Attachment E.2

SA Water Wastewater Treatment Plants and Catchments

SA Water

Regulatory Business Proposal 2013

Government of South Australia

SA Water

Contents

1. Common terms and explanatory notes

Ammonia (NH_4-N) - ammonia has the chemical formula NH_3 in its pure gaseous form. In wastewater it is typically found in the dissolved form NH_4^+ at normal pH. Pure NH_3 is toxic to aquatic organisms. Ammonia nitrogen is the main form of inorganic nitrogen present in wastewater. Units are milligrams of ammonia (expressed as nitrogen equivalent) per litre of wastewater (mg/L).

Average annual flow (AAF) - AAF is indicative of plant capacity. Occasionally, AAF received by a wastewater treatment plant may exceed the “nameplate” AAF capacity. This does not necessarily mean that the plant is overloaded, as the process capacity (see “capacity” below) may not have been exceeded. For example, infiltration of groundwater may result in a high hydraulic load on a plant, but the wastewater strength will be diluted, so the plant process capacity is not overloaded. Typical units are megalitres per day (ML/d).

Average dry weather flow (ADWF) - refers to the minimum monthly flow recorded. It typically occurs during summer months, when there is little or no rainfall. Typical units are megalitres per day (ML/d).

Biochemical oxygen demand (BOD) - is a measure of the strength of sewage: the higher the value, the more putrescibles in the wastewater. It represents the oxygen needed by micro-organisms to oxidise and stabilise waste. Pollutants measured are biodegradable carbonaceous compounds, primarily from human faecal wastes. These include carbohydrates (e.g. starches and sugars), proteins and fats. Units are milligrams of oxygen consumed per litre of wastewater (mg/L).

Capacity - wastewater treatment plant capacity is defined by two criteria:

- Hydraulic capacity - the capacity of the plant internal pipework and inlet works to physically pass the peak flow. In systems where one or more pumping stations feed raw wastewater to the plant, the duty pumping capacity and WWTP design hydraulic capacity are matched to avoid overflows. The design criterion is typically peak wet weather flow (PWWF) which can vary from 2.5 to 7 times the average annual flow, depending on the nature of the drainage area served. PWWF tends to be diluted (due to infiltration), so BOD and nitrogen loads entering the plant may not exceed the process capacity.
- Process capacity – typically the ability of the aeration system (in modern activated sludge plants), to supply sufficient oxygen for the biomass to biochemically oxidise the diurnal peak carbonaceous and nitrogen pollutant load entering the plant. Design is typically based on the diurnal peak month BOD and total nitrogen loads. The plant design diurnal peak instantaneous flow is typically 1.8 to 2 times the average daily flow. Process capacity is typically expressed in terms of the average and peak BOD load (kg/d) and nitrogen load (kg/d) that the plant can process, without deterioration in treated wastewater quality, or other operational problems.

Chemical oxygen demand (COD) - relevant to the larger metropolitan WWTPs only, COD is a measure of wastewater organic strength in terms of the oxygen required to chemically oxidise the wastes present. Units are milligrams of oxygen consumed per litre of wastewater (mg/L).

Environmental Improvement Programs (EIPs) - developed in conjunction with the EPA, EIPs set an agreed framework, actions and timetable for the improvement of the environmental performance of wastewater treatment plants in terms of reducing impacts on receiving environments. SA Water has implemented EIPs for all of its metropolitan plants and 13 of its 19 country plants. Various requirements for EIPs under existing licence conditions are detailed in this document.

EPA tier system - the EPA has developed a tier ranking system for wastewater treatment plants, which determines environmental risk based on the receiving environment, community, human and commercial impacts, compliance, pollutants/emissions, planning, land use, and management. The EPA considers all “tier 1” sites as causing environmental harm, “tier 2” less environmental harm and “tier 3” as relatively insignificant. The tier category is then used to guide the level of EPA regulatory action.

Government Inspection Point (GIP) - small vertical riser pipe topped by a cast iron lid, connecting the household drainage pipe to the sewer network. Located near the property boundary, GIPs allow access to inspect the state of the household connection pipe and remove blockages.

Monitoring - SA Water undertakes routine sampling and analysis of influent sewage and treated wastewater in order to monitor the wastewater characteristics at each wastewater treatment plant, in accordance with a monitoring program approved by EPA. An approved monitoring program is a licence requirement at all plants.

Oxidised nitrogen (OxN) - oxidised nitrogen is the sum of nitrite (NO_2^-) and nitrate (NO_3^-). Oxidised nitrogen is typically not present in sewage or raw wastewater. In the wastewater treatment process, ammonia and organic nitrogen are bio-chemically converted to oxidised nitrogen (principally nitrate) in a process referred to as nitrification. In advanced wastewater treatment, the oxidised nitrogen is converted to nitrogen gas in a process referred to as de-nitrification. Units are milligrams of nitrogen and oxygen compounds (expressed as the nitrogen equivalent per litre of wastewater (mg/L).

Peak wet weather flow (PWWF) - is a measure of maximum volumes flowing into a sewage treatment plant during or immediately after a period of heavy rainfall and is not always available, particularly at the smaller country plants. Historically, operators have manually recorded only the daily or weekly flow. Progress is being made in linking plant instrumentation to the SA Water SCADANet system, which will allow historical trend information (such as instantaneous flows) to be retrieved. This has yet to be fully implemented.

Salinity - total dissolved solids (TDS) - a measure of the salinity of a wastewater. TDS measures the combined content of all inorganic and organic substances contained in wastewater: molecular, ionized or micro-granular (colloidal sol) suspended forms. The most common chemical constituents are sodium, calcium, potassium and chloride. Salinity is a key measure of the suitability of recycled water for irrigation of crops and plants. Freshwater is typically defined as where TDS is less than 1,500 mg/L.

Sampling - activated sludge plants typically use refrigerated auto-samplers set up to capture a 24-hour flow weighted composite sample. Refrigeration helps preserve the sample and wastewater samples are transported in ice. However, if a plant is remote and it takes time for samples to be transported and analysed, some deterioration may occur. Composite samples provide the most accurate indication of average wastewater characteristics over a 24-hour period. At a number of country lagoon plants, sampling is undertaken by obtaining grab samples - single wastewater samples obtained manually by an operator. This does not necessarily allow a representative sample to be obtained, as raw wastewater strength (particularly BOD and nitrogen) may vary diurnally over a 24-hour period, although the effect is small in lagoon systems where hydraulic detention time is usually some days. Grab samples may be the only sampling possible if power is not available at a site or a flow meter suitable for control of an auto-sampler is not available. A program is in place to implement composite wastewater sampling at as many sites as possible. If a wastewater treatment plant upgrade is being planned, intensive sewage characterisation using 24-hour flow weighted composite and 2-hour interval diurnal sampling is typically initiated. At wastewater treatment plants, the sewage concentration and load of some parameters may vary significantly over time. Sewage strength may vary diurnally, between weekdays and the weekend and seasonally, particularly where significant industrial wastewater is discharged to the sewer network or there is a large influx of people during holidays.

Suspended solids - total (SS) - suspended solids which are the small particles of inorganic (minerals) and organic matter carried in wastewater (e.g. grit, sand, clay, meat, vegetables etc). The organic component contributes to BOD. Units are milligrams of solids per litre of wastewater (mg/L).

Total Kjeldahl Nitrogen (TKN as N) - a measure of the total amount of inorganic and organic nitrogen (from ammonia, urea, proteins, amino acids and other compounds) present in wastewater. The term refers to the chemical test procedure used to obtain the measurement. Both nitrogen and phosphorous are considered pollutants when their concentrations in water are sufficient to allow excessive growth of aquatic plants, particularly algae. Units are milligrams of nitrogen compounds (expressed as the nitrogen equivalent) per litre of wastewater (mg/L).

Total nitrogen (TN) - the sum of oxidised nitrogen and TKN.

Total phosphorous (TP) - phosphorous is a nutrient and, in domestic sewage, principally originates from the degradation of phosphate-containing commercial detergents and the human metabolism. Some commercial practices also produce high levels of phosphorous compounds.

2. Summary table

2.1. Metropolitan wastewater plants

Plant	Population served (2011 Census)	Design capacity (ML/day)	Average daily inflow 2010-11 (ML/day)	Average daily inflow 2010-11 (% of design capacity)	Page Ref.
Bolivar	695,630	165	144.39	87.5%	33
Glenelg	198,169	60	48.11	80.1%	67
Bolivar HS	75,023	32	23.87	74.6%	33
Aldinga	11,947	2.1	1.52	72.4%	8
Christies Beach	149,313	45	26.48	58.8%	50

2.2. Country wastewater plants

Plant	Population served (2011 Census)	Design capacity (ML/day)	Average daily inflow 2010-11 (ML/day)	Average daily inflow 2010-11 (% of design capacity)	Page Ref.
Myponga	595	0.05	0.11	220.0%	124
Murray Bridge	13,892	2.12	2.56	120.8%	117
Gumeracha	1,018	0.13	0.14	107.7%	75
Angaston	1,909	0.43	0.45	104.7%	17
Port Pirie	13,825	4.1	4.23	103.2%	167
Hahndorf	4,545	1.01	0.98	97.0%	82
Finger Point	26,283	6.0	5.19	86.5%	59
Port Lincoln	14,088	4.0	3.10	77.5%	160
Victor Harbor	12,483	3.40	2.59	76.2%	174
Millicent	5,024	1.4	1.00	71.4%	104
Naracoorte	5,691	1.54	1.01	65.6%	139
Port Aug West	13,985	1.26	0.75	59.5%	153
Heathfield	13,016	3.6	2.07	57.5%	90
Port Aug East	13,985	2.66	1.51	56.8%	146
Whyalla	22,088	6.94	3.75	54.0%	182
Bird-in-Hand	5,129	2.4	1.15	47.9%	24
Mannum	2,567	0.81	0.38	46.9%	97
Nangwarry	514	0.24	0.10	41.7%	133
Mount Burr	377	0.24	0.06	25.0%	111

** 13,985 is combined population served for Port Augusta East and Port Augusta West*

.

3. Metropolitan drainage areas

4. Aldinga Wastewater Treatment Plant

4.1. Summary

Commissioned:	Stage I oxidation ditch ("A" plant) in 1997; Stage II oxidation ditch ("B" plant) and other upgrades in 2011.
Treatment process:	Screens and grit removal, activated sludge oxidation ditch bioreactors, secondary clarifiers, effluent disinfection using chlorine followed by two storage lagoons. Sludge stabilisation and drying lagoons are also provided.
Disposal of treated wastewater:	Storage on-site in lagoons and reuse on local vines. Surplus treated sewage can be applied to a crop in the adjacent paddock through a centre pivot irrigator.

Figure 1 Aldinga wastewater treatment plant site

Parameter	Design ("A" & "B" Plants Combined)[1]	Actual (2010-11)
Flows (Megalitres per day; ML/d)		
Average dry weather	1.79	1.29
Average annual	2.10	1.52
Peak month average	2.52	1.88
Peak day flow	4.62	2.11
Peak wet weather	6.30	n/a
Avg Influent Concentration (mg/L)		
Biochemical Oxygen Demand (BOD)	250	231
Suspended Solids (SS)	250	200
Total Kjeldahi Nitrogen (TKN)	75	71
Ammonia (NH_3-N)	53	53
Total Phosphorous (TP)	13	11
Avg Raw Wastewater Load (kg/dy)		
Biochemical Oxygen Demand (BOD)	525	342
Suspended Solids (SS)	525	290
Total Kjeldahl Nitrogen (TKN)	158	105
Ammonia (NH_3-N)	110	79

Population[2]

2005	2011
7,119	11,947

The number of connections in this catchment is expected to grow significantly in the near future: from 4,595 in 2010-11 to a forecast 5,510 in 2015-16.

[1] Source: "*Aldinga Wastewater Treatment Plant – Process Design Summary*" (United Water, 2009).
[2] Indicative population numbers based on SA Water information about the number of Government Inspection Point (GIP) connections, multiplied by population density of 2.6 (number of occupants per residence).

Figure 2 Aldinga plant schematics

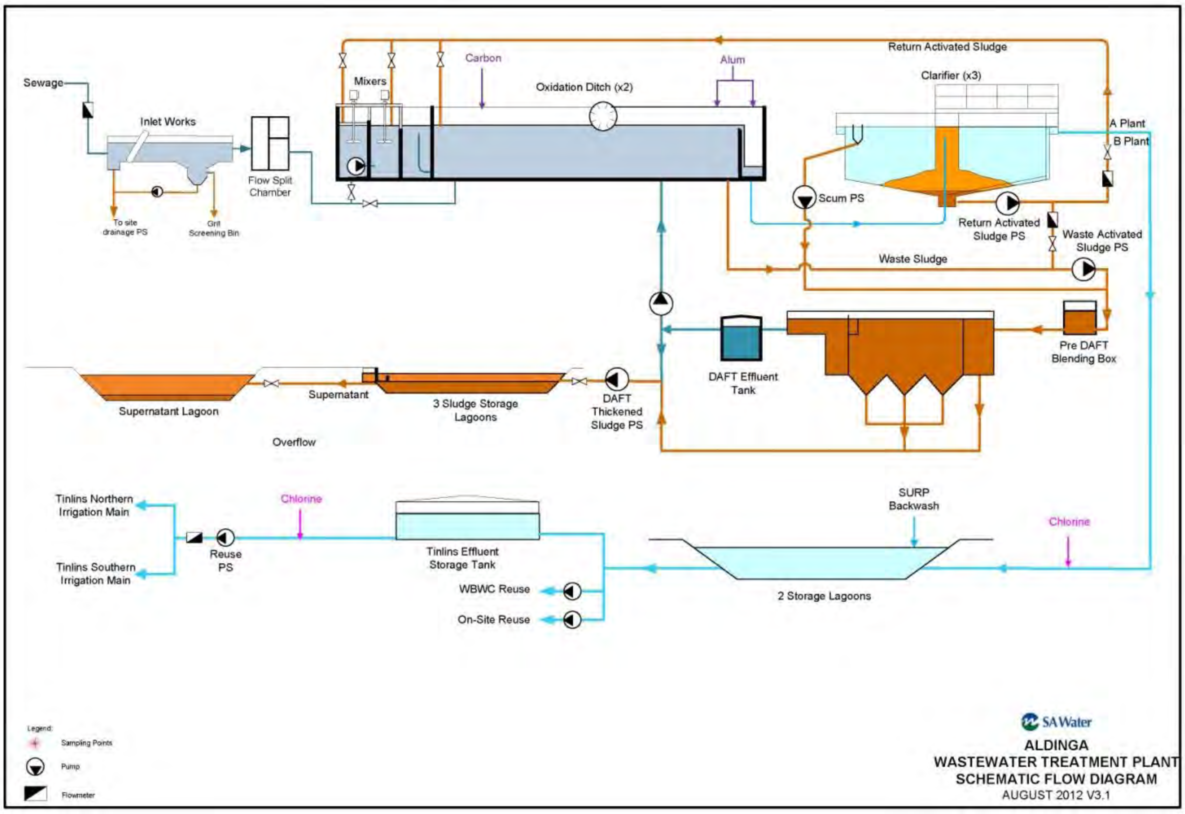


Figure 3 Aldinga wastewater treatment plant drainage area

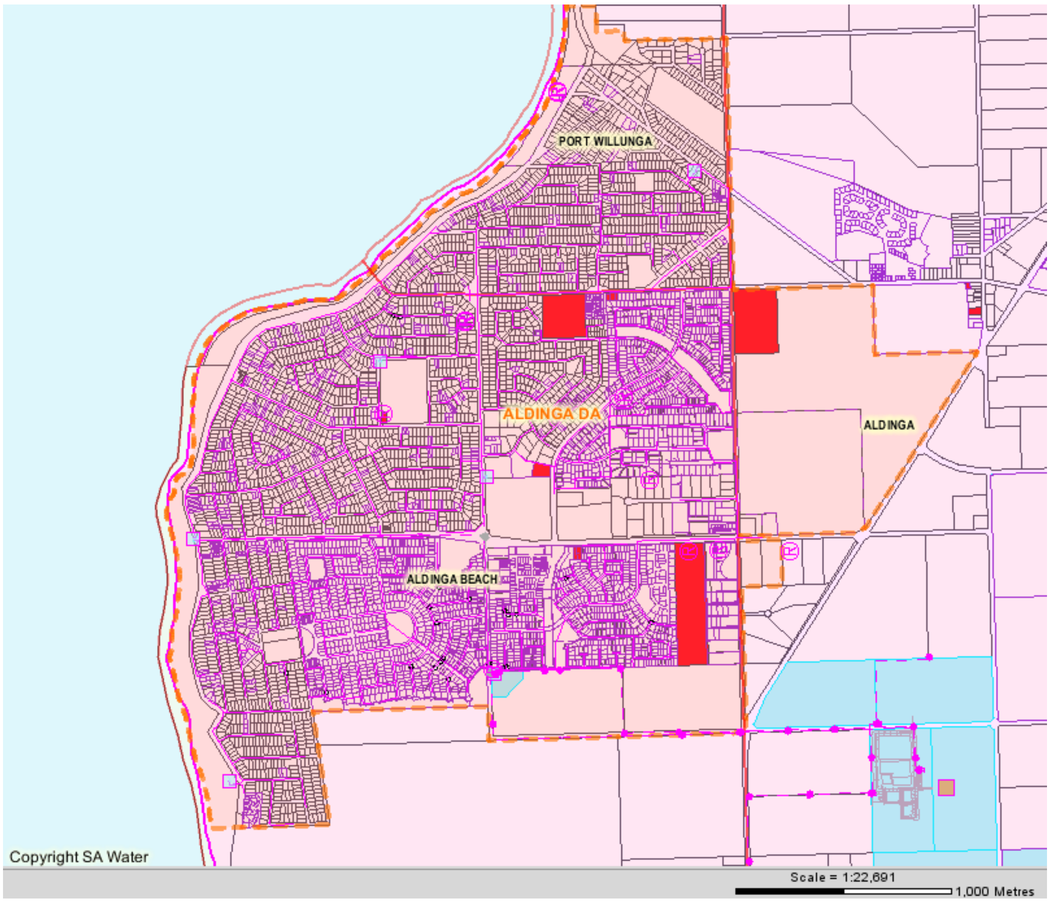
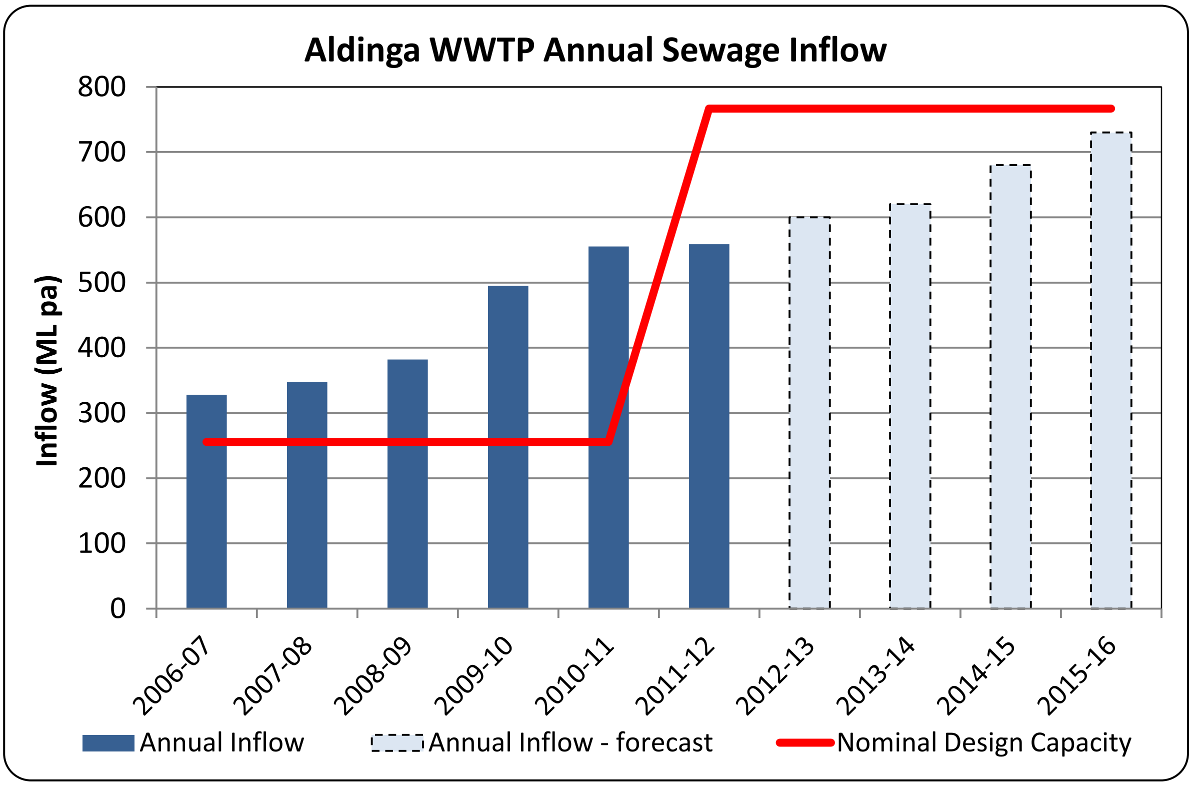


Figure 4



Note: annual flows have exceeded the nominal average annual flow (AAF) design capacity in recent years, prior to the construction of Stage II. This has been of concern, but the plant hydraulic capacity is defined by the design peak instantaneous flow, not annual average flow. Significant growth in the region has led to a sharp increase in the number of connections to the plant.

Figure 5

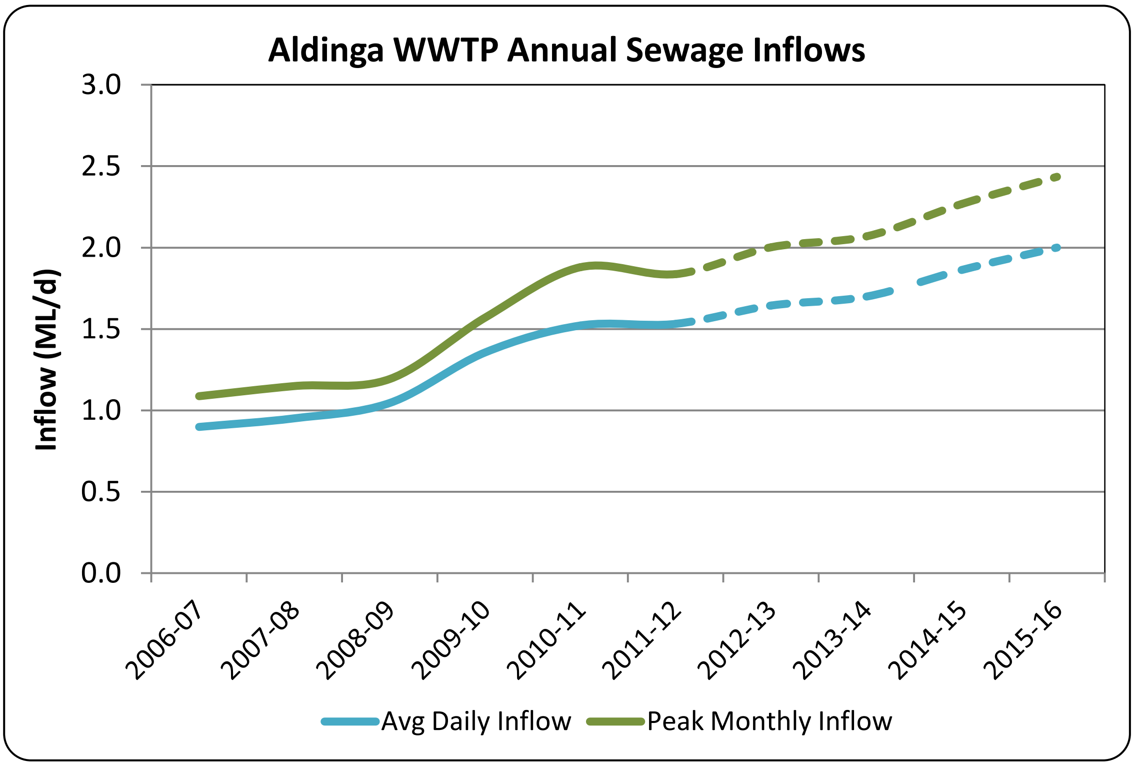
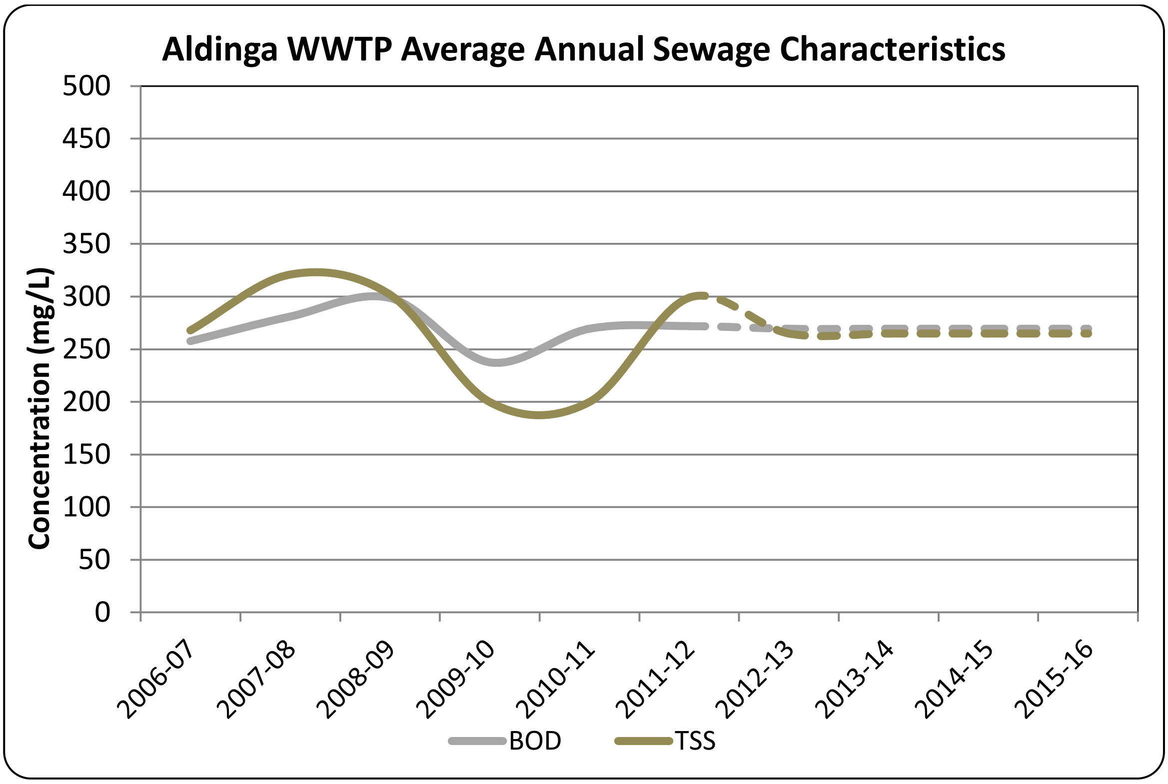


Figure 6



Note: the 2006-07 concentration peaks were most likely due to lesser dilution during the drought, while the trough in 2010-11 was most likely due to high summer rainfall diluting the inflow.

Figure 7

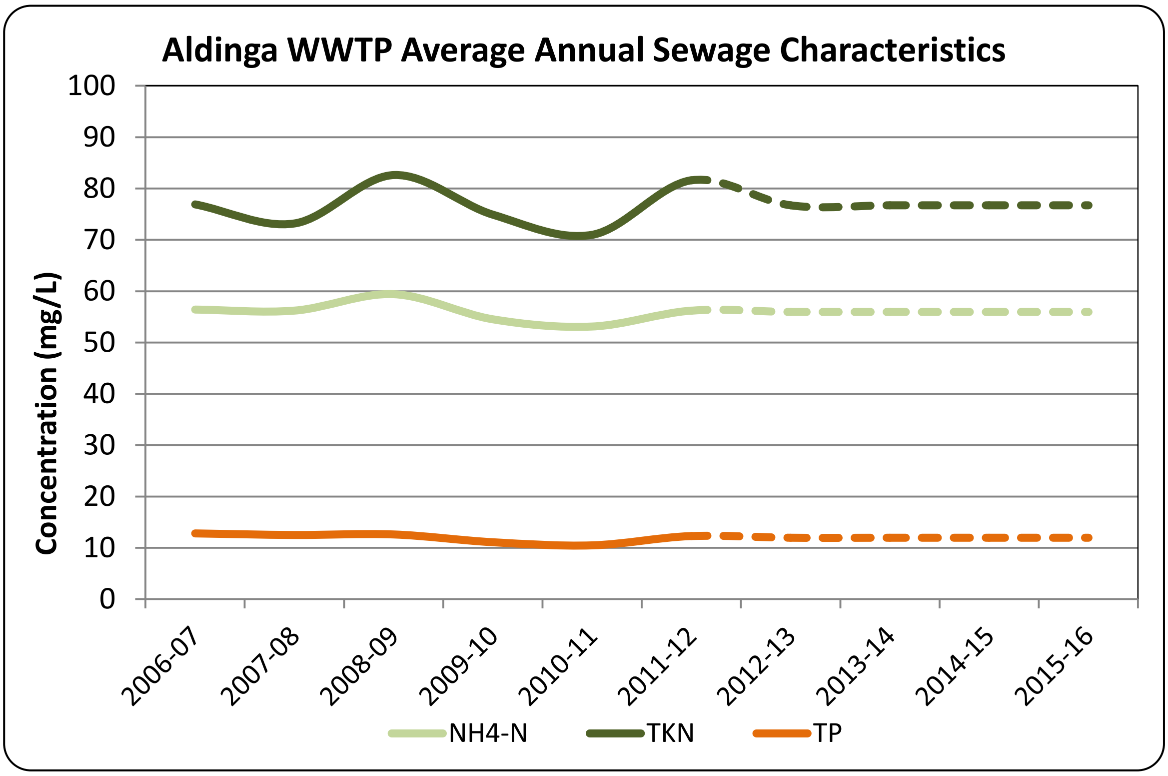
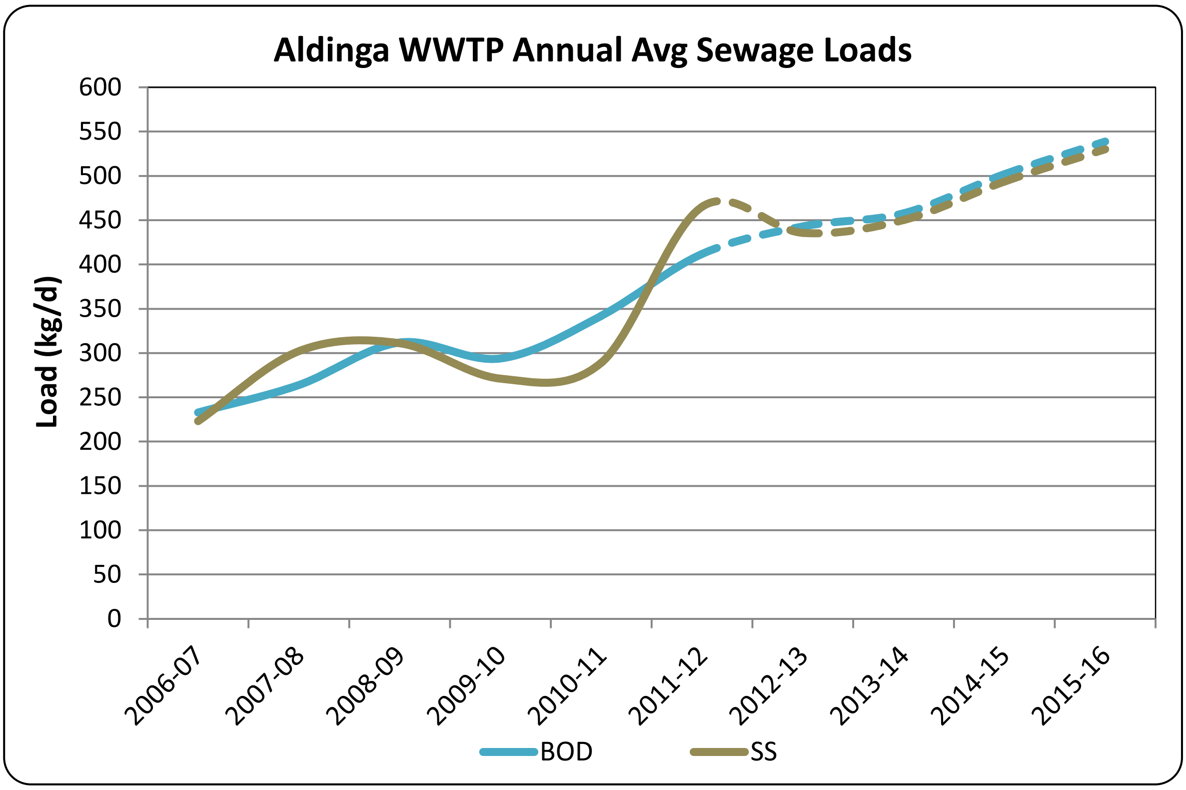
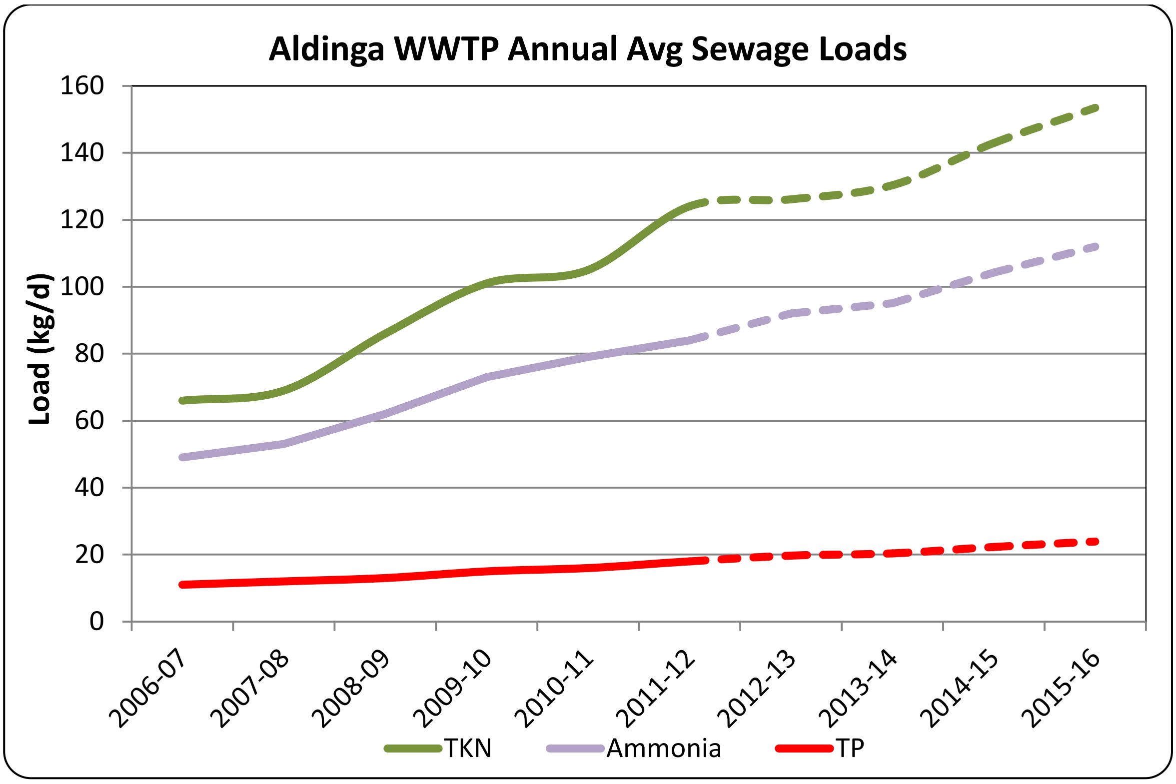

Aldinga WWTP Average Annual Sewage Characteristics
Concentration (mg/L)
100
90
80
70
60
50
40
30
20
10
0
2006-07
2007-08
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
2014-15
2015-16
NH4-N
TKN
TP

Figure 8



Note: projected sewage loads are based on projected annual average flows multiplied by projected average annual pollutant concentrations. BOD, SS ammonia and TKN all trend steeply upwards at Aldinga due to the forecast rapid increase in sewage flows in future years.

Figure 9



4.2. Key points

- The Aldinga wastewater treatment plant is situated approximately 3.3km east of the coastline at Aldinga. The plant is situated outside of the network drainage area, which includes the coastal townships of Aldinga Beach, Port Willunga and Aldinga.

- The plant was constructed in 1997, as part of a Build, Own, Operate and Transfer (BOOT) scheme, which also included the Rowley Road sewer pumping station and pumping main to the plant. SA Water acquired the plant in December 2007, earlier than planned, when the owner was placed in receivership.

- The original “A” plant was not designed or constructed to SA Water standards. Stage II infrastructure included new inlet works (flow splitting, screens and grit removal) to serve both the existing “A” plant and a new “B” plant. “A” plant has also been refurbished. Both stages at Aldinga employ the activated sludge oxidation ditch technology.

- Treated sewage is disinfected with chlorine and flows through a chlorine contact tank into the finished water storages. Two earthen rock-pitched storages of 235ML and 90ML capacity provide balancing storage for winter flows with summer reuse.

- Aldinga is a “zero discharge” plant as the original scheme was designed for no effluent discharge to any water body. All treated sewage has been reused for viticultural irrigation of an adjacent vineyard and surplus treated sewage has been reused on pasture.

- In the event that there is insufficient demand or irrigation capacity for reusing treated sewage from Aldinga, the system allows excess water to be returned to the Christies Beach network and discharged via the Christies Beach WWTP outfall. The EPA has imposed strict licence conditions to ensure discharge via the outfall occurs only under emergency conditions, (such as potential for storage lagoon overflow) and appropriate controls and monitoring are in place.

- The Aldinga site includes other infrastructure not part of the Aldinga WWTP, including a 700ML treated wastewater storage, a Managed Aquifer Storage and Recovery (ASR) scheme and the Aldinga recycled water treatment plant. This infrastructure receives treated sewage pumped from the Christies Beach WWTP to the north, which is further treated and used for dual reticulation and irrigation.

- SA Water and the Willunga Basin Water Company operate the ASR scheme, which involves recycled water being stored in the aquifer during winter (when irrigation demand is low) and then retrieved for irrigation use in summer. *Refer to Christies Beach WWTP in this attachment.*

Key points - future:

- The drainage area for the Aldinga WWTP has undergone significant growth in the past 10 years with an increase of 3170 active connections (GIPs). This development has driven a need to increase the capacity of the plant.

- A capital project is under way to upgrade the Rowley Road wastewater pump station - the final pump station within the drainage network that pumps via a rising main to the Aldinga WWTP - to increase its capacity and minimise the risk of environmental incidents through overflow of this pump station. This work is due for completion in 2012.

- While the upgrade of the Rowley Road pump station and associated rising mains addresses network overflows, it will shift the problems associated with high flows from the networks to the WWTP. The WWTP inlet works will be significantly overloaded when the pump station operates at a greater capacity. The hydraulic capacity of the WWTP inlet works is 73 L/s and as such will be significantly overloaded once the main pump station operates above this capacity, resulting in sewerage overflows at the treatment plant's inlet works.

- The upgraded pump station incorporates variable speed drives allowing flows to the treatment plant to be managed in the short term until the Aldinga WWTP capacity upgrade - with much of the work proposed for the forthcoming regulatory period - is complete. Details of this project are included in Chapter 6 of this Proposal.

- Aldinga WWTP is ranked as a "tier 3"[3] treatment plant by the EPA. Under the current licence there is no requirement for an EIP.

[3] Refer to notes to the attachment.

5. Angaston Wastewater Treatment Plant

5.1. Summary

Commissioned:	The plant was commissioned in 1963 to serve the rural township of Angaston.
Treatment process:	Imhoff tank, aerated lagoon, two polishing lagoons.
Disposal of treated wastewater:	Treated sewage from lagoon "C" is pumped to irrigate wine grapes on an adjacent property on the northern side of Angaston Creek. Any treated sewage that is not recycled is chlorinated and discharged into Angaston Creek.

Figure 10 Angaston wastewater treatment plant

Parameter	Design	Actual (2010-11)
Flows (Megalitres per day; ML/d)		
Average dry weather	0.366	0.424
Average annual	0.431	0.455
Peak month average	0.517	0.532
Peak wet weather	1.098	n/a
Avg Influent Concentration (mg/L)		
Biochemical Oxygen Demand (BOD)	400	495
Suspended Solids (SS)	400	332
Avg Raw Wastewater Load (kg/dy)		
Biochemical Oxygen Demand (BOD)	146	232

Note: the Angaston wastewater treatment plant was not designed for nitrification/de-nitrification and, therefore, a limited number of parameters are currently monitored. The design figures above are based on the original hydraulic parameters. Surface aeration has been added to lagoon 1 which allows additional load to be carried.

Population served[4]

2006 Census	2011 Census
1865	1909

[4] Figures for catchment areas based on Australian Bureau of Statistics, 2006 and 2011 Census data, www.abs.gov.au. For 2006 Angaston "Urban Centre/Locality" data was used. In 2011 Angaston "Gazetted locality" provided the best fit for the catchment area.

