages from the Bureau of Meteorology. For extreme temperatures, the present average is based on 1964-2003. For fire danger, the present average is based on 1974-2003. For drought, the present average is for a period centred on 1990.

2 Range represents average July and January maximum temperature.

3 Defined as 1 in 40 year 1-day rainfall total. Values represent the range in seasonal projections from a limited set of climate models.

4 The values for drought represent average monthly drought frequencies, based upon the Bureau of Meteorology's criteria for serious rainfall deficiency (see also Burke et al., 2006).

5 Number of days annually with a "very high" or "extreme" fire danger index. Changes are for 2020 and 2050, respectively, as in Hennessy et al. (2005).

[Commonwealth Scientific and Industrial Research Organisation, 2007, Climate Change in the Hawkesbury-Nepean Catchment]

Climate variability is expected to increase in the future due to changes to the composition of the atmosphere. The Commonwealth Scientific and Industrial Research Organisation (CSIRO) has lead the Australian research in this field. The NSW Office of Environment and Heritage commissioned the CSIRO to investigate the likely change in rainfall and fire danger in NSW, and the expected changes for the Mittagong area are summarised in the table below.

Change in climate

	Average rainfall		Days with extreme or catastrophic fire danger		Temperature	
Season	**2020-2039**	**2060-2079**	**2020-2039**	**2060-2079**	**2020-2039**	**2060-2079**
Summer	-0.2%	+10.7%	+0.4	+0.7	+0.90°C	+2.41°C
Autumn	+11.8%	+13.9%	-0.0	+0.0	+0.61°C	+2.02°C
Winter	-4.7%	+1.0%	+0.0	+0.0	+0.42°C	+1.66°C
Spring	-5.7%-	-4.9%	+0.3	+1.2	+0.77°C	+2.24°C
Average	+0.4%	+6.5%	+0.7	+2.0	+0.68°C	+2.08°C
Minimum					+0.66°C	+2.11°C
Maximum					+0.70°C	+2.10°C

http://www.climatechange.environment.nsw.gov.au/Climate-projections-for-NSW/Interactive-map

The increase in the number of days with extreme or catastrophic fire danger is of concern due to the significant increase in water demands during years with bush fires close to communities supplied with reticulated water.

The CSIRO Climate Change in Australia report includes expected changes in evapotranspiration (the amount of water plants require and the key determinate of irrigation water required). The results are summarised in the table below.

Change in evapotranspiration

	Evapotranspiration		
Season	**2030**	**2050**	**2070**
Summer	+2 to +4 %	+4 to +8 %	+4 to +8 %
Autumn	+2 to +4 %	+4 to +8 %	+8 to +12 %
Winter	+4 to +8 %	+8 to +12 %	+8 to +12 %
Spring	-2 to +2 %	+2 to +4 %	+4 to +8 %
Average	+2 to +4 %	+4 to +8 %	+4 to +8 %

CSIRO, 2007. Climate Change in Australia: technical report, Commonwealth Scientific and Industrial Research Organisation, Aspendale, Vic,