Figure 11 Angaston wastewater treatment plant drainage area

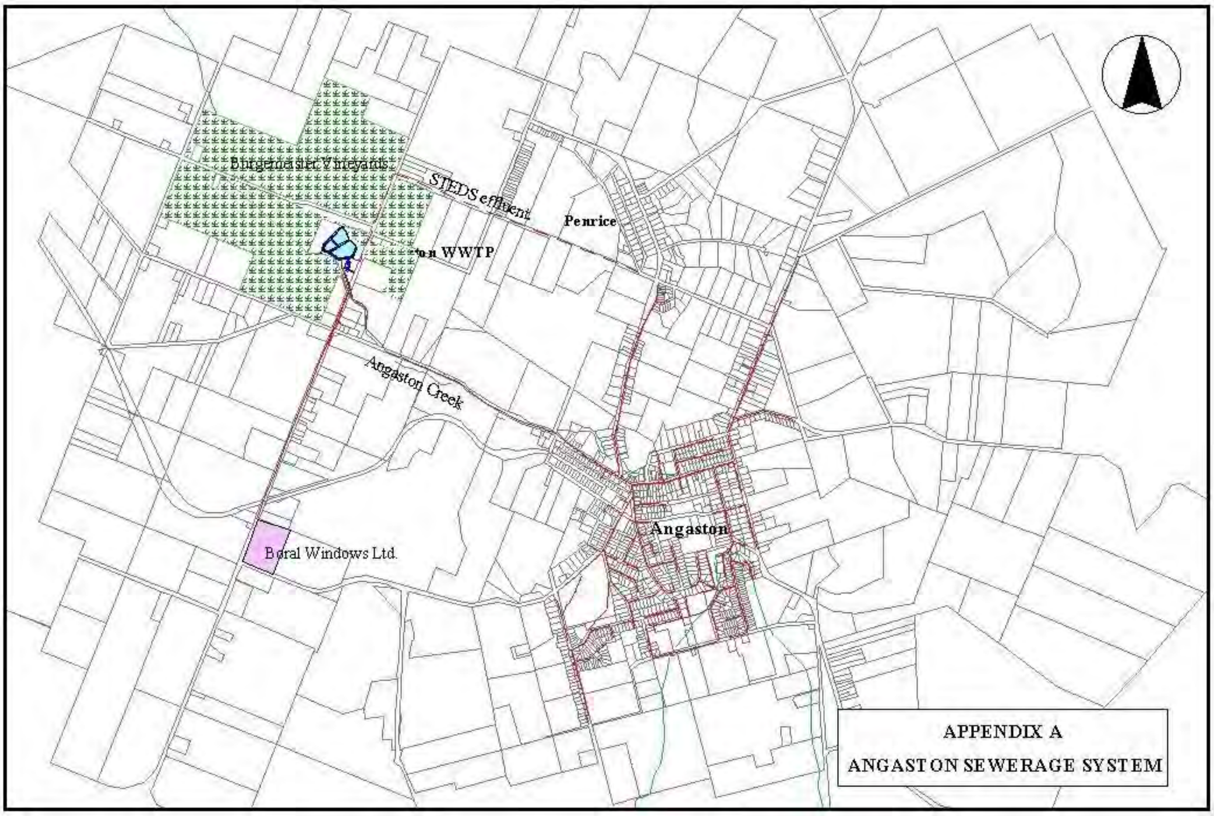


Figure 12 Angaston wastewater treatment plant schematics

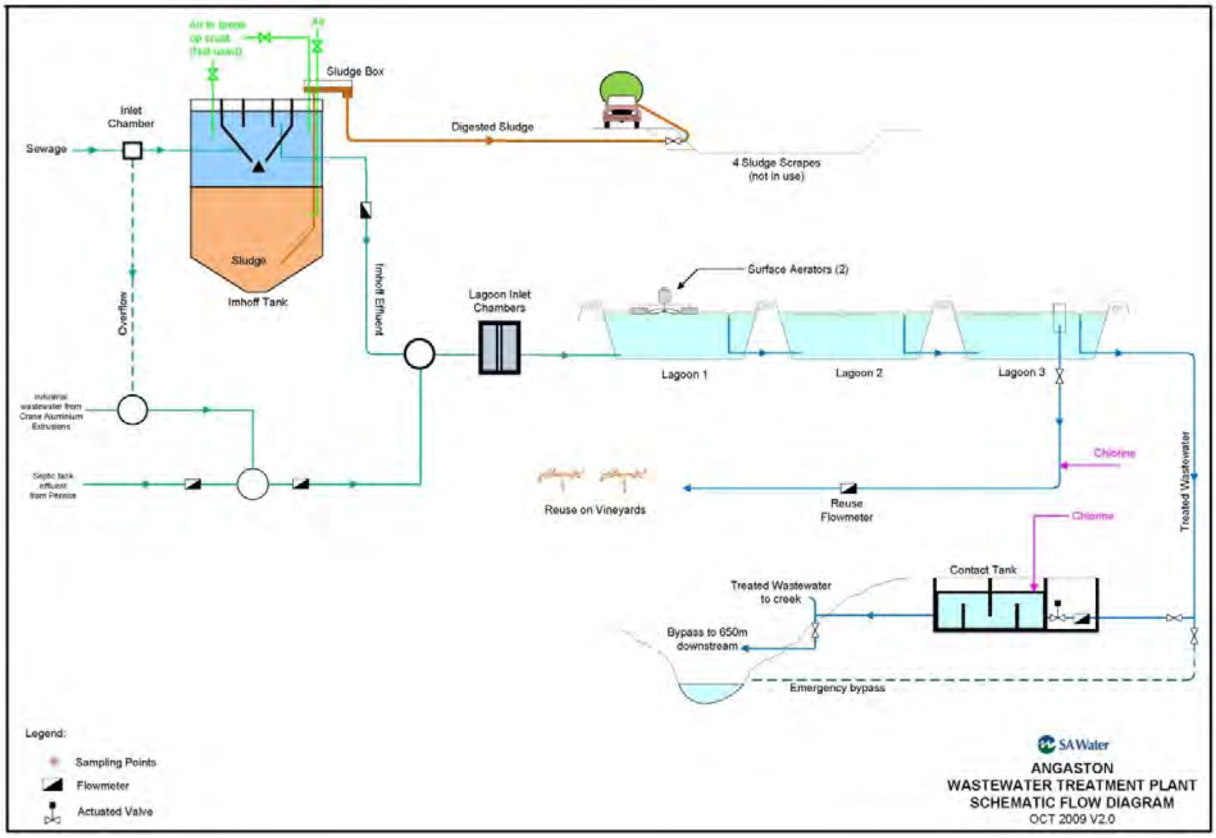


Figure 13

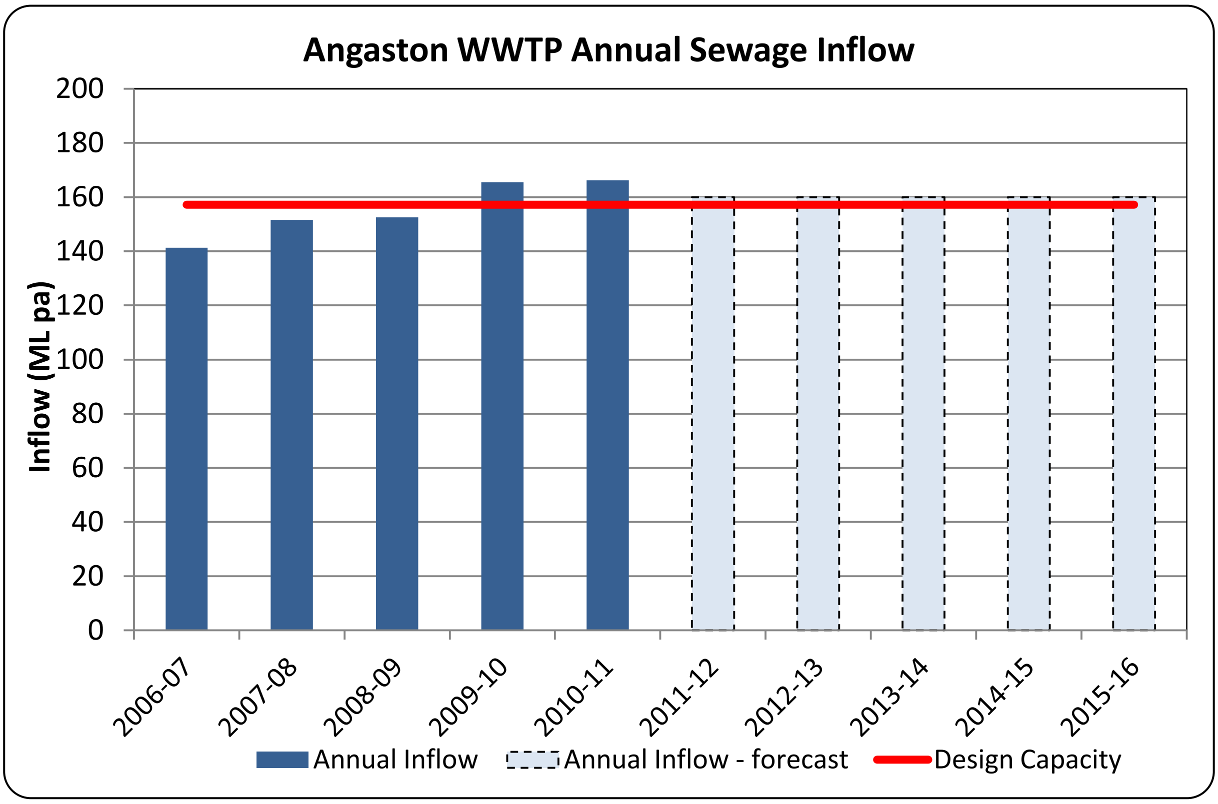


Figure 14

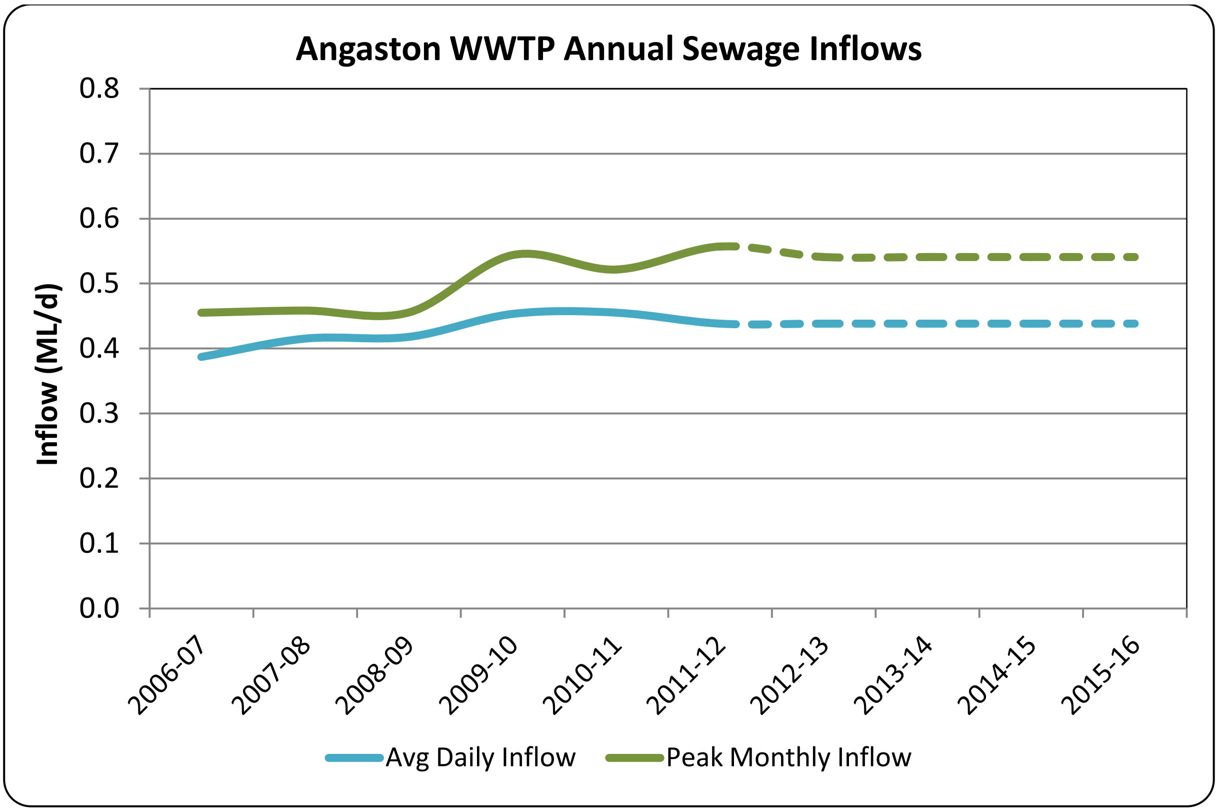


Figure 15

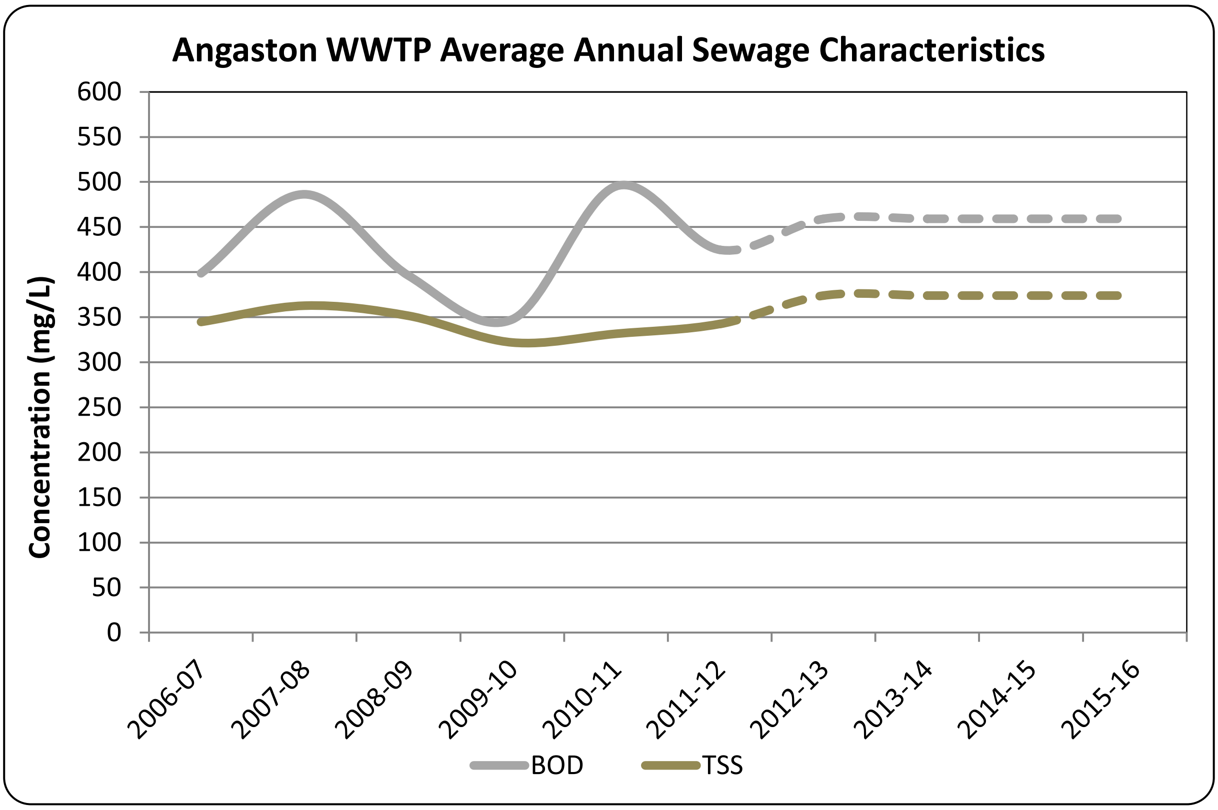


Figure 16

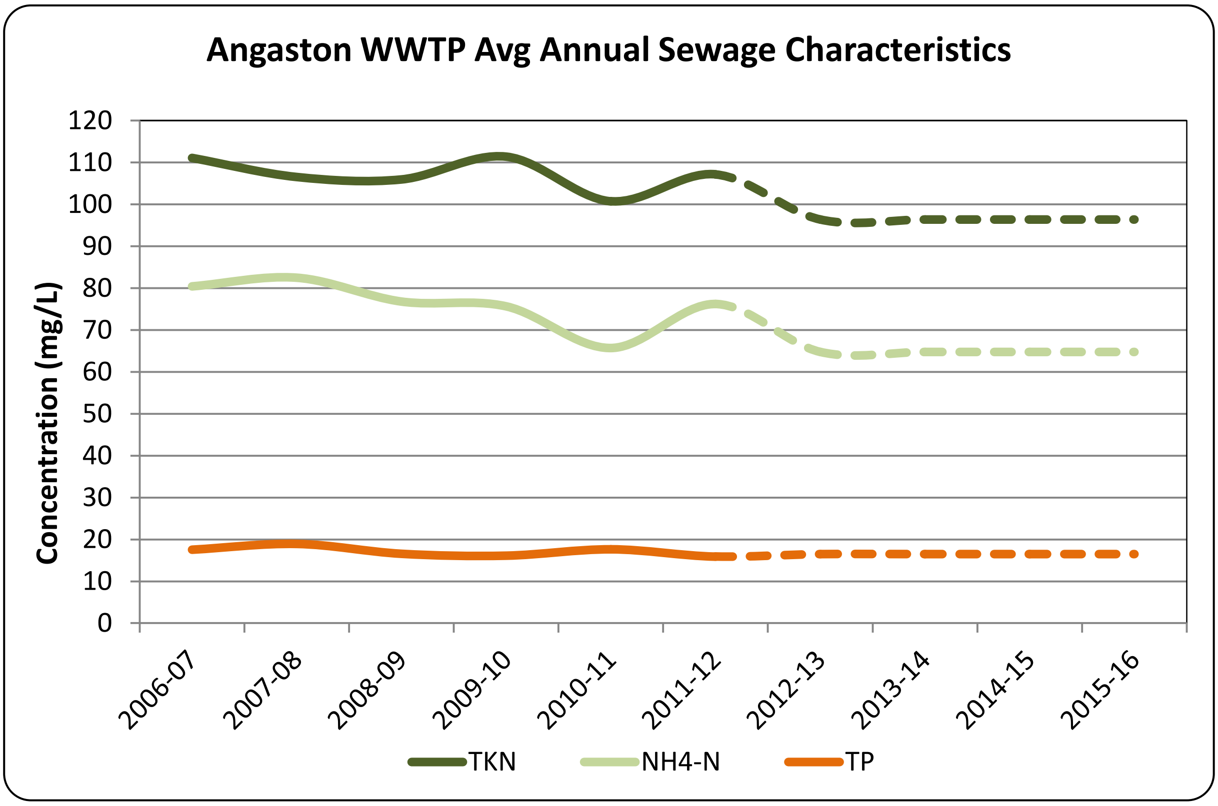


Figure 17

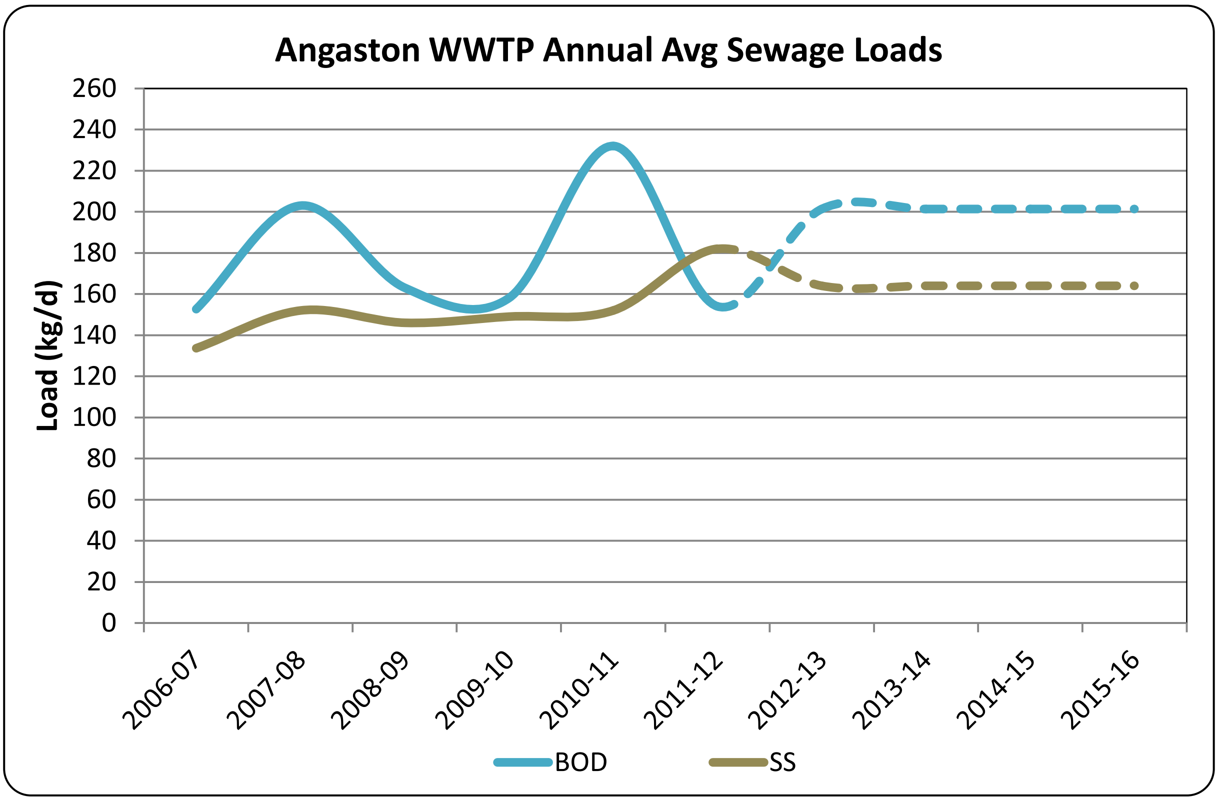
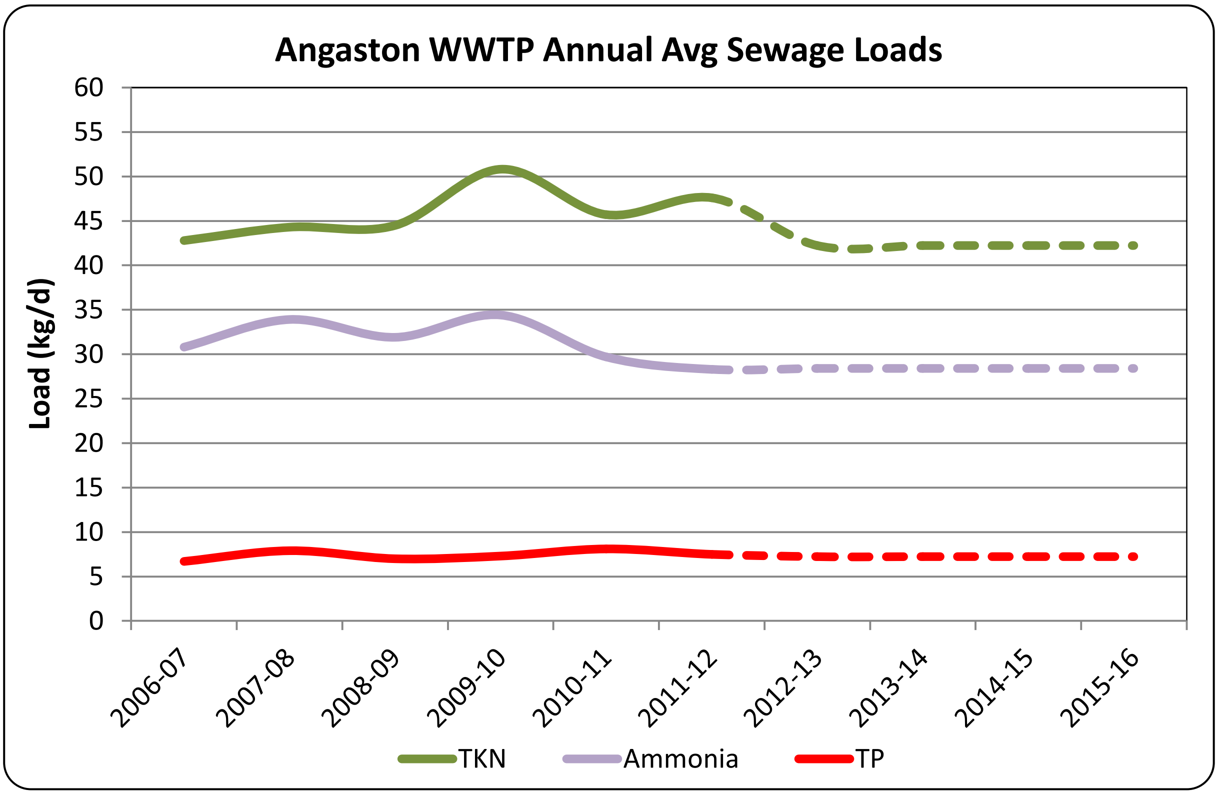


Figure 18



5.2. Key points

- The Angaston wastewater treatment plant receives sewage from the Barossa Valley township of Angaston, septic tank effluent from the small community of Penrice and some from local industry.

- The WWTP uses conventional primary and secondary treatment processes. Sewage gravitates from the sewerage system to an Imhoff tank, where primary sedimentation and sludge digestion takes place. Primary effluent then gravitates from the Imhoff tank to lagoon "A", where it is aerated with a single floating mechanical aerator. Effluent then flows from lagoon "A" to lagoons "B", then "C".

- A 5kW surface aerator was installed in 1983 to improve effluent quality and to provide additional treatment capacity. Although the plant was designed for purely domestic sewage, industrial discharges are accepted and discharged directly into lagoon "A". Septic tank effluent from the small town of Penrice is also discharged into lagoon "A" and the additional aerator was installed at that time.

- The remaining sewage is chlorinated in a contact tank and discharged to the Angaston Creek. Angaston Creek flows through the township of Nuriootpa, joins the North Para River and subsequently the Gawler River that flows into Gulf St Vincent, approximately 60km to the west.

- Lagoon sludge is periodically dredged and the dewatered material is sent to a composter. Imhoff Tank sludge is removed by a liquid waste contractor and used to condition vineyard soil.

Key points - future:

- Only a small amount of development is expected to occur within the town boundary.

- High flows of water in Angaston Creek, along the south-west site boundary, have led to the watercourse encroaching onto the site. This has posed a threat to infrastructure and remedial measures are due to be completed in the forthcoming regulatory period.

- The EPA has required investigations into the impact of treated sewage discharges on the Angaston Creek receiving waters and environment. The EPA has stated it would prefer no creek discharge, but this is not currently feasible as there is no on-site winter storage and there is insufficient demand for treated sewage. Reuse is maximised in summer but can be variable depending on demand due to extremes of climate

- Angaston WWTP is ranked as a "tier 2"[5] treatment plant by the EPA and under the current licence there is no requirement for an EIP. However, there is a condition for SA Water to conduct an assessment of options to minimise discharge to the Angaston River, and for this assessment to inform a wastewater treatment plant upgrade strategy.

[5] Refer to notes to the attachment.

6. Bird-In-Hand Wastewater Treatment Plant

6.1. Summary

Commissioned: Originally an anaerobic and aerated lagoon plant was commissioned in 1965. The plant has been upgraded to an activated sludge process and commissioned in late 2011.

Treatment process: Screens, grit removal, activated sludge biological nitrogen removal with chemical phosphorous reduction, secondary clarifiers followed by filtration and UV disinfection. Mechanical sludge dewatering is followed by anaerobic digestion on-site.

Disposal of treated wastewater: On-site reuse for pasture irrigation**.** Supply to external customers off-site via a new recycled water distribution network. Treated sewage that is not reused is discharged to Dawesley Creek.

Figure 19 Bird-in-Hand wastewater treatment plant

Parameter	2010 Upgrade Design	Actual (2010-11)
Flows (Megalitres per day; ML/d)		
Average dry weather	1.600	0.854
Average annual	2.400	1.153
Peak month average	2.880	1.722
Peak day flow	4.080	n/a
Peak wet weather	12.500	n/a
Avg Influent Concentration (mg/L)		
Biochemical Oxygen Demand (BOD)	378	284
Suspended Solids (SS)	378	153
Total Kjeldahi Nitrogen (TKN)	81	67
Ammonia (NH_3-N)	n/a	48
Total Phosphorous (TP)	12.5	13
Avg Raw Wastewater Load (kg/dy)		
Biochemical Oxygen Demand (BOD)	900	299
Suspended Solids (SS)	900	165
Total Kjeldahl Nitrogen (TKN)	195	74
Ammonia (NH_3-N)	n/a	54
Phosphorous	300	14

Population served[6]

2006 Census	2011 Census
4190	5129

[6] Indicative figures for catchment areas based on Australian Bureau of Statistics, 2006 and 2011 Census data, www.abs.gov.au. This includes statistical areas of Lobethal and Woodside, excluding Charleston.

Figure 20 Plant schematics

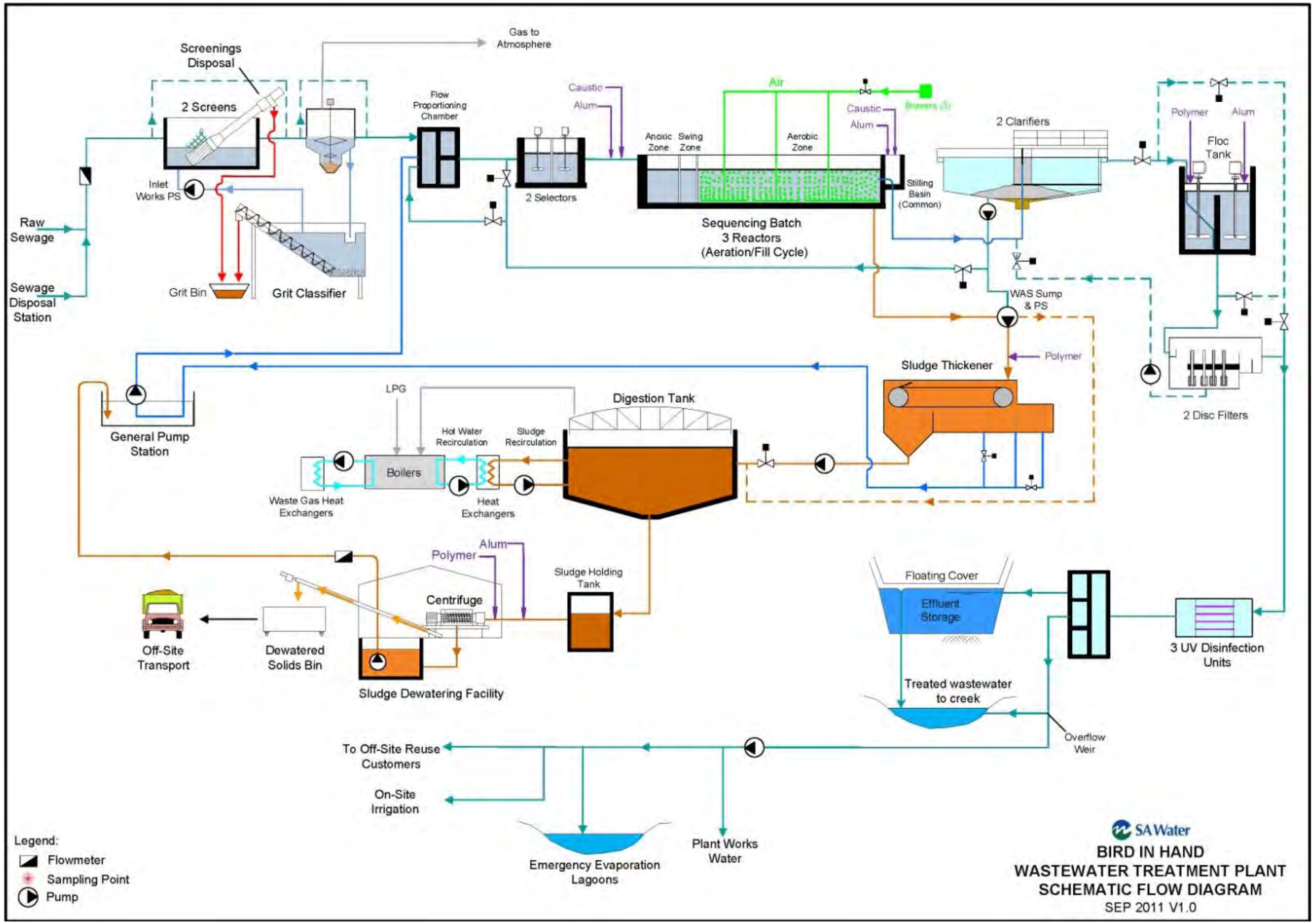


Figure 21 Bird-in-Hand drainage area

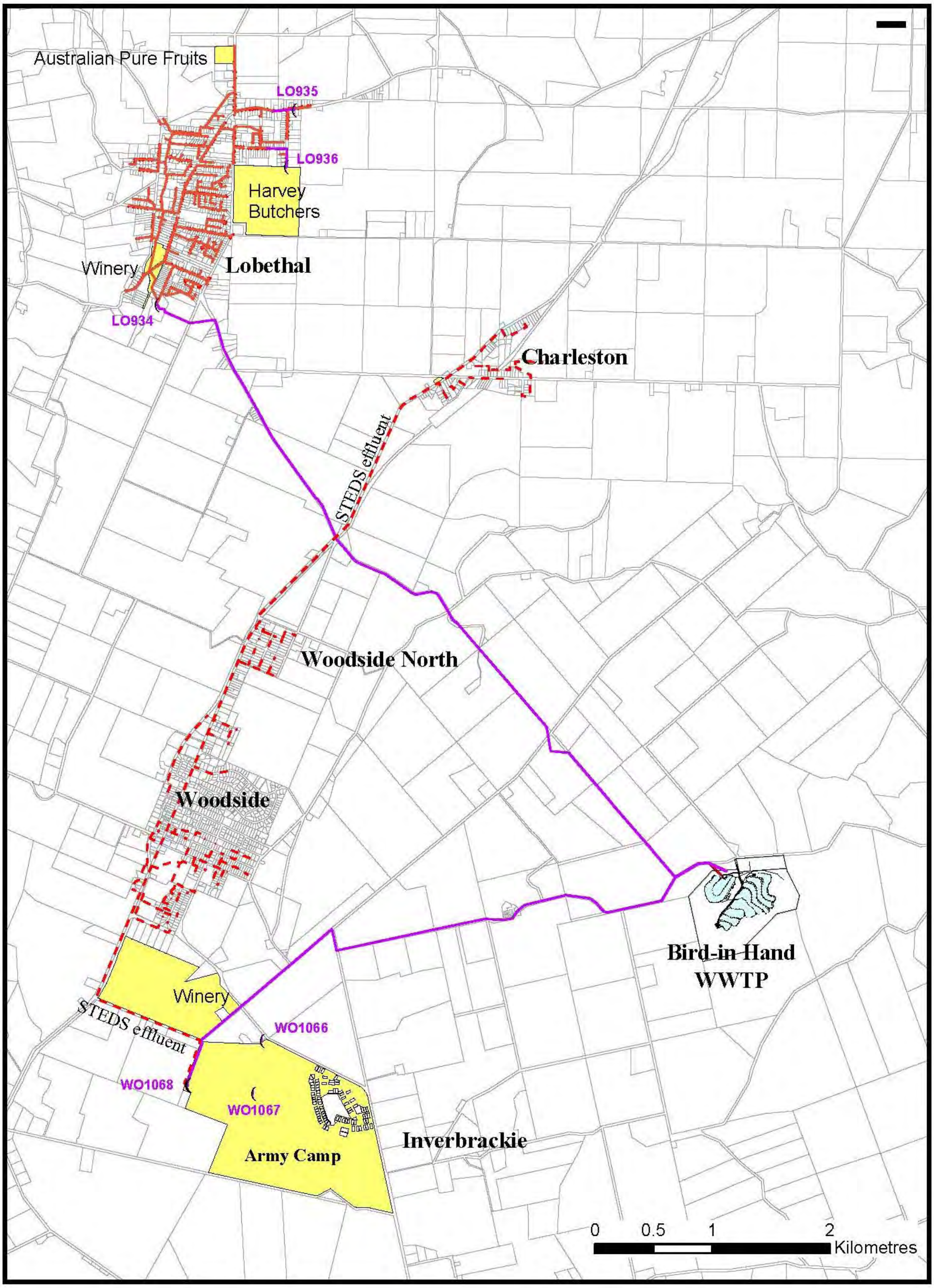


Figure 22

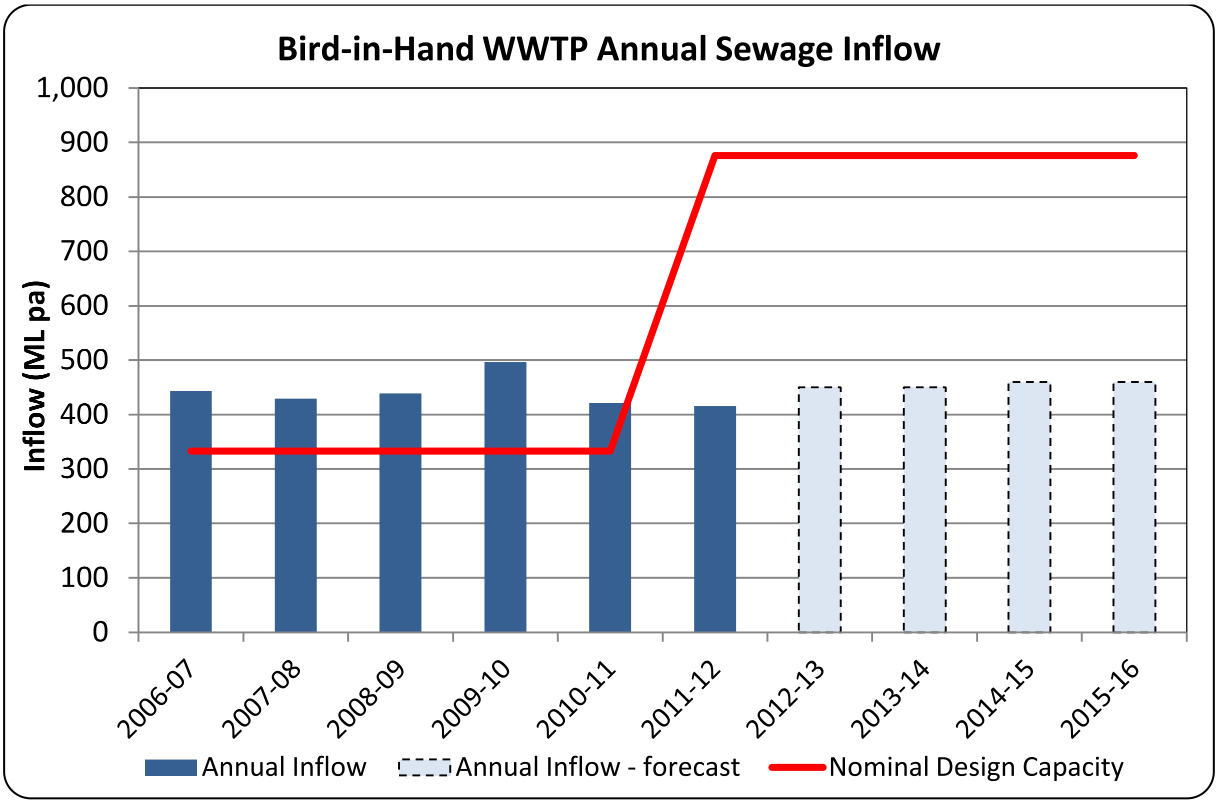


Figure 23

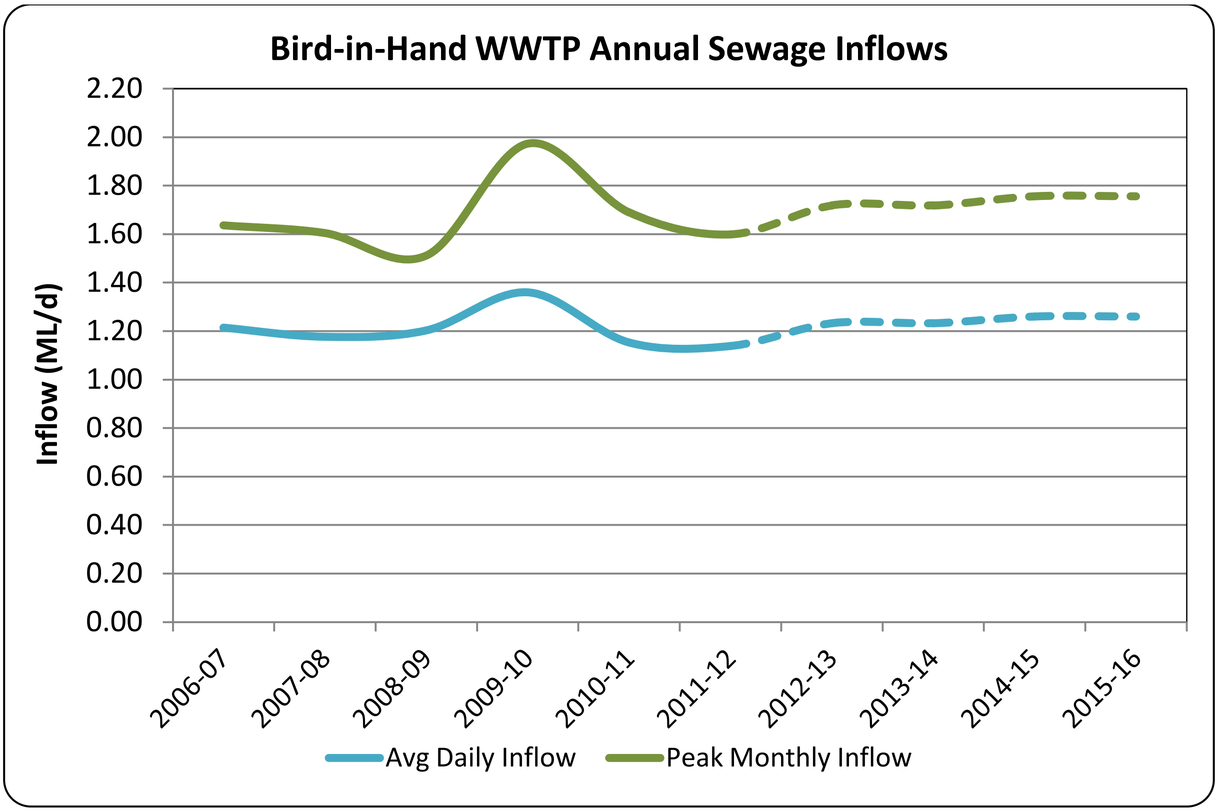


Figure 24

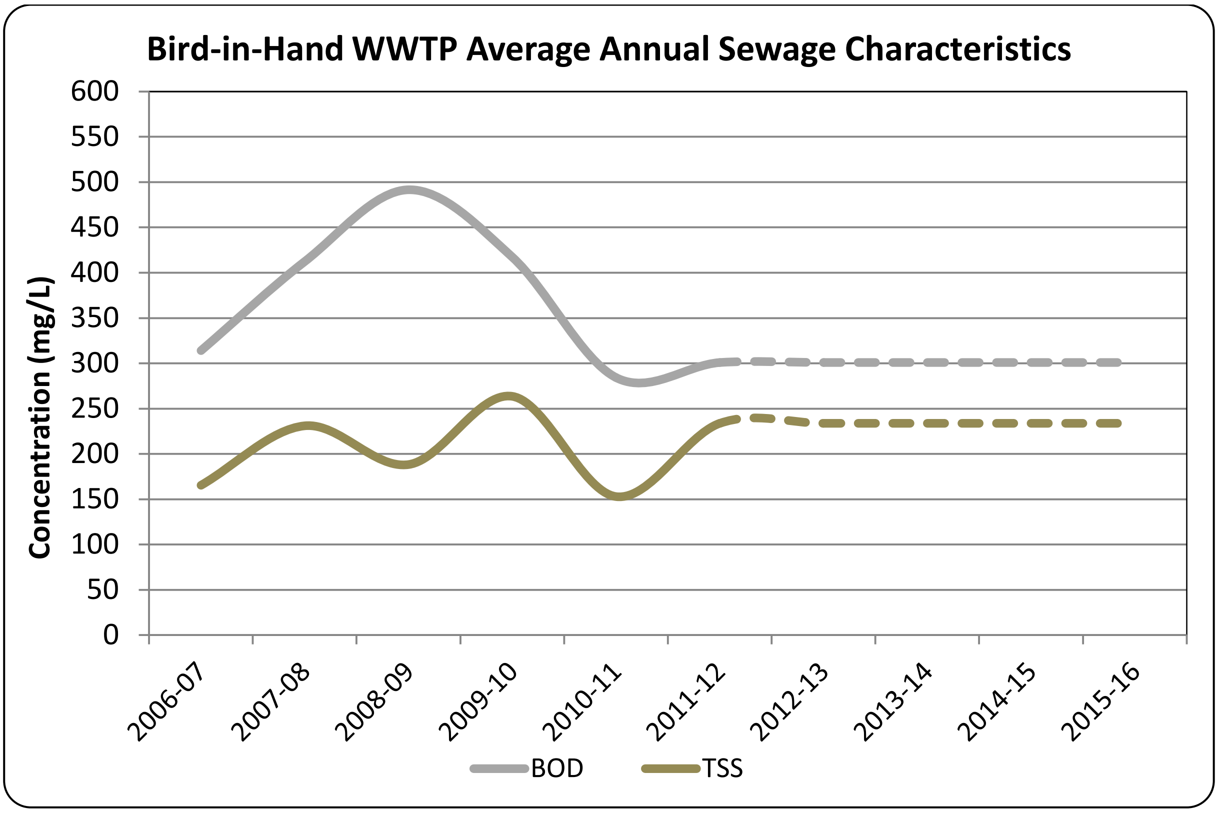


Figure 25

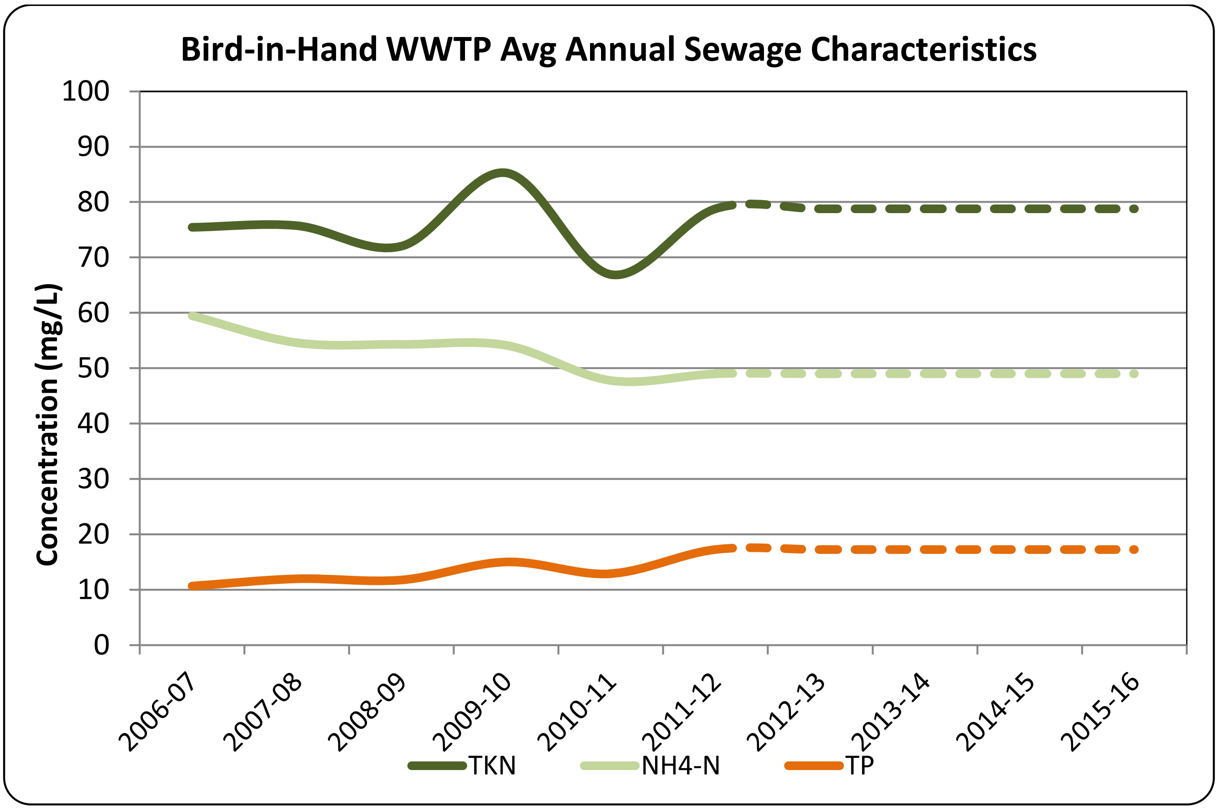


Figure 26

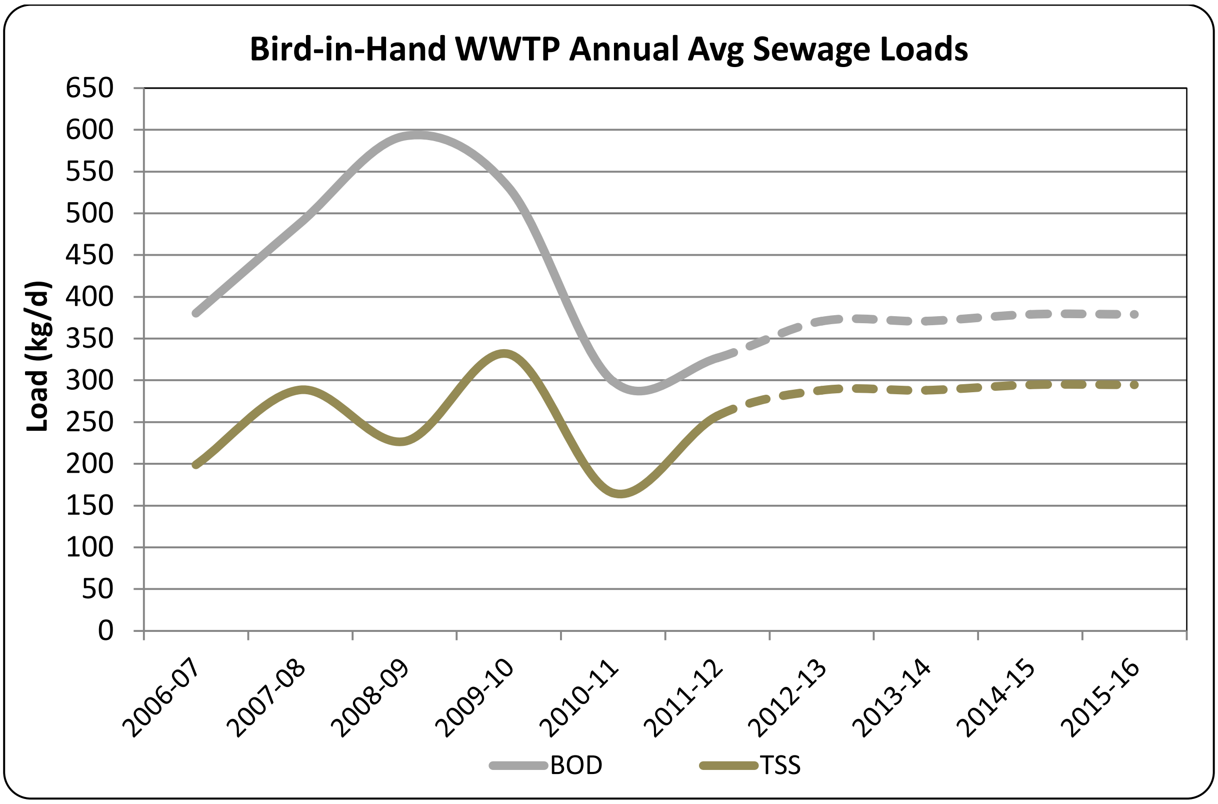
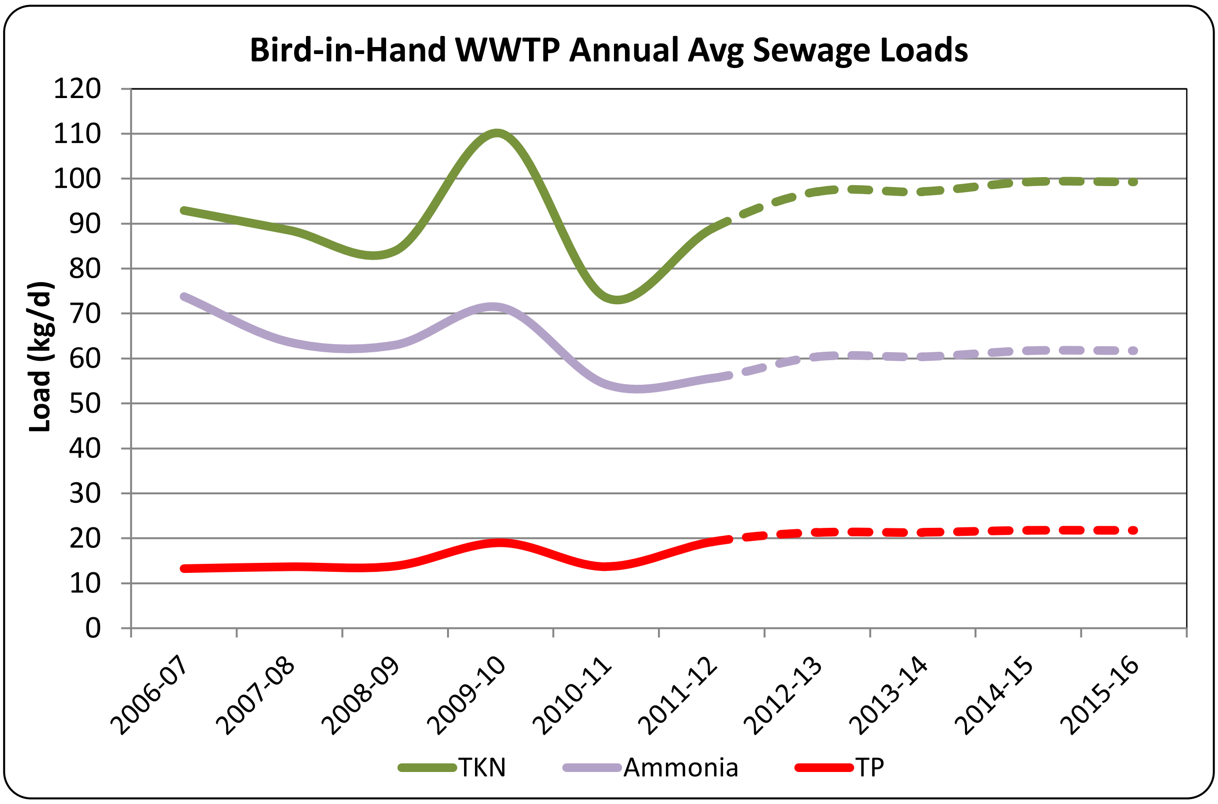

Bird-in-Hand WWTP Annual Avg Sewage Loads
Load (kg/d)
650
600
550
500
450
400
350
300
250
200
150
100
50
0
2006-07
2007-08
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
2014-15
2015-16
BOD
TSS

Figure 27



Note: high phosphorous loads from the abattoir were observed during plant commissioning in 2011-12. Trade waste controls are being tightened in an effort to ameliorate the problem.

6.2. Key points

- The Bird-in-Hand wastewater treatment plant receives sewage from the Adelaide Hills Township of Lobethal and the Woodside Army Camp, as well as septic tank effluent pumped from the towns of Charleston and Woodside. Population served varies depending on the number of service personnel at the Inverbrackie Army Camp.

- Sewage is delivered to the plant via pumping mains from Lobethal and Woodside. The original treatment process consisted of two anaerobic lagoons followed by an aerated lagoon and seven aerobic lagoons. The original plant capacity was intended to accommodate high industrial loads from the woollen mills in Lobethal, but these shut down in the late 1980s.

- Treated wastewater is discharged into Dawesley Creek, which flows into the Bremmer River. An on-site reuse scheme commenced operations in 2001.

- A number of complaints about poor water quality from landholders along Dawesley Creek prompted negotiations with the community and EPA concerning the need for improvements to the environmental performance of the plant. An EIP incorporating a plant upgrade to the activated sludge process was approved in 2008 and the new activated sludge plant was commissioned in late 2011. The $60 million upgrade and recycled water scheme was aimed at reducing both nitrogen and phosphorous concentrations in the treated wastewater and minimising discharges to Dawesley Creek.

- The new activated sludge plant employs three parallel process trains which include common screens & grit removal facilities, anaerobic bio-selectors, anoxic and aerated zones (for enhanced biological nutrient reduction) and secondary clarifiers. Alum dosing for chemical phosphorous reduction is included, together with caustic soda dosing for pH control.

- Waste sludge is thickened using a gravity drainage deck thickener and fed to an anaerobic digestion tank. The digested sludge is then de-watered using a centrifuge and the cake is trucked to a composter for eventual use as a farm soil conditioner. Waste methane gas is burned to heat and mix the contents of the anaerobic digester.

- The upgraded plant incorporates cloth media disk filtration and UV disinfection to provide recycled water suitable for irrigation of horticulture (with restrictions) and pasture. A 50 ML lined and covered recycled water balancing storage and recycled water pumping station distribute treated sewage to local customers are also included in the scheme. The water recycling component is aimed at eliminating treated wastewater discharges to Dawesley Creek during summer and minimise discharges during “shoulder” seasons.

Key points - future:

- The upgraded Bird-in-Hand WWTP was designed to cater for planned population increases in the drainage area to the year 2035.

- Bird-in-Hand WWTP is currently ranked as a “tier 1”[7] treatment plant by the EPA. The EPA has indicated it will reassess the tier ranking to “tier 2” following commissioning and stable operation of the new plant. Under the current licence there is no requirement for an EIP.

[7] Refer to notes to the attachment.

7. Bolivar Wastewater Treatment Plant

7.1. Summary

Commissioned:	The trickling filter plant was commissioned in 1966. An activated sludge upgrade was commissioned in February 2001.
Treatment process:	Screens and grit removal, primary sedimentation tanks, activated sludge bioreactors, secondary clarifiers and polishing lagoons.
Disposal of treated wastewater:	Discharge via 11 km outfall open channel to coastal marine waters at St Kilda north of the plant. Irrigation of market gardens at Virginia after treatment through the Bolivar Dissolved Air Flotation & Filtration (DAFF) plant. After additional chlorination, supply to dual reticulation network at Mawson Lakes.

Figure 28 Bolivar wastewater treatment plant

Parameter	**Design**	**Actual (2010-11)**
Flows (Megalitres per day; ML/d)		
Average dry weather	148.5	137.7
Average annual	165.0	144.4
Peak dry weather	198.0	224.7
Peak month	280.0	161.4
Peak wet weather	500.0	467.0
Avg Concentration (mg/L)		
Biochemical Oxygen Demand (BOD)	450	439
Chemical Oxygen Demand (COD)	1,250	809
Suspended Solids (SS)	700	463
Total Kjeldahi Nitrogen (TKN)	80	69
Ammonia (NH_3-N)	46	46
Total Phosphorous (TP)	15	10
Avg Raw Wastewater Load (kg/dy)		
Biochemical Oxygen Demand (BOD)	74,250	63,352
Chemical Oxygen Demand (COD)	206,250	117,189
Suspended Solids (SS)	115,500	66,995
Total Kjeldahi Nitrogen (TKN)	13,200	9,945
Ammonia (NH_3-N)	7,590	6,593

Population[8]

2005	**2011**
651,261	695,630

[8] Indicative population numbers based on SA Water information about the number of Government Inspection Point (GIP) connections, multiplied by population density of 2.6 (number of occupants per residence).

Figure 29 Bolivar activated sludge wastewater treatment plant schematics

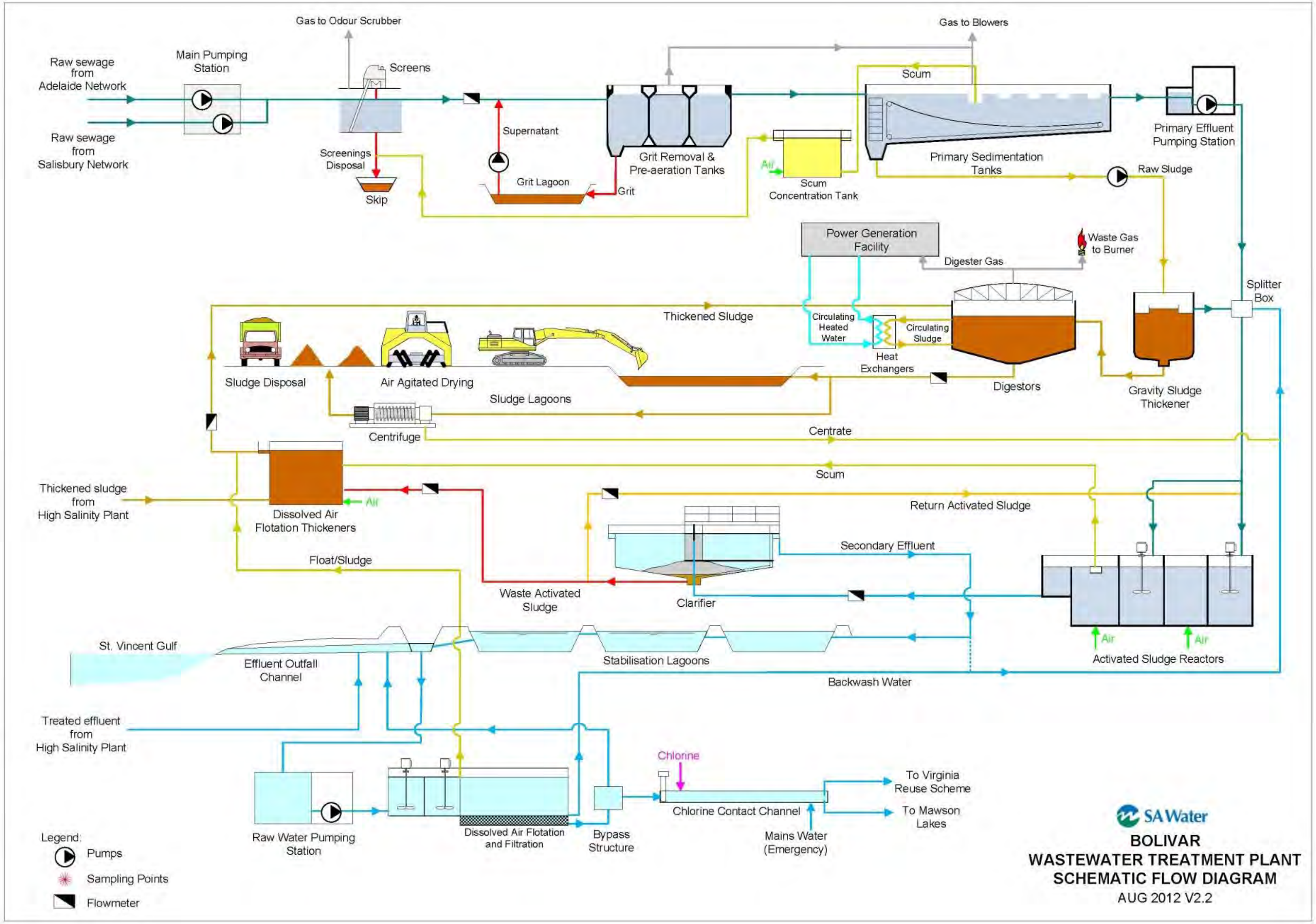


Figure 30

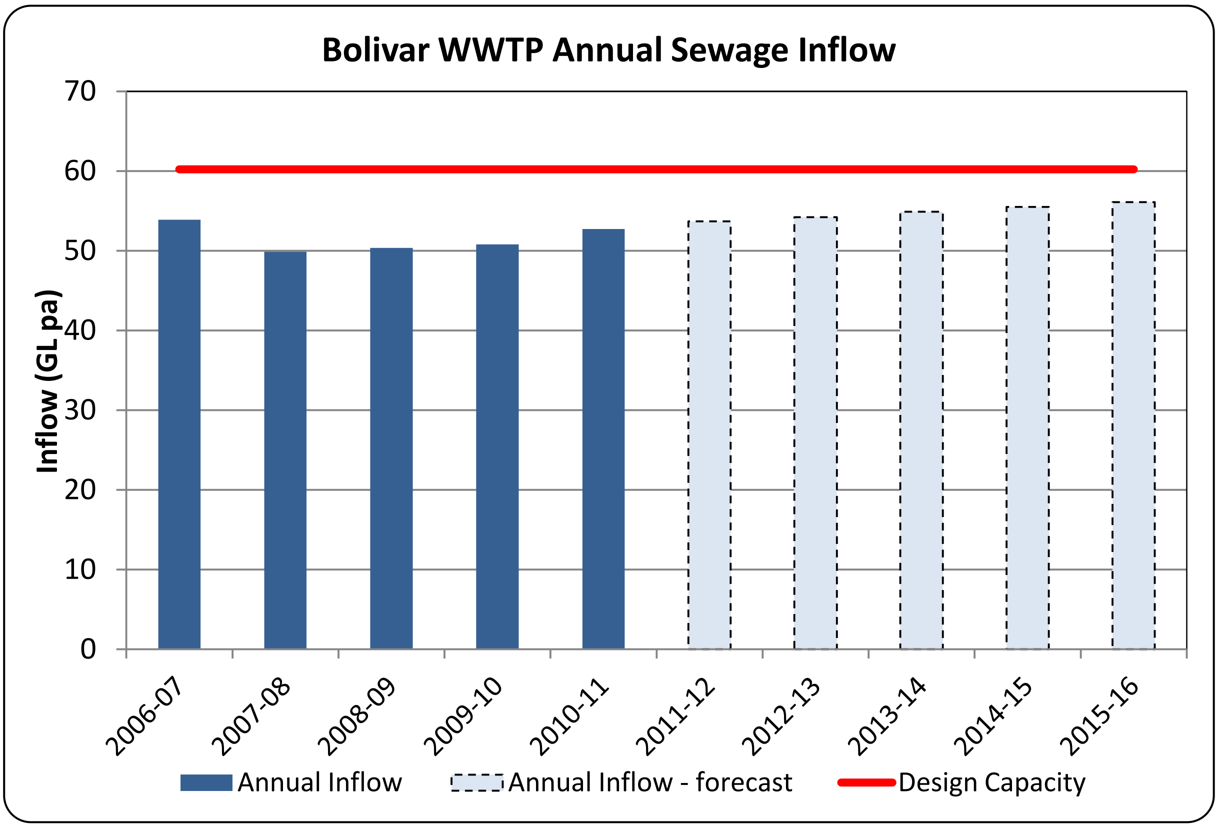
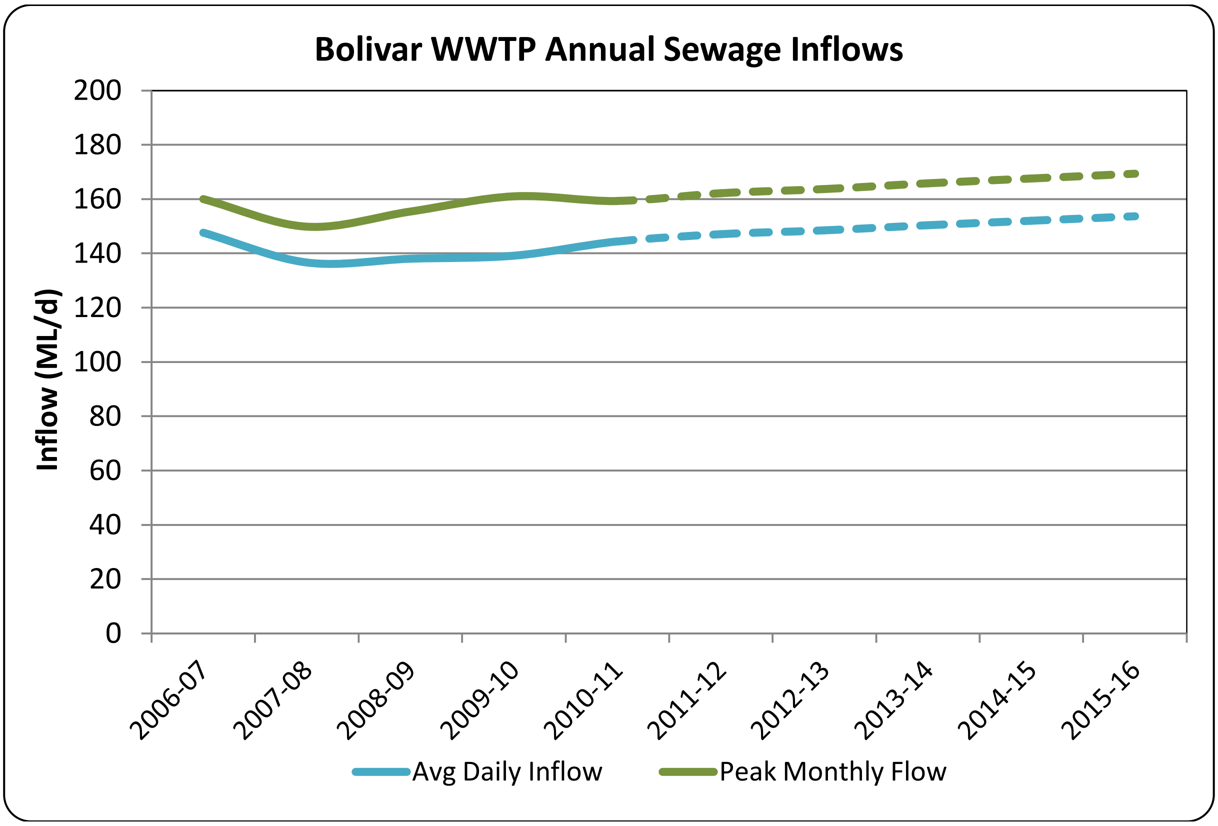


Figure 31



Note: the reduction in inflow from 2006-07 to 2009-10 corresponds with the period of significant drought.

Figure 32

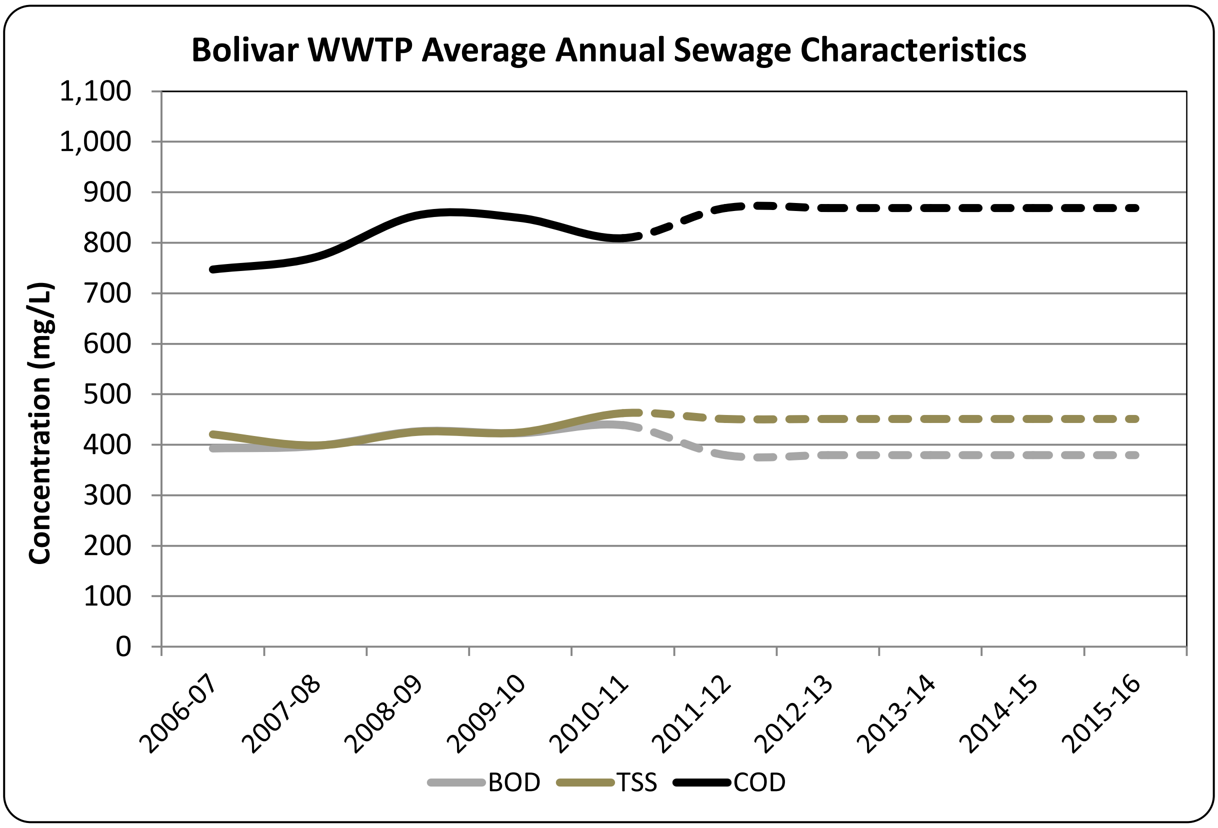


Figure 33

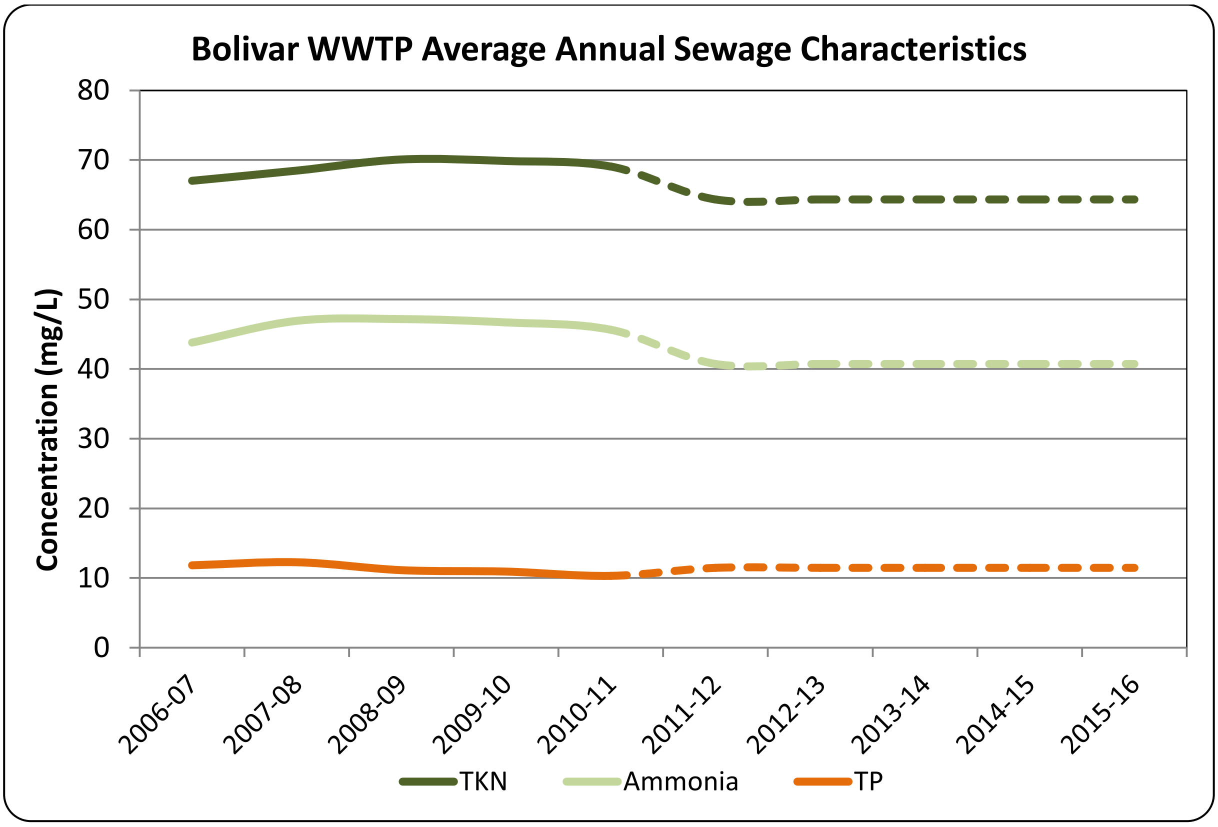
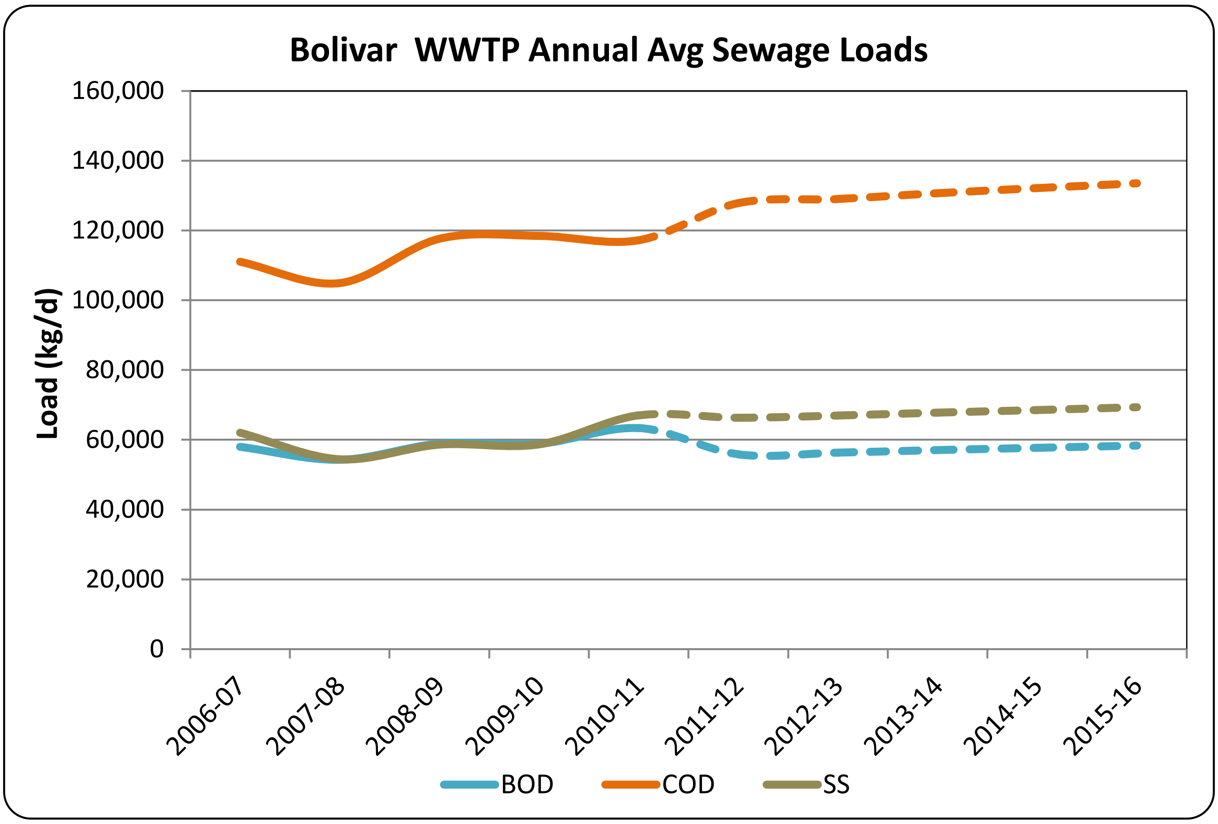
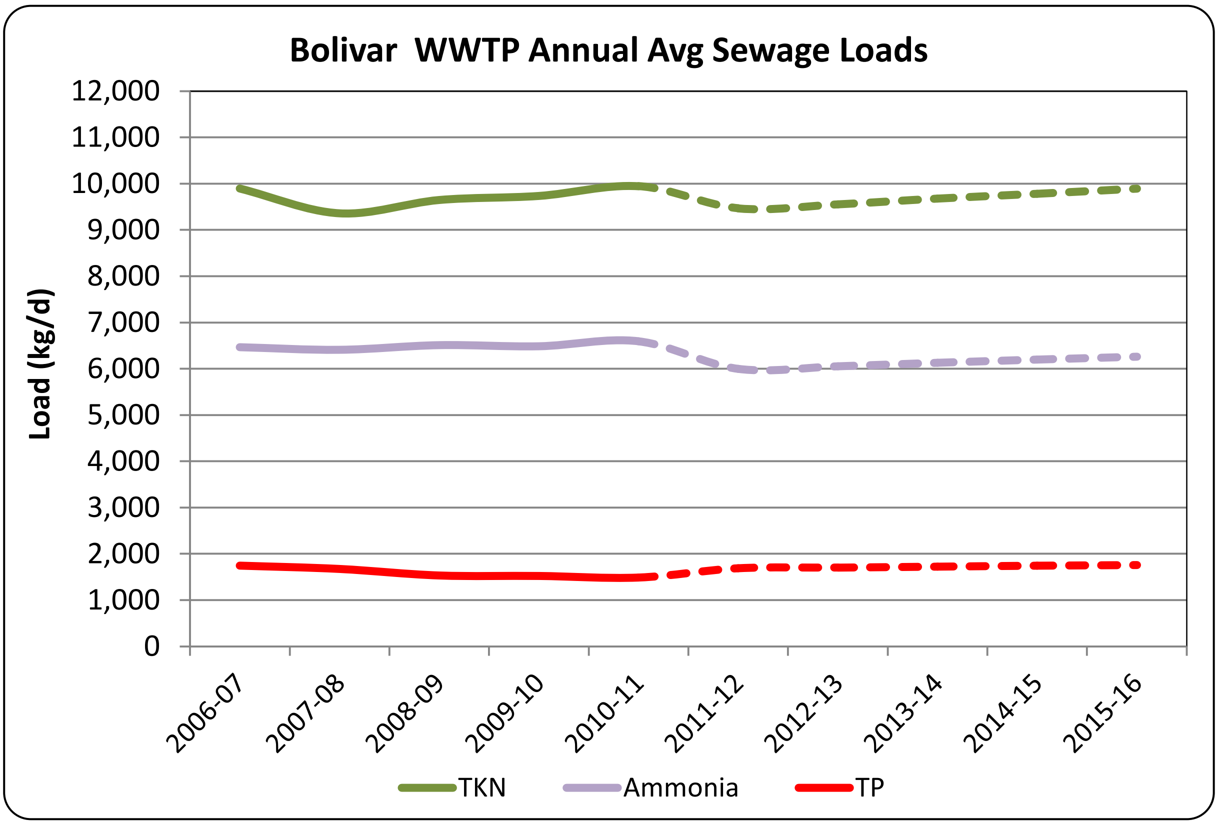


Figure 34



Note: nitrogen concentrations are assumed to return to pre-drought levels from 2011-12.

Figure 35



7.2. Key points

- The Bolivar wastewater treatment plant became operational in 1966 and replaced the Islington Sewage Farm. The Bolivar plant is the largest sewage treatment plant in South Australia and serves the largest catchment in the greater Adelaide region.

- The original design used a trickling filter process to treat the sewage. The plant serviced Adelaide suburbs north of the River Torrens and as far east as Glen Osmond. An area around Le Fevre Peninsula, drained to the Port Adelaide WWTP, which was replaced by Bolivar High Salinity WWTP in 2005. The Bolivar WWTP and Bolivar HS plant are separate facilities but are located on the same site.

- A major odour event in 1997 led to the modification of the EIP for Bolivar, that included upgrading the plant to 750,000 equivalent population capacity, including the following works:
  - Covering of the inlet works, primary sedimentation tanks and primary sludge thickening tanks for odour control, with a chemical odour treatment facility;
  - Upgrading of the plant by replacing the trickling filters with the activated sludge process, designed for partial de-nitrification;
  - Increase of the hydraulic and treatment capacity from 150 ML/d to 165 ML/d;
  - Retention of the former waste stabilisation lagoons as polishing lagoons and to provide natural disinfection;
  - A target of 50% annual reuse through ultimate development of the Virginia Pipeline Scheme (see below).

- In 2005, three of the six polishing lagoons were taken off-line and drained to deal with a midge problem that had led to yearly complaints from the neighbouring community. These three lagoons will be brought back into service temporarily in 2012 as an experiment to improve overall lagoon nitrogen reduction.

- Primary sludge and waste activated sludge is thickened and anaerobically digested on site. Bolivar also receives digested sludge pumped from Glenelg WWTP. Digested sludge is dried in lagoons or mechanically de-watered by centrifuge at the Bolivar site.

- De-watered sludge is further dried using the mechanically agitated air-drying process and stored on site for up to three years. The stabilised sludge is supplied to farmers for use as a soil conditioner with approval of the EPA.

- Off-gases from the digestion process are used to produce electrical power for use by the plant, with waste heat used to heat the anaerobic digesters to their 35 deg C operating temperature.

- Treated sewage in excess of reuse demand continues to be discharged to sea via the St Kilda outfall channel, as allowed by the plant's EPA licence.

- In 1999, the 105 ML/d capacity Bolivar Dissolved Air Flotation & Filtration (DAFF) Plant was commissioned as part of the development of the Virginia Pipeline Scheme (VPS). The Bolivar DAFF plant provides tertiary treatment of Bolivar lagoon effluent to a standard acceptable for irrigation of vegetables. The VPS, which is operated and maintained by a private company (Water Reticulation Services, Virginia) distributes the treated sewage to market gardeners in the Northern Adelaide Plains.

- Since 2005, recycled water from the Bolivar DAFF plant has been "shandied" with stormwater from the City of Salisbury and delivered, via a third pipe dual reticulation system, to the Mawson Lakes residential development. The recycled water receives additional chlorination so that it is suitable for domestic use, including toilet flushing and garden watering.

- In 2010-11, 15.9GL of treated sewage was recycled, almost 31% of the treated sewage produced by the plant that year. In the peak irrigation month during summer, 55.9% of Bolivar treated sewage was recycled.

- The Bolivar WWTP is licensed by the EPA. Supply and use of recycled water from the Bolivar DAFF plant is subject to approvals from the SA Department for Health and Ageing.

Key points - future:

- Covering of the inlet works and primary sedimentation tanks for odour control has accelerated degradation of structural concrete and metal work, necessitating major asset refurbishment works in the forthcoming regulatory period.

- Population growth in the northern suburbs of Adelaide over the next 30 years is expected to require augmentation of the sewer collection network and treatment capacity. Investigations are currently being undertaken regarding planning of the infrastructure needed to accommodate these population increases as part of the Northern Suburbs Wastewater Strategy. In the meantime, a range of projects is proposed for the forthcoming regulatory period to improve performance and treatment capacity of the plant.

- The EPA's 2007 Adelaide Coastal Waters Study has resulted in development of a draft Adelaide Coastal Waters Quality Improvement Plan which includes provision for limits on the total annual nitrogen load discharged from all sources to metropolitan coastal waters. The potential impact on SA Water from implementation of the plan is a requirement to reduce metropolitan WWTP nutrient loads from 1,147 tonnes per annum (2010-11) to about 300 tonnes per annum. Bolivar contributes the bulk of the WWTP metropolitan nitrogen load (59%).

- Significant reduction in Bolivar nitrogen loads discharged to the marine environment is likely to require:
    - Process upgrading of Bolivar for enhanced nitrogen removal;
    - Increased sewage recycling; or
    - A combination of the two.

- Bolivar WWTP is ranked as a "tier 1"[9] treatment plant by the EPA and is likely to remain a "tier 1" plant into the future. Under the current licence - due to expire in 2015 - there is no requirement for an EIP. Further negotiations with the EPA concerning nitrogen reduction targets are pending.

[9] Refer to notes to the attachment.

8. Bolivar High Salinity Wastewater Treatment Plant

8.1. Summary

Commissioned:	The plant began operations in October 2004.
Treatment process:	The activated sludge plant is a sequencing batch reactor configuration. Treated wastewater is disinfected by UV irradiation before disposal.
Disposal of treated wastewater:	Discharge into the St Kilda outfall channel downstream of the outlet Weir No.1. It mixes with the Bolivar WWTP lagoon discharge and the combined flow is released into coastal waters north of Bolivar.

Figure 36 Bolivar high salinity wastewater treatment plant

Parameter	Design	Actual (2010-11)
Flows (Megalitres per day; ML/d)		
Average dry weather	28.0	21.0
Average annual	32.0	23.9
Peak month average	38.4	26.0
Peak day flow	54.4	32.2
Peak wet weather	80.0	n/a
Avg Influent Concentration (mg/L)		
Biochemical Oxygen Demand (BOD)	260	246
Chemical Oxygen Demand (COD)	625	607
Total Suspended Solids (SS)	300	230
Total Kjeldahi Nitrogen (TKN)	50	48
Ammonia (NH_3-N)	34	34
Total Phosphorous (TP)	10	6
Total dissolved solids (TDS)	6,500	7,220
Avg Raw Wastewater Load (kg/dy)		
Biochemical Oxygen Demand (BOD)	8,320	5,867
Chemical Oxygen Demand (COD)	20,000	14,594
Total Suspended Solids (SS)	9,600	5,413
Total Kjeldahl Nitrogen (TKN)	1,600	1,138
Ammonia (NH_3-N)	1,088	807
Total phosphorous (as P)	320	149

Population[10]

2005	2011
72,717	75,023

[10] Indicative population numbers based on SA Water information about the number of Government Inspection Point (GIP) connections, multiplied by population density of 2.6 (number of occupants per residence).

Figure 37 Bolivar high salinity plant schematics

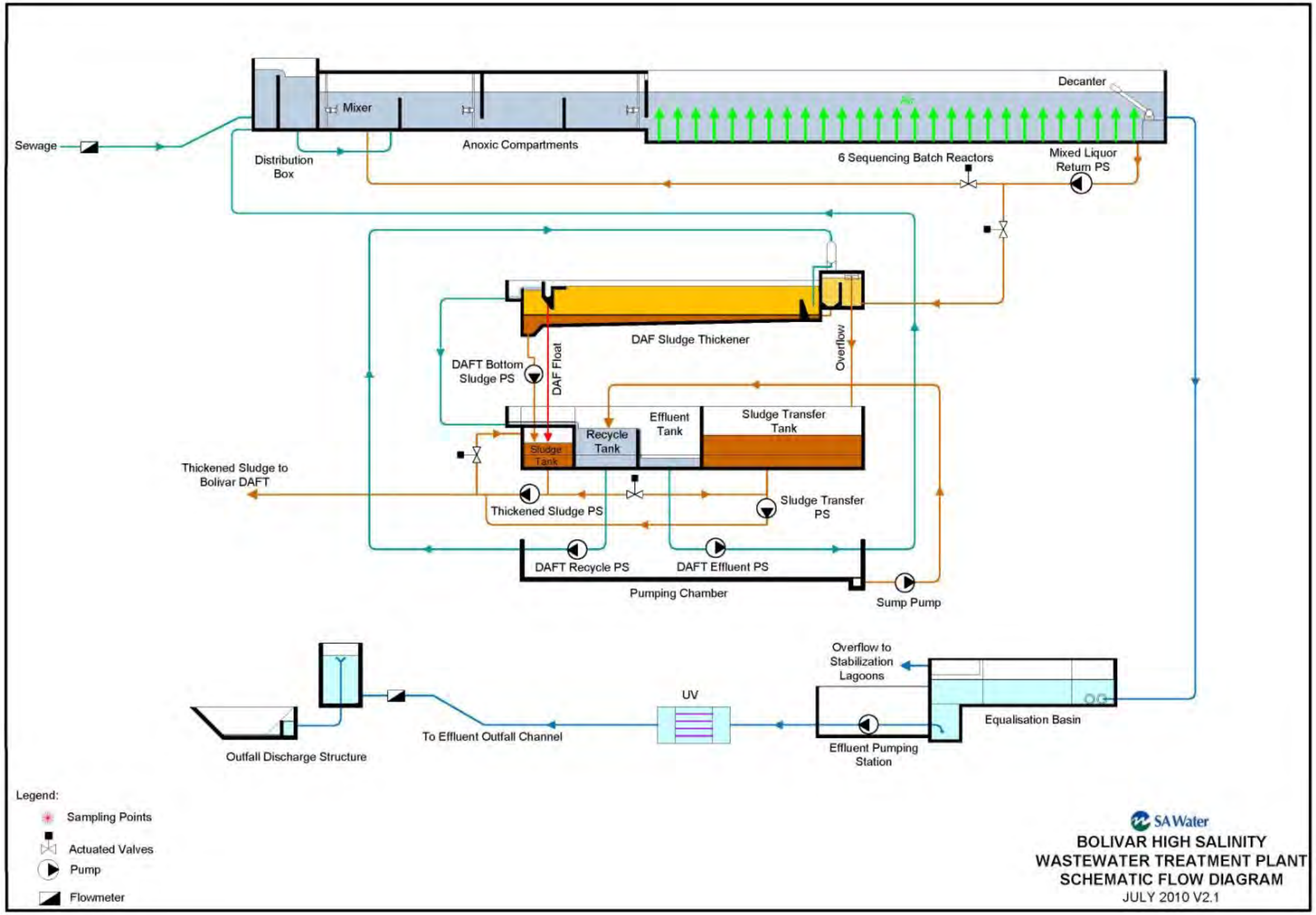


Figure 38 Bolivar high salinity drainage area (blue)

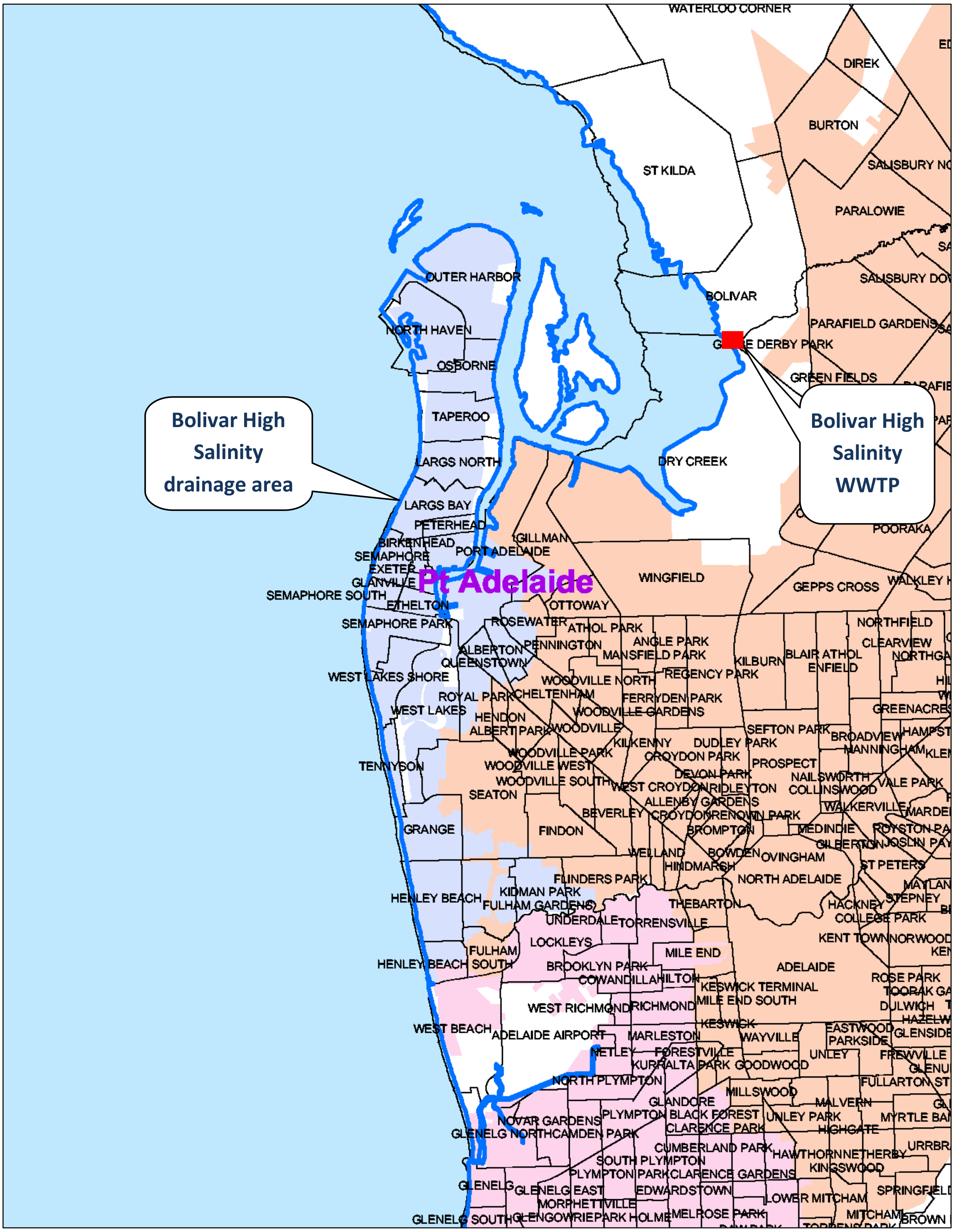


Figure 39 Port Adelaide to Bolivar pumping main

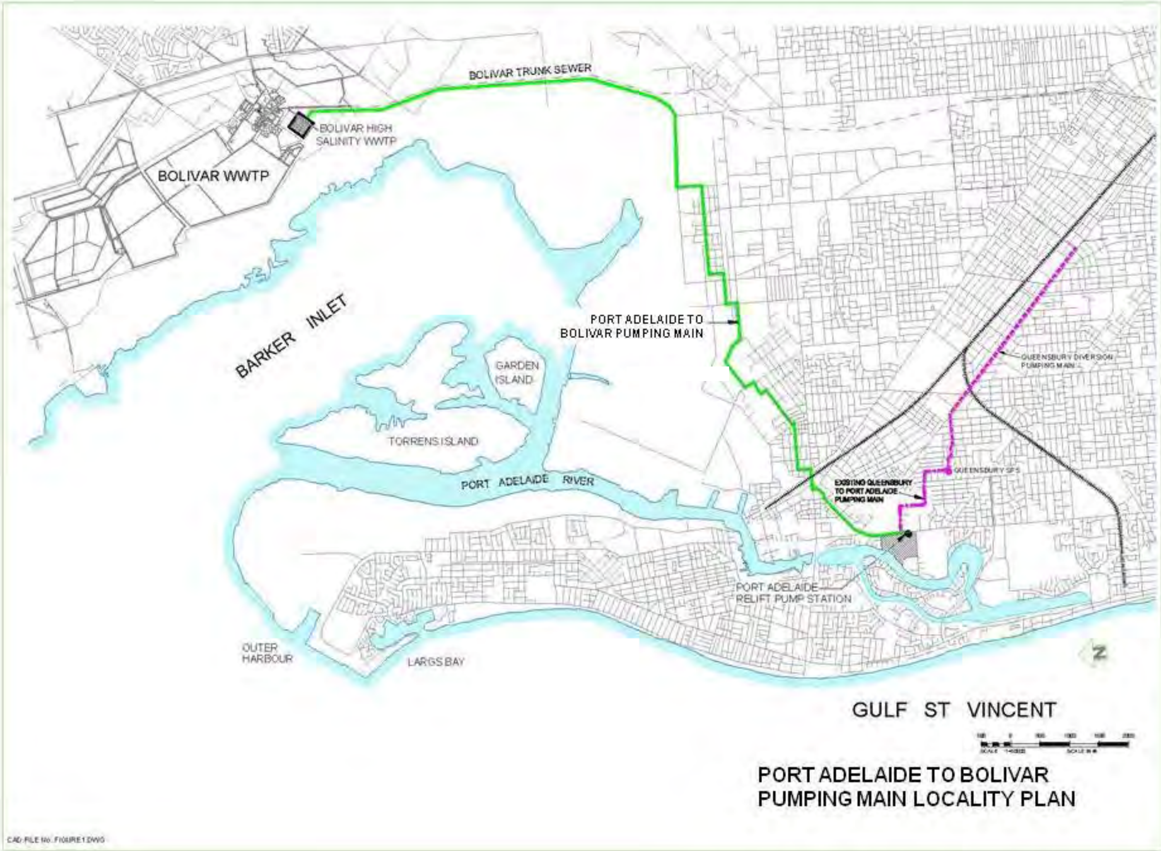


Figure 40

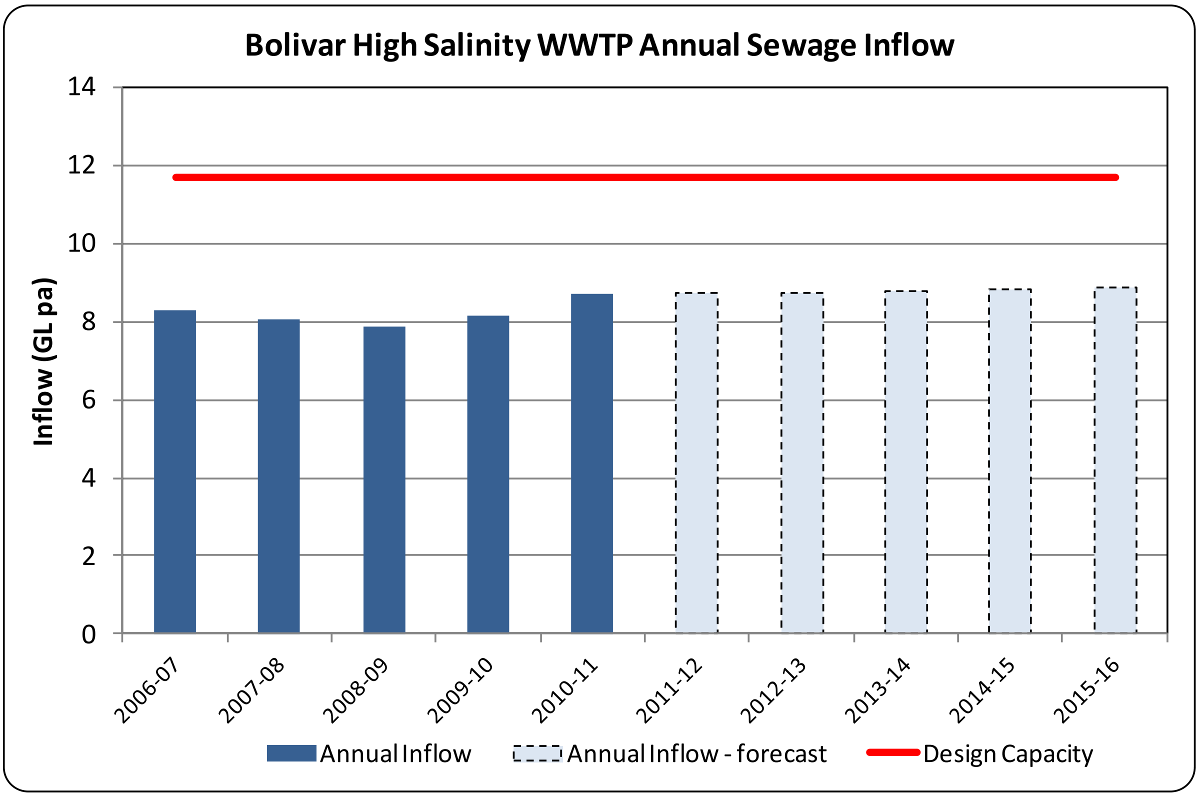


Figure 41

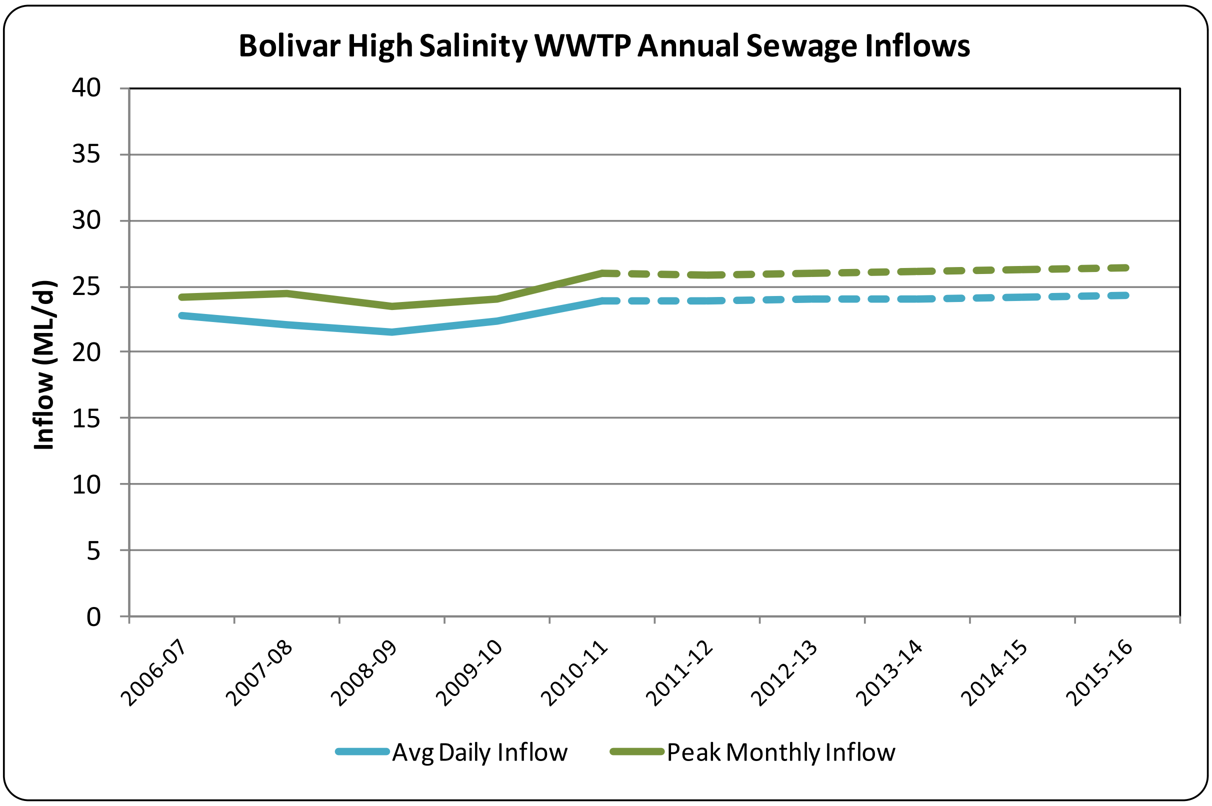


Figure 42

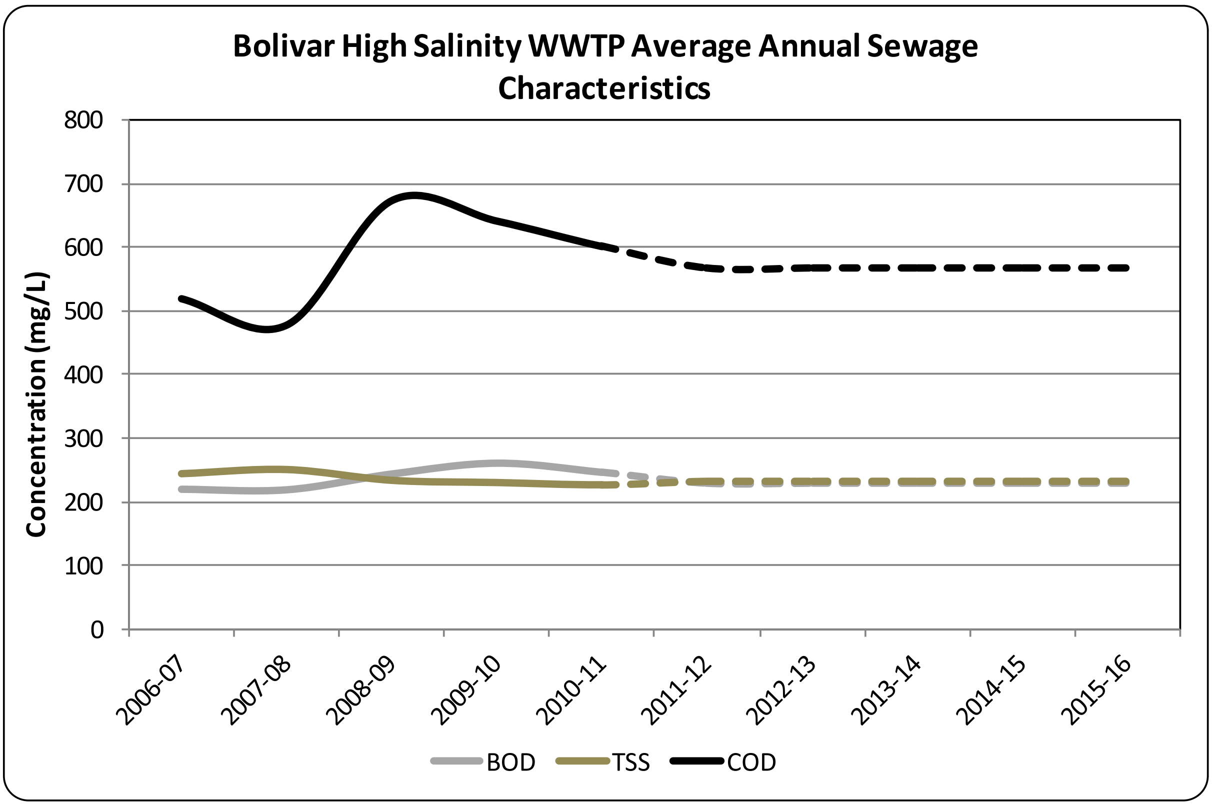


Figure 43

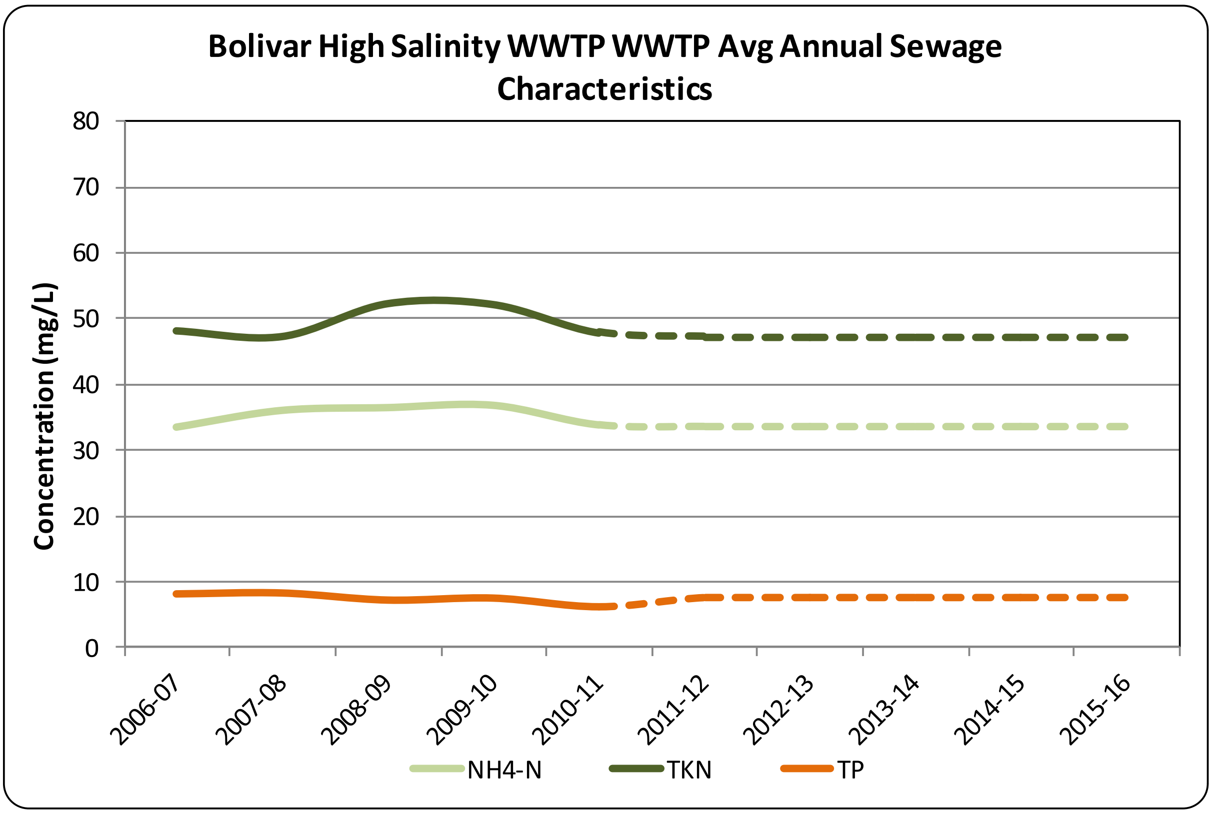


Figure 44

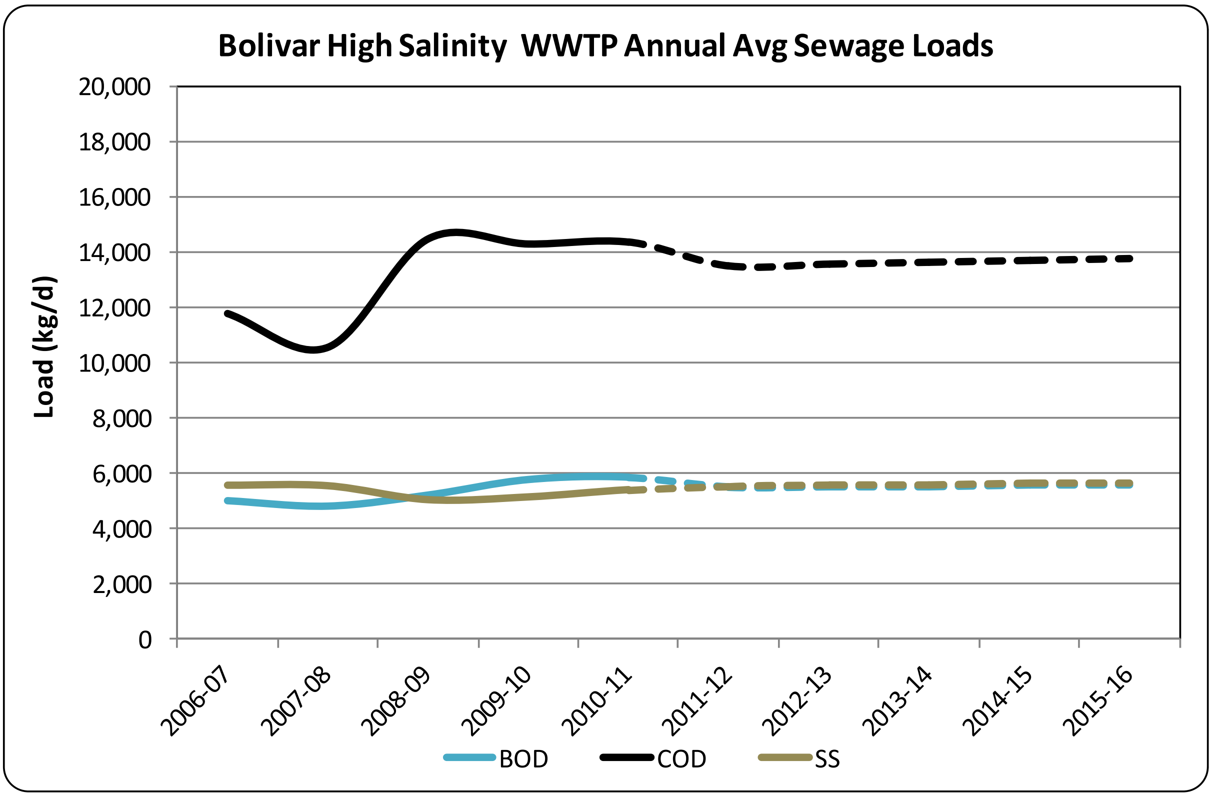
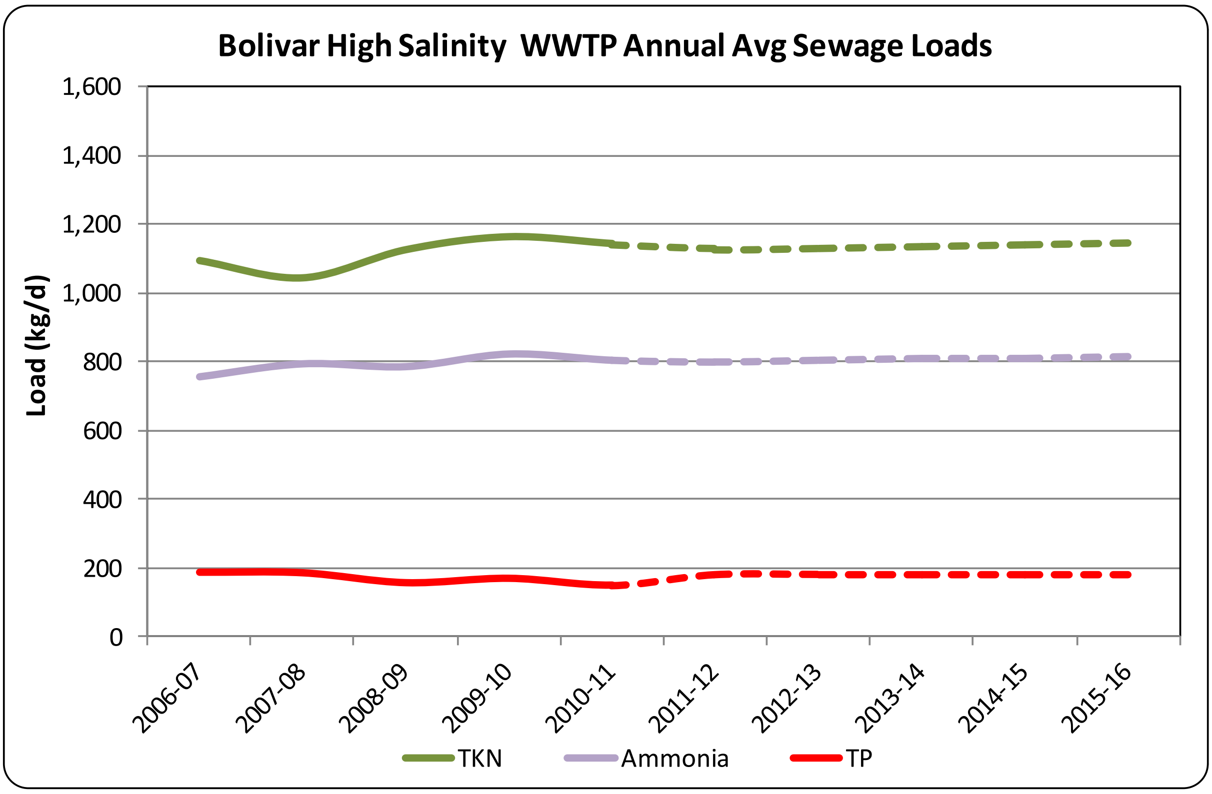


Figure 45



8.2. Key points

- The Bolivar High Salinity WWTP was commissioned in late 2004, replacing the Port Adelaide WWTP which had been discharging treated sewage into the Port Adelaide River. The EPA had expressed concern about the impacts of the nutrients on the river water quality and particularly the increased risk of algal blooms.