Available: http://www.climatechangeinaustralia.gov.au/en/publications-library/

Appendix G Sewer Catchment Performance

G.1 Odour Septicity Potential

Scheme	Pump Station	Pump rate (L/s)	Rising main length (m)	Combined run time for SPS (hrs/day)		SPS Transfer Rate (kL/day)			Detention Time (hrs)		
				Dry Weather	Wet Weather	Dry Weather	Wet Weather	Dry Weather (from L/EP/d)	Dry Weather	Wet Weather	Dry Weather (from L/EP/d)
Berrima	SPS-BE1	10	1,104	1.35	4.73	49	170	99	10.05	2.87	4.93
	SPS-BE5	20	1,033	nd	nd			267			3.08
Bowral	SPS1	50	387	2.15	8.85	387	1,593	525	1.23	0.30	0.91
	SPS2	10	374	1.35	6.08	49	219	272	3.71	0.82	0.66
	SPS3	10	502	1.14	4.70	41	169	125	5.70	1.38	1.88
	SPS6	10	692	2.13	7.42	77	267	132	4.10	1.18	2.38
	SPS11	50	1,415	2.82	8.38	507	1,509	781	4.94	1.66	3.21
Bundanoon	SPS-BU1	27	651	0.63	5.35	62	520	80	5.43	0.64	4.17
	SPS-BU2	31	461	0.72	4.90	80	547	142	1.91	0.28	1.08
	SPS-BU4	15	231	0.73	2.43	40	131	49	3.29	0.99	2.64
Mittagong	Colo Vale SPS 2	10	161	4.65	12.08	167	435	75	0.24	0.09	0.54
	Hill Top PS	35	129	3.81	9.25	480	1,166	479	0.36	0.15	0.36
	Frankland St PS	30	593	2.00	8.53	216	921	526	1.46	0.34	0.60
	Aylmerton SPS 1	10	672	7.37	13.78	265	496	32	0.35	0.19	2.91
	Mittagong SPS 1	200	402	1.67	8.18	1,202	5,890	1,221	1.24	0.25	1.23
	Willow Vale PS 1	320	15	2.48	11.02	2,857	12,695	2,658	0.28	0.06	0.30
Moss Vale	SPS-MV4	14	467	1.36	9.60	68	484	170	5.58	0.79	2.25
	SPS-MV5	30	516	0.64	4.59	69	496	88	2.34	0.33	1.83
	SPS-MV8	20	1,341	2.57	12.32	185	887	189	5.69	1.19	5.57
	SPS-MV12	17	1,680	3.50	20.76	214	1,271	198	6.08	1.02	6.57

G.2 SPS Emergency Storage Volumes

Scheme	Pump Station	Contributing Pump Stations	Operating Volume	Emergency Storage Volume	ADWF (kL/day)		Time to fill Emergency Storage Volume	
					Gravity Only	Gravity + Pumped	Gravity Only	Gravity + Pumped
Berrima	SPS-BE1	1,2,3,4	1.3	5.7	16.5	65.5	8.3	2.1
	SPS-BE5	1,5,6,7	1.3	4.8	38.4	181.6	3.0	0.6
Bowral	SPS-BW1	1,3,4,6,7,8,9,10	5.0	25.1	221.3	440.9	2.7	1.4
	SPS-BW2	2	4.8	43.7	216.9	216.9	4.8	4.8
	SPS-BW3	3,4,8	3.5	19.8	38.8	89.5	12.2	5.3
	SPS-BW6	6,7,9	1.4	9.5	31.2	117.9	7.3	1.9
	SPS-BW11	11,12,14	9.0	15.8	581.4	778.1	0.7	0.5
	Bowral Lift PS	All	31.8	43.4	2676.3	2676.3	0.4	0.4
Bundanoon	SPS-BU1	1	5.3	20.5	77.2	77.2	6.4	6.4
	SPS-BU2	2,7,11	10.9	97.1	65.3	138.0	35.7	16.9
	SPS-BU4	4,5,6	1.2	3.3	22.0	49.2	3.6	1.6
Mittagong	Colo Vale SPS 2	Colo Vale 1 and 2	0.5	8.1	75.4	75.4	2.6	2.6
	Hill Top PS	Hill Top 1 to 8	1.4	22.8	473.4	473.4	1.2	1.2
	Frankland St PS	Joadga St, Frankland St	18.9	21.8	345.6	345.6	1.5	1.5
	Aylmerton SPS 1	Aylmerton 1 and 2	0.5	7.6	31.9	31.9	5.7	5.7
	Mittagong SPS 1	Joadga St, Frankland St, Swimming Pool, Nero St, Mittagong PS	30.2	62.8	505.9	851.6	3.0	1.8
	Willow Vale PS 1	All	38.0	146.3	756.4	2188.7	4.6	1.6
Moss Vale	SPS-MV4	4,6	8.1	26.1	157.2	164.5	4.0	3.8
	SPS-MV5	5	2.7	17.4	87.1	87.1	4.8	4.8
	SPS-MV8	8,9,10	3.8	7.8	180.2	182.0	1.0	1.0
	SPS-MV12	12	2.7	19.9	189.4	189.4	2.5	2.5

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