- After extensive consultation, an EIP was developed to pump the more saline raw sewage from the Port Adelaide drainage area through a 17 km x 900 mm diam. pipeline to a new wastewater treatment plant located at the Bolivar site. Lower salinity raw sewage from part of the Port Adelaide drainage area (30% of the total flow) was diverted into the Bolivar Trunk Sewer for subsequent reuse after treatment.

- The majority of the Port Adelaide drainage area is near the coast and is low lying. Highly saline groundwater is close to the surface and there is significant ingress of saline groundwater into the sewer network. A second wastewater treatment plant at Bolivar was deemed necessary to protect the Virginia Pipeline Scheme from the influx of saline treated sewage.

- The Bolivar High Salinity Plant was designed for biological nutrient reduction, primarily to deliver low nitrogen concentrations in the effluent. Screens and a grit removal vortex are located at the Port Adelaide relift pumping station (PARPS). A biological odour control facility has been installed at PARPS and Bolivar HS the plant inlet.

- The Bolivar High Salinity WWTP is an activated sludge plant and one of the largest facilities in Australia to employ the sequencing batch reactor process configuration. All treatment processes take place in six bioreactors and no primary or secondary clarifiers are required, with a lower capital cost than conventional configurations.

- Immediately downstream of the treated wastewater pumping station, the treated sewage passes through a series of UV reactors to reduce *E. Coli* levels to less than 150 org per 100mL. The comparatively high salinity (about 7,500 mg/L TDS) of the treated sewage makes it unsuitable for reuse. Instead, it is mixed with treated sewage discharged from Bolivar lagoons and the resultant flow is discharged through mangroves, 11.4 km north of the Bolivar site, into coastal waters.

- Waste activated sludge is thickened in a dissolved air flotation (DAF) facility and the thickened sludge is pumped to the Bolivar WWTP DAF units where salt is “washed out” before being re-thickened to ensure its suitability for agriculture reuse, after anaerobic digestion and de-watering.

Key points - future:

- A major project to address serious degradation of the plant’s anoxic tanks has been proposed for the forthcoming regulatory period. The anoxic tanks provide a process stream for treating incoming highly saline sewage and significant deterioration would put the operation of the plant at risk.

- Investigations are being undertaken to modify the drainage area served by Bolivar High Salinity WWTP in the Wingfield area.

- Implementation of the Adelaide Coastal Water Quality Improvement Plan may pressure SA Water to improve the nitrogen reduction achieved at the Bolivar high salinity WWTP.

9. Christies Beach Wastewater Treatment Plant

9.1. Summary

Commissioned:	"A" (Stage I) plant was commissioned in 1970 and "B" plant (Stage 2) in 1981. The intermittent fixed film activated sludge EIP upgrade was commissioned in 2003 and the "C" plant capacity upgrade began operations in 2012.
Treatment process:	The Christies Beach plant employs the activated sludge process. The original "A" and "B" plants employ coarse screens and grit removal ahead of primary sedimentation tanks, aeration tanks and secondary clarifiers, with chlorination of the discharge. The new "C" plant utilises fine screens and membrane bioreactor (MBR) process trains, followed by UV disinfection. Waste sludge is screened, thickened and undergoes anaerobic digestion, followed by mechanical de-watering.
Disposal of treated wastewater:	Chlorinated effluent from "A" and "B" plants is preferentially pumped into the Willunga Basin Pipeline scheme and Southern Urban Reuse Scheme (SURS) to be reused. Surplus is discharged into coastal waters. Treated wastewater from "C" plant is discharged into coastal waters through a new outfall and diffuser. If demand is high, "C" plant treated wastewater will be transferred to the Willunga Pipeline Scheme.

Figure 46 Christies Beach wastewater treatment plant

Parameter	Design (after capacity upgrade project complete)	Actual (2010-11)
Flows (Megalitres per day; ML/d)		
Average dry weather	38.3	22.6
Average annual	45.0	26.5
Peak month average	54.0	31.2
Peak day flow	112.5	n/a
Peak wet weather	135.0	n/a
Avg Influent Concentration (mg/L)		
Biochemical Oxygen Demand (BOD)	245	274
Chemical Oxygen Demand (COD)	580	599
Suspended Solids (SS)	278	359
Total Kjeldahi Nitrogen (TKN)	68	71
Ammonia (NH_3-N)	51	57
Total Phosphorous (TP)	13	11
Avg Raw Wastewater Load (kg/dy)		
Biochemical Oxygen Demand (BOD)	11,025	7,429
Chemical Oxygen Demand (COD)	26,100	14,314
Suspended Solids (SS)	12,510	9,519
Total Kjeldahl Nitrogen (TKN)	3,060	1,880
Ammonia (NH_3-N)	2,295	1,505
Total Phosphorous (TP)	599	300

Population[11]

2005	2011
142,919	149,313

[11] Indicative population numbers based on SA Water information about the number of Government Inspection Point (GIP) connections, multiplied by population density of 2.6 (number of occupants per residence).

Figure 47 Christies Beach wastewater treatment plant schematics

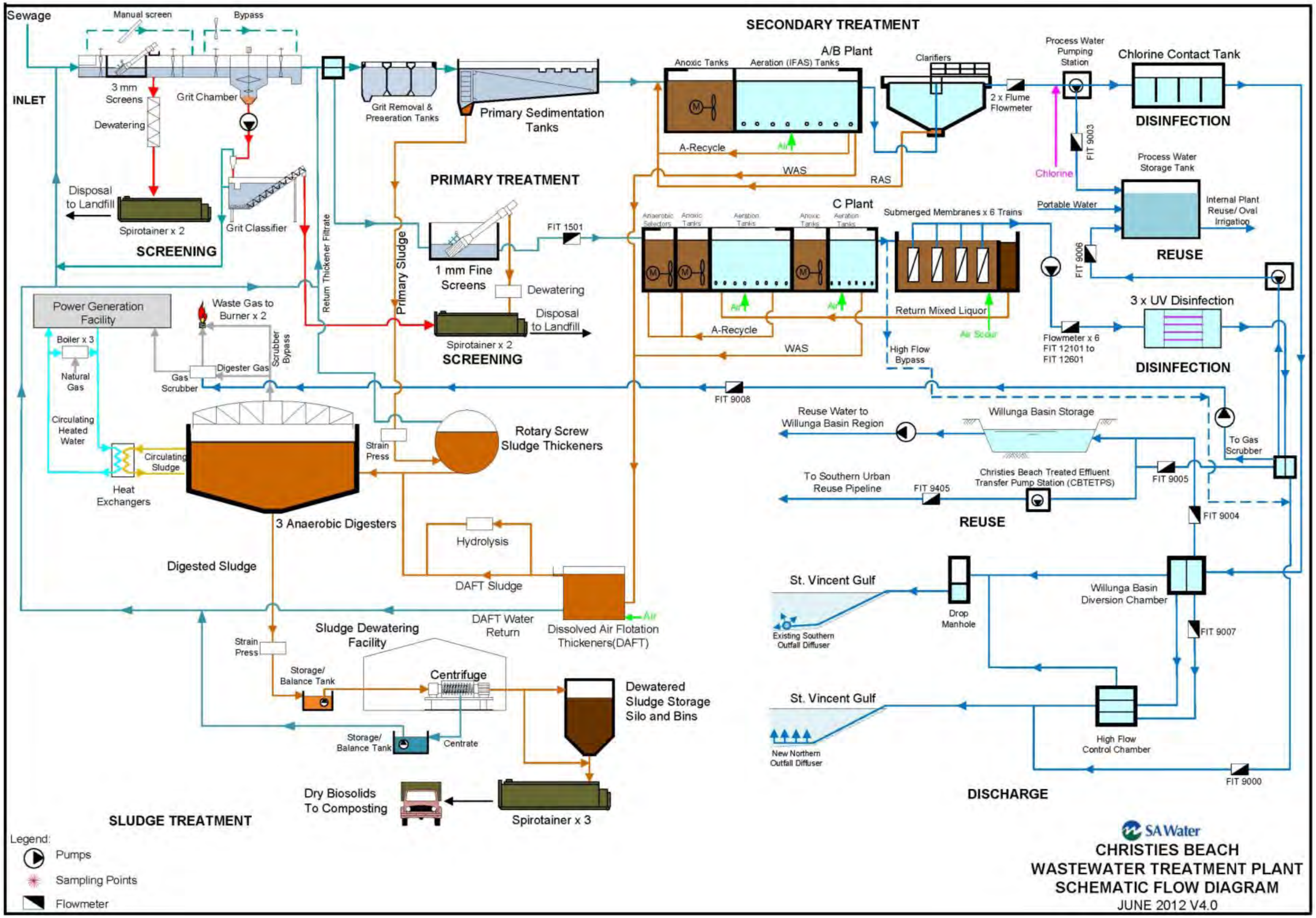


Figure 48 Christies Beach drainage area (purple shading)

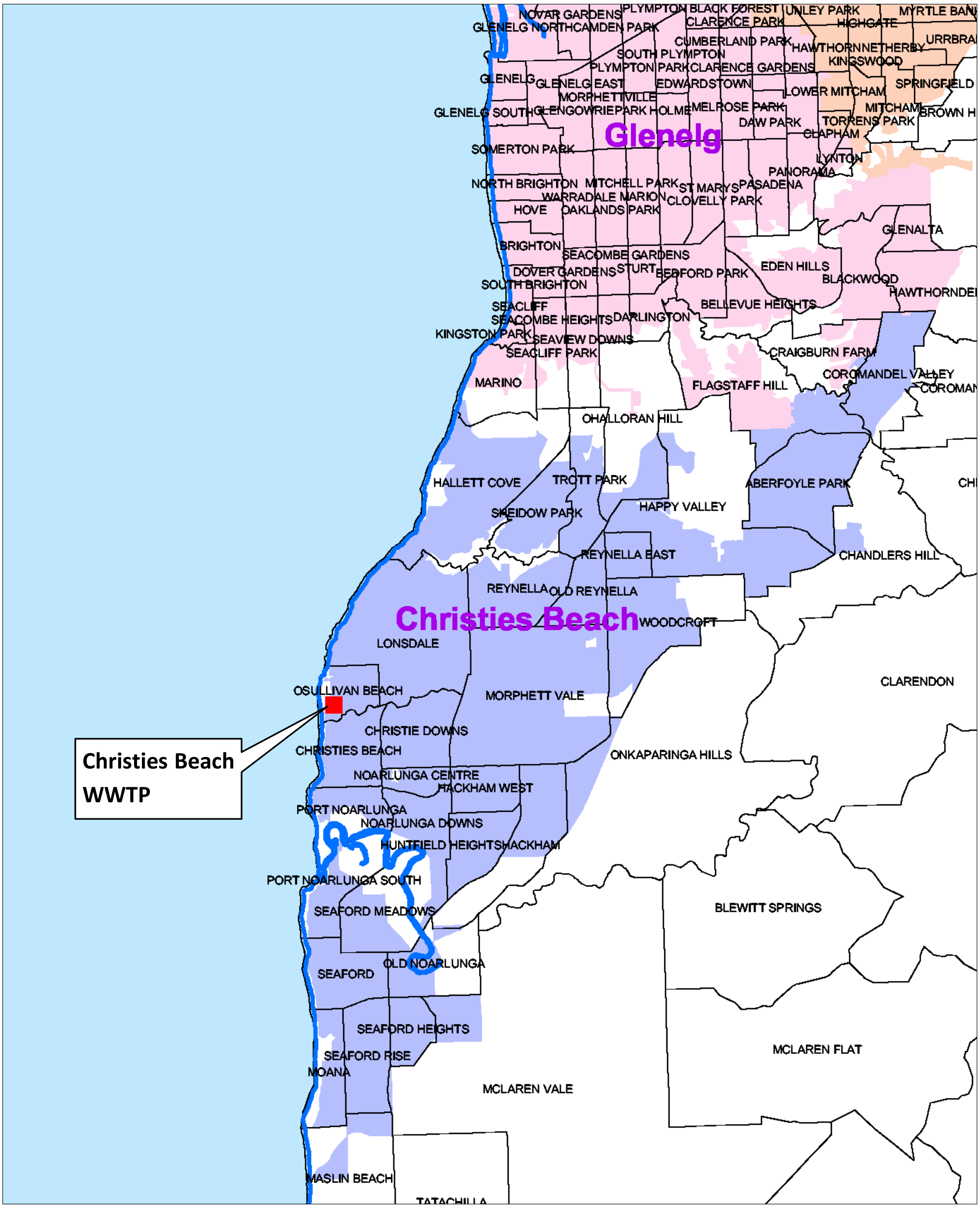
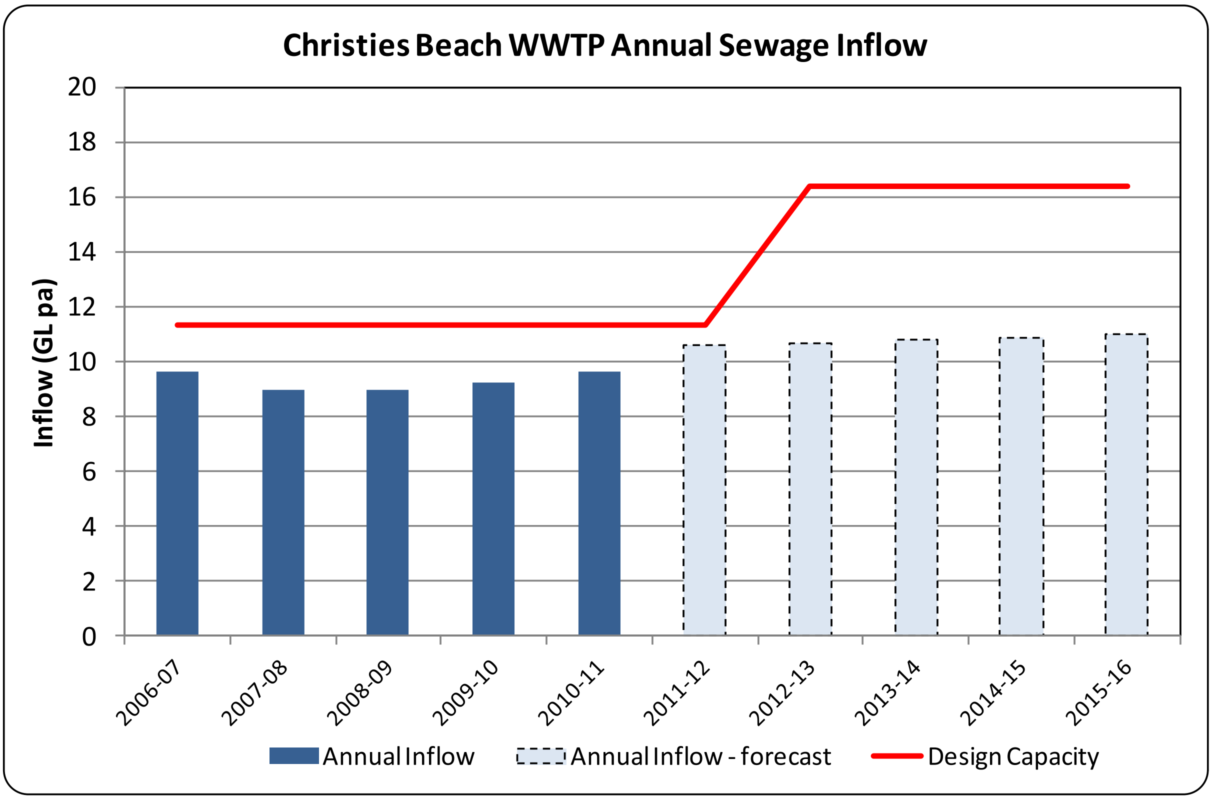


Figure 49



Note: the current plant capacity upgrade is designed to accommodate flows and loads from an equivalent population of 225,000 in 25 years. By comparison, the EIP upgrade in 2003 was for a 155,000 equivalent population design capacity.

Figure 50

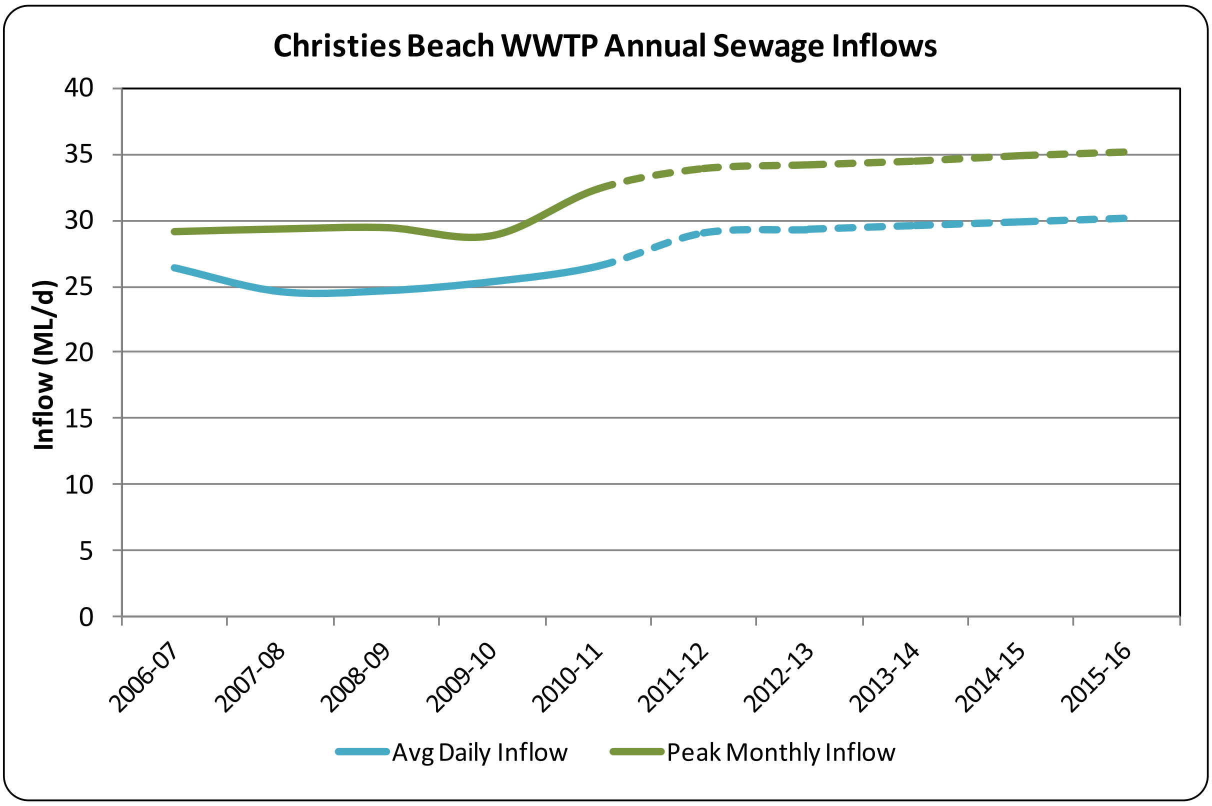
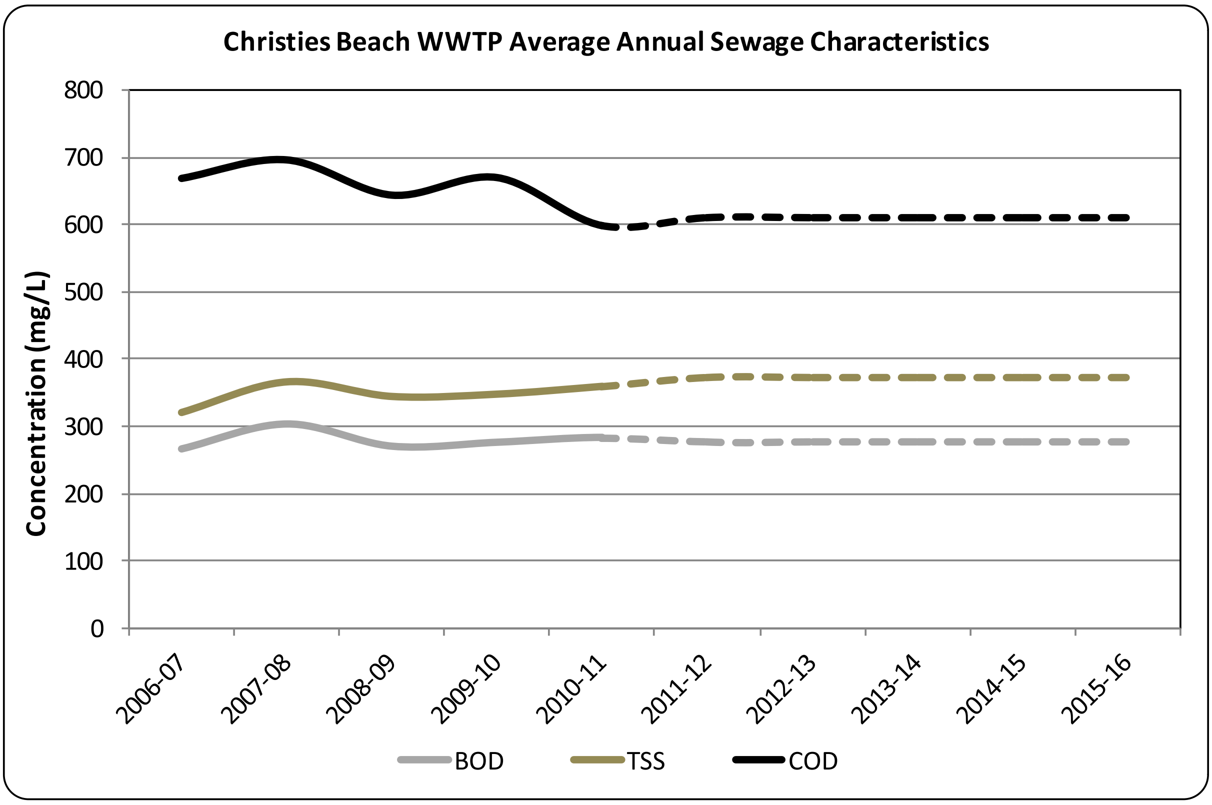
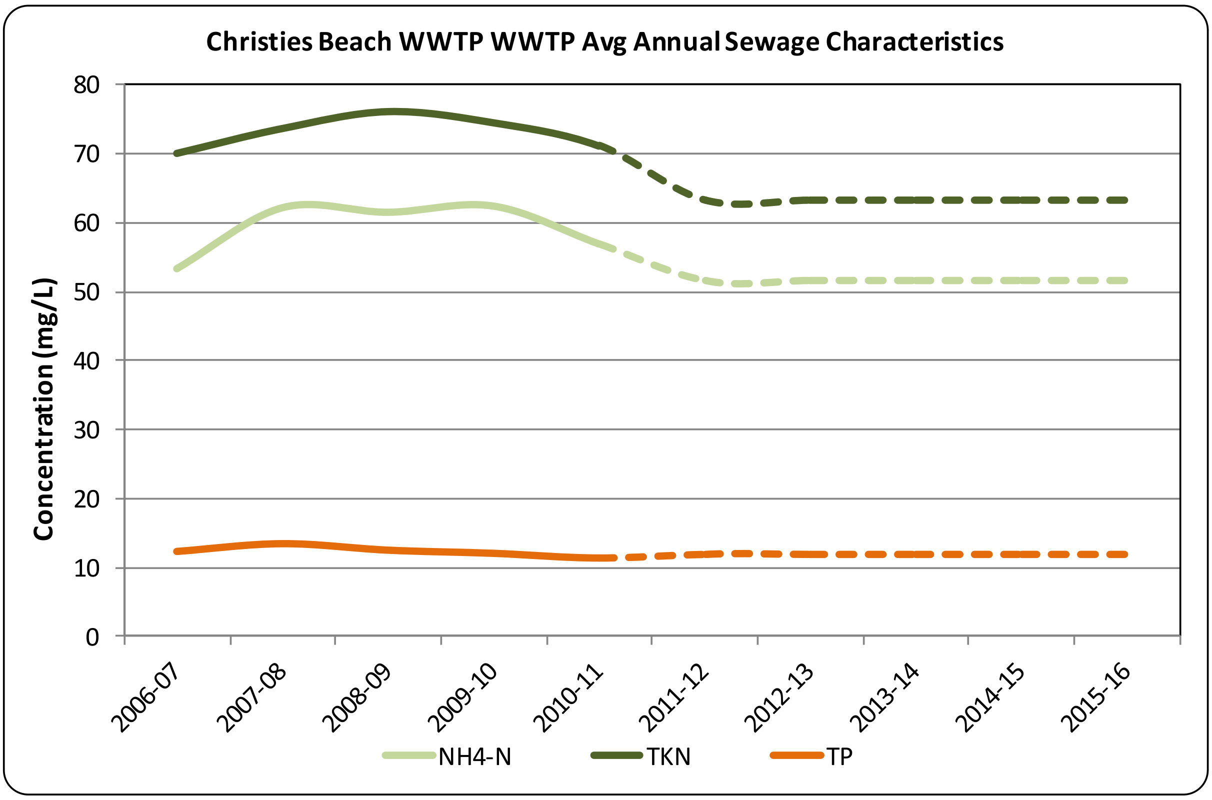


Figure 51



Note: BOD sewage concentrations were typically elevated during the drought period.

Figure 52



Note: nitrogen sewage concentrations were typically elevated during the drought period.

Figure 53

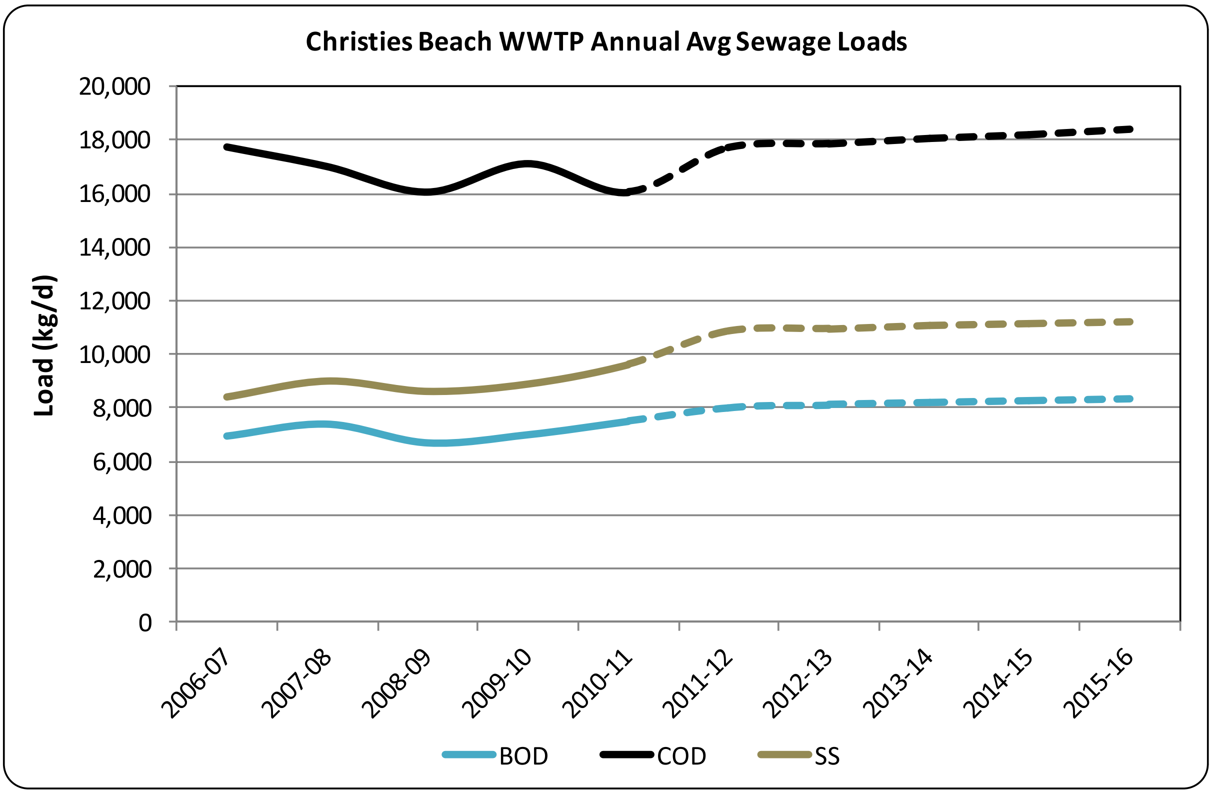
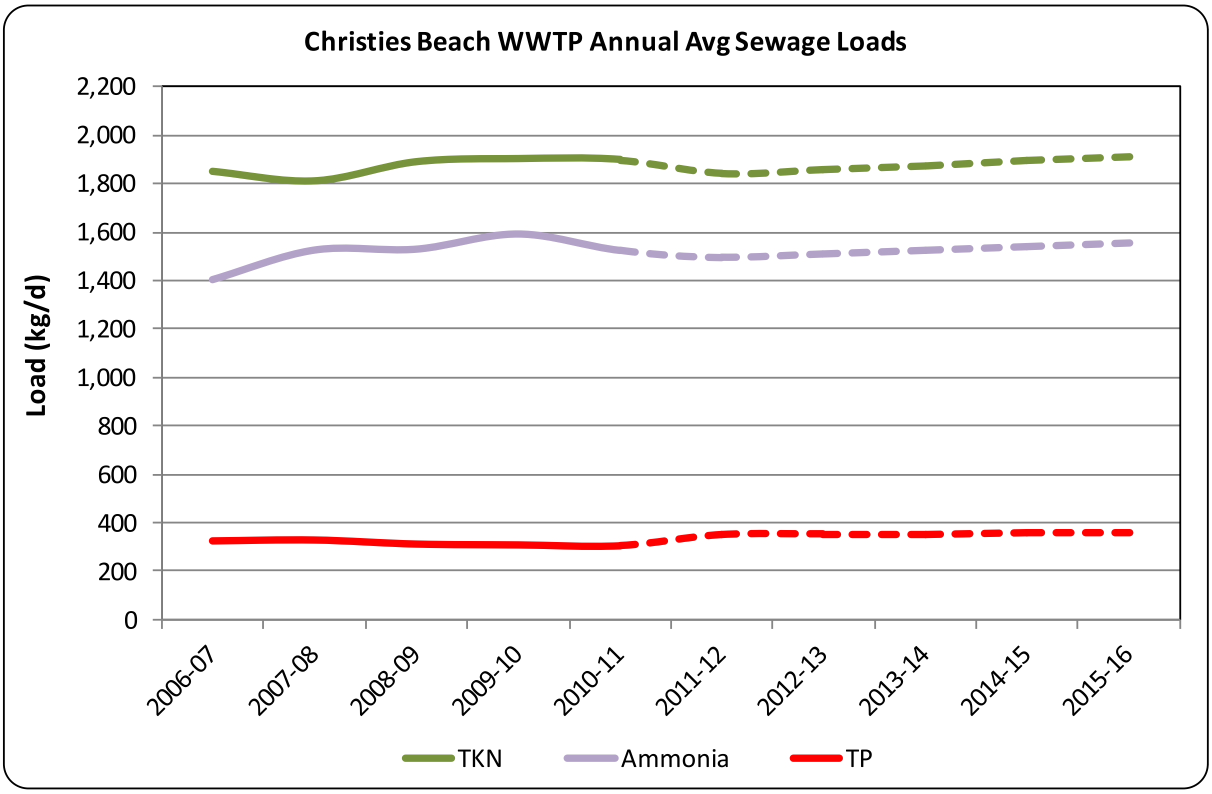


Figure 54



9.2. Key points

- The Christies Beach "A" plant commenced operation in 1971 with a capacity of 50,000 equivalent population (EP) to cater for the rapidly growing population on the southern suburbs of Adelaide. Plant capacity was doubled in 1979, with the commissioning of "B" plant. Two additional clarifiers were added in 1994 and, with other process modifications, the plant capacity was increased to 135,000 EP.

- "A" and "B" plants were designed as the conventional activated sludge process with coarse screens, grit removal, primary sedimentation tanks, aeration tanks and secondary clarifiers. Treated sewage was chlorinated and then discharged through a chlorine contact tank to Gulf St Vincent via a 305m long open-ended outfall. Waste sludge was discharged to sludge de-watering lagoons at Noarlunga Downs, located next to the Onkaparinga River. Dried sludge was transported to Bolivar WWTP for eventual disposal as soil conditioner on farmland. Some treated sewage was supplied to a nearby school for irrigation of ovals.

- SA Water's Environment Improvement Program (EIP) for the Christies Beach WWTP, as endorsed by the EPA in 1998, incorporated the following elements:
    - Upgrading the treatment process for enhanced nitrogen reduction;
    - Maximising reuse opportunities; and
    - Environmental monitoring and research as part of the Adelaide Coastal Waters Study.

- As part of the EIP, "A" & "B" plants were upgraded with the intermittent fixed film activated sludge (IFAS) process at a cost of $13.5 million. The upgrade was completed in 2002. The aim of the upgrade was to reduce the concentration of nitrogen in treated sewage and thus reduce the potential impacts on the marine environment. There was no change to the plant hydraulic capacity (average annual flow 31 ML/d).

- The IFAS process involved the creation of anoxic (without oxygen) and aerobic (oxygenated) zones within the existing aeration tanks. A large volume of free-floating plastic media is incorporated in the aerobic zones to provide a much larger surface area for naturally occurring biomass to grow. The biomass incorporates bacteria that bring about nitrification of ammonia and other compounds. The volume of biomass is substantially increased by the presence of the media, which means substantially more nutrient reduction can be achieved compared to the existing activated sludge process.

- The initial performance of the upgraded plant in respect of nitrogen reduction did not achieve the design targets. Further process re-configuration and installation of methanol (carbon) dosing to assist de-nitrification was undertaken. As a result of the IFAS upgrade and other modifications, total nitrogen concentration in the treated sewage was reduced from about 36 mg/L to about 23 mg/L, with ammonia reduced from about 24 mg/L to 9 mg/L.

- In parallel with this work, feasibility studies, negotiations and other works were undertaken leading to the development of the Willunga Basin Pipeline reuse scheme, which commenced operations in 1999. In line with EPA requirements, this scheme diverts a significant proportion of the treated sewage from Christies Beach to the Willunga region for reuse in irrigation of vines and other crops.

- Planning investigations in the early 2000s identified the need for a future capacity upgrade at Christies Beach to cope with on-going further expansion of residential developments in the drainage area served by the plant. In 2008, final planning approval was received for a $272 million project to increase the capacity of the plant, and construction began in 2010. Design average annual flow capacity has been increased from 31 ML/d to 45 ML/d. The project also includes power generation from digester gas. The Christies Beach Upgrade Project is scheduled for completion in 2013-14. As shown in Figure 49, the major capacity upgrade is being achieved by 2012-13. No further capacity increases are planned through the regulatory period.

- A significant outcome of the project has been the decommissioning in 2009 of the sludge de-watering lagoons at Noarlunga Downs, which had been the source of numerous community complaints over many years due to odours, proximity to housing and potential impacts on the Onkaparinga River. Sludge is now managed through a new dissolved air flotation sludge thickener and centrifuges for sludge dewatering at a new sludge management facility, with trucking of dewatered sludge to a composter for disposal.

- Negotiations with the EPA resulted in one of the design objectives being to significantly reduce the concentration of nitrogen in treated sewage discharges, as a response the outcomes of the Adelaide Coastal Waters Study. “C” plant discharges to the marine environment, as the process delivers the lowest total nitrogen in the effluent. “C” plant effluent can also be fed into the reuse system when demand for recycled water is high. “A” and “B” plants’ treated sewage is, whenever possible, diverted to Willunga Basin for reuse. When demand for recycled water is low, this can be discharged to sea.

- The EPA have foreshadowed seeking to impose a requirement, potentially through a future license condition, of limiting the total nitrogen discharge to coastal waters from Christies Beach WWTP to 100 tonnes per annum. The upgrade and reuse being achieved should deliver this outcome, at least in the short term.

- Treated sewage is also pumped to Aldinga WWTP, where it is stored and further treated before being piped to a dual reticulation system at a new residential development at Seaford Meadows as part of the Southern Urban Reuse Scheme (SURS). This moves forward with one of the original EIP aims of maximising reuse.

KEY POINTS - FUTURE:

- Christies Beach WWTP is ranked as a “tier 1”[12] treatment plant by the EPA. The EPA has indicated it will reassess the tier ranking (to “tier 2”) following commissioning of the upgraded plant and stable operation. The current licence is due to expire in November 2012.

- While the Christies Beach upgrade will be completed within the forthcoming regulatory period, a number of challenges remain, including:
    - Dealing with the commitment to the EPA to limit annual total nitrogen discharges to a maximum of 100 tonnes in the longer term at the same time as population in the drainage area increases;
    - Expanding reuse of treated sewage by Willunga Basin and Southern Urban Reuse Scheme to assist in reducing the marine nitrogen load.

[12] Refer to notes to the attachment.

10. Finger Point Wastewater Treatment Plant

10.1. Summary

Commissioned: The plant was commissioned in 1989.

Treatment process: Step screen and vortex grit chamber ahead of a single intermittent decant extended aeration basin with six low speed surface aerators. Treated wastewater is discharged into two polishing lagoons before chlorination and discharge to sea via an outfall pipe. Waste activated sludge gravitates to four sludge stabilisation and dewatering lagoons. Lagoons are emptied annually and digested sludge stockpiled on site, for eventual reuse or disposal.

Disposal of treated wastewater: Treated wastewater is discharged to the sea via a short outfall pipe terminating at a rock shelf 100 metres beyond the high water mark.

Figure 55 Finger Point wastewater treatment plant aeration basin

Parameter	Design	Actual (2010-11)
Flows (Megalitres per day; ML/d)		
Average dry weather	5.10	4.40
Average annual	6.00	5.19
Peak month average	7.20	5.80
Peak day flow	10.20	7.47
Peak wet weather	17.3	n/a
Avg Influent Concentration (mg/L)		
Biochemical Oxygen Demand (BOD)	410	200
Suspended Solids (SS)	320	210
Total Kjeldahi Nitrogen (TKN)	n/a	62
Ammonia (NH_3-N)	n/a	47
Total Phosphorous (TP)	n/a	10
Avg Raw Wastewater Load (kg/dy)		
Biochemical Oxygen Demand (BOD)	6,900 / 2,460*	1,034
Suspended Solids (SS)	2,000	1,099
Total Kjeldahl Nitrogen (TKN)	n/a	324
Ammonia (NH_3-N)	n/a	248
Total phosphorous (TP)	n/a	51

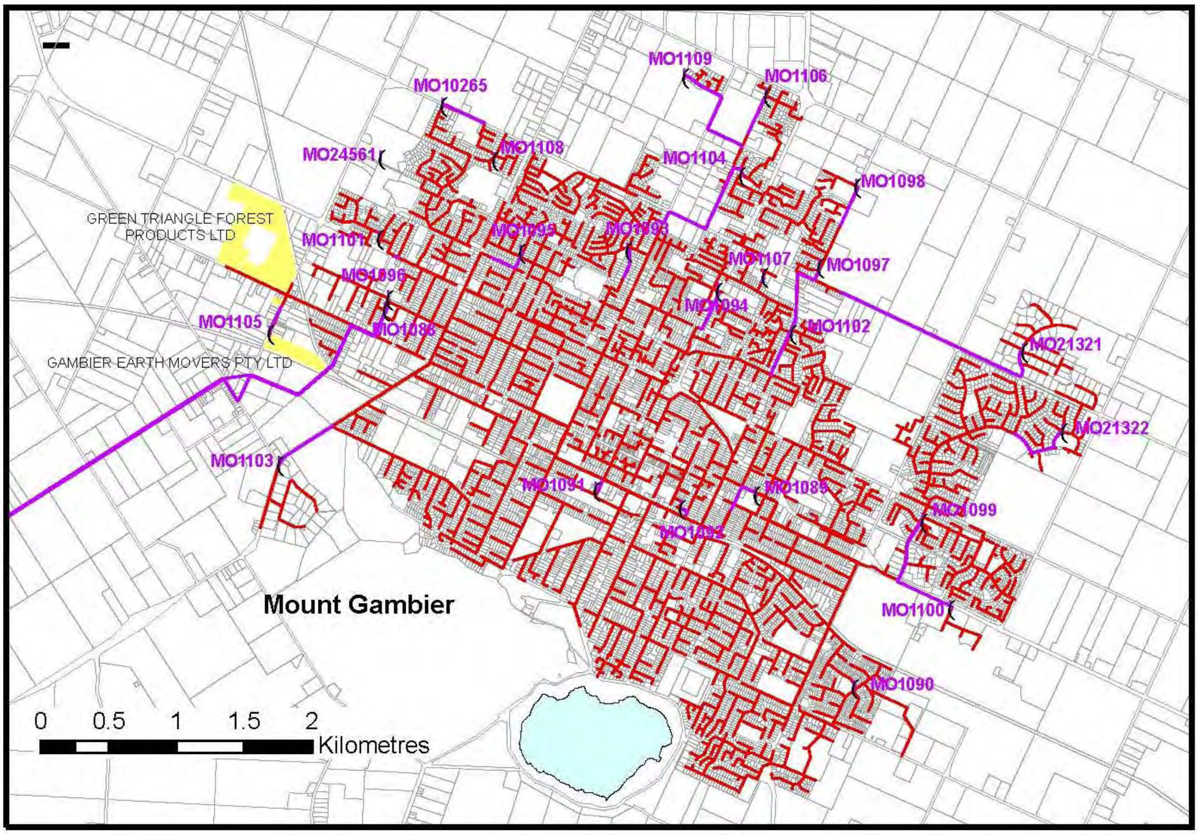
** Aeration capacity was designed to cope with large quantities of whey (4,800 kg BOD/d) from a cheese factory which has since closed.*

Population served[13]

2006 Census	2011 Census
24,401	26,283

[13] Indicative figures for catchment areas based on Australian Bureau of Statistics, 2006 and 2011 Census data, www.abs.gov.au. This includes Mount Gambier statistical area and Port MacDonnell "Suburb" data.

Figure 56 Finger Point drainage area (Mount Gambier) and transfer main to the plant



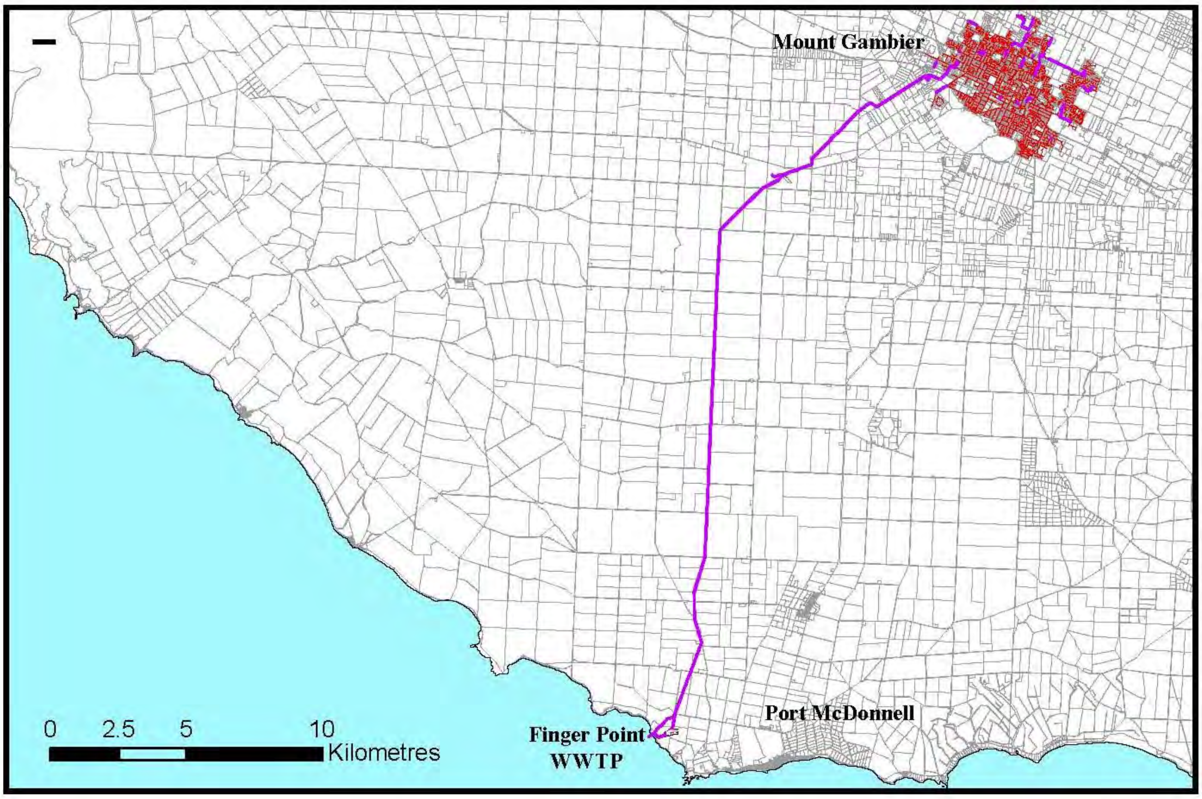


Figure 57 Finger Point wastewater treatment plant schematics

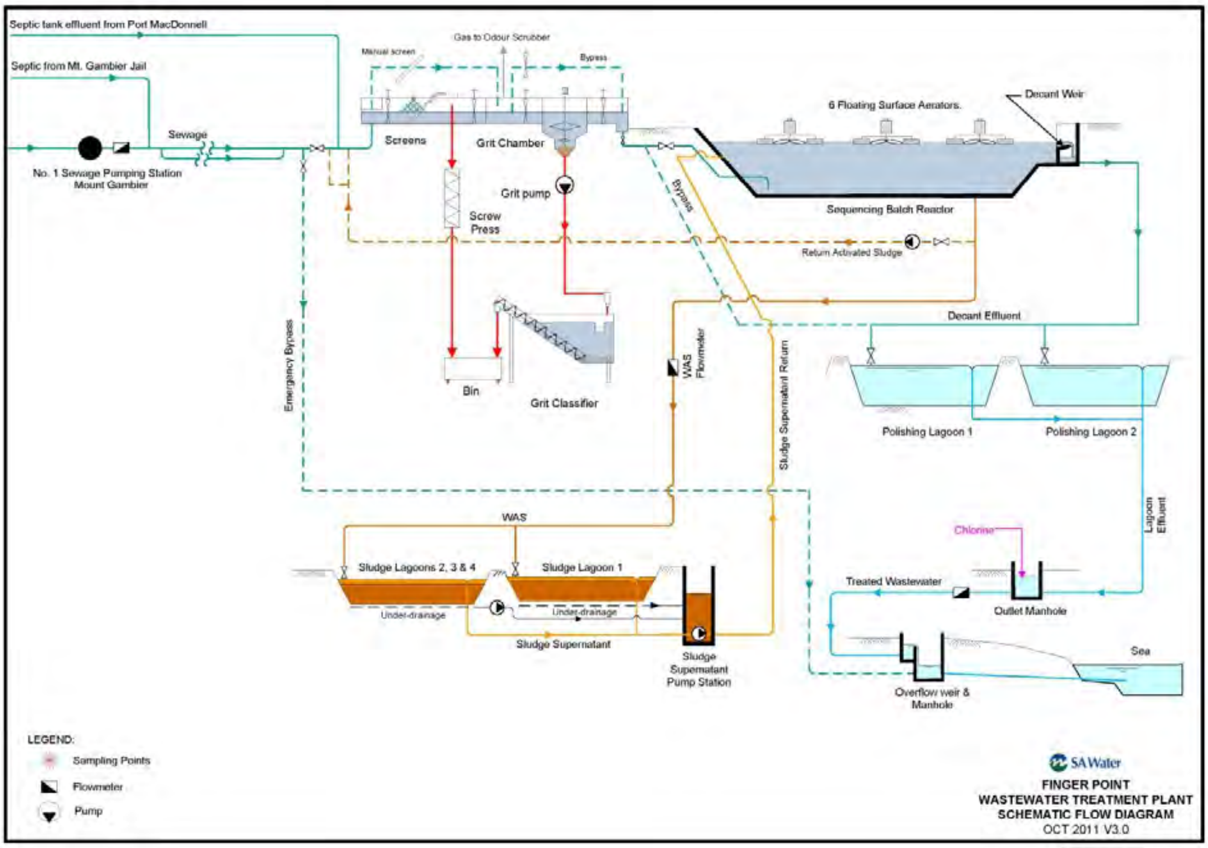


Figure 58

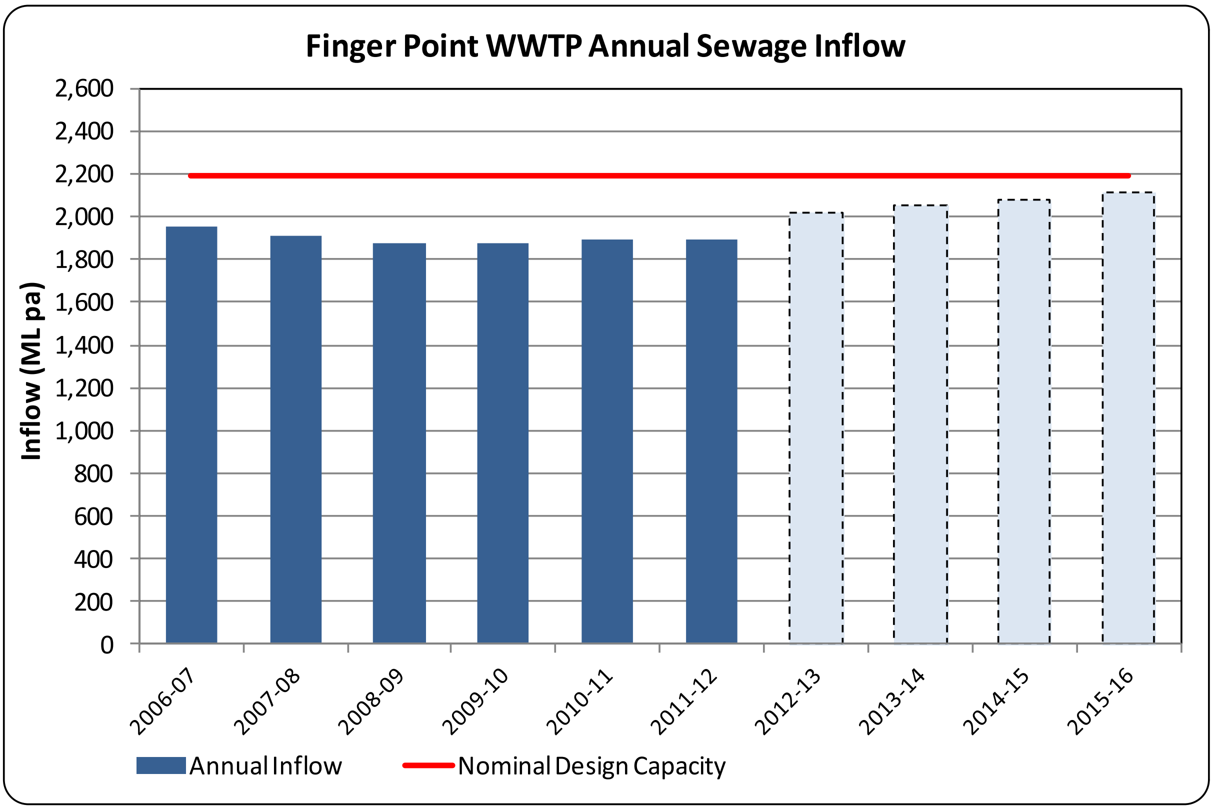


Figure 59

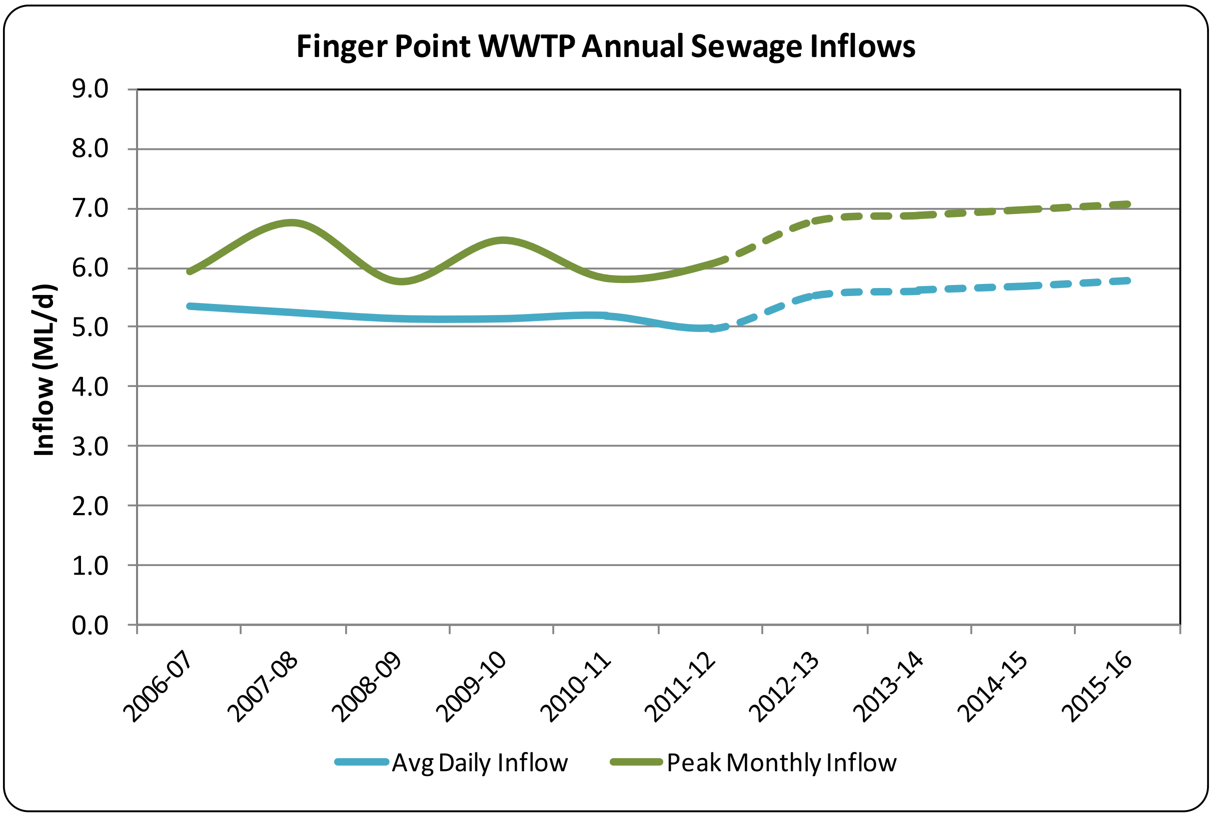
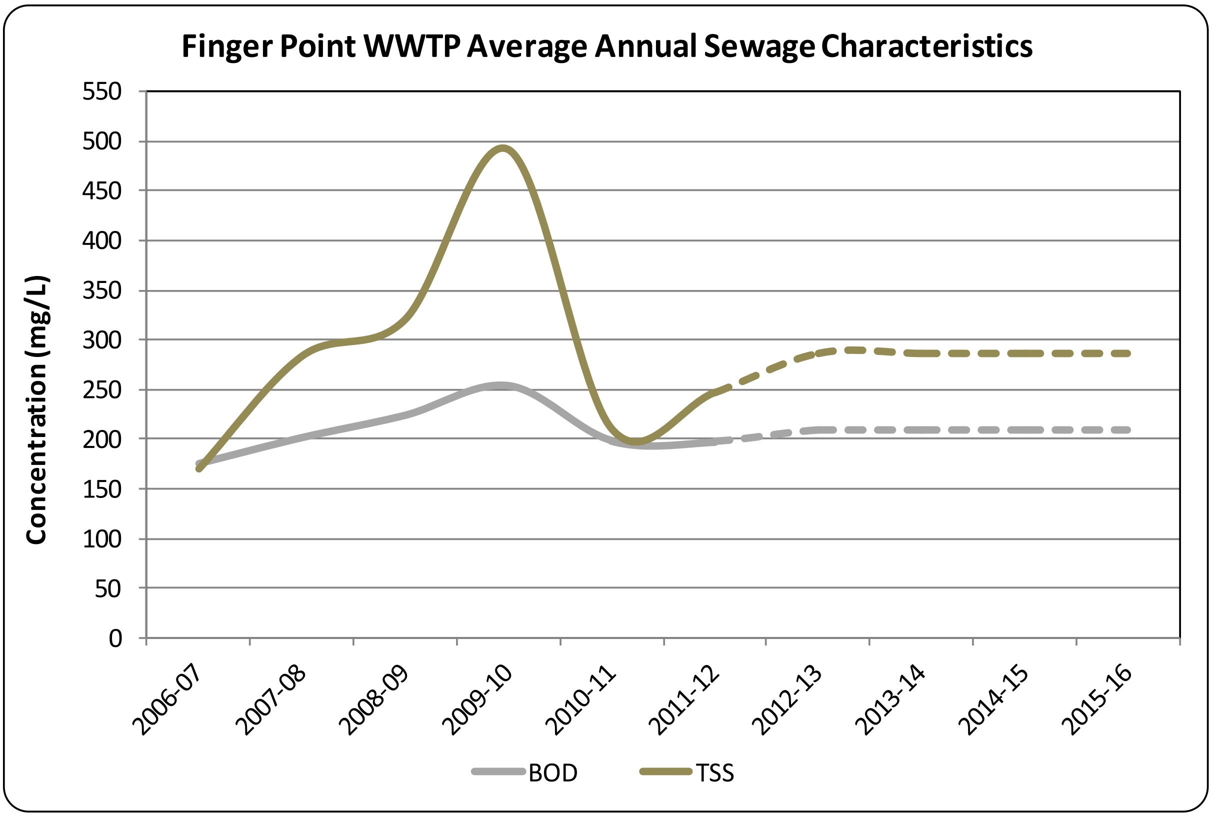


Figure 60



Note: several abnormally high results in 2009-10 give a high annual average. Concentration is from analysis of a single monthly sample at the aeration basin inlet. Treated wastewater quality was not compromised.

Figure 61

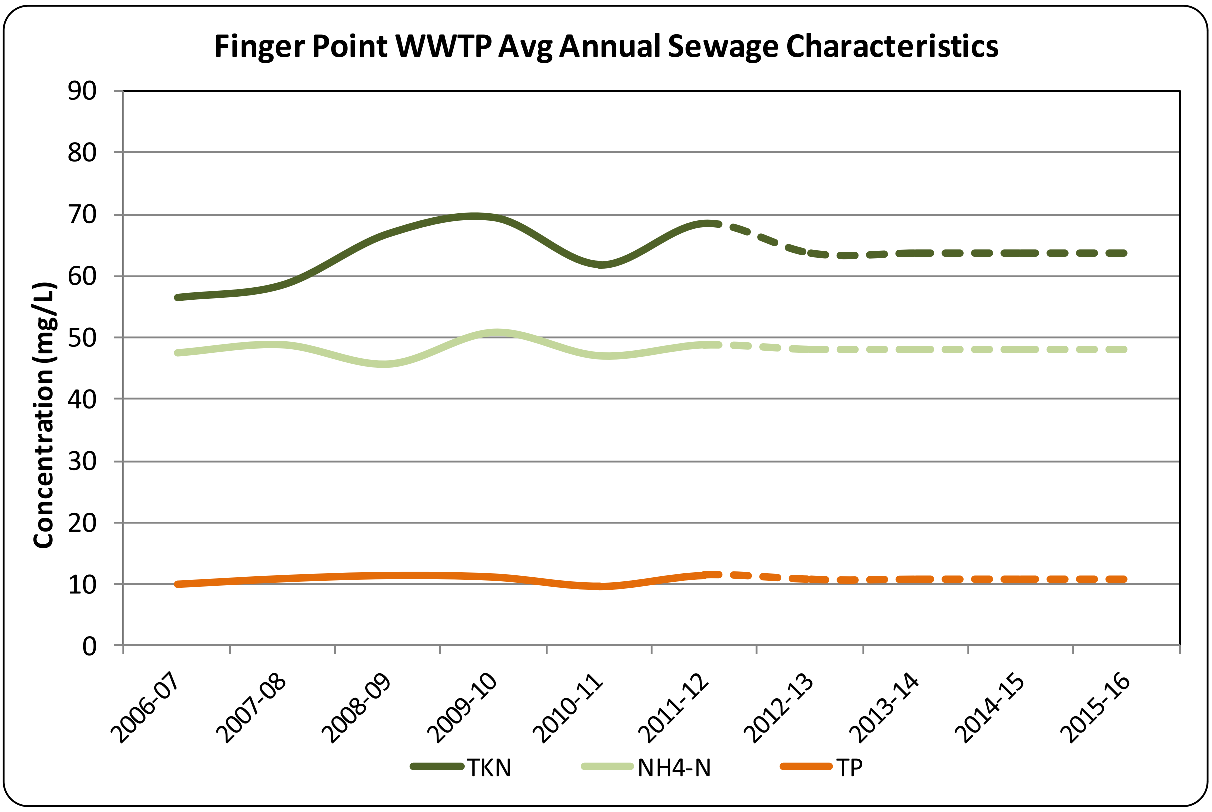


Figure 62

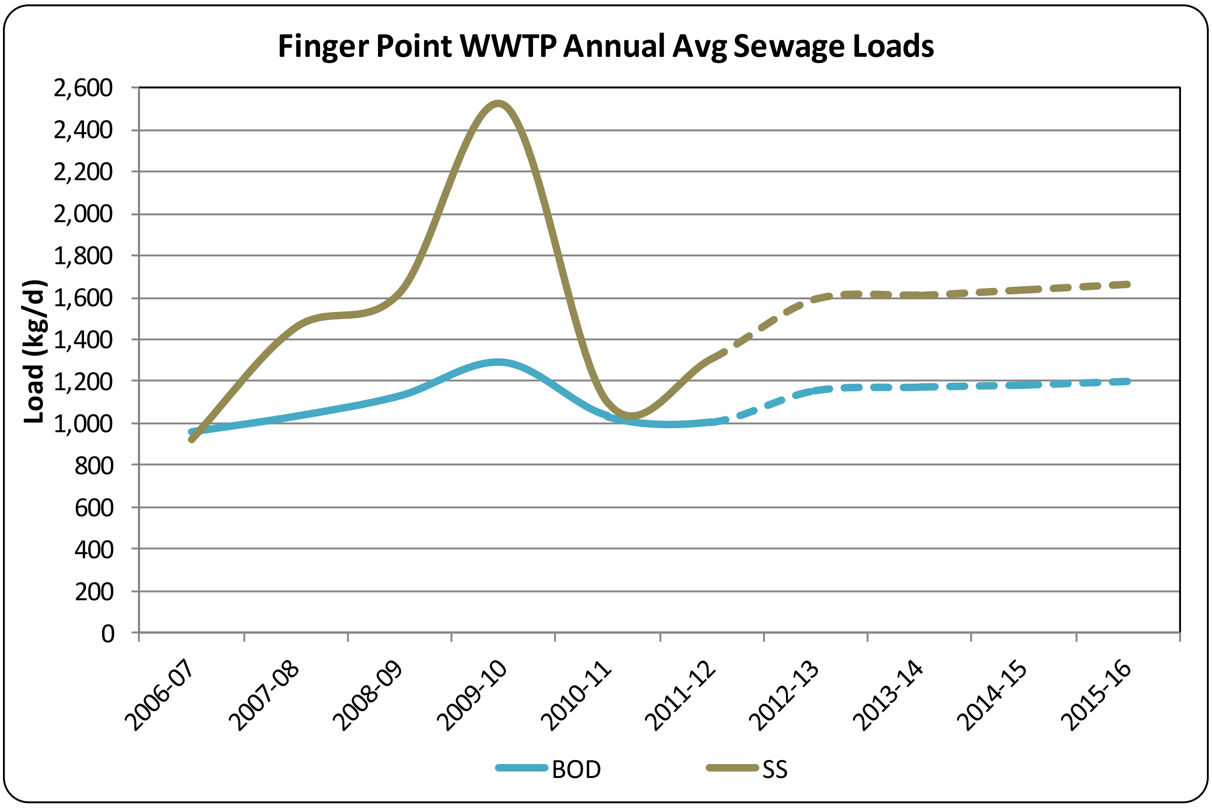
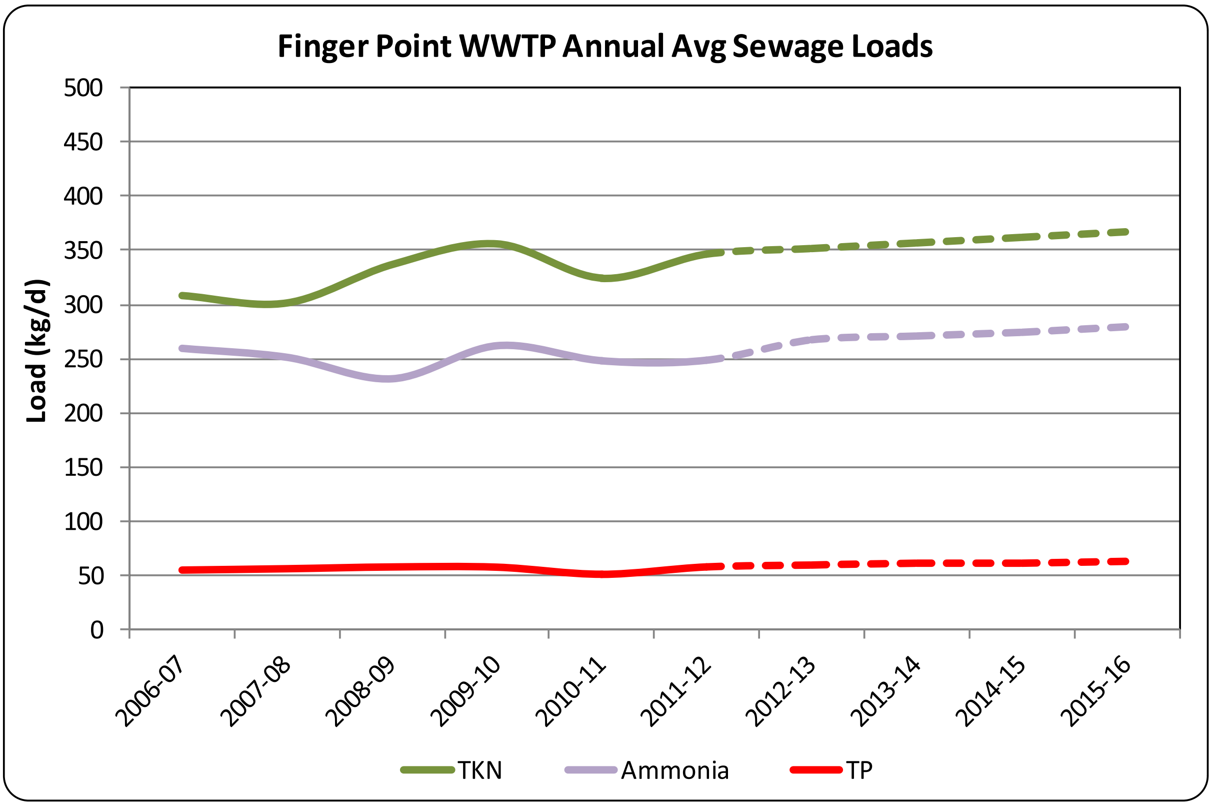


Figure 63



10.2. Key points

- Discharge of raw sewage from Mount Gambier commenced in 1976 and the Finger Point WWTP was commissioned in 1989. Sewage from the township is pumped from the No.1 sewage pumping station in Commercial St, Mount Gambier, through a 30km length of pumping and gravity pipelines to the Finger Point plant, located on the coast to the south. Raw wastewater is from domestic, commercial and some industrial activities. Septic tank wastewater from the Port McDonnell township is also received.

- A 3mm step screen and grit vortex removal facility was constructed in 2007 at a cost of \$1.7 million. Problems have been experienced with excessive quantities of rags and large solids blocking the screens and causing sewage overflows. The inlet works have been bypassed awaiting a solution to be developed.

- The activated sludge IDAL treatment process employs a single 13.5ML concrete-lined aeration basin, which continually accepts raw wastewater. The plant typically operates on a four-hour cycle comprising two hours of aeration, one hour of settling and one hour of decanting. These periods are operator adjustable. If the aeration basin reaches high water level, a storm cycle is initiated and the system quickly moves into decant phase. Decant weirs allow clarified effluent to be discharged into two 5ML polishing lagoons, prior to chlorination of the discharge.

- The nominal pollution load process capacity of the plant was originally provided to deal with short-term whey discharges at the time of commissioning. Only 4 of the 6 surface aerators are currently employed, with the other two used for intermittent mixing only. The plant control system hardware and software (PLC and SCADA) was upgraded in 2009.

- Waste Activated Sludge is discharged to one of 4 sludge dewatering lagoons, which are emptied in an annual cycle. An underdrain system was recently installed in the lagoons to assist de-watering prior to de-sludging.

Key points - future:

- A hardstand area was constructed adjacent to the sludge de-watering lagoons in 2010. Sludge has been stockpiled on-site for many years, but the EPA expressed concerns about the sustainability of this practice and potential impacts on local groundwater. It was agreed that a drained impervious hardstand area would be provided for storage of sludge and that off-site disposal would be pursued.

- The hardstand has proved to be inadequate to allow storage of sludge for the three years required by the SA Biosolids Guidelines[14] to allow for pathogen reduction. A project has been proposed to increase the hardstand area for sludge stockpiling.

- Finger Point wastewater treatment plant is ranked as a “tier 2”[15] treatment plant by the EPA. Under the current licence there is no requirement for an EIP.

[14] EPA, South Australian Biosolids Guidelines for safe handling, reuse or disposal of biosolids, June 1997, and Draft South Australian Biosolids Guidelines for safe handling, reuse or disposal of biosolids, May 2009.
[15] Refer to notes to the attachment.

11. Glenelg Wastewater Treatment Plant

11.1. Summary

Commissioned:	Stage I activated sludge plant was commissioned in 1933 and other Stages in 1945, 1962 and 1973. “D” plant (part of an EIP upgrade) was commissioned in October 2002.
Treatment process:	Screens and grit removal, primary sedimentation tanks, integrated fixed film activated sludge bioreactors (“B” and “C” plants), BNR bioreactor (“D” plant), secondary clarifiers, treated wastewater disinfection using chlorine. Sludge digestion on-site with digested sludge pumped to Bolivar WWTP. Production of electrical power on-site from burning digester off-gas.
Disposal of treated wastewater:	Treated sewage is used for local irrigation and, after further treatment, is supplied for irrigation of Adelaide Park Lands and made available to other potential users (e.g. local government). Treated sewage that is not reused is discharged to Gulf St Vincent via two outfall pipes.

Figure 64 Glenelg wastewater treatment plant

Parameter	Design*	Actual (2010-11)
Flows (Megalitres per day; ML/d)		
Average dry weather	54	45.9
Average annual	60	48.1
Peak month average	72	57.8
Peak wet weather	180	n/a
Avg Concentration (mg/L)		
Biochemical Oxygen Demand (BOD)	260	271
Chemical Oxygen Demand (COD)	650	529
Suspended Solids (SS)	350	308
Total Kjeldahi Nitrogen (TKN)	60	57
Ammonia (NH_3-N)	44	39
Total Phosphorous (TP)	11	10
Avg Raw Wastewater Load (kg/dy)		
Biochemical Oxygen Demand (BOD)	15,600	13,096
Chemical Oxygen Demand (COD)	39,000	25,481
Suspended Solids (SS)	21,000	14,820
Total Kjeldahi Nitrogen (TKN)	3,600	2,733
Ammonia (NH_3-N)	2,640	1,877
Total Phosphorous (TP)	660	474

Population[16]

2005	2011
191,329	198,169

[16] Indicative population numbers based on SA Water information about the number of Government Inspection Point (GIP) connections, multiplied by population density of 2.6 (number of occupants per residence).

Figure 65 Glenelg wastewater treatment plant drainage area

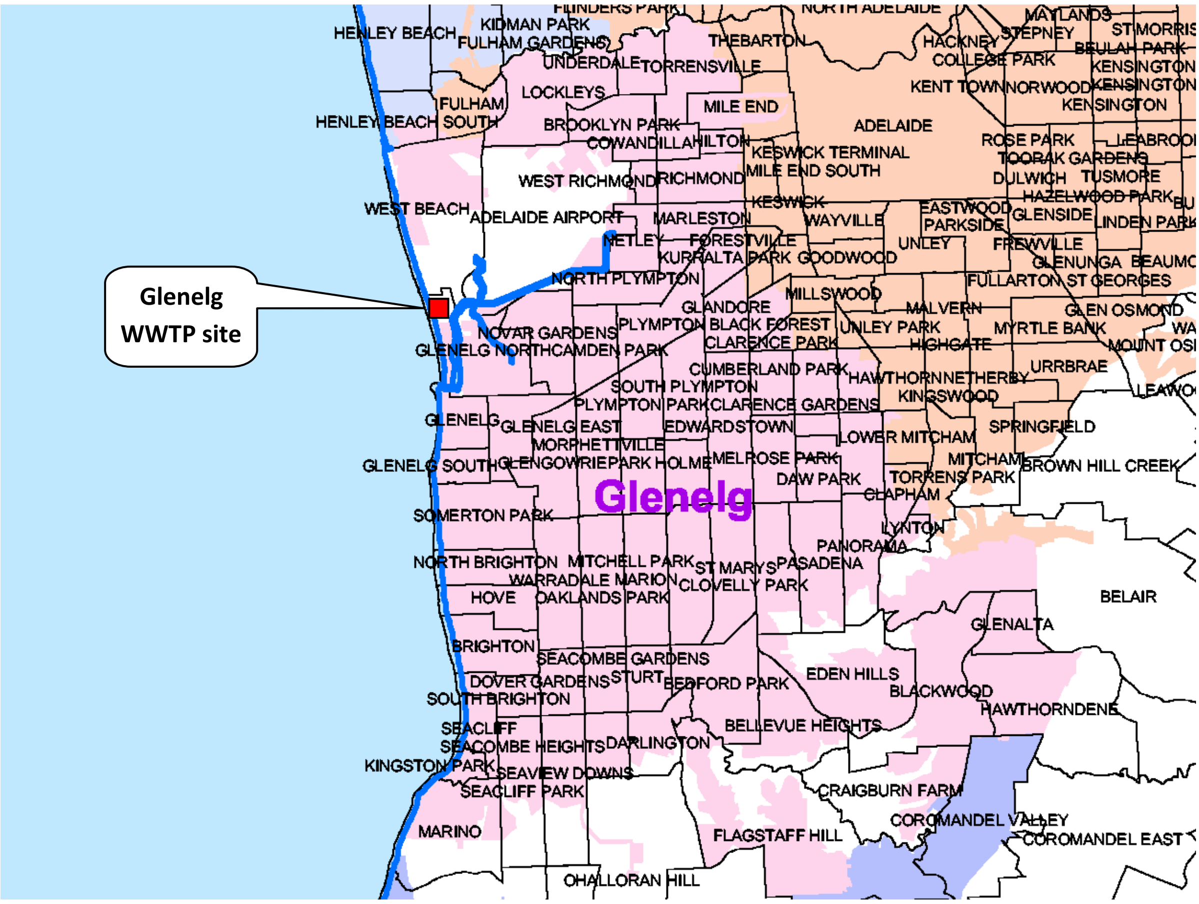


Figure 66 Glenelg plant schematics

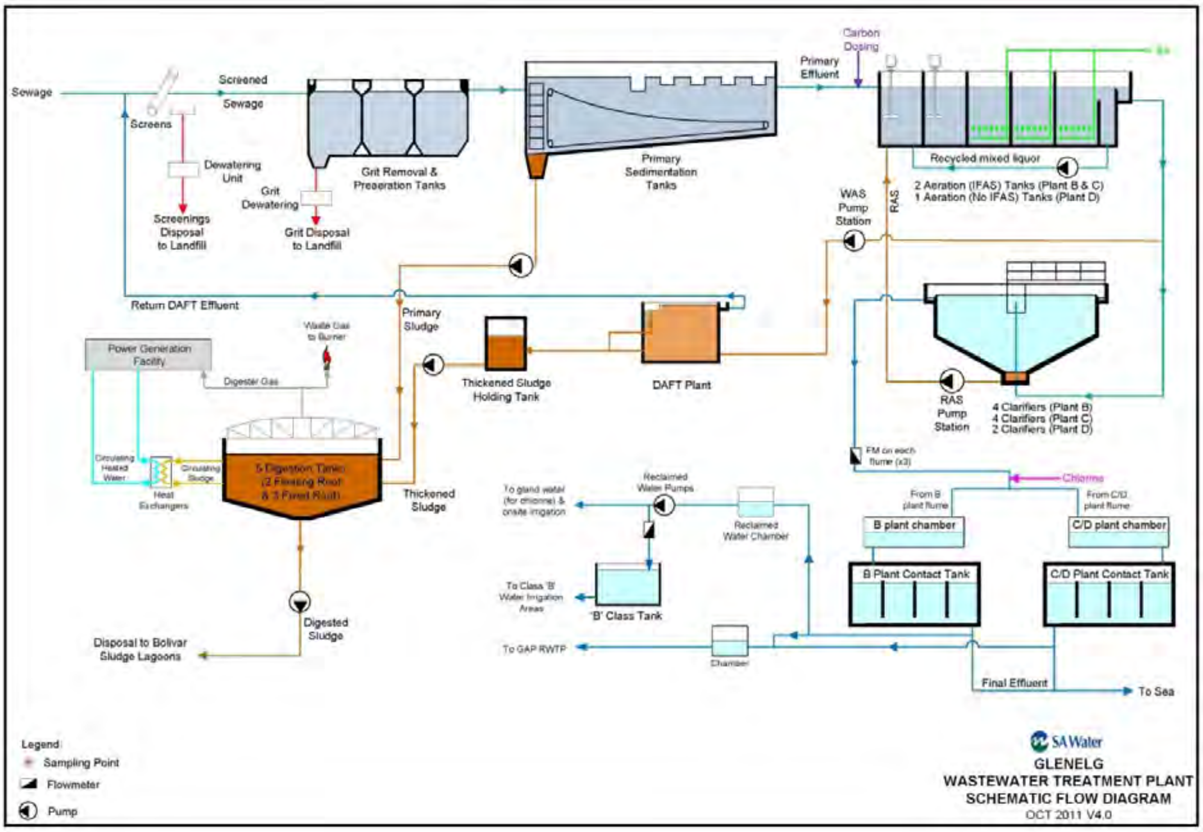
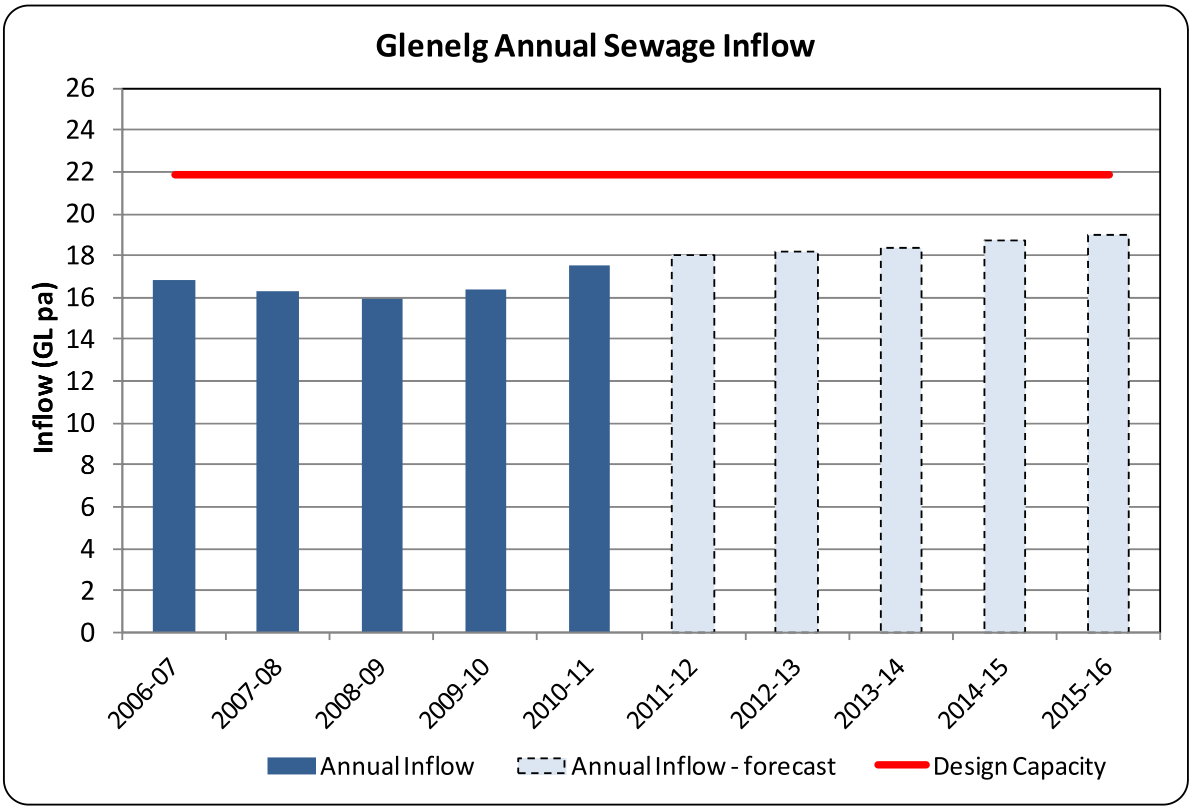


Figure 67



Note: the reduction in inflows between 2006-07 and 2010-11 has been attributed largely to the impact of drought and water restrictions.

Figure 68

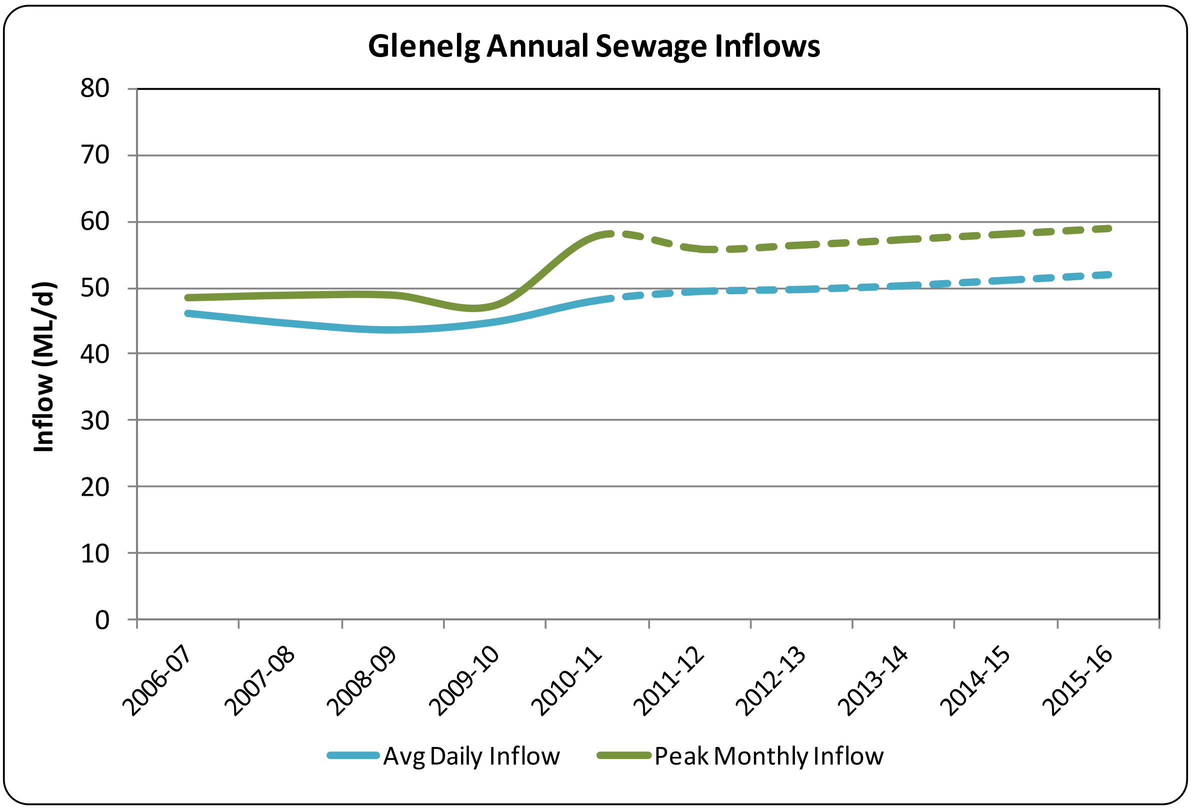
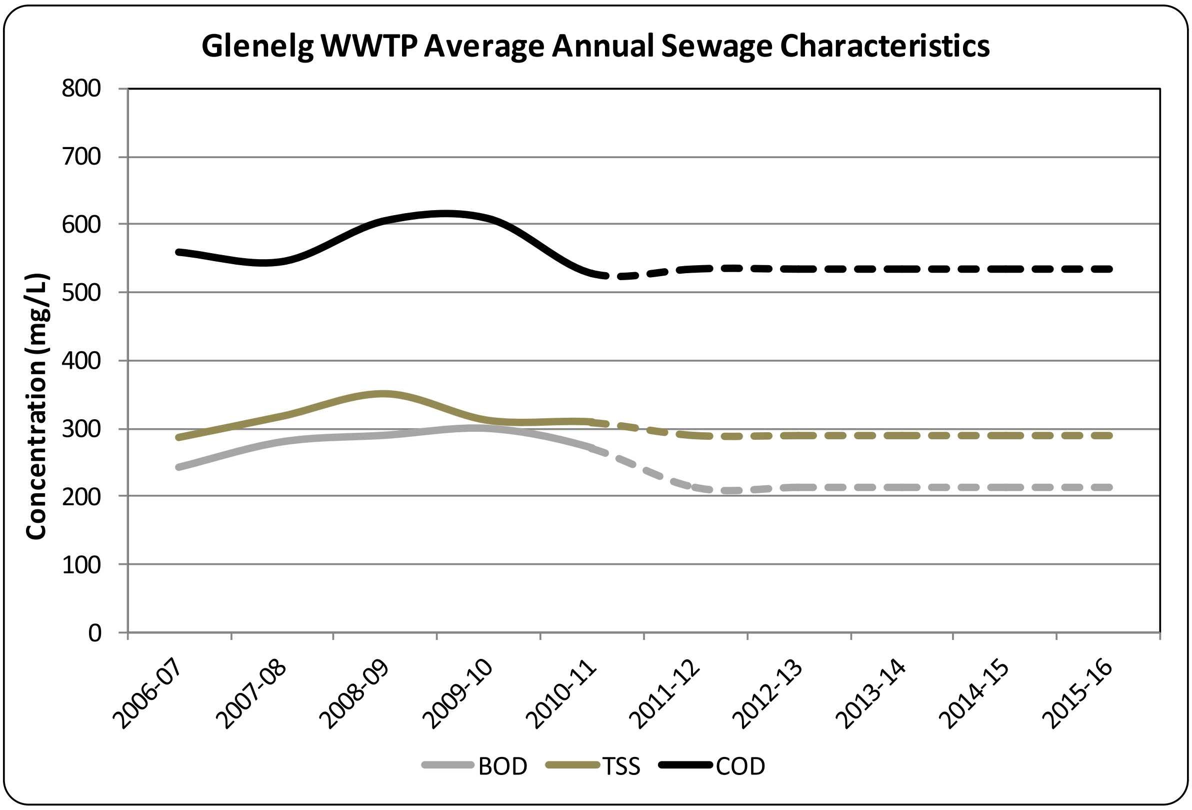


Figure 69



Note: for the period 2006-07 to 2010-11 customer wastewater volumes decreased. However, organic and nutrient contaminant loads did not significantly change. Projections assume a return to pre-drought loads.

Figure 70

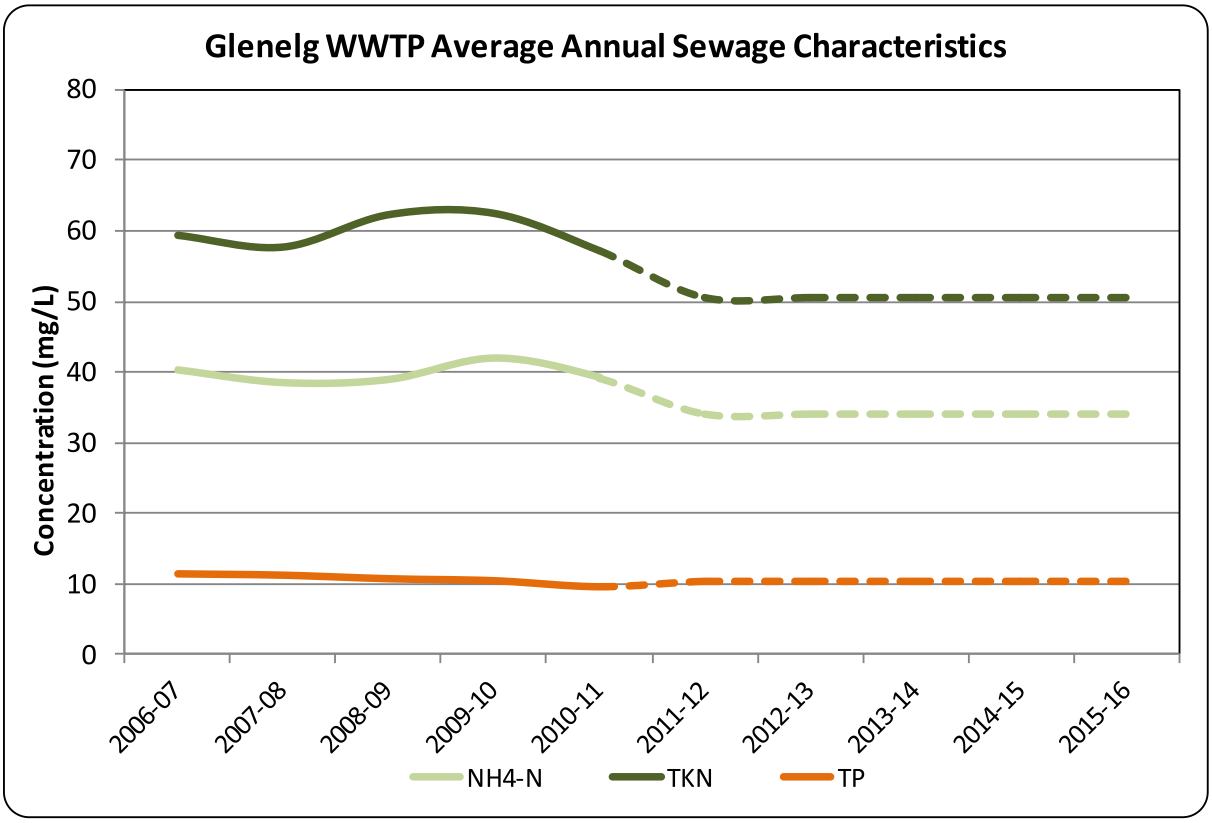
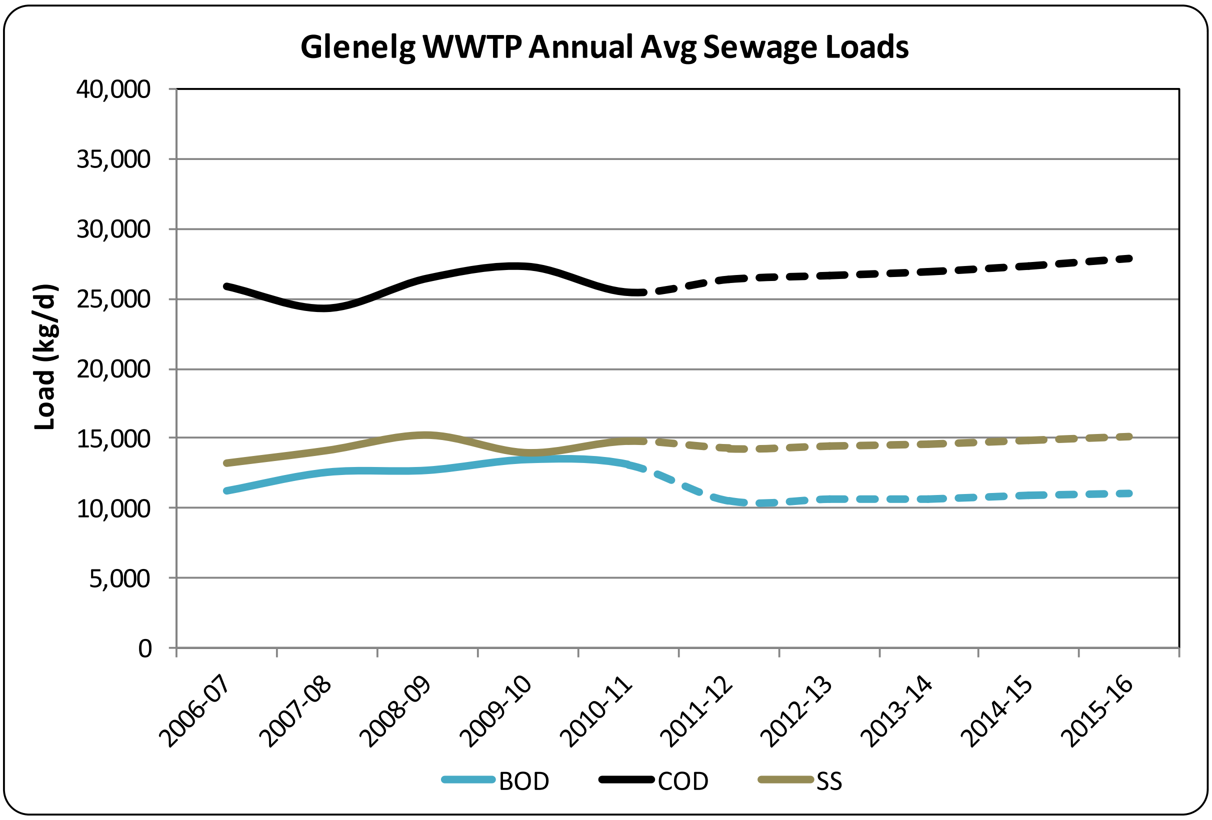
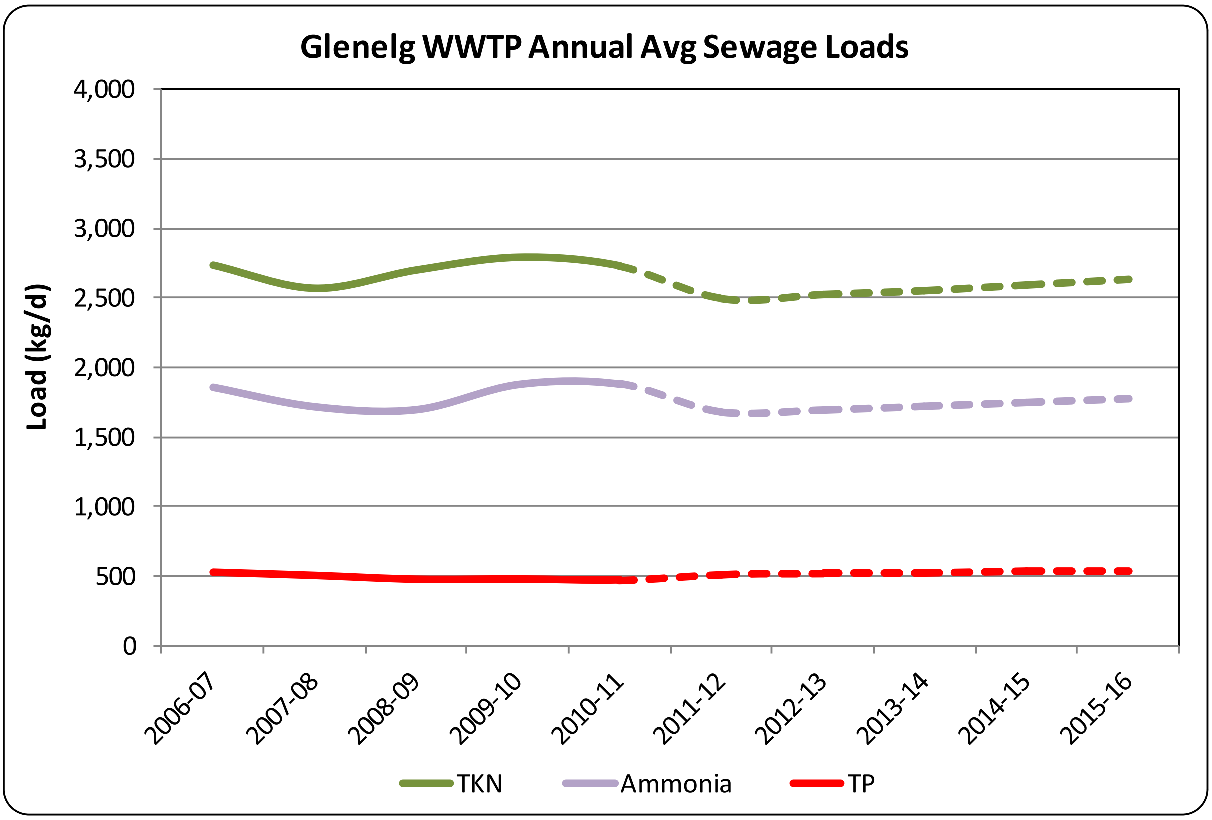


Figure 71



Note: Sewage loads (kg/d) are the result of flows multiplied by pollutant concentrations. Long term increases in loads are mainly due to population increases in drainage areas or the start up of major new industries.

Figure 72



11.2. Key points

- The Glenelg Wastewater Treatment Plant is situated between the Patawalonga and the coast, near the south-west corner of Adelaide Airport. The main Glenelg sewage pumping station is located several hundred metres south east of the WWTP on the eastern side of the Patawalonga watercourse.

- The sewage collection network area generally includes areas to the west and south of the Adelaide CBD. The network area extends to the River Torrens in the north (with a few areas north of the river), to Marino in the south, and to the Adelaide foothills (including Flagstaff Hill, Eden Hills and the Blackwood and Hawthorndene areas). The drainage area is mainly residential and commercial, with some industry. The scope for significant population expansion in the drainage area through new residential development is limited.

- An activated sludge plant to cater for an equivalent population (EP) of 40,000 was commissioned in 1933 ("A" plant). The plant was remodelled and enlarged in 1945 and an ocean outfall for the effluent was constructed. Another activated sludge facility ("B" plant) was commissioned in 1962, and further extension, "C" plant, was commissioned in June 1973.

- Digested sludge was discharged to the sea from the site until 1993 when, in accordance with a State Government commitment, sludge discharges at all coastal plants ceased and Glenelg digested sludge was pumped to Bolivar, via a new Glenelg to Bolivar sludge pumping main.

- In November 1995, the EPA endorsed the Glenelg WWTP EIP as an interim program pending further development and the results of community consultation. The objective of the EIP was to reduce impacts on the marine environment by focussing on reducing nutrients being discharged, principally nitrogen.

- Following community consultation and further negotiations with the EPA, a revised EIP was approved. The upgrade of the Glenelg WWTP was completed in 2002 and included:

    - De-commissioning of the old "A" plant;
    - Modifying "B" and "C" plants to incorporate anoxic zones, intermittent fixed film activated sludge (IFAS) media to increase biomass, without the need for additional bioreactor tank volume, and a new aeration system;
    - Construction of a new activated sludge "D" plant designed for biological nitrogen reduction (BNR);
    - Construction of a new sludge thickening plant - dissolved air flotation thickening;
    - New blower building and electrical switch-room for "D" plant and other equipment;
    - Odour control measures at the inlet works and primary settling tanks.

- Recycling of treated sewage from Glenelg WWTP commenced in 1962, with installation of a pumping station, pipeline and balancing tank. The infrastructure was expanded in 1972 to provide treated wastewater for use by Adelaide Airport, several local golf courses, a nearby school and university playing fields. The City of Holdfast Bay also has used the treated sewage to irrigate lawn areas along the Patawalonga and beach fronts for many years.

- In 2009, treated sewage from the Glenelg WWTP was treated further through the Glenelg Recycled Water Treatment Plant employing membrane filtration UV disinfection and chlorination. The tertiary treatment process was required to allow supply of high quality recycled water to irrigate the Adelaide Park Lands through the Glenelg to Adelaide recycled water scheme, which also allows for reuse by other parties along the 8km pipe route to the City (e.g. local government).

- Recent investigations into the ingress of saline groundwater have resulted in some repairs being undertaken in the local low-lying sewer network near the plant to minimise treated wastewater salinities, so that it is suitable for reuse.

Key points - future:

- Major works are proposed for the forthcoming regulatory period to replace old inlet screens at the plant, which are a major contributor to odour issues from the plant, and address issues in relation to other deteriorating assets. These rehabilitation and replacement works are critical to ensure the plant can continue to operate effectively and in line with environmental and safety requirements.

- Population growth in the drainage area is relatively static, with few vacant or greenfield areas available to be developed. Residential infill and replacement of low density housing with high density residential developments is the main source of increases in house numbers.

- Infiltration of saline water into the sewer network and consequent increases in treated sewage salinity need to be carefully monitored and managed to ensure sustainability for local irrigation customers and the Glenelg to Adelaide recycled water scheme.

- Glenelg WWTP is ranked as a “tier 1”[17] treatment plant by the EPA. Under the current licence there is no requirement for an EIP.

[17] Refer to notes to the attachment.

12. Gumeracha Wastewater Treatment Plant

12.1. Summary

Commissioned:	Gumeracha WWTP was commissioned in 1965.
Treatment process:	An Imhoff tank, 2 trickling (biological) filters, followed by a humus tank. Clarified effluent is discharged into two concrete-lined stabilisation lagoons. Effluent then passes through three granular media pressure filters and is chlorinated.
Disposal of treated wastewater:	Discharges to the River Torrens ceased in 1996. All treated sewage is reused on a 15ha pine plantation 1km to the north of the plant. There is emergency provision to discharge treated sewage to the River Torrens upstream of the Gumeracha Weir.

Figure 73 Gumeracha wastewater treatment plant

Parameter	Design*	Actual (2010-11)
Flows (Megalitres per day; ML/d)		
Average dry weather	0.092	0.103
Average annual	0.109	0.138
Peak month average	0.131	0.236
Peak day flow	0.185	0.960
Peak wet weather	0.218	n/a
Avg Influent Concentration (mg/L)		
Biochemical Oxygen Demand (BOD)	n/a	195
Suspended Solids (SS)	n/a	187
Total Kjeldahi Nitrogen (TKN)	n/a	67
Ammonia (NH_3-N)	n/a	44
Total Phosphorous (TP)	n/a	10
Avg Raw Wastewater Load (kg/dy)		
Biochemical Oxygen Demand (BOD)	223	27
Suspended Solids (SS)	n/a	26
Total Kjeldahl Nitrogen (TKN)	n/a	9
Ammonia (NH_3-N)	n/a	6

** The original design equivalent population included allowances for a town of 400 persons, as well as large trade waste contributions from a cheese factory, a fruit glace works and a slaughterhouse. These industries have disappeared and the pollution loading on the plant is much less than the original design allowance. The above design figures are based on the original hydraulic parameters.*

Population served[18]

2006 Census	2011 Census
731	1018

[18] Indicative figures for catchment areas based on Australian Bureau of Statistics, 2006 and 2011 Census data, (Gumeracha Urban Centre/Locality in 2006 and Gazetted Locality in 2011), www.abs.gov.au.

Figure 74 Gumeracha plant schematics

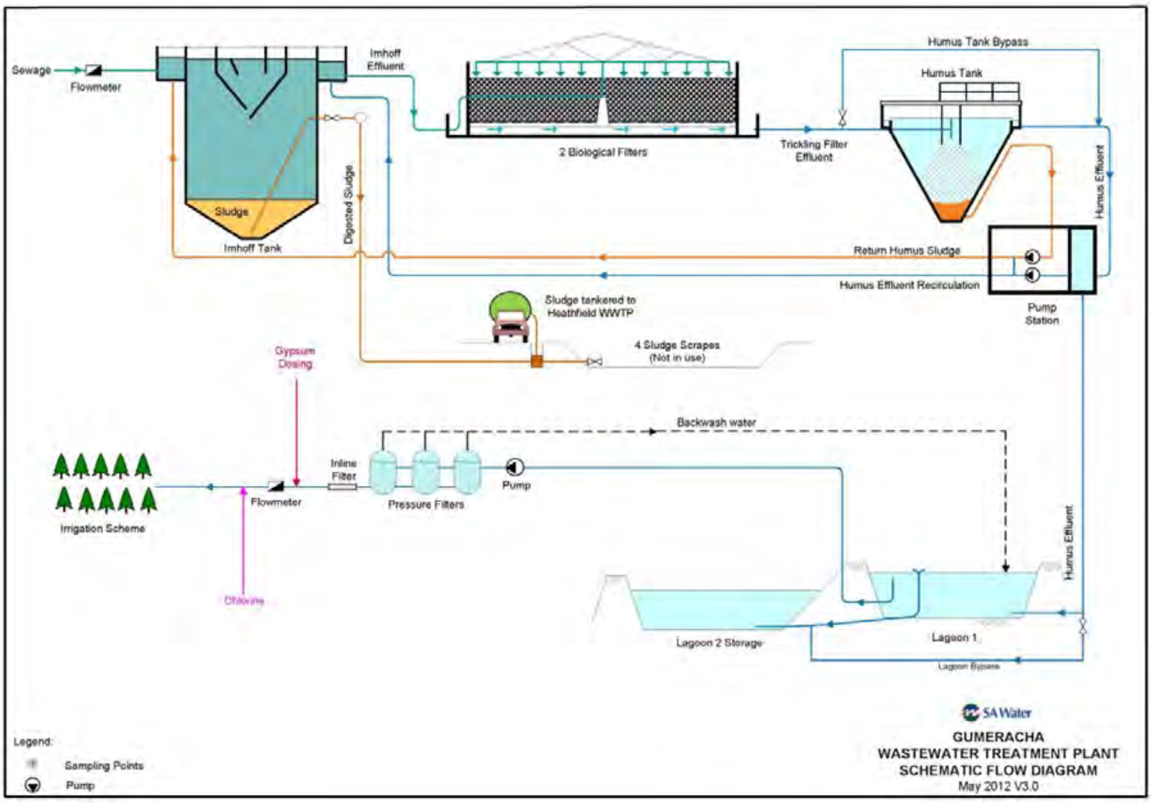


Figure 75 Gumeracha drainage area

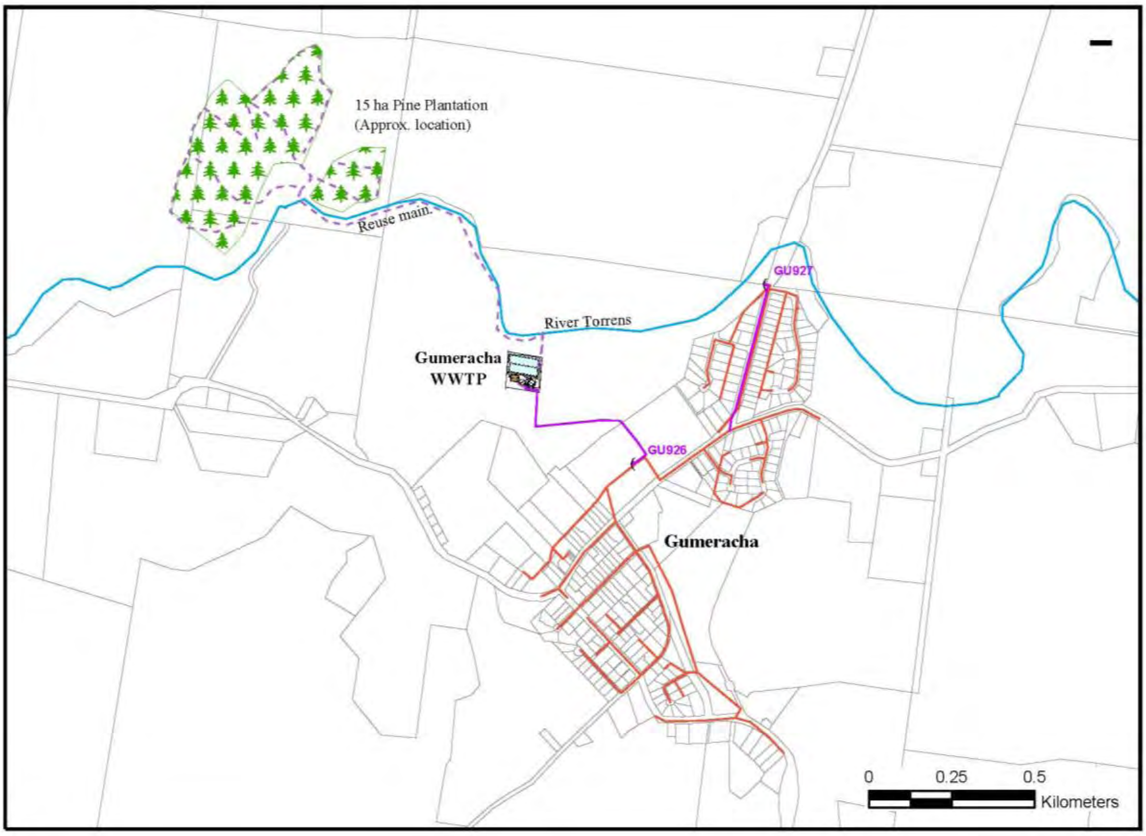


Figure 76

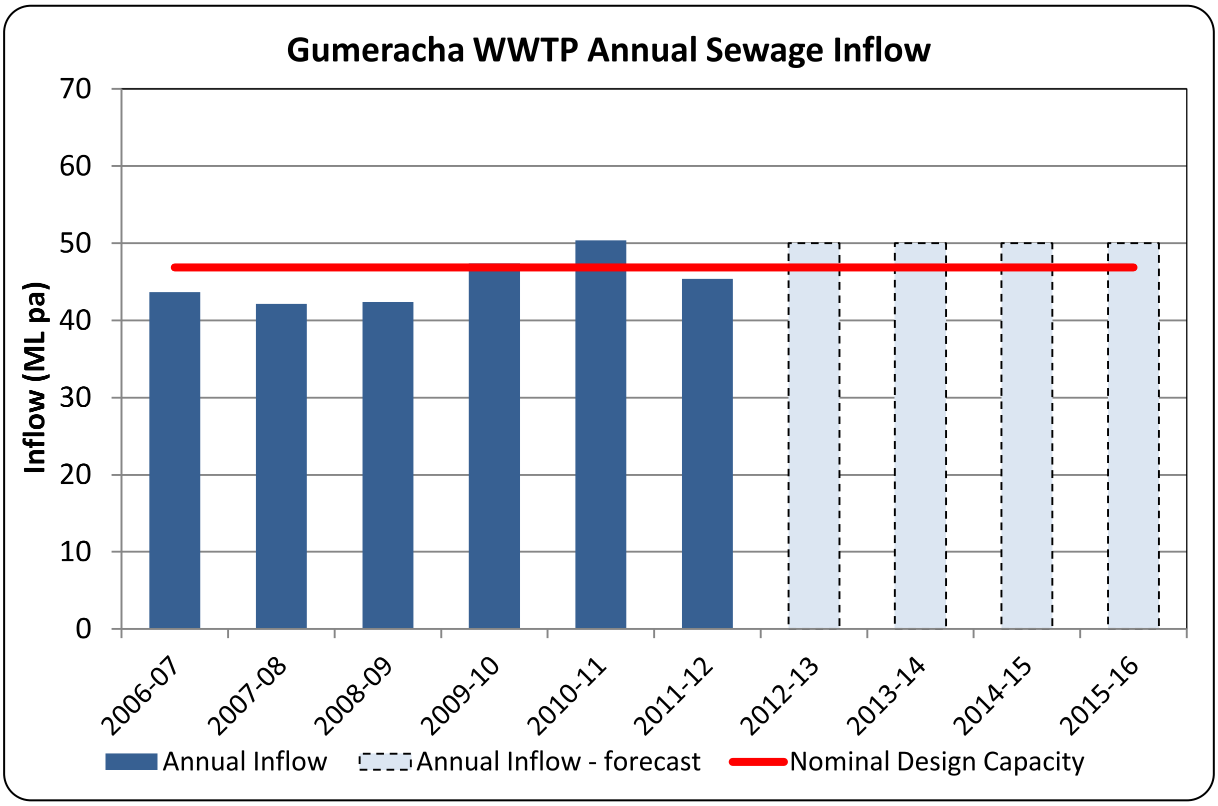


Figure 77

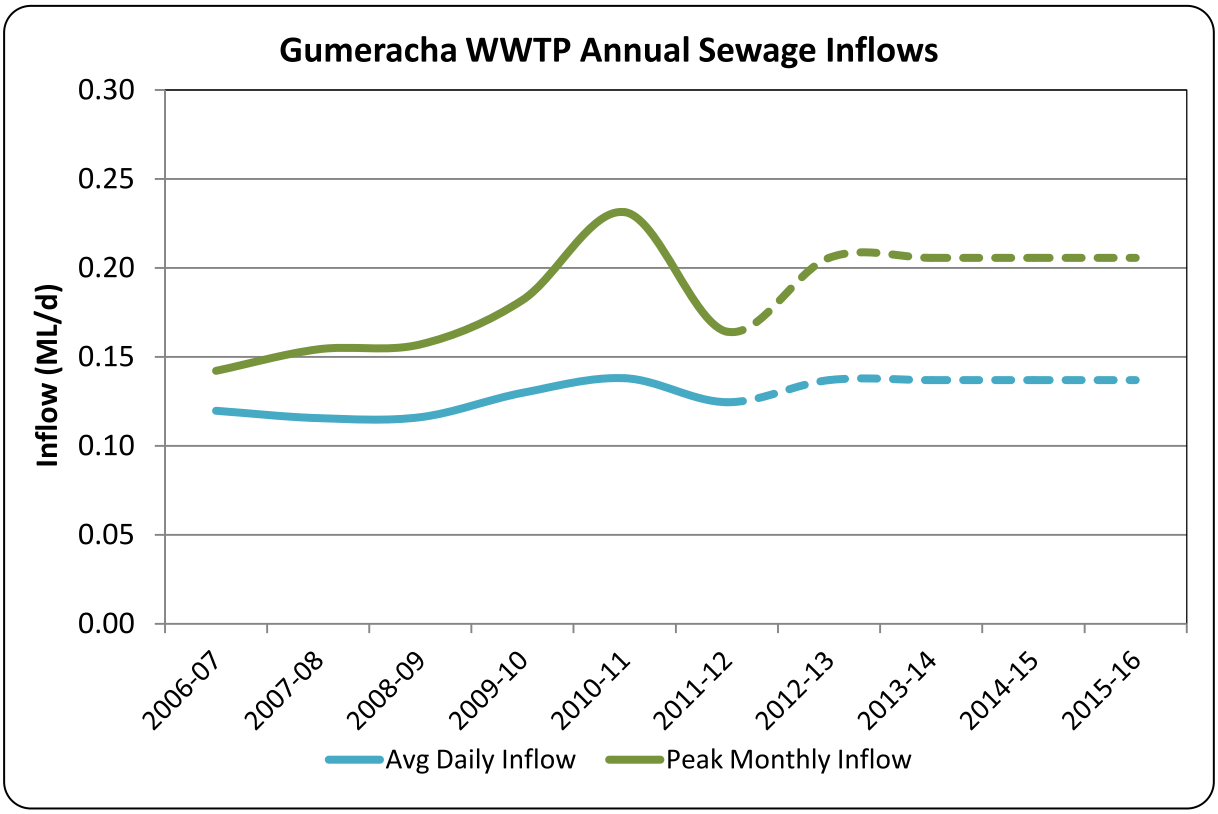


Figure 78

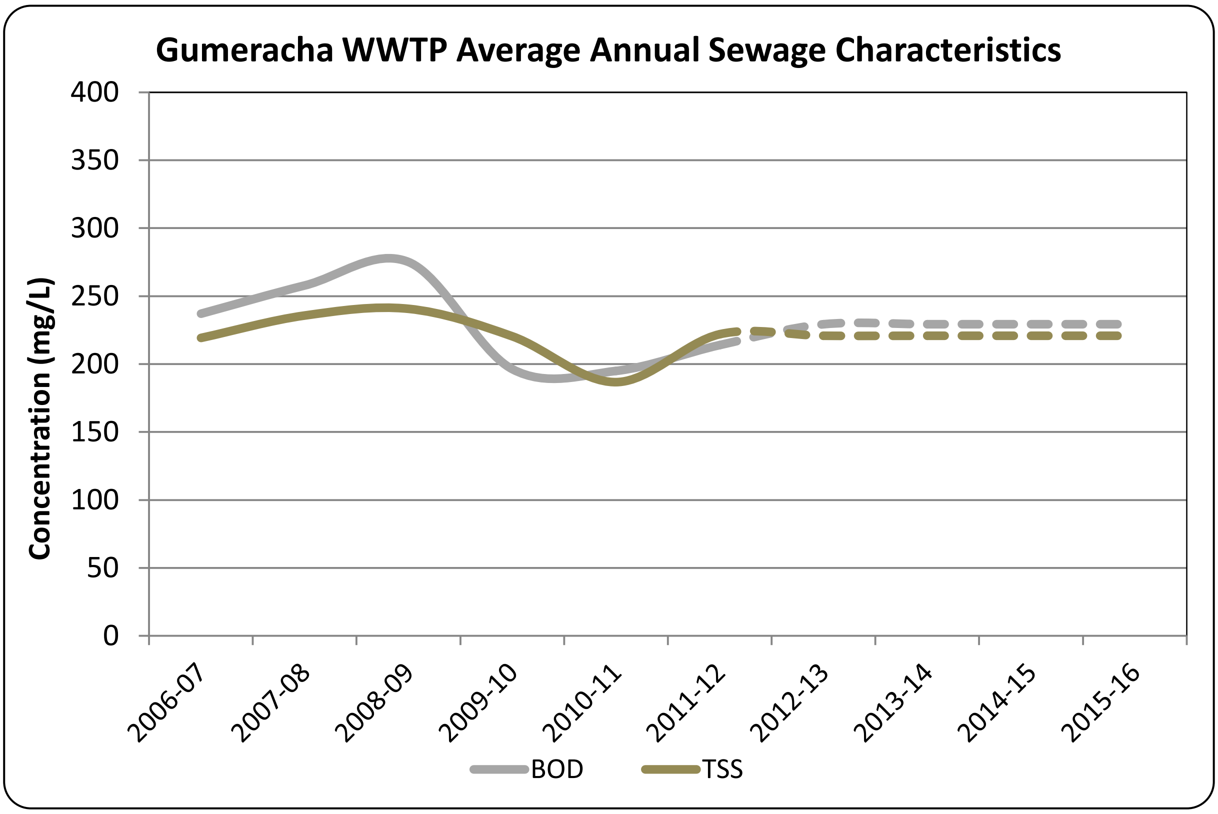


Figure 79

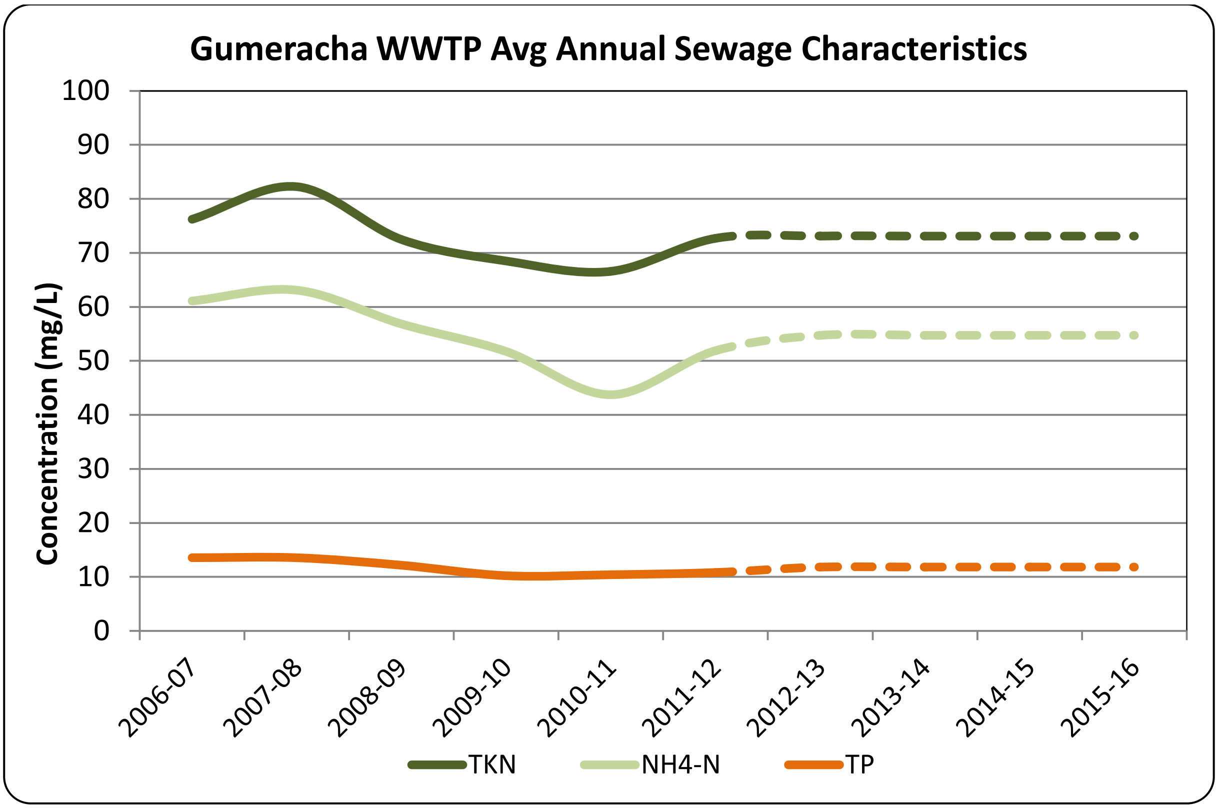


Figure 80

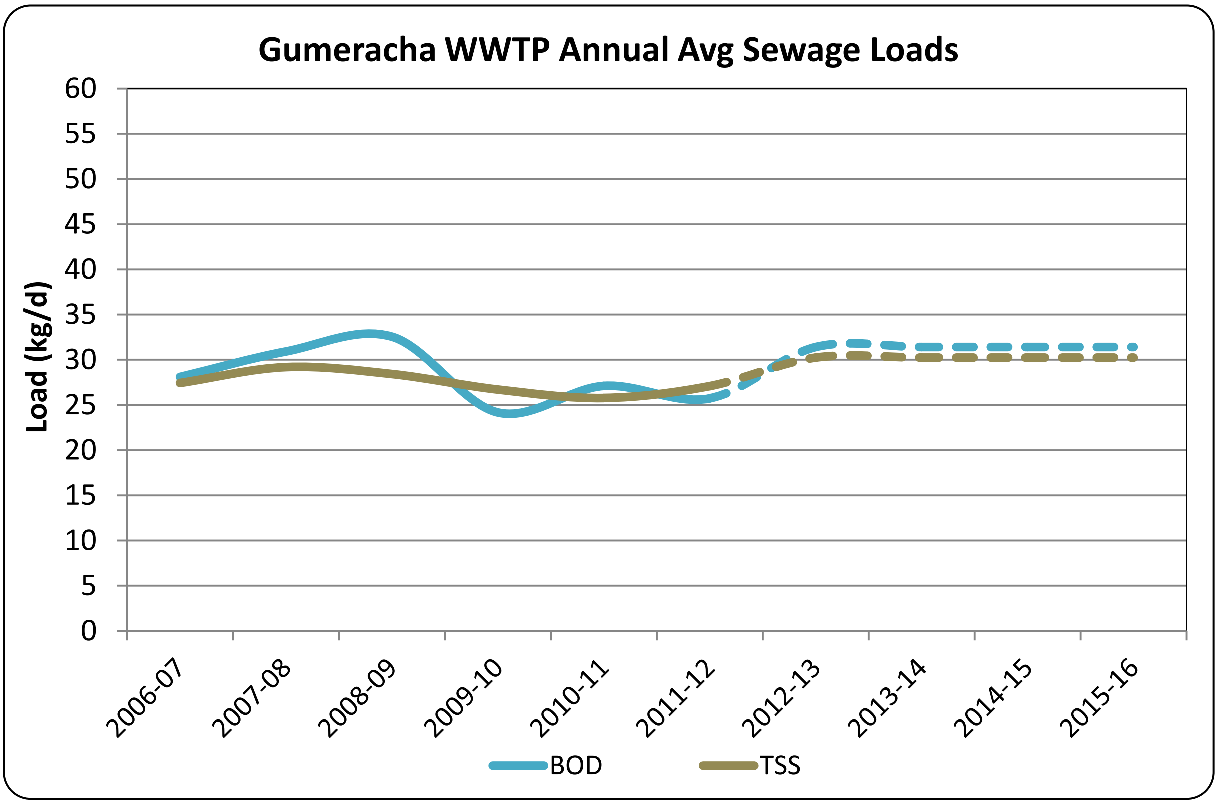
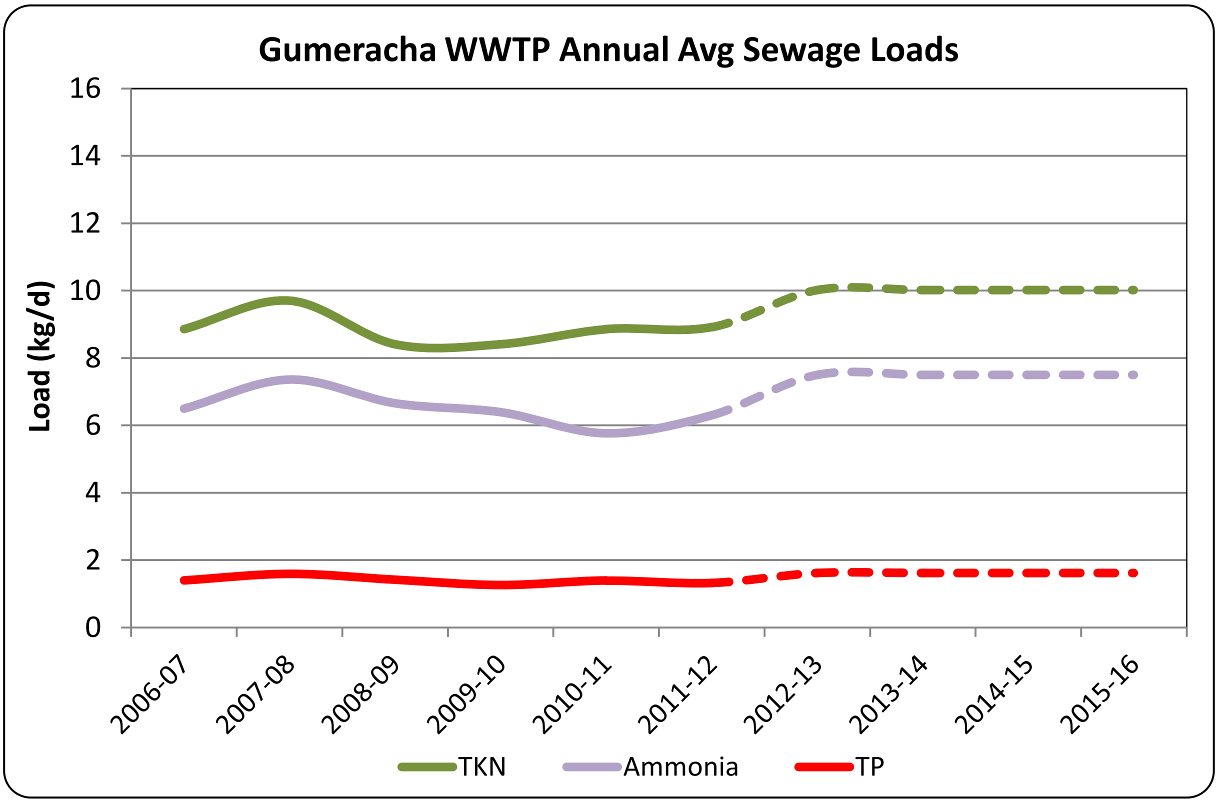


Figure 81



12.2. Key points

- The Gumeracha WWTP serves the Adelaide Hills township of Gumeracha.
- The WWTP process includes an Imhoff tank, two biological filters, a humus tank and concrete-lined polishing lagoons. The plant was designed to reduce organic pollution, but was not designed for nitrogen (nitrification and de-nitrification) or phosphorous reduction.
- Initially, treated sewage from Gumeracha WWTP was discharged into the River Torrens. The discharge was licensed by the then Department of Water Resources.
- A 1992 license condition required an investigation of options for land-based disposal of effluent from the Gumeracha plant. An investigation into nutrient removal options was also to be undertaken in the event that effluent land disposal was considered uneconomic or not feasible.
- In May 1993, the then E&WS Department advised only land-based disposal of the reclaimed water from Gumeracha WWTP should be considered as the plant was located in a water supply catchment area and there were concerns regarding the impacts of the discharge on the River Torrens microbiological quality and potential for algal blooms from the nutrient input.
- These concerns led to commissioning of a reuse scheme in August 1996. Treated sewage is filtered and chlorinated and pumped to a site about 1.2 km northwest of the Plant for drip irrigation of an established 15 ha pine tree plantation operated by Forestry SA.
- Lagoon sludge is periodically dredged with the dewatered material sent to a composter. Imhoff tank sludge is taken by a liquid waste contractor to a licensed disposal site.

Key Points - Future:

- The Gumeracha WWTP is lightly loaded and the rate of population growth in the drainage area is projected to be low.
- There is emergency provision to overflow high winter flows to the River Torrens, above the Gumeracha Weir which is the offtake from the River Torrens to Millbrook reservoir.
- The current reuse area is proposed to be expanded to maintain the current disposal practice to allow for the planned thinning of the existing plantation trees by Forestry SA in 2013-14. SA Water is investigating additional irrigation reuse options.
- Gumeracha WWTP is ranked as a “tier 3”[19] treatment plant by the EPA. Under the current licence there is no requirement for an EIP.

[19] Refer to notes to the attachment.

13. Hahndorf Wastewater Treatment Plant

13.1. Summary

Commissioned: Stage 1 was commissioned in 1975 and Stage 2 (second bioreactor and clarifier) in 1994.

Treatment process: The Hahndorf WWTP is an activated sludge plant in the oxidation ditch configuration with chemical phosphorous removal. Wastewater is disinfected by chlorination.

Disposal of treated wastewater: Discharge into the adjacent Hahndorf Creek and a small amount of reuse.

Figure 82 Hahndorf wastewater treatment plant

Parameter	**Design (Stages 1 & 2 combined)**	**Actual (2010-11)**
Flows (Megalitres per day; ML/d)		
Average dry weather	0.86	0.729
Average annual	1.01	0.980
Peak month average	1.52	1.575
Peak day flow	3.04	3.339
Peak wet weather	5.06	n/a
Avg Influent Concentration (mg/L)		
Biochemical Oxygen Demand (BOD)	320	305
Suspended Solids (SS)	320	217
Total Kjeldahi Nitrogen (TKN)	83	61
Ammonia (NH_3-N)	n/a	37
Total Phosphorous (TP)	15	10
Avg Raw Wastewater Load (kg/dy)		
Biochemical Oxygen Demand (BOD)	322	276
Suspended Solids (SS)	322	205
Total Kjeldahl Nitrogen (TKN)	83	54
Ammonia (NH_3-N)	n/a	33
Total Phosphorous (TP)	16	9

Population served[20]

2006 Census	**2011 Census**
3306	4545

[20] Indicative figures for catchment areas based on Australian Bureau of Statistics, 2006 and 2011 Census data, www.abs.gov.au. Includes Hahndorf (Suburb), Balhannah (Urban Centre/Locality) and Oakbank (Urban Centre/Locality). Verdun was not available in 2006 but included in 2011.

Figure 83 Hahndorf plant schematics

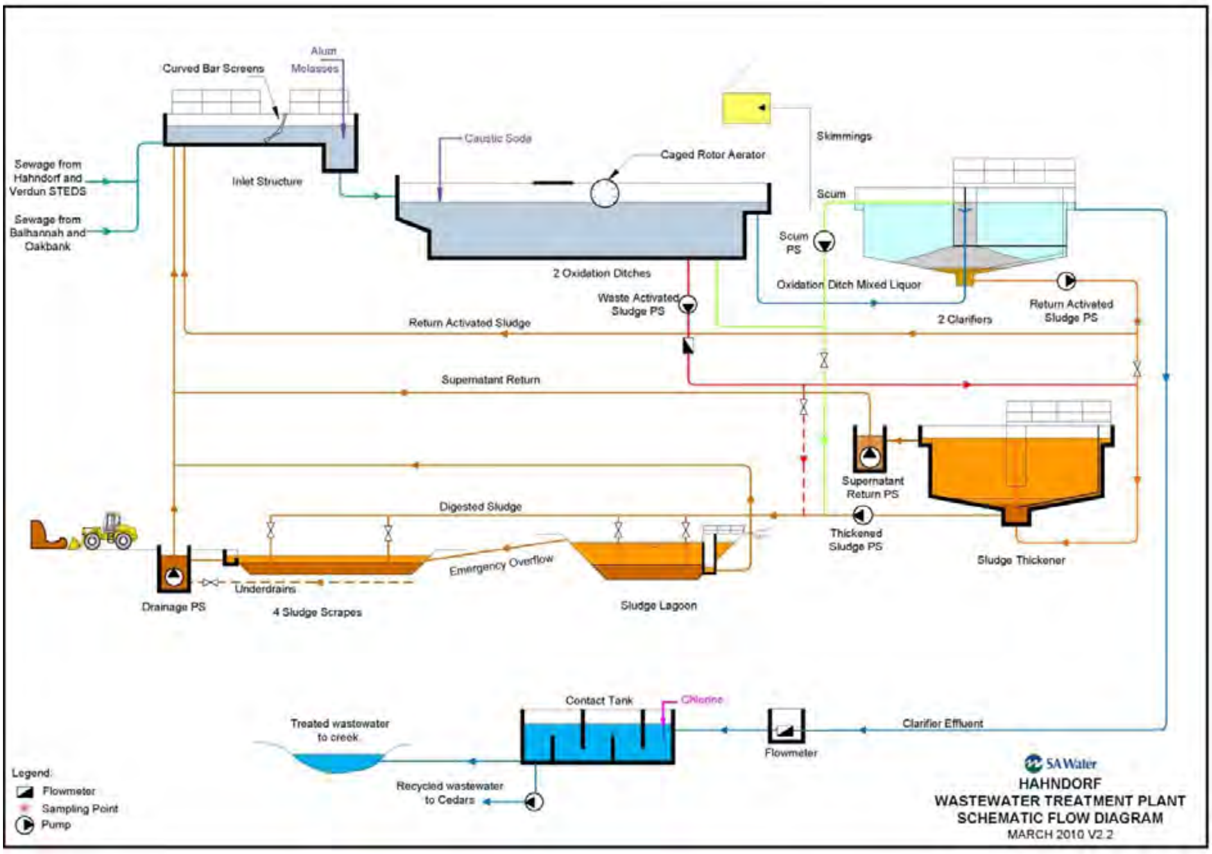


Figure 84 Hahndorf drainage area

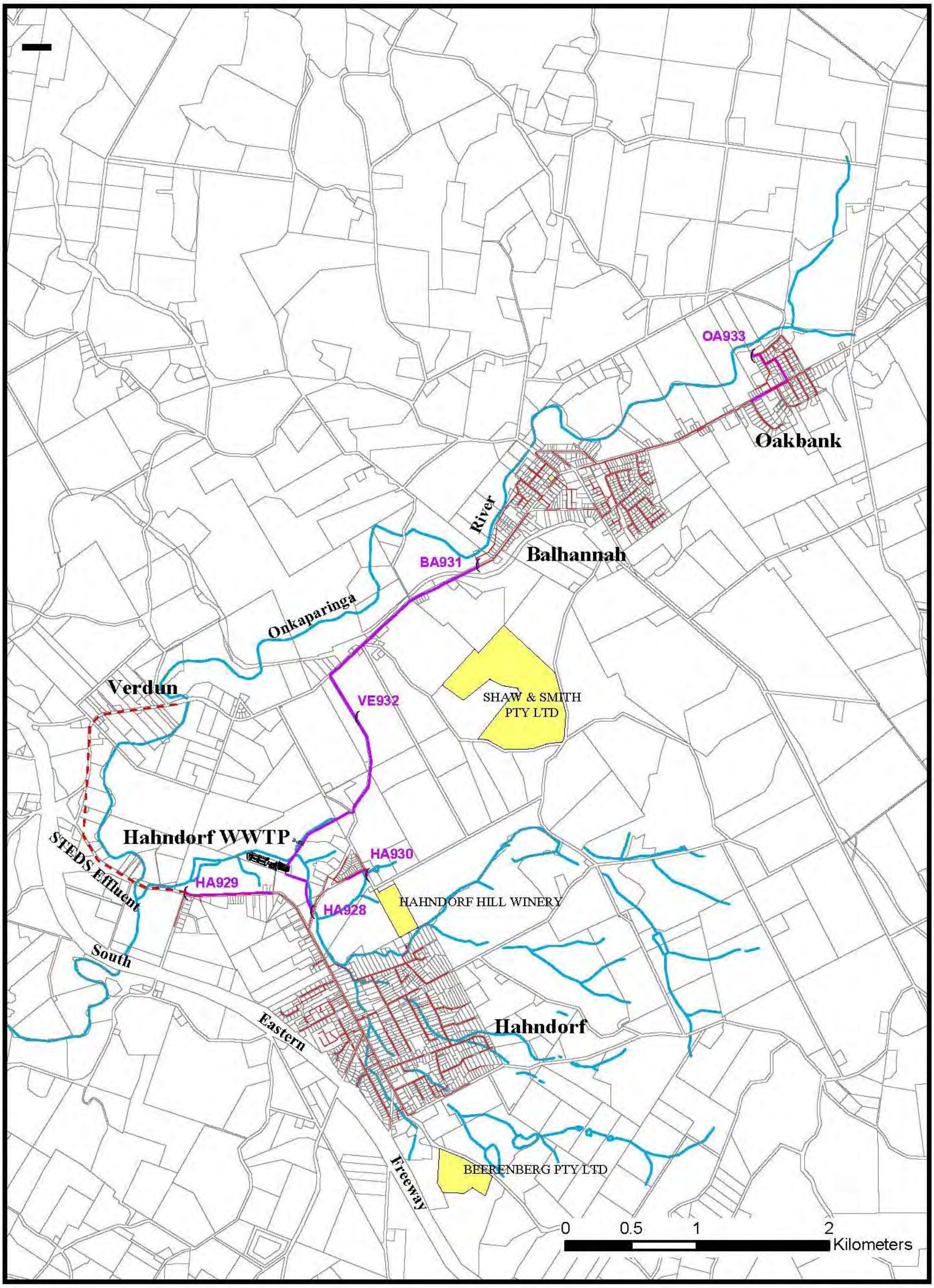
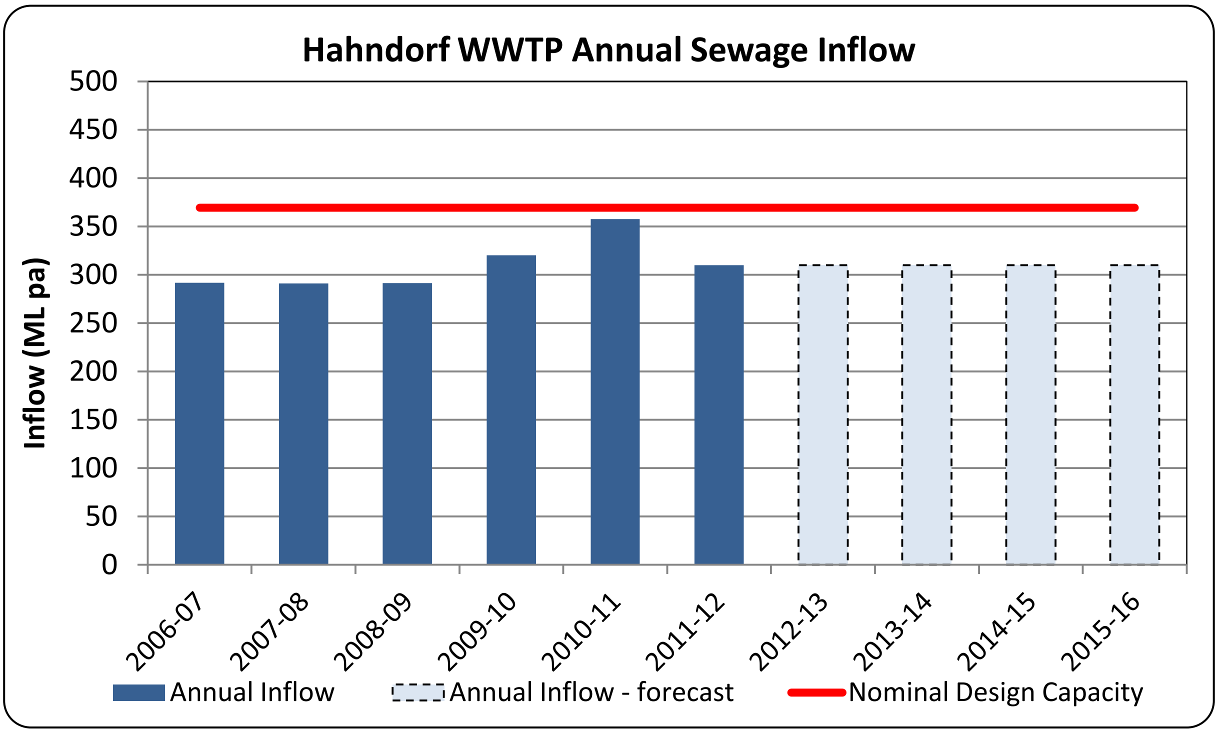


Figure 85



Note: in 2010-11 annual rainfall returned to pre-drought levels and the summer was particularly wet.

Figure 86

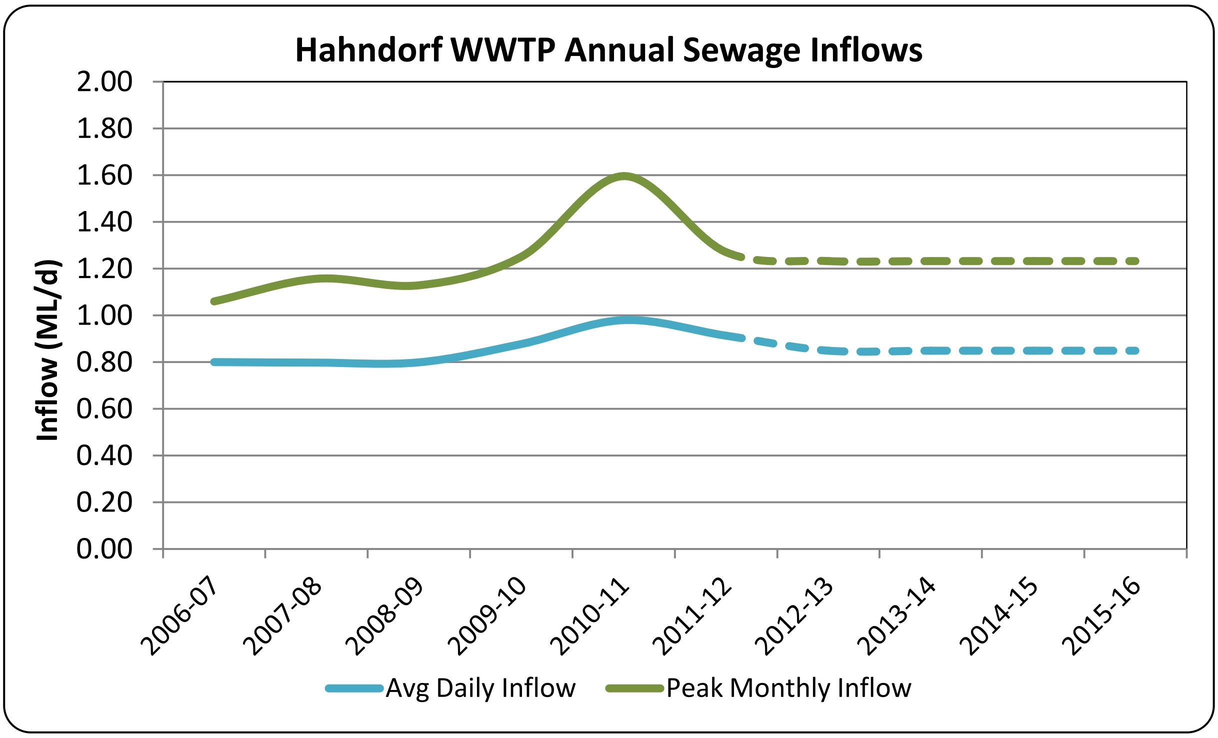


Figure 87

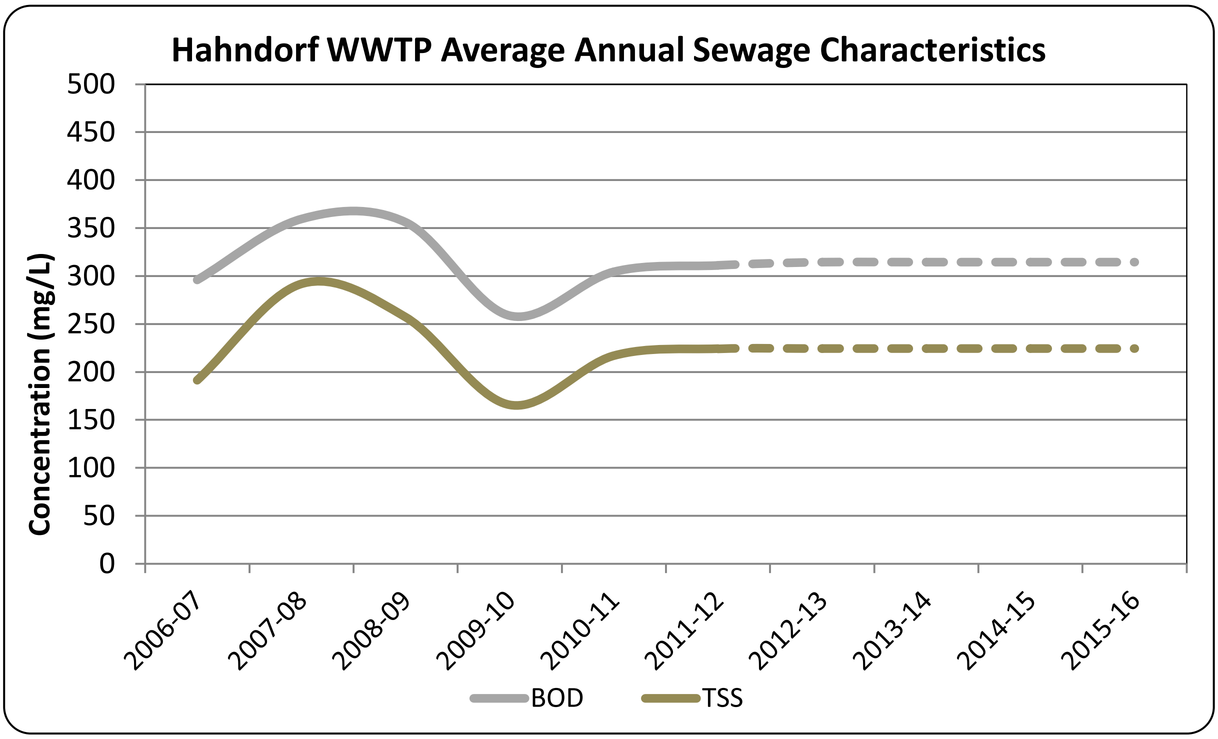


Figure 88

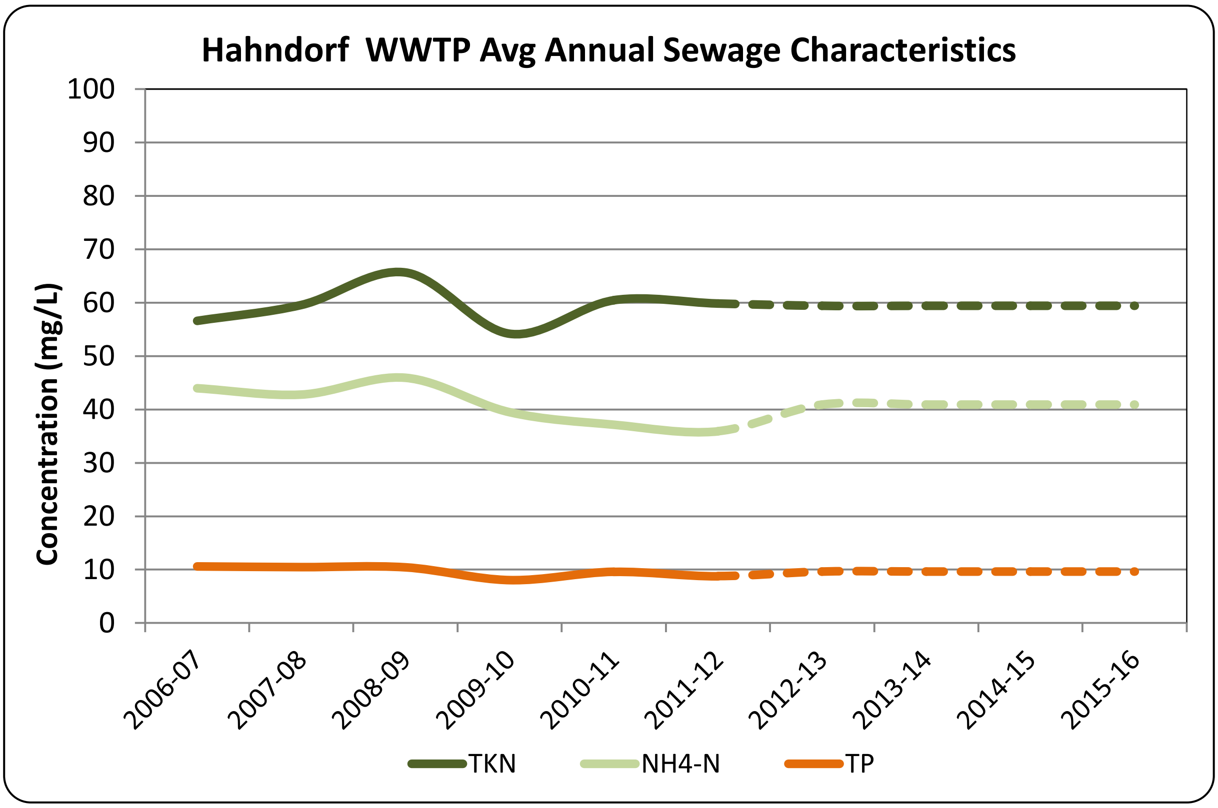


Figure 89

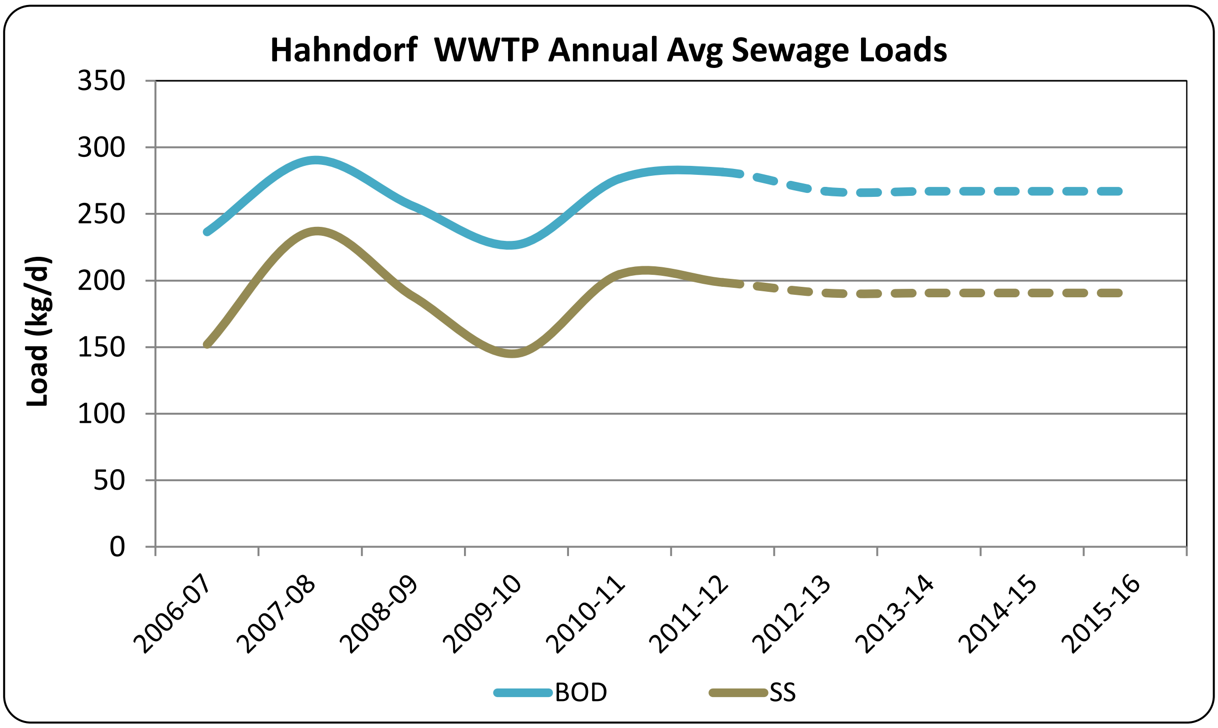
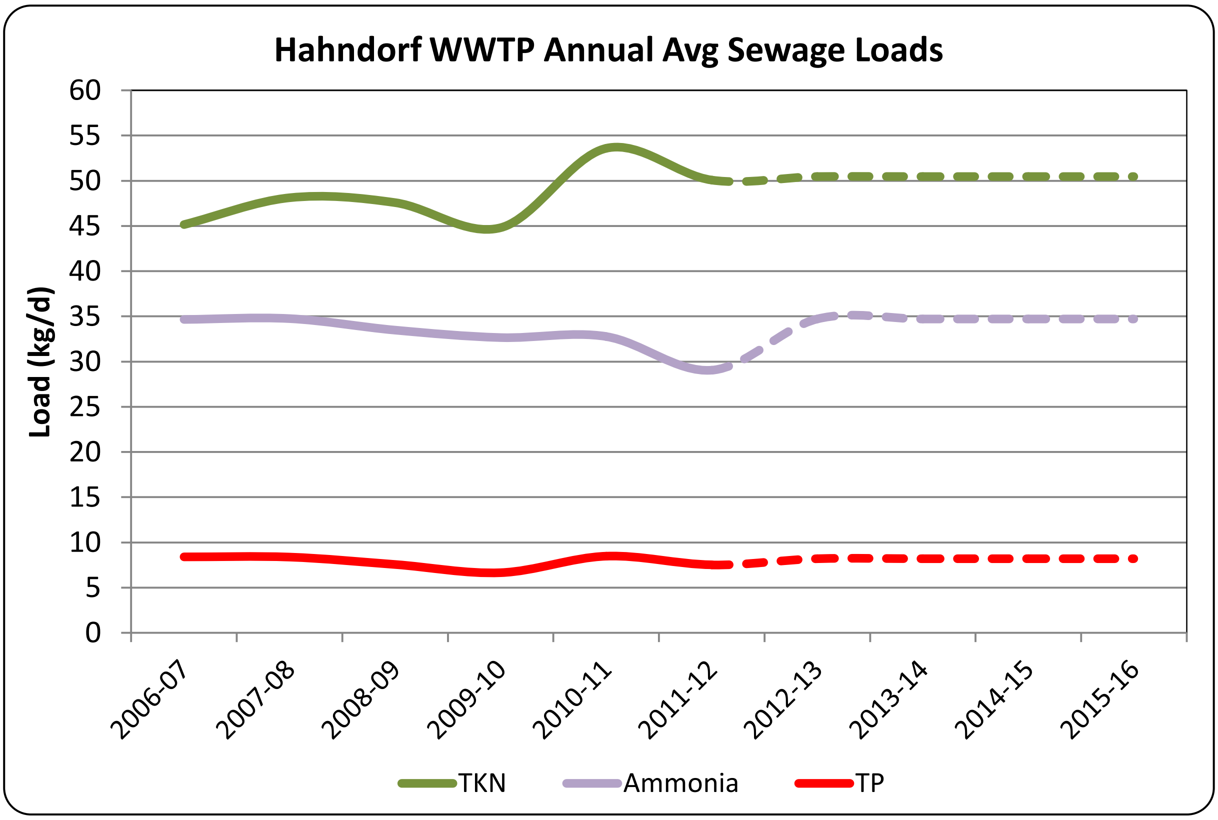


Figure 90



13.2. Key points

- The plant serves the Adelaide Hills townships of Hahndorf, Oakbank, Balhannah and Verdun.
- An assessment of the impact of the discharge was undertaken by SA Water in the early 1990s. It found that Hahndorf Creek was being degraded by nutrients in the discharged effluent. As a result, in 1994 the plant was upgraded (Stage 2) to increase the removal of the nutrients, nitrogen and phosphorus, from the treated wastewater and to provide greater hydraulic capacity.
- Raw sewage passes through a coarse bar-screen at the head of the plant. Stages 1 and 2 comprise separate activated sludge oxidation ditches employing rotating paddle surface aerators, followed by secondary clarifiers. The 1994 upgrade included a flow splitter, alum for chemical phosphorous reduction, caustic soda for pH correction and molasses to facilitate biological de-nitrification. The Stage 2 plant is larger than the original plant and the flow split is 40% to Stage 1 and 60% to Stage 2.
- The treated sewage discharge from the clarifiers is disinfected in a chlorine contact tank, and then discharged to the Hahndorf Creek, a tributary of the Onkaparinga River.
- Typically, the effluent discharged to the creek contains 1.5 mg/L oxidised nitrogen and 0.34 mg/L total phosphorus.
- During holiday periods flows of sewage into the plant increases significantly. This is particularly the case on the Easter long weekend, when the Oakbank horse racing event attracts large numbers of people.
- A small volume of treated sewage is reused by a nearby customer for irrigation of gardens. A private dam on the Heathfield Creek downstream of the plant discharge point is used to impound water for market gardening irrigation.

Key points - future:

- A project is proposed to address potential for spills/overflows into Hahndorf Creek.
- Hahndorf wastewater treatment plant is ranked as a “tier 2”[21] treatment plant by the EPA. Under the current licence there is no requirement for an EIP.

[21] Refer to notes to the attachment.

14. Heathfield Wastewater Treatment Plant

14.1. Summary

Commissioned:	The original plant began operations in 1981. It was upgraded between 2002 and 2004.
Treatment process:	Heathfield is a continuous flow activated sludge plant designed for biological nitrogen and phosphorous reduction. Treated sewage is disinfected by UV irradiation, with the capacity to chlorinate very high flows. Waste activated sludge is thickened, aerobically digested and dewatered by a centrifuge, and dried sludge is trucked to Bolivar.
Disposal of treated wastewater:	Discharge into Heathfield Creek, which flows into the Sturt Creek and, via the Patawalonga, into Gulf St Vincent.

Figure 91 Heathfield wastewater treatment plant

Parameter	Design	Actual (2010-11)
Flows (Megalitres per day; ML/d)		
Average dry weather	2.50	1.42
Average annual	3.60	2.07
Peak month average	-	4.06
Peak day flow	-	7.55
Peak wet weather	20.90	n/a
Avg Influent Concentration (mg/L)		
Biochemical Oxygen Demand (BOD)	250	215
Chemical Oxygen Demand (COD)	550	n/a
Suspended Solids (SS)	230	202
Total Kjeldahi Nitrogen (TKN)	55	57
Ammonia (NH_3-N)	n/a	39
Total Phosphorous (TP)	11	9
Avg Raw Wastewater Load (kg/dy)		
Biochemical Oxygen Demand (BOD)	900	384
Chemical Oxygen Demand (COD)	1,980	n/a
Suspended Solids (SS)	580	373
Total Kjeldahl Nitrogen (TKN)	198	104
Ammonia (NH_3-N)	n/a	71
Total Phosphorous (TP)	40	16

Population served[22]

2006 Census	2011 Census
13,135	13,016

[22] Indicative figures for catchment areas based on Australian Bureau of Statistics, 2006 and 2011 Census data, www.abs.gov.au. State suburbs included: Aldgate, Bridgewater, Crafers, Heathfield, Piccadilly and Stirling.

Figure 92 Heathfield plant schematics

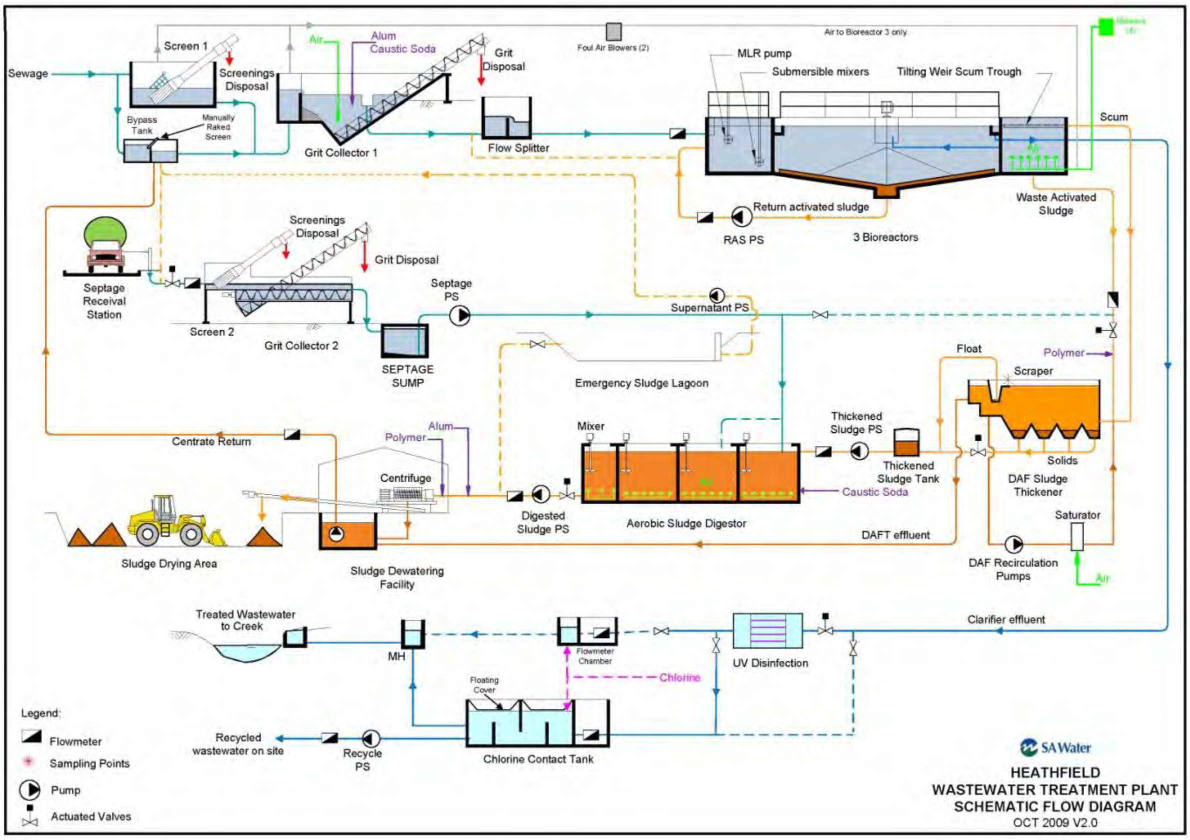


Figure 93 Heathfield drainage area

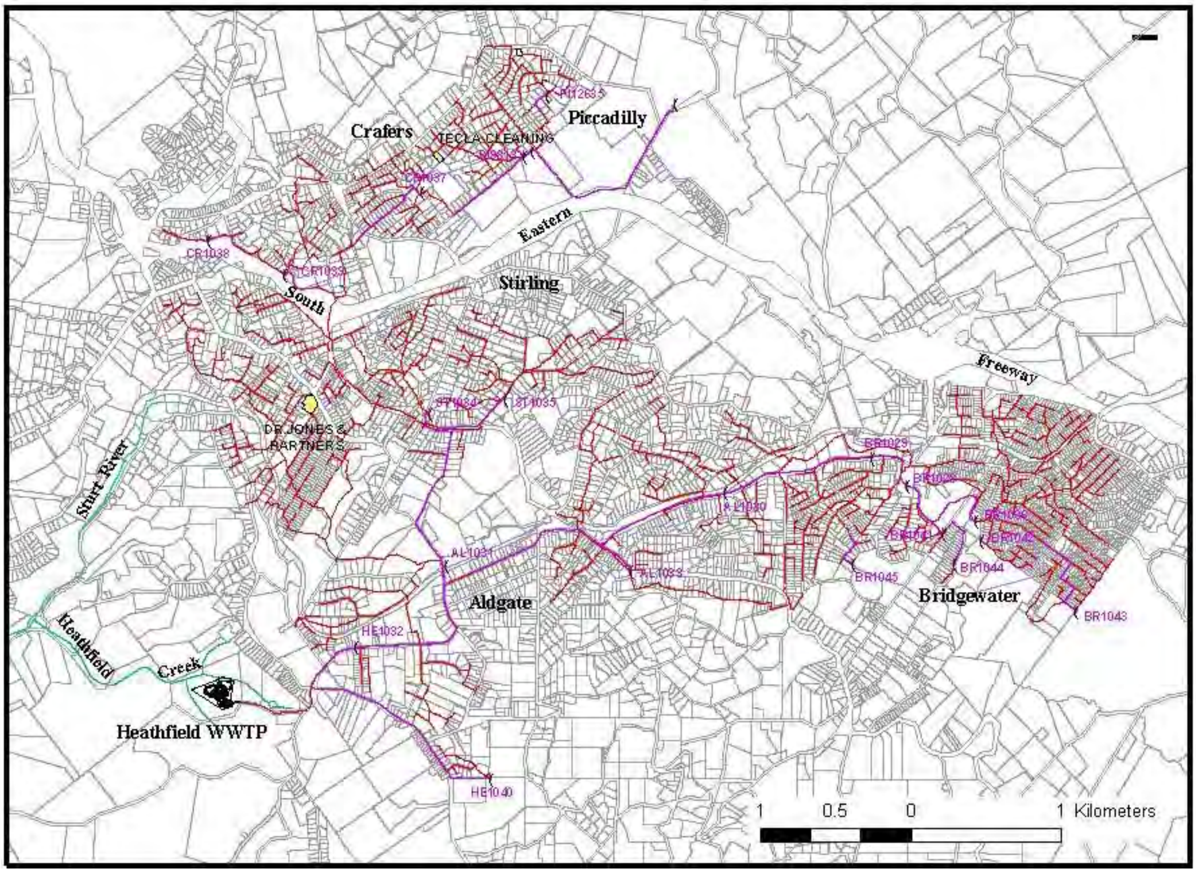
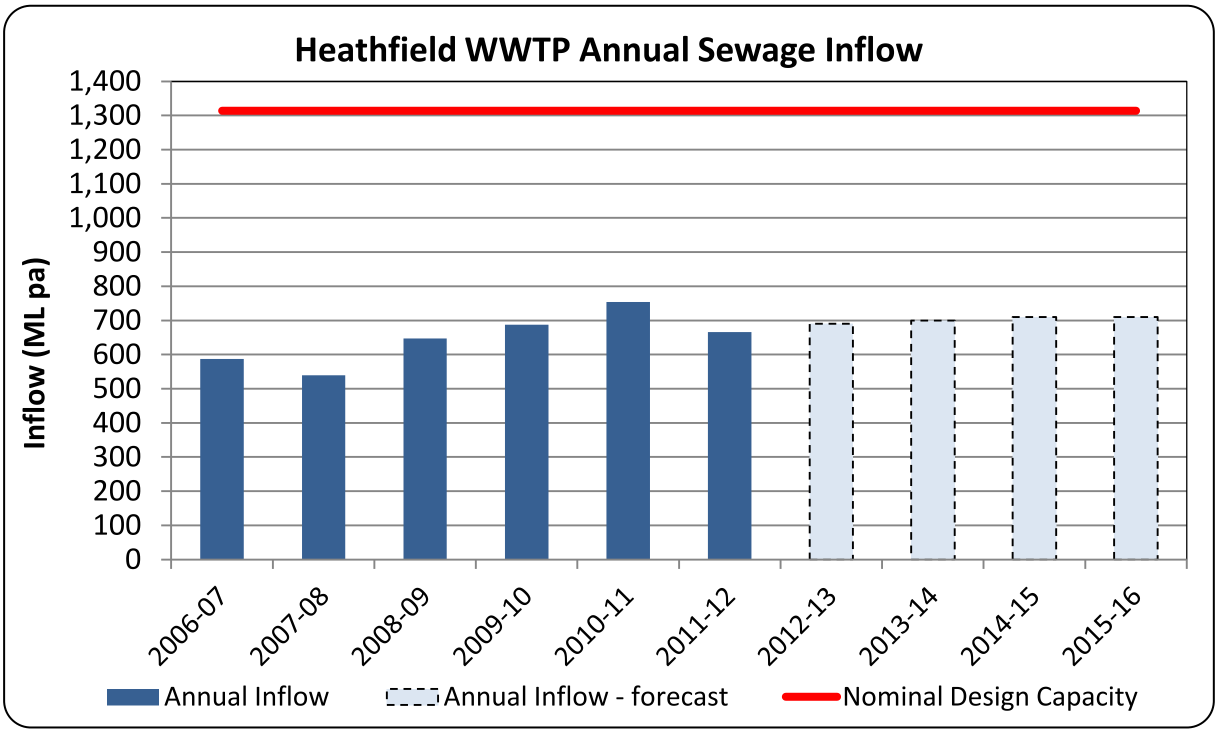


Figure 94



Note: annual rainfall in 2010-11 returned to pre-drought levels and the summer was particularly wet. This had impacts on concentrations and loads at wastewater treatment plants, as reflected in the peaks and troughs in the following graphs.

Figure 95

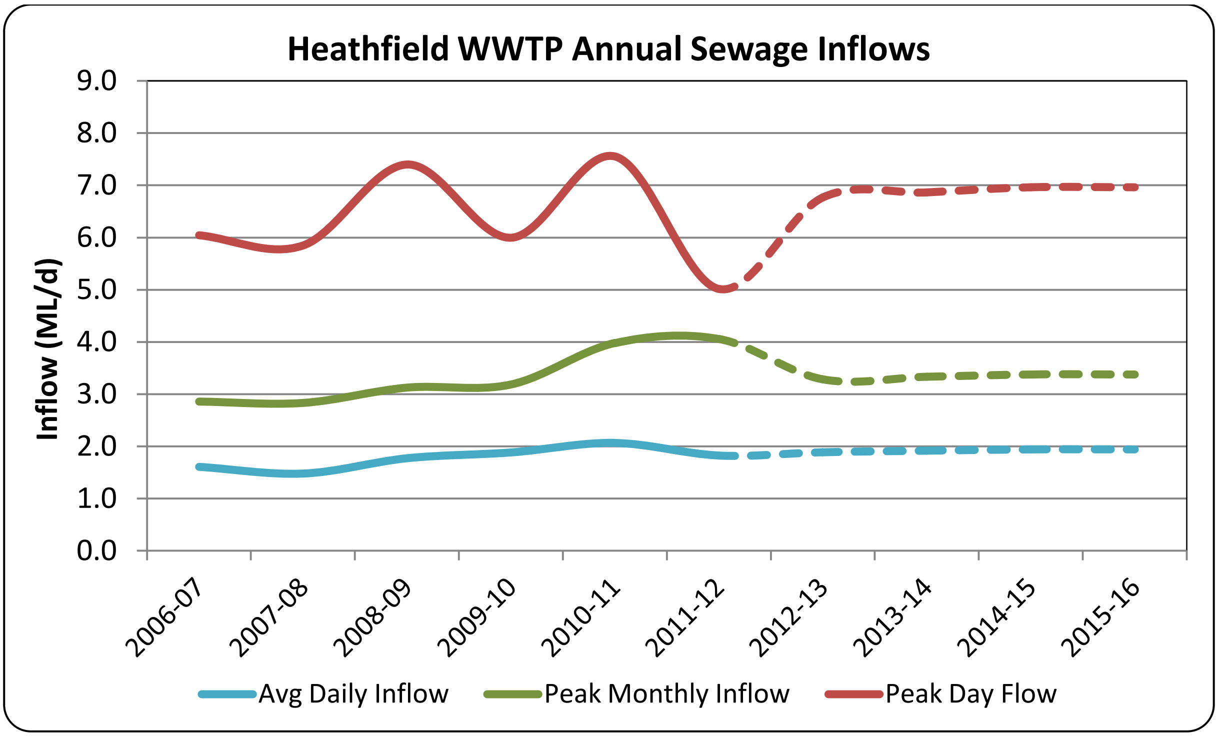


Figure 96

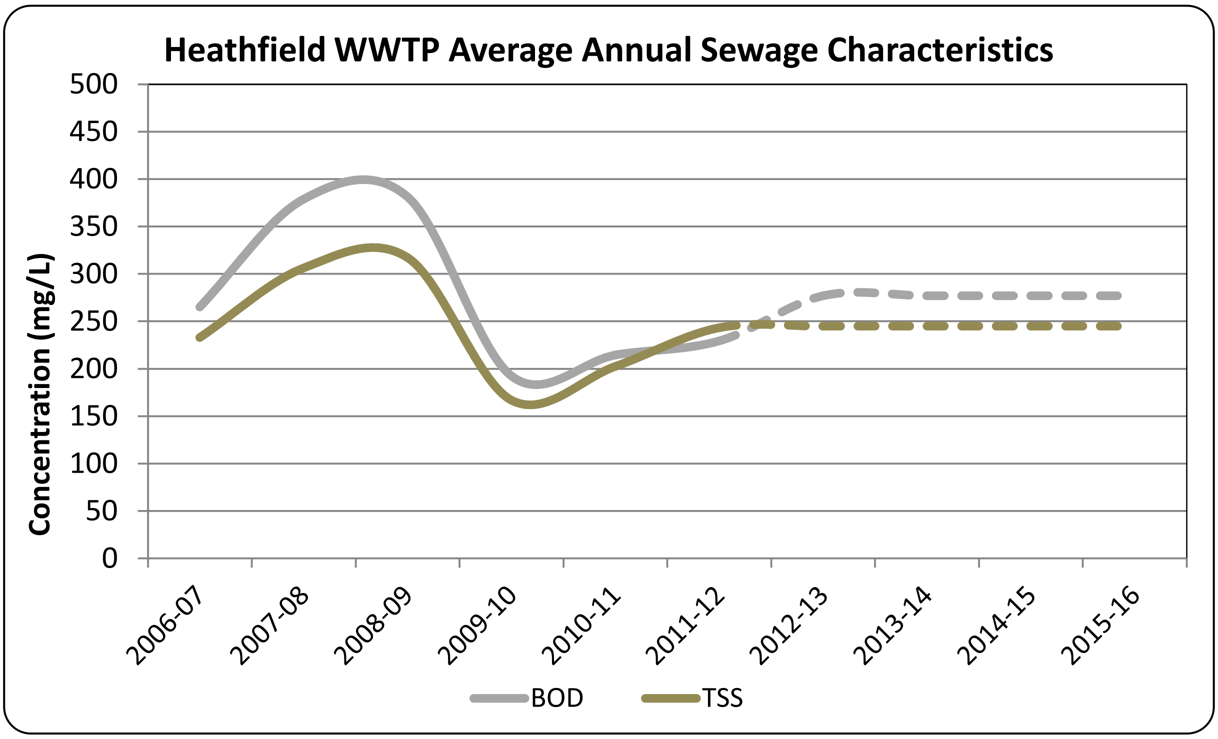


Figure 97

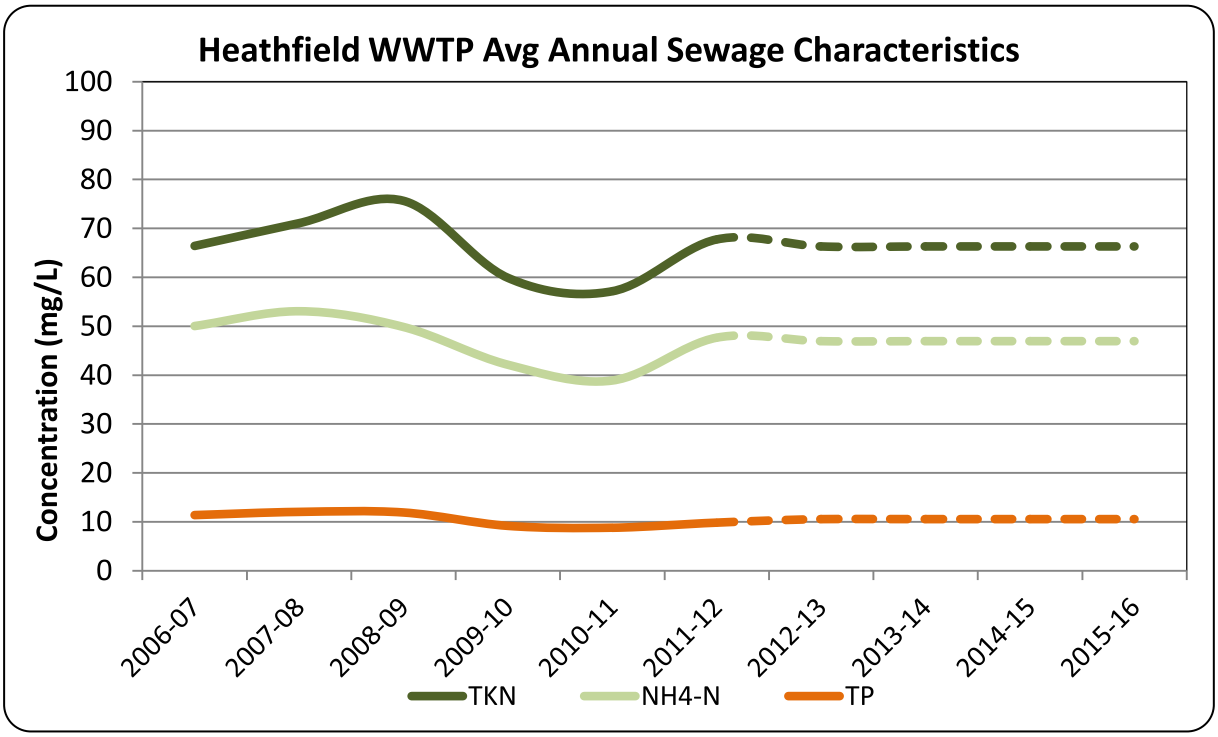


Figure 98

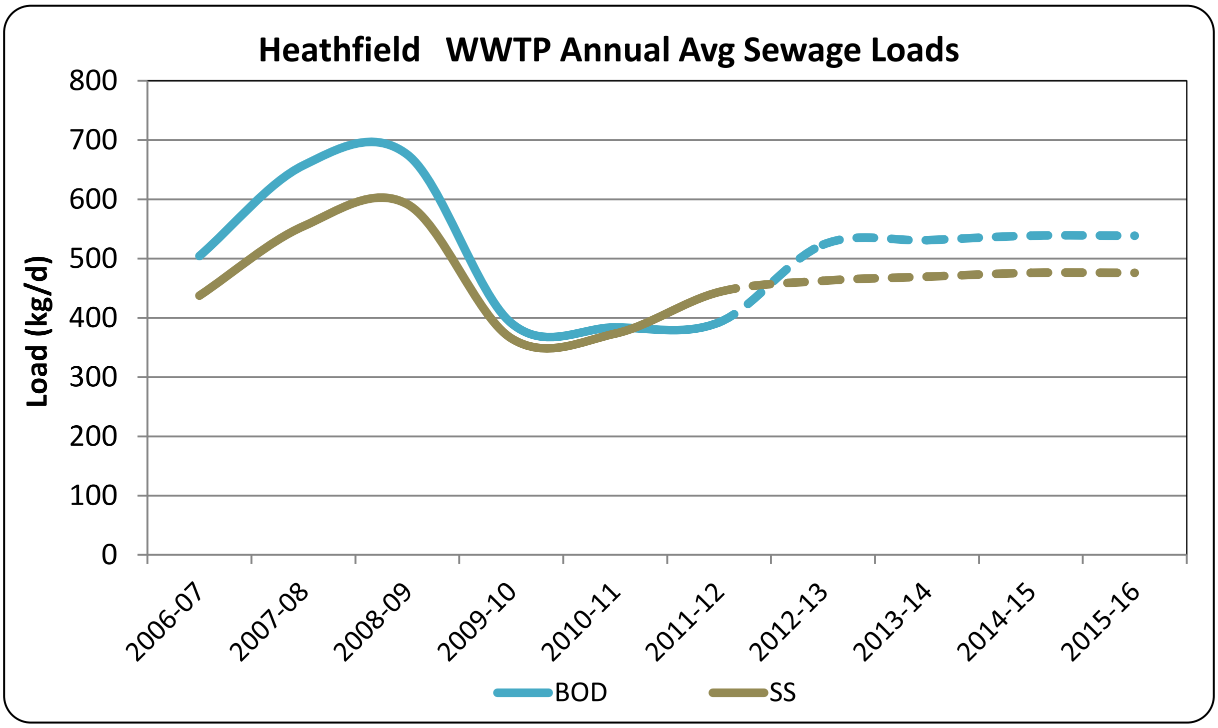
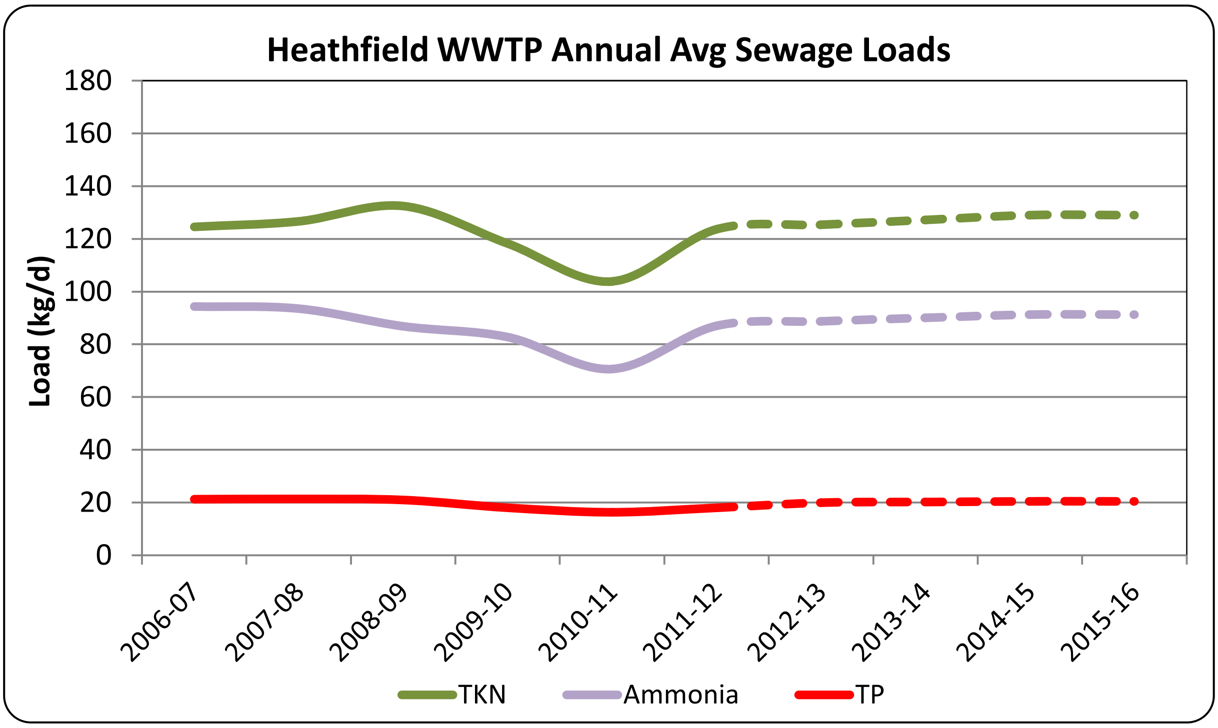


Figure 99



14.2. Key points

- The drainage area served by the plant includes the townships of Crafers, Piccadilly, Stirling, Aldgate and Bridgewater. There is an ongoing in-fill sewering program to connect additional properties to the sewer network.

- The sewage entering the plant is primarily domestic sewage, with some winery waste.

- The initial EPA licence issued for the plant required development of an Environment Improvement Program (EIP). This arose after receiving water investigations undertaken in the mid-1990s identified impacts on the Heathfield Creek and Sturt River from discharges of treated sewage.

- The final EIP approved by the EPA required an upgrade of the Heathfield WWTP to reduce the concentration of nitrogen and phosphorous in discharges. The works, undertaken in 2002 and 2003, included an upgrade to the plant hydraulic capacity and introduction of UV disinfection to replace chlorination. The plant treatment process includes UV disinfection of all treated wastewater up to flows of 120 L/s (10.4 ML/d) and chlorination when flows exceed 120 L/s.

- De-watered sludge is carted to Bolivar for temporary storage and ultimate disposal for soil conditioning of farmland.

- A number of ancillary works have been undertaken since the plant upgrade in 2003. These include access platforms and ladders at the inlet works, modifications to the odour control facility at the inlet works and upgraded caustic soda dosing.

- Low alkalinity in the raw sewage during one winter in the mid-2000s was a major problem. The design ratio for peak wet weather flow is high compared against annual average flow at 5.8: 1, compared to typically 2.5: 1 to 3.0: 1 for other SA Water plants. Raw wastewater flows during winter can be very high due to high rainfall in the hilly terrain in the drainage area and proximity of sewers to streams, resulting in excessive groundwater and rainfall runoff infiltration.

Key points - future:

- Heathfield WWTP is ranked as a "tier 2"[23] treatment plant by the EPA. Under the current licence there is no requirement for an EIP. There is, however, a requirement by EPA to develop an options assessment to achieve no detectable chlorine in wastewater discharged to Heathfield Creek. The finding of this options assessment - to be completed by December 2012 - will be incorporated into a future EIP and may potentially lead to modifications of the existing licence.

- Projects are also proposed for the forthcoming regulatory period to improve the capacity of the plant to handle high infiltration during rain periods - a major issue for the plant.

[23] Refer to notes to the attachment.

15. Mannum Wastewater Treatment Plant

15.1. Summary

Commissioned:	The Mannum wastewater treatment plant began operations in 1968.
Treatment process:	The plant consists of two Imhoff tanks followed by a stabilisation lagoon and storage lagoons. Recycled water is disinfected with chlorine.
Disposal of treated wastewater:	All treated wastewater is reused to irrigate the Mannum Golf Course.

Figure 100 Mannum wastewater treatment plant

Parameter	Design	Actual (2010-11)
Flows (Megalitres per day; ML/d)		
Average dry weather	0.687	0.310
Average annual	0.808	0.379
Peak month average	0.970	0.436
Peak day flow	1.374	0.887
Peak wet weather	1.834	n/a
Avg Influent Concentration (mg/L)		
Biochemical Oxygen Demand (BOD)	n/a	251
Suspended Solids (SS)	n/a	273
Total Kjeldahi Nitrogen (TKN)	n/a	76
Ammonia (NH_3-N)	n/a	53
Total Phosphorous (TP)	n/a	11
Avg Raw Wastewater Load (kg/dy)		
Biochemical Oxygen Demand (BOD)	252	94
Suspended Solids (SS)	n/a	103

Population served[24]

2006 Census	2011 Census
2,408	2,567

[24] Indicative figures for catchment areas based on Australian Bureau of Statistics, 2006 and 2011 Census data for Mannum (State Suburb), www.abs.gov.au.

Figure 101 Mannum plant schematics

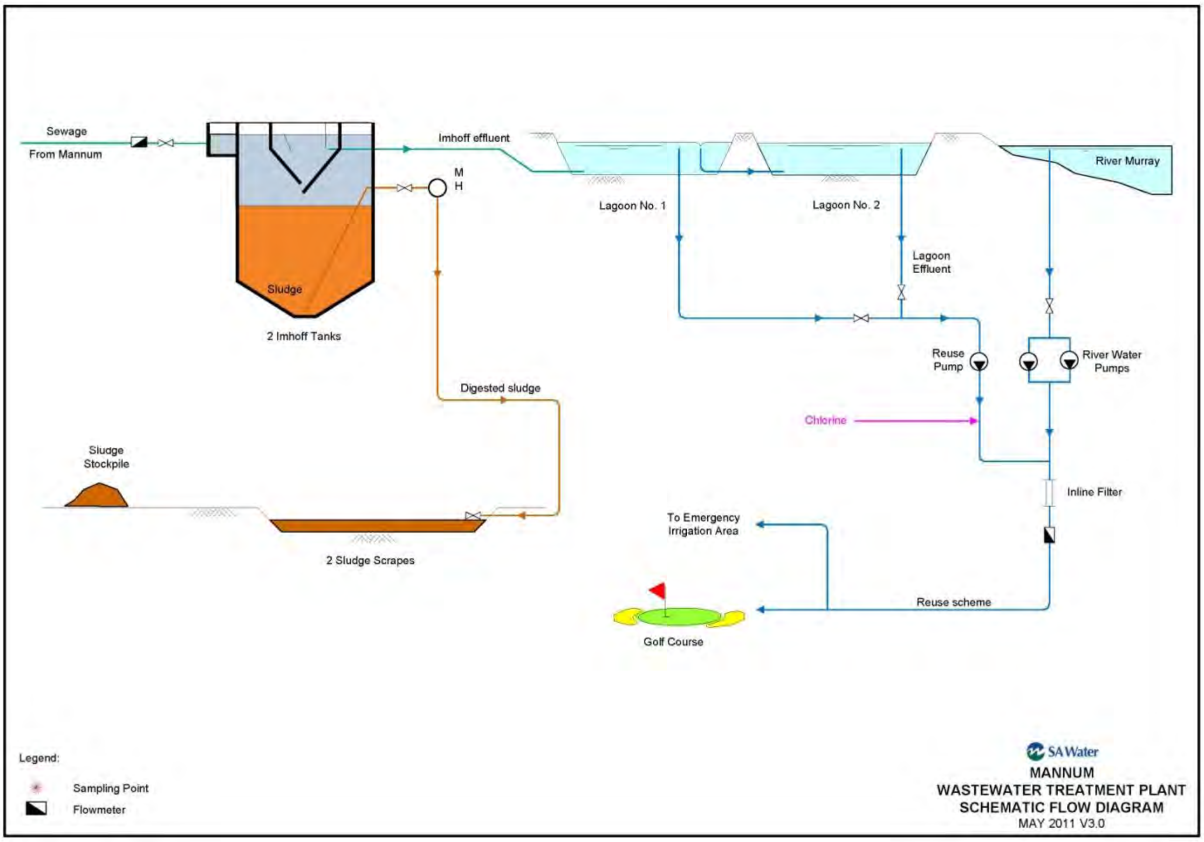


Figure 102 Mannum drainage area

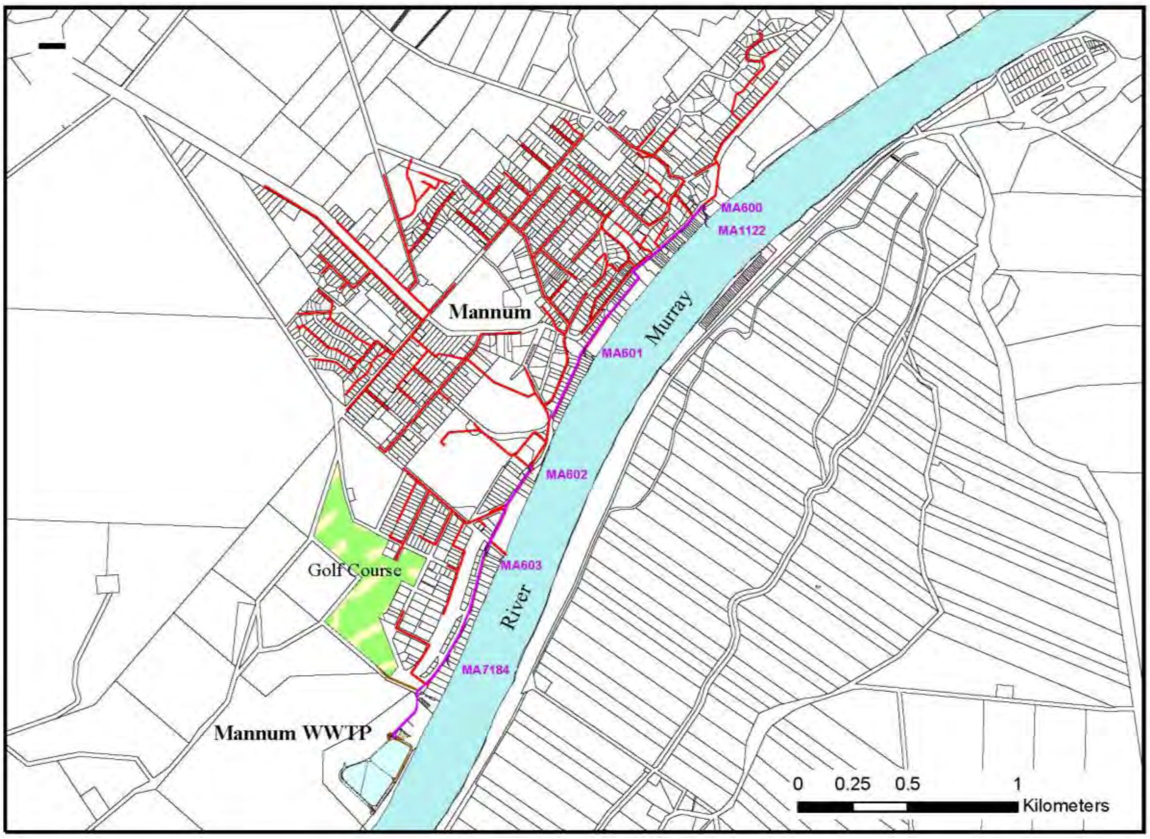


Figure 103

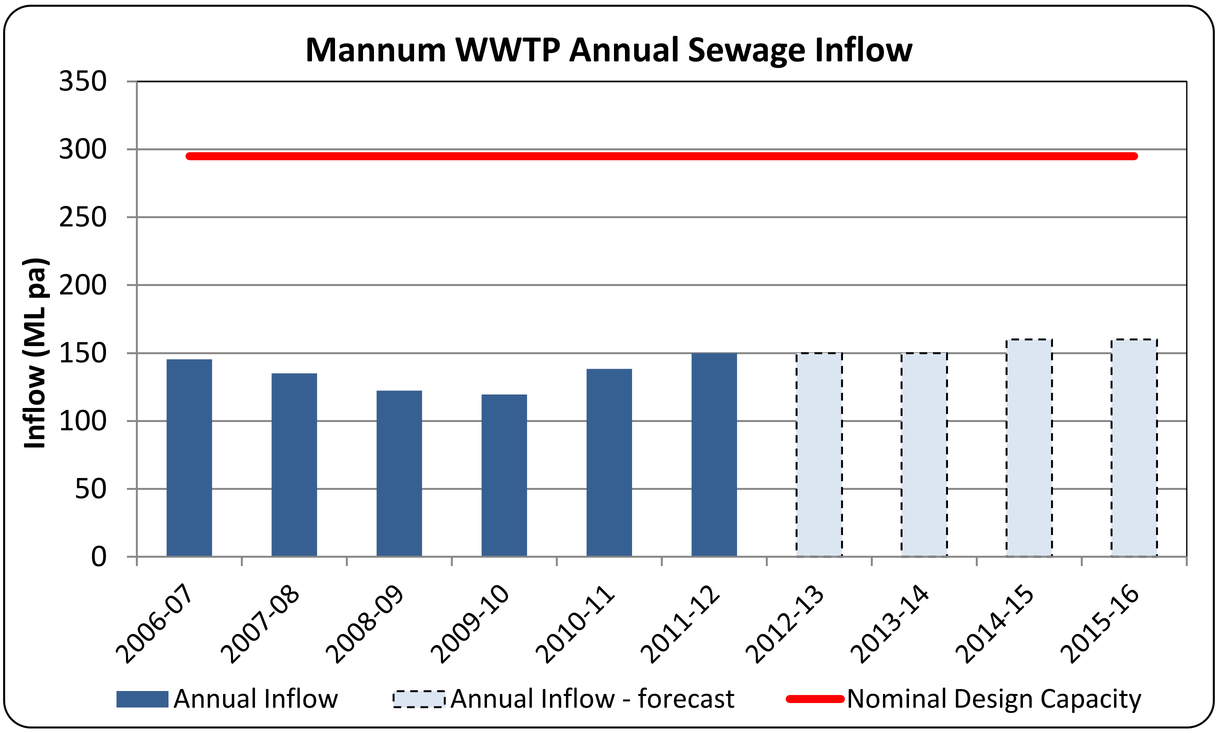


Figure 104

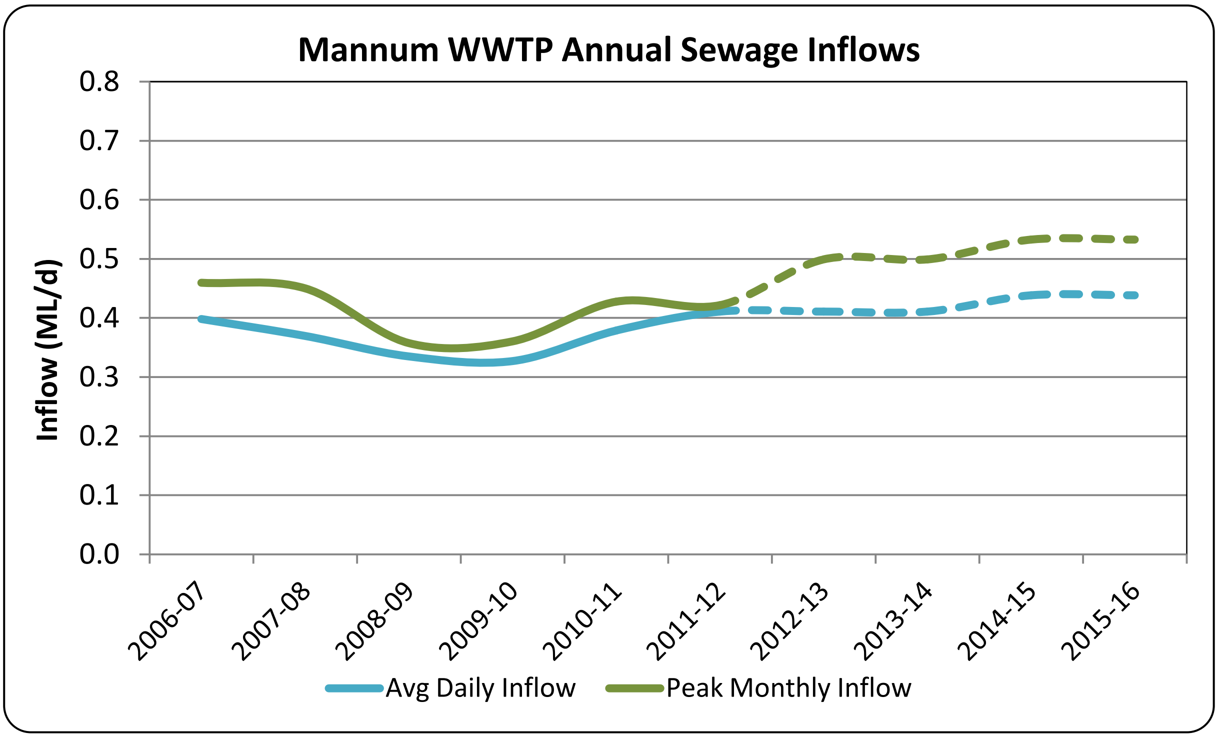
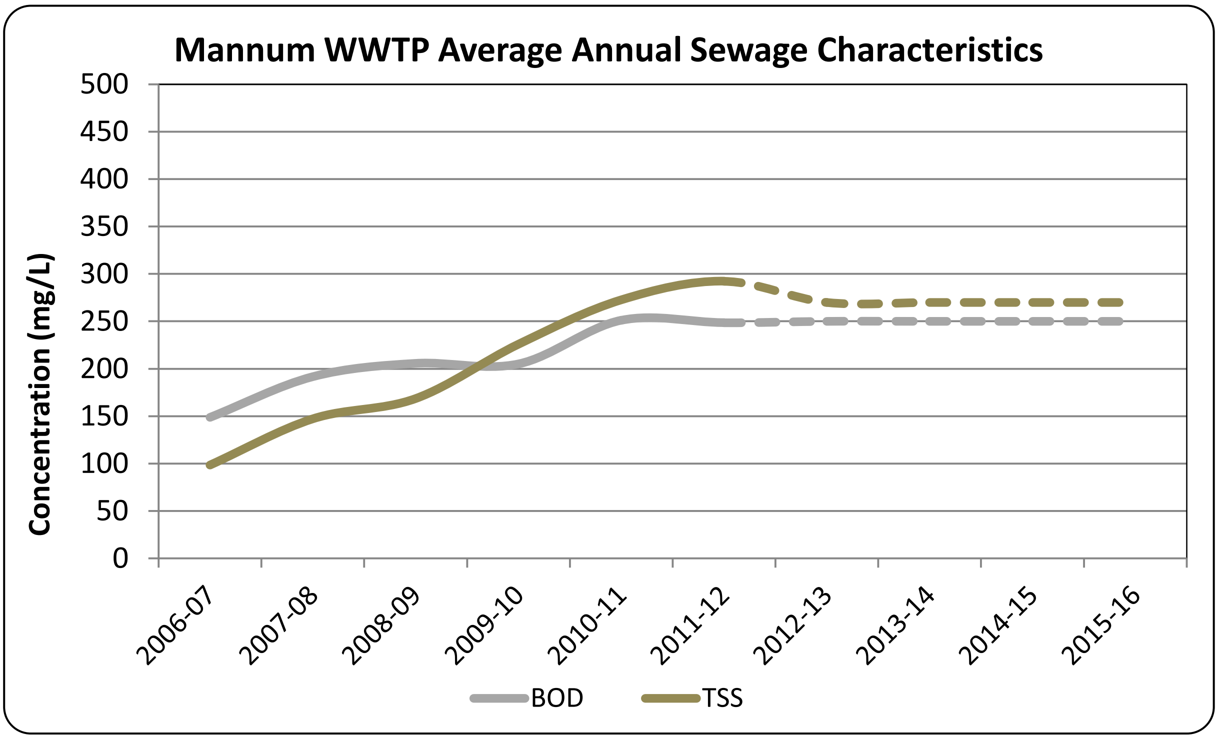


Figure 105



Note: the nominal increase in sewage BOD and SS concentration may be due to a change in sampling regime.

Figure 106

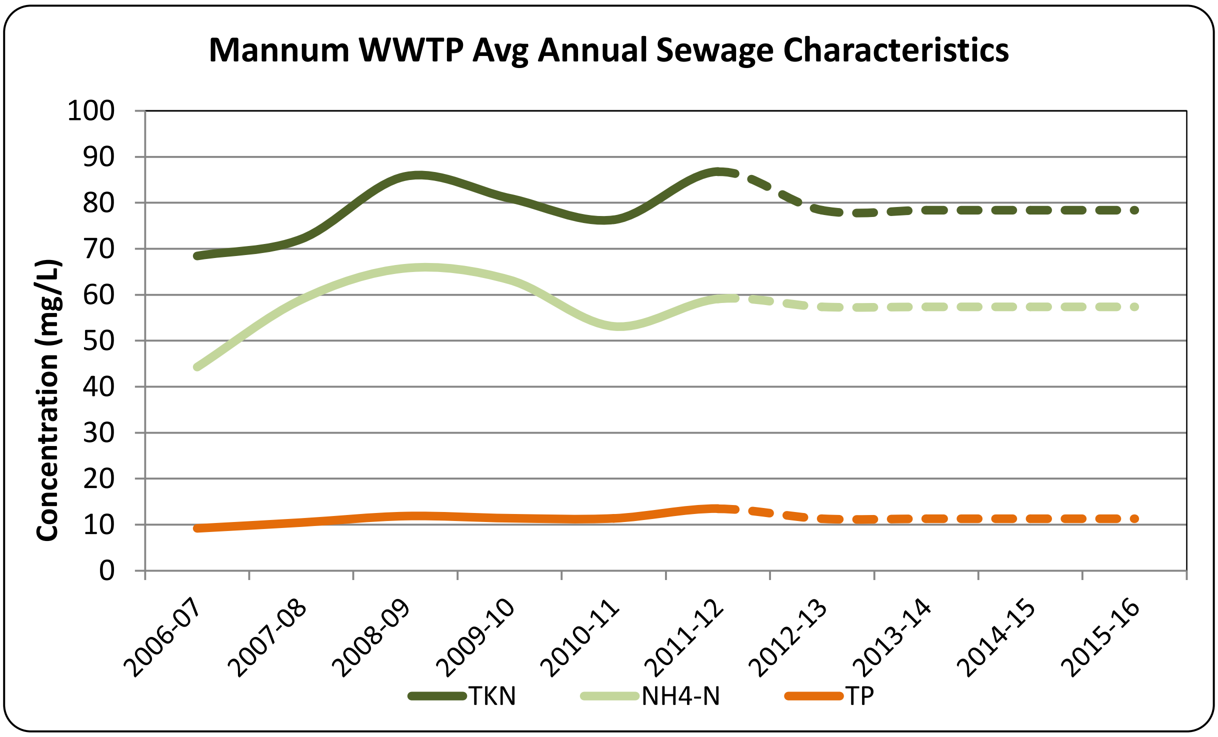


Figure 107

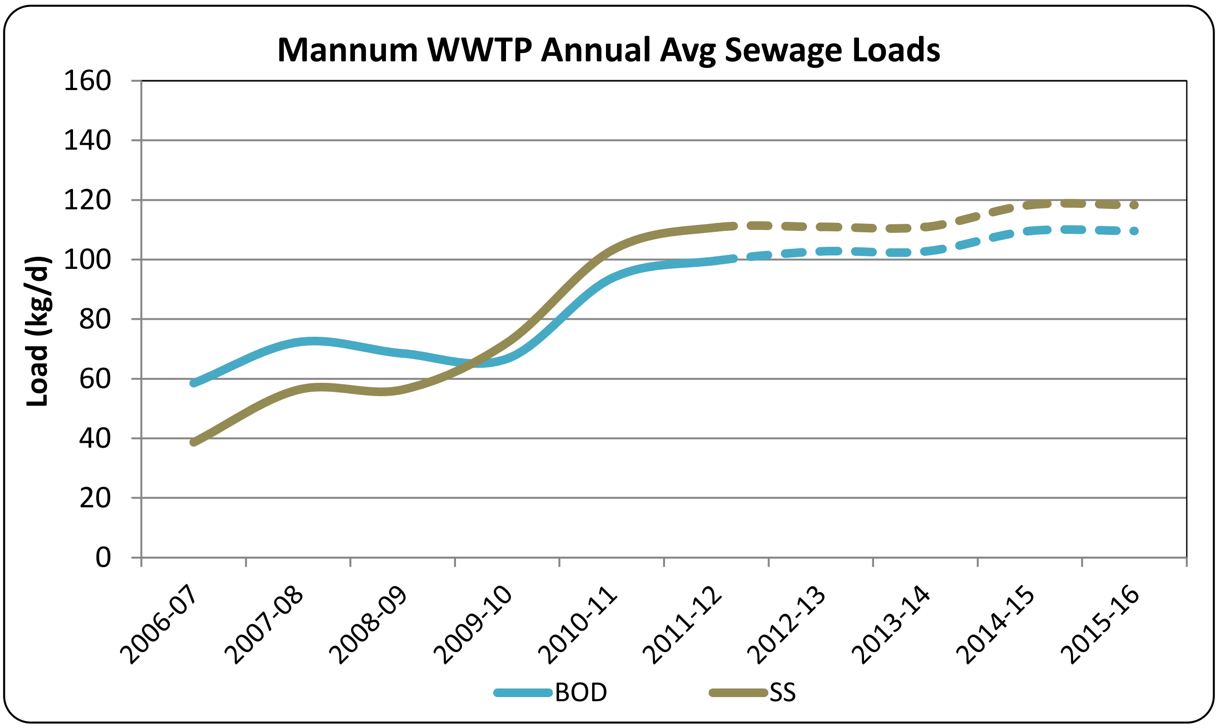
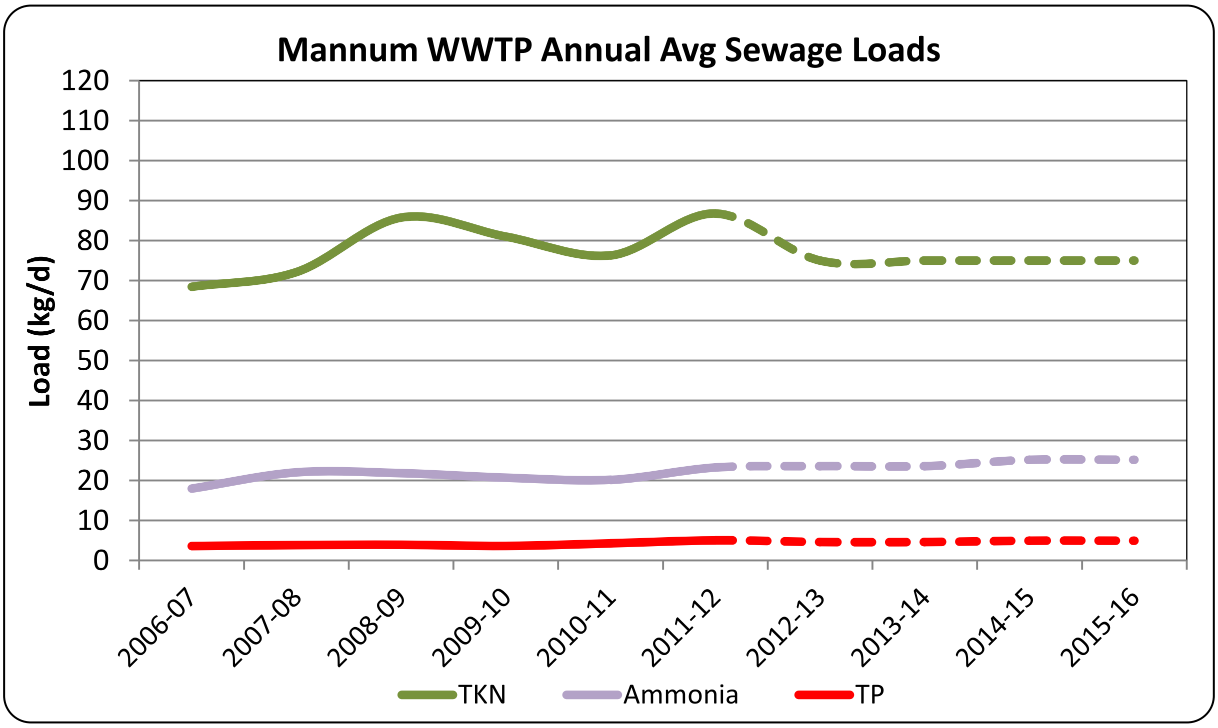


Figure 108



15.2. Key points

- The Mannum WWTP serves the River Murray township of Mannum and is located south-west of the residential area. The raw wastewater is mainly from residential sources.

- The treatment process employs two Imhoff tanks for primary sedimentation and digestion of organic solids in the influent sewage. Overflow from the Imhoff tanks discharges into two aerobic stabilisation lagoons arranged in series. Natural processes reduce the organic pollutants and provide a degree of disinfection, but the plant was not designed to nitrify effluent.

- Prior to October 1991, chlorinated effluent from the treatment lagoons was discharged to the River Murray. However, licence conditions[25] imposed on the then E&WS Department - along with the Department's concerns about the adverse impacts of nutrients on the river - led to the development of a reuse scheme, with all treated effluent used by the local golf course.

- Treated wastewater is now pumped from the lagoons, chlorinated and used to irrigate the nearby Mannum Golf Course or stored in the 38ML capacity lagoons during winter, when irrigation demand is low. An area has been set aside for short-term irrigation if there is no demand from the golf course. Reuse has been approved by the Department of Health and Ageing.

- The original design incorporated sludge scrapes to dry digested sludge that was periodically removed from the Imhoff tanks. Sludge is now removed from the tanks by vactor truck and carted to Bolivar for temporary storage and eventual disposal of stabilised biosolids to farmland for soil conditioning.

- The Mannum WWTP is located next to the River Murray in the floodplain and is thus at risk of contaminating the watercourse if floods overtop the lagoon embankments.

Key points - future:

- There is insufficient winter storage for all climatic variability requiring the regular use of the "emergency" irrigation area for disposal. State Government policy is to remove all treatment facilities from the River Murray flood plain below 1956 flood level.

- A project is under way to investigate the feasibility of relocating the Mannum WWTP to accommodate a marina and housing development alongside the plant and address existing issues, including risks associated with the plant's proximity to the River Murray.

- In 2010, SA Water purchased a new site on high ground and of a size that would provide sufficient buffer to any future development, some 3kms from the existing site.

- Mannum WWTP is ranked as a "tier 3"[26] treatment plant by the EPA. Under the current licence there is no requirement for an EIP.

[25] Government of SA, Licence to dispose of material, April 1992.
[26] Refer to notes to the attachment.

16. Millicent Wastewater Treatment Plant

16.1. Summary

Commissioned: The Millicent wastewater treatment plant was commissioned in 1968

Treatment process: Four Imhoff tanks followed by three stabilisation and polishing lagoons.

Disposal of treated wastewater: Treated wastewater is discharged into earthen drainage channel or reused on irrigation of adjacent pasture.

Figure 109 Millicent wastewater treatment plant Imhoff tanks and lagoons

Parameter	Design	Actual (2011-12)
Flows (Megalitres per day; ML/d)		
Average dry weather	1.190	1.157
Average annual	1.400	3.131
Peak month average	1.680	5.88
Peak day flow	2.380	9.050
Peak wet weather	3.819	n/a
Avg Influent Concentration (mg/L)		
Biochemical Oxygen Demand (BOD)	315	49
Suspended Solids (SS)	n/a	82
Total Kjeldahi Nitrogen (TKN)	n/a	28
Ammonia (NH_3-N)	n/a	17
Total Phosphorous (TP)	n/a	4
Avg Raw Wastewater Load (kg/dy)		
Biochemical Oxygen Demand (BOD)	442	147
Suspended Solids (SS)	n/a	243
Total Kjeldahl Nitrogen (TKN)	n/a	72
Ammonia (NH_3-N)	n/a	49
Total Phosphorous (TP)	n/a	9

Note: 2011-12 data is presented above as some of the 2010-11 flow data is suspect. The 2011-12 data is consistent with earlier years and is representative of flows and loads to the plant.

Population served[27]

2006 Census	2011 Census
4771	5024

[27] Indicative figures for catchment areas based on Australian Bureau of Statistics, 2006 and 2011 Census data, www.abs.gov.au. In 2006 this was defined as Millicent (Urban Centre/Locality) and in 2011 as Millicent (Gazetted Locality).

Figure 110 Millicent plant schematics

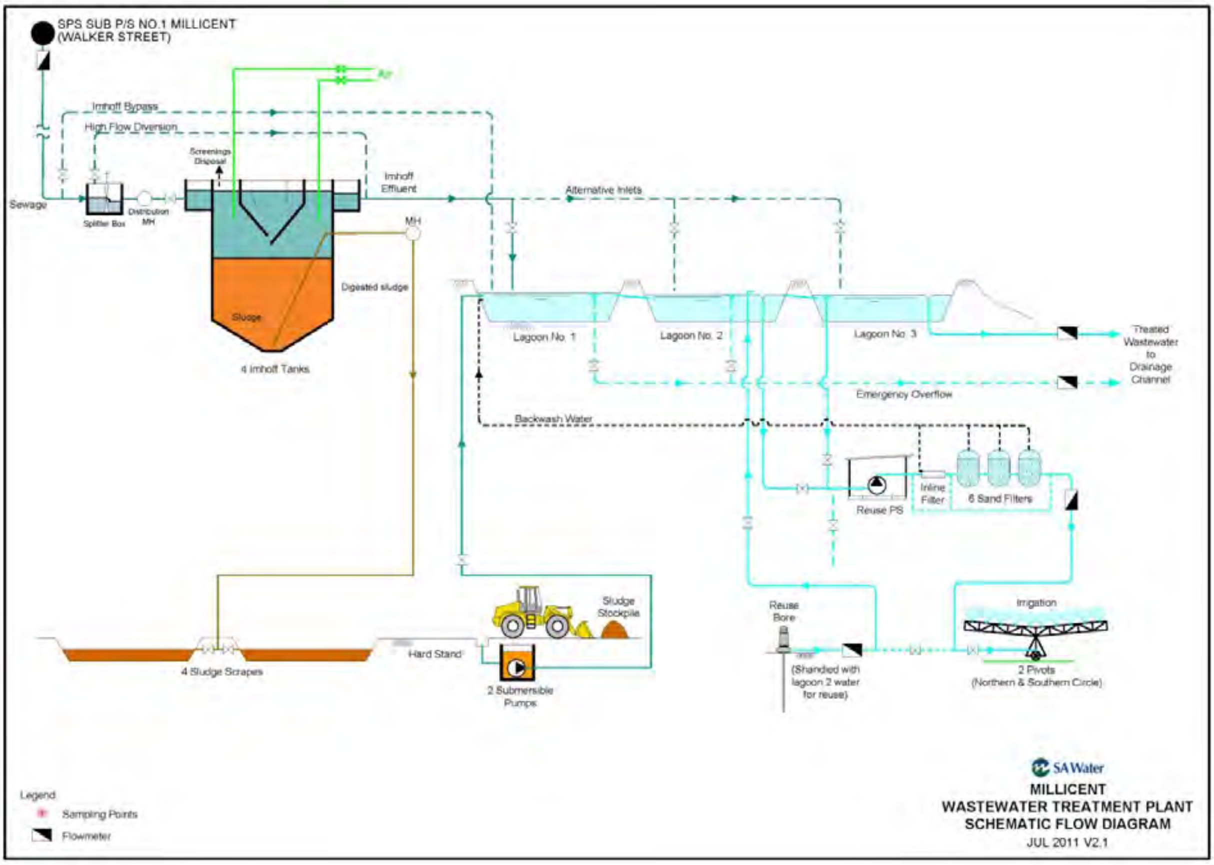


Figure 111 Millicent drainage area

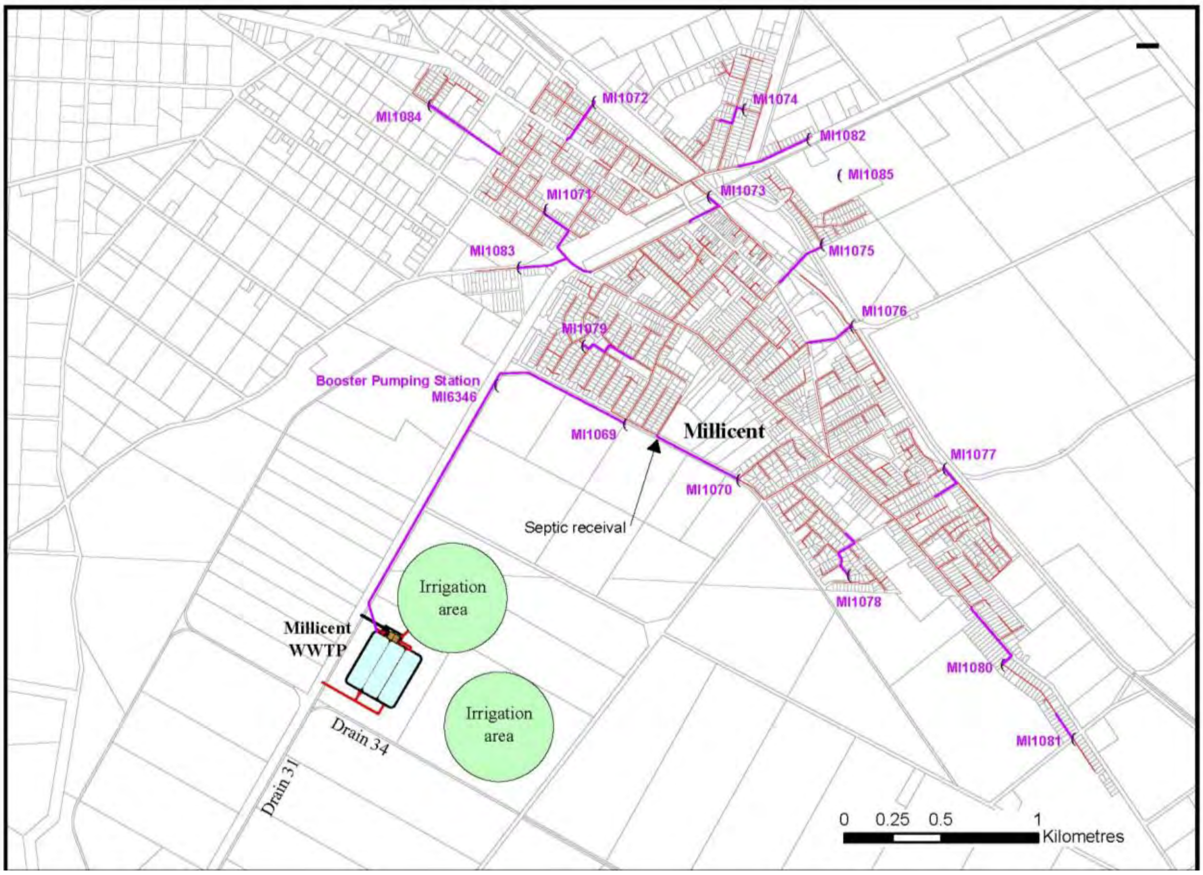
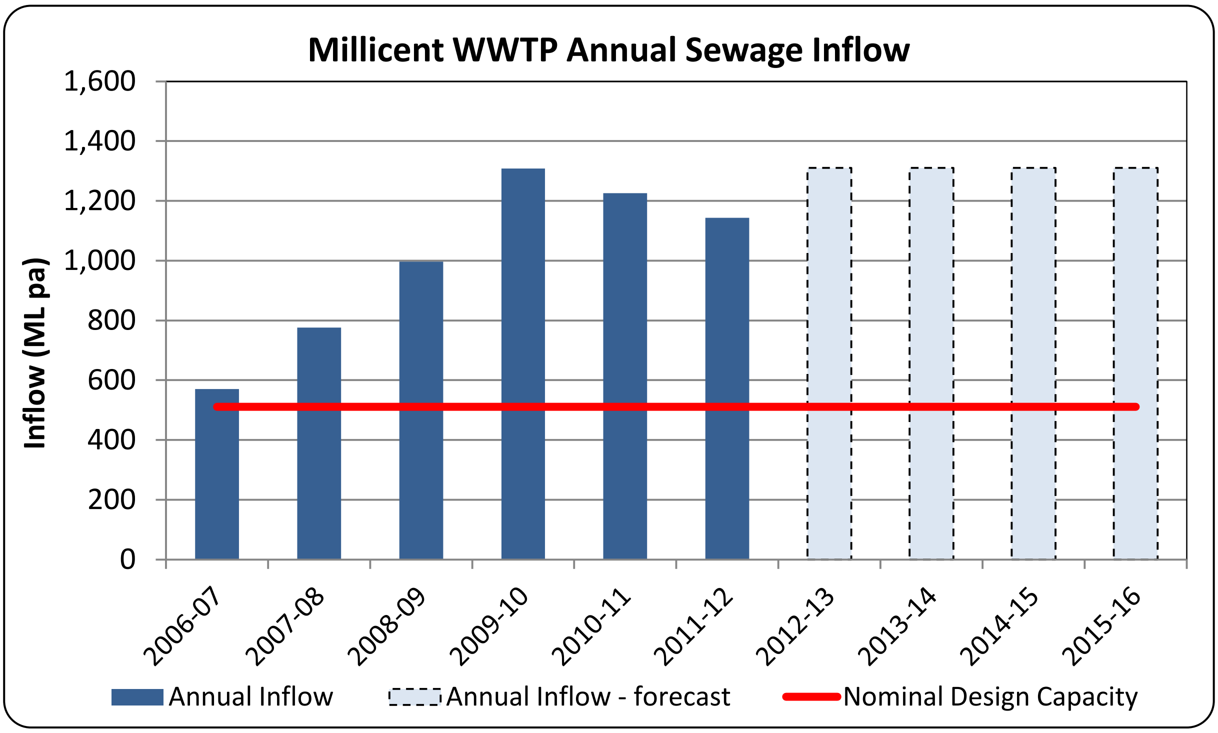


Figure 112



Note: infiltration from groundwater significantly dilutes the flow into the Millicent plant. The dilute nature of the sewage means less treatment is required and the quality of effluent is acceptable. At times the flow is diverted around the Imhoff tanks.

Figure 113

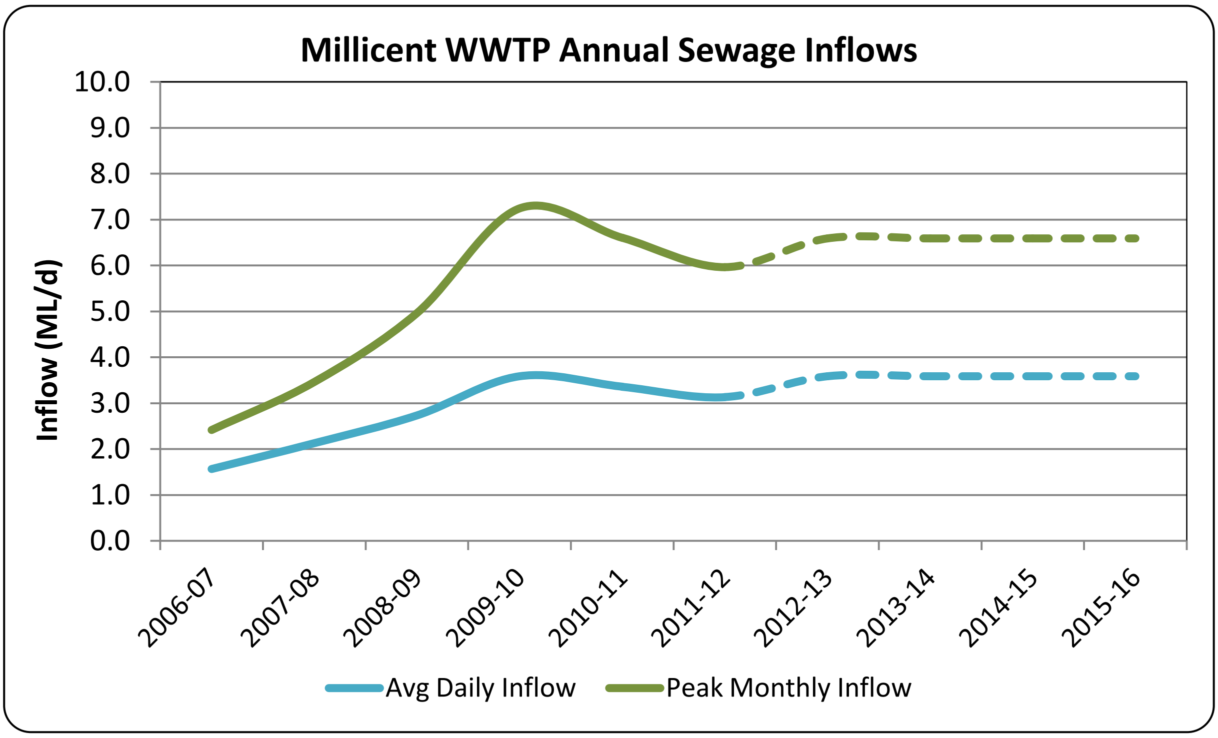
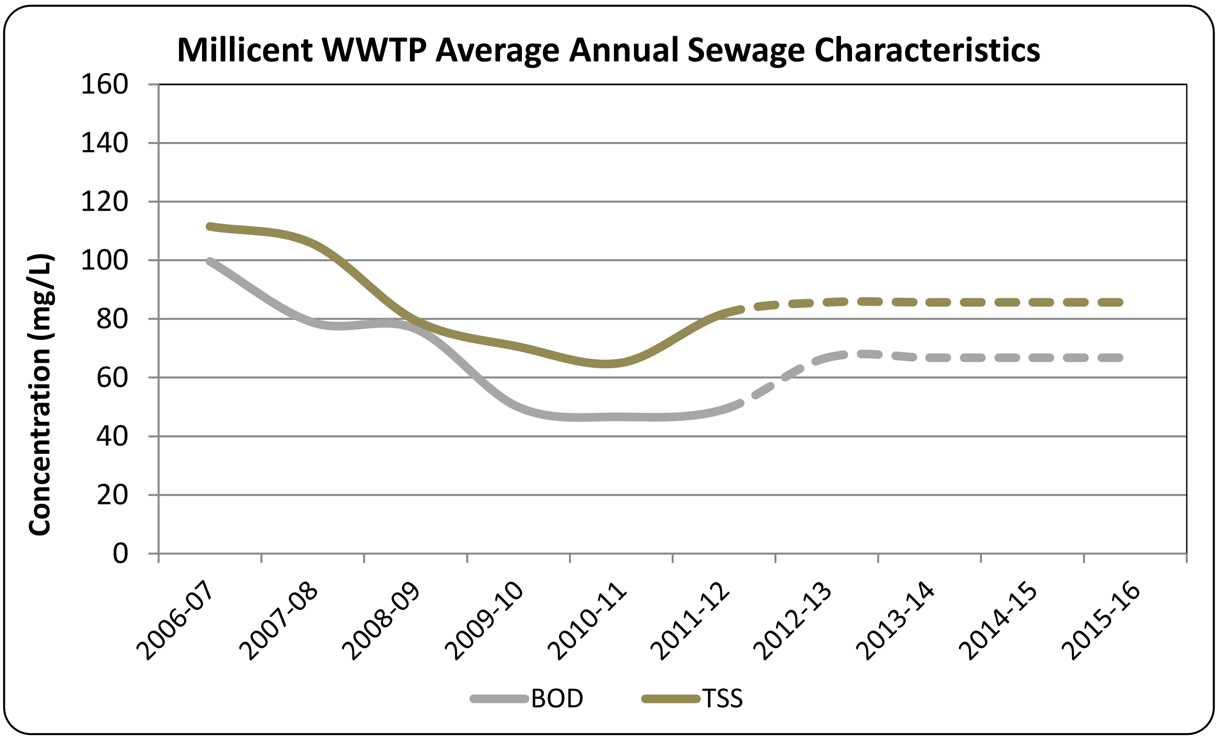


Figure 114



Note: 2006-07 was the height of the drought and sewage was less dilute, with concentrations higher than normal.

Figure 115

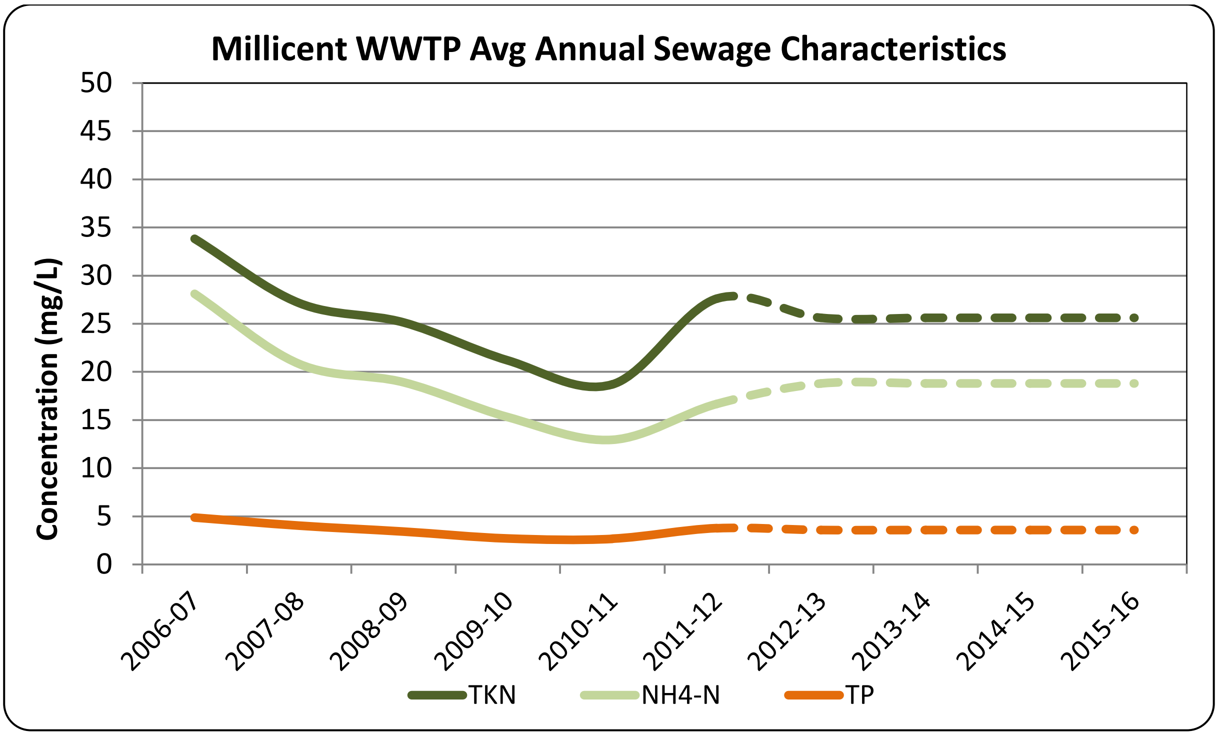


Figure 116

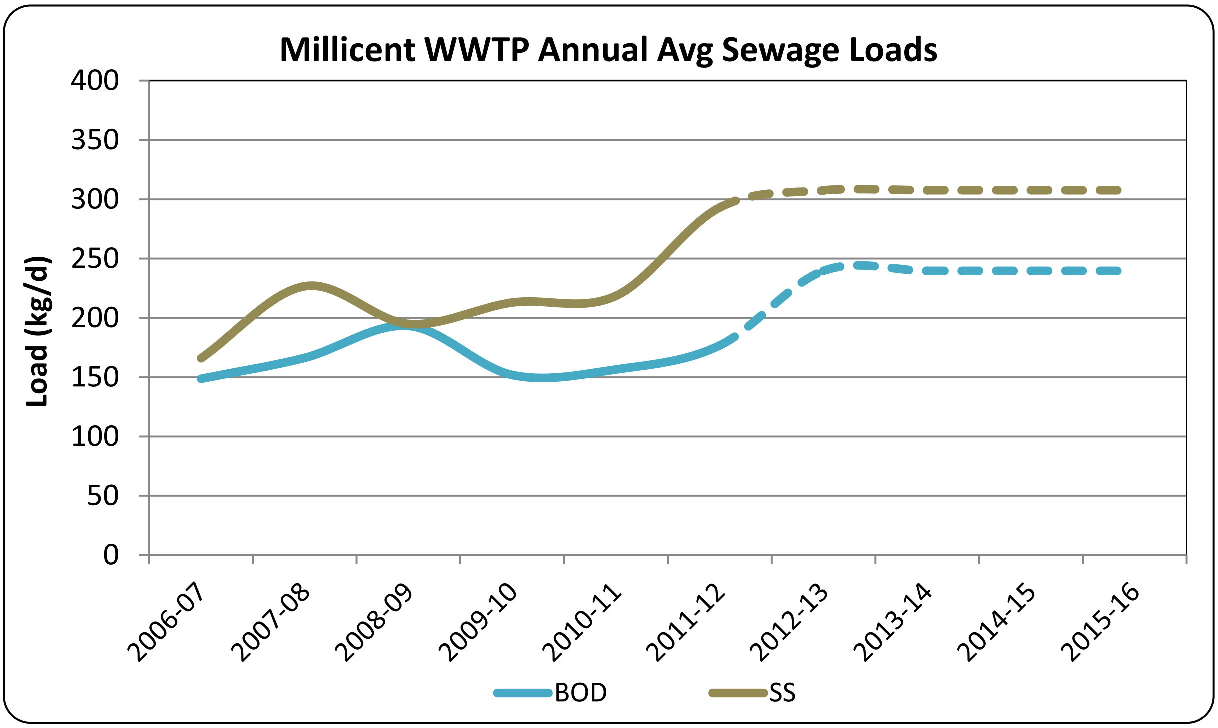
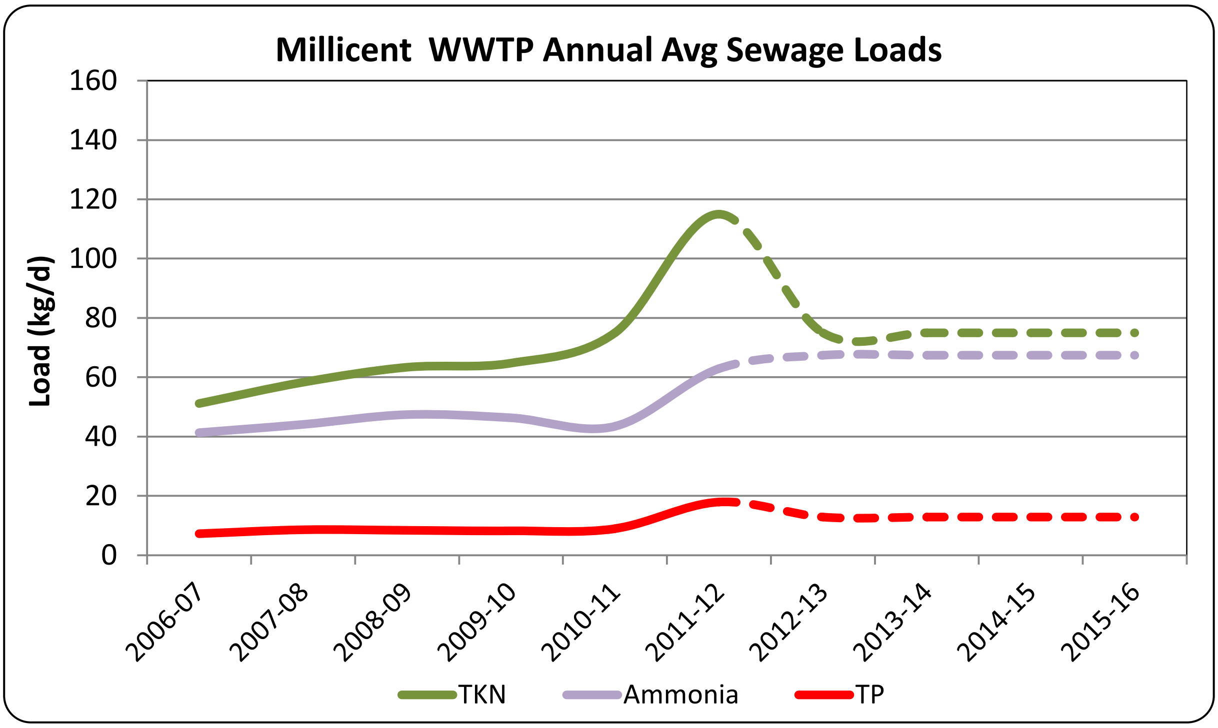


Figure 117



16.2. Key points

- The Millicent plant was commissioned in 1968 and receives domestic wastewater from the township of Millicent.

- The Millicent WWTP uses conventional primary and secondary treatment processes. There are no inlet screens. Wastewater is pumped into four Imhoff tanks operating in parallel, in which primary sedimentation and sludge digestion takes place. Primary effluent then gravitates to three oxidation lagoons. The lagoons generally operate in series; however, they may operate in parallel when affected by winter infiltration into the sewers. Lagoons 2 and 3 have suffered outbreaks of blue-green algae in summer and have had to be taken offline from time to time.

- Sludge from the Imhoff tanks is sent to four sludge drying beds. Dry sludge is mechanically removed and stockpiled on site. Lagoon sludge is periodically dredged and the de-watered material is stock-piled on site for three years prior to land application. A sludge hardstand area was constructed in 2010, in accordance with EPA requirements.

- In 2001, SA Water implemented a reuse scheme, with treated wastewater used to irrigate pasture on the site and adjacent privately owned land. The reuse scheme incorporates sand pressure filters and a groundwater bore to ensure supply in drier periods. Surplus treated un-chlorinated wastewater overflows the lagoons into “drain 34” (SEDB[28]) and discharges 10km away into Lake Bonney via Milnes Gap. An Irrigation Management Plan for land based disposal was approved in June 2000.

- Very high levels of groundwater infiltration into the sewers result in winter flows that, at times, must be partially diverted around the Imhoff Tanks direct to the lagoons. However, because this flow is significantly less in concentration of contaminants, less treatment is required and the quality of the effluent is acceptable.

- The lack of inlet screens allows large material to pass through the plant, reducing the quality of the sludge. This may affect possible options for the disposal of the biosolids stockpile.

Key points - future:

- Millicent WWTP is ranked as a “tier 1”[29] treatment plant by the EPA. Under the current licence there is no requirement for an EIP. However, the EPA is currently undertaking an environmental values process for Lake Bonney that will inform the conditions of the next licence, which is due to take effect in June 2013. These new licence conditions may result in the need to expand reuse or undertake a process upgrade at the plant. The dilute nature of the influent sewage will likely mean that conventional treatment processes cannot be optimally used and that storage and reuse of winter flows may be impractical. Infiltration can be an expensive, and difficult, problem to rectify and SA Water will continue to work with the EPA to find an appropriate solution.

- Projects are proposed for the forthcoming regulatory period to ensure the ongoing reliability of the plant.

[28] SEDB – Southeast Drainage Board is a statutory government body responsible for operations and maintenance of surface drainage infrastructure in the south-east of South Australia.
[29] Refer to notes to the attachment.

17. Mount Burr Wastewater Treatment Plant

17.1. Summary

Commissioned: The Mount Burr WWTP was commissioned in 1963.

Treatment process: A single Imhoff tank followed by a biological (trickling) filter then a polishing lagoon. Digested sludge removed from the Imhoff tanks is placed in sludge scrapes.

Disposal of treated wastewater: Discharge into an adjacent natural wetland via an earth-lined channel.

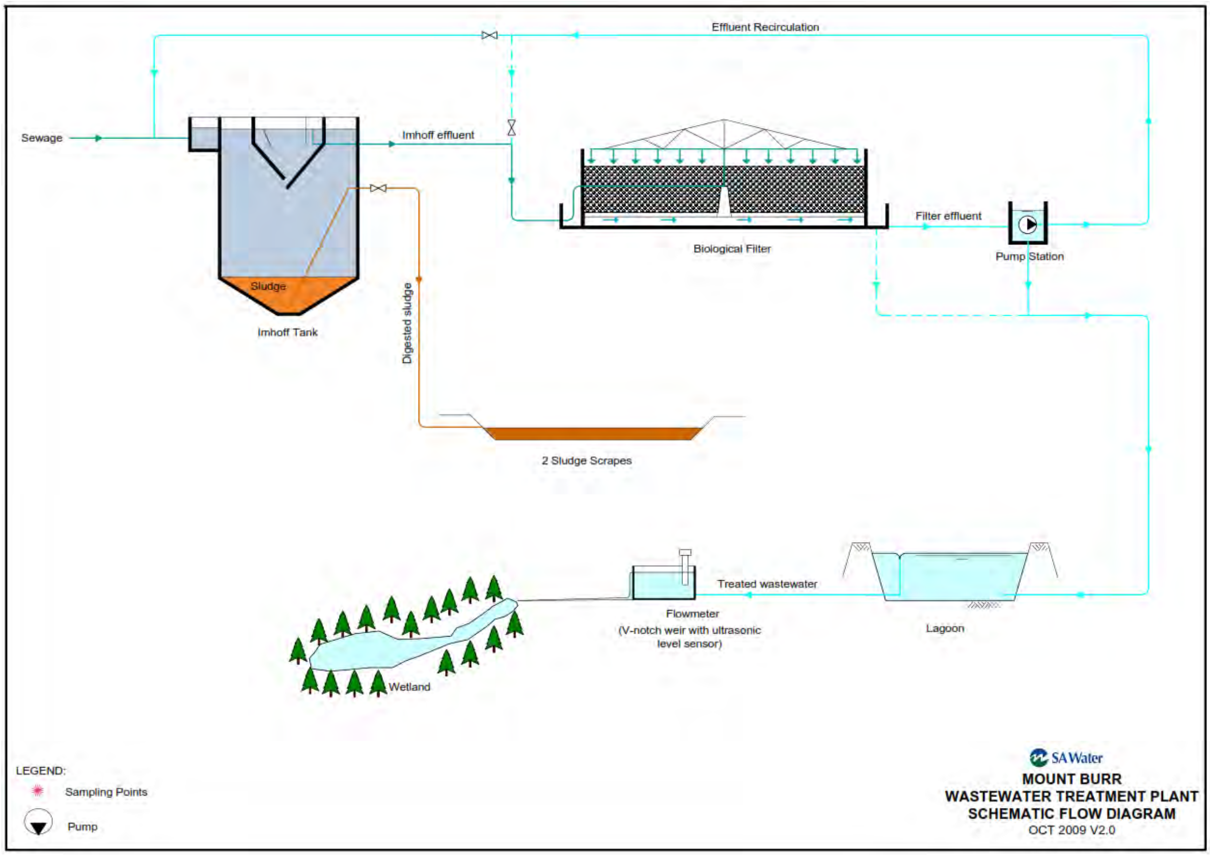
Figure 118 Mount Burr wastewater treatment plant

Parameter	Design	Actual (2010-11)
Flows (Megalitres per day; ML/d)		
Average dry weather	0.203	0.049
Average annual	0.235	0.061
Peak month average	0.282	0.086
Peak day flow	0.400	--
Peak wet weather	0.600	--
Avg Influent Concentration (mg/L)		
Biochemical Oxygen Demand (BOD)	312	187
Avg Raw Wastewater Load (kg/dy)		
Biochemical Oxygen Demand (BOD)	73.5	11.9

Population served[30]

2006 Census	2011 Census
380	377

Figure 119 Mount Burr schematics



30 Indicative figures for catchment areas based on Australian Bureau of Statistics, 2006 and 2011 Census data, www.abs.gov.au. Defined as Mount Burr (Urban Centre/Locality) in 2006 and (Gazetted Locality) in 2011.

Figure 120 Mount Burr drainage area

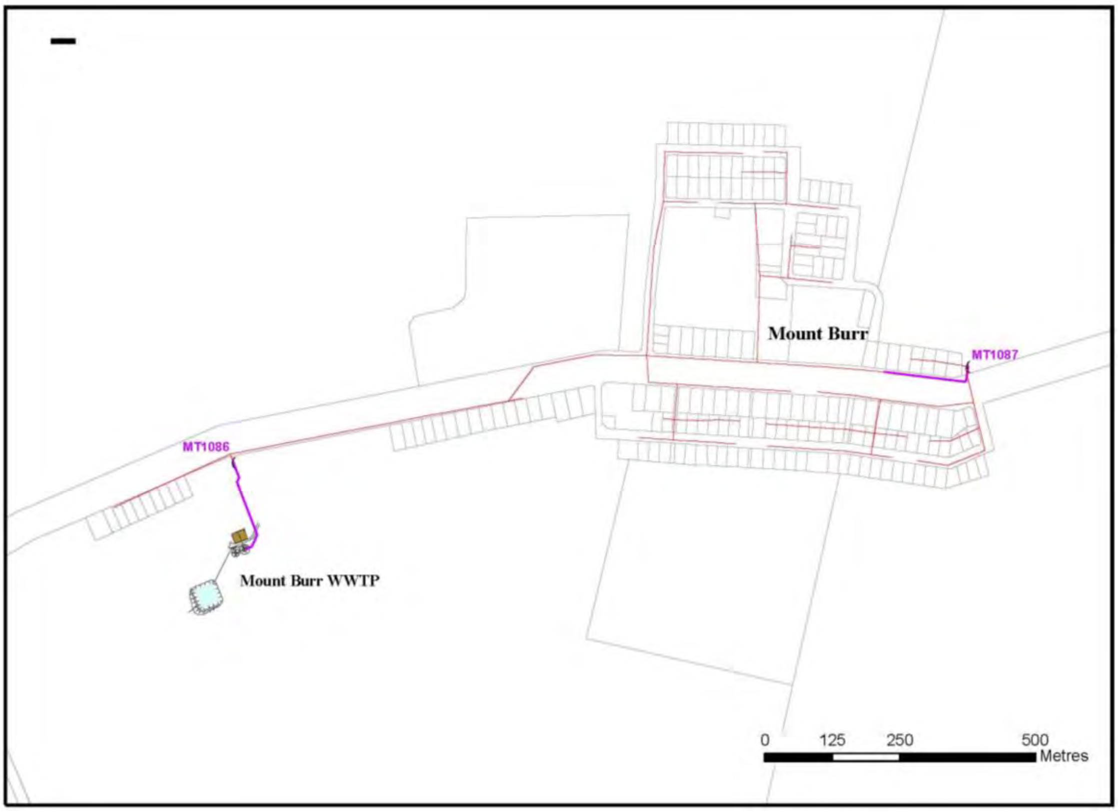


Figure 121

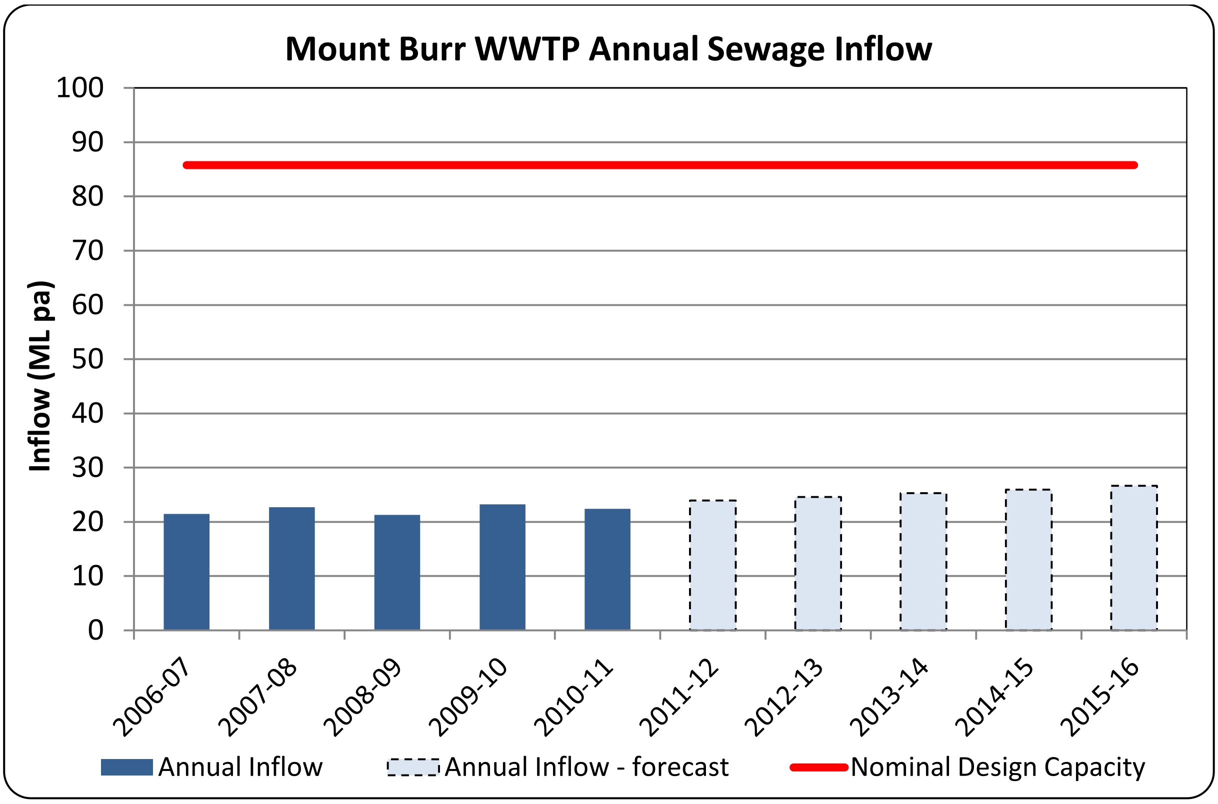


Figure 122

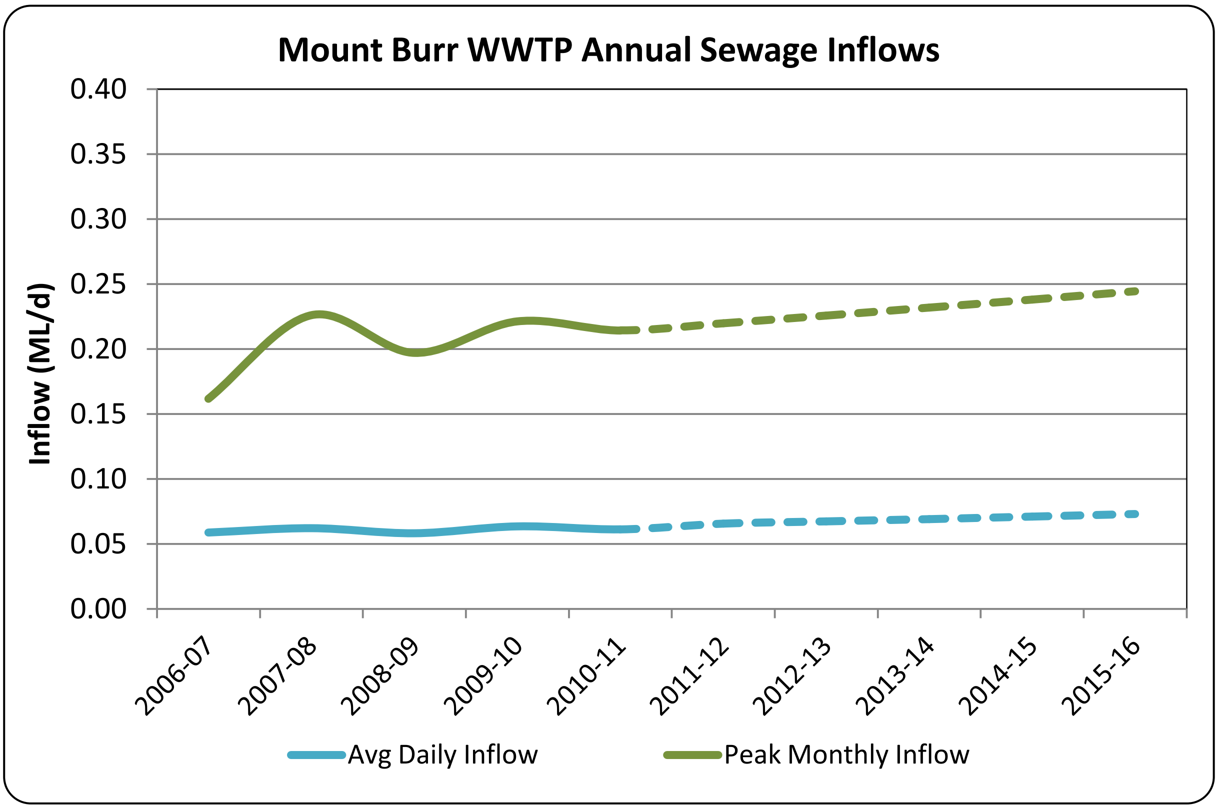


Figure 123

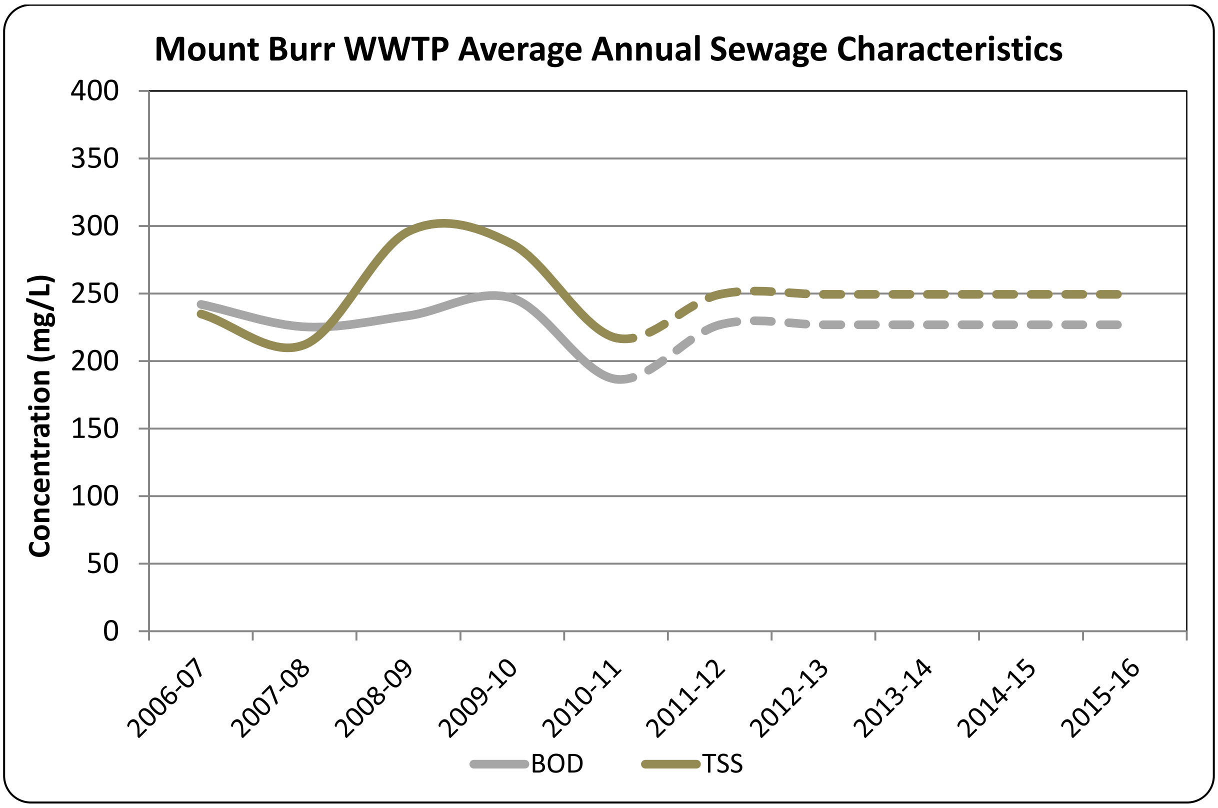


Figure 124

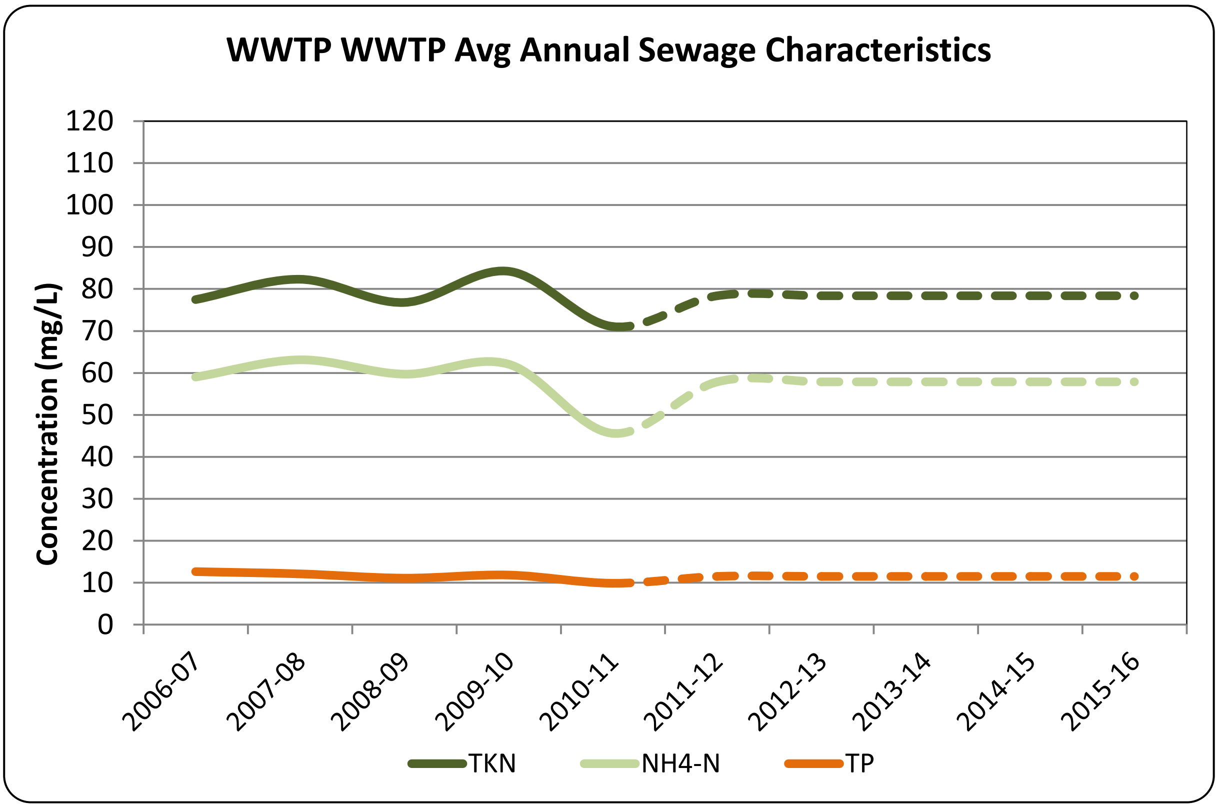


Figure 125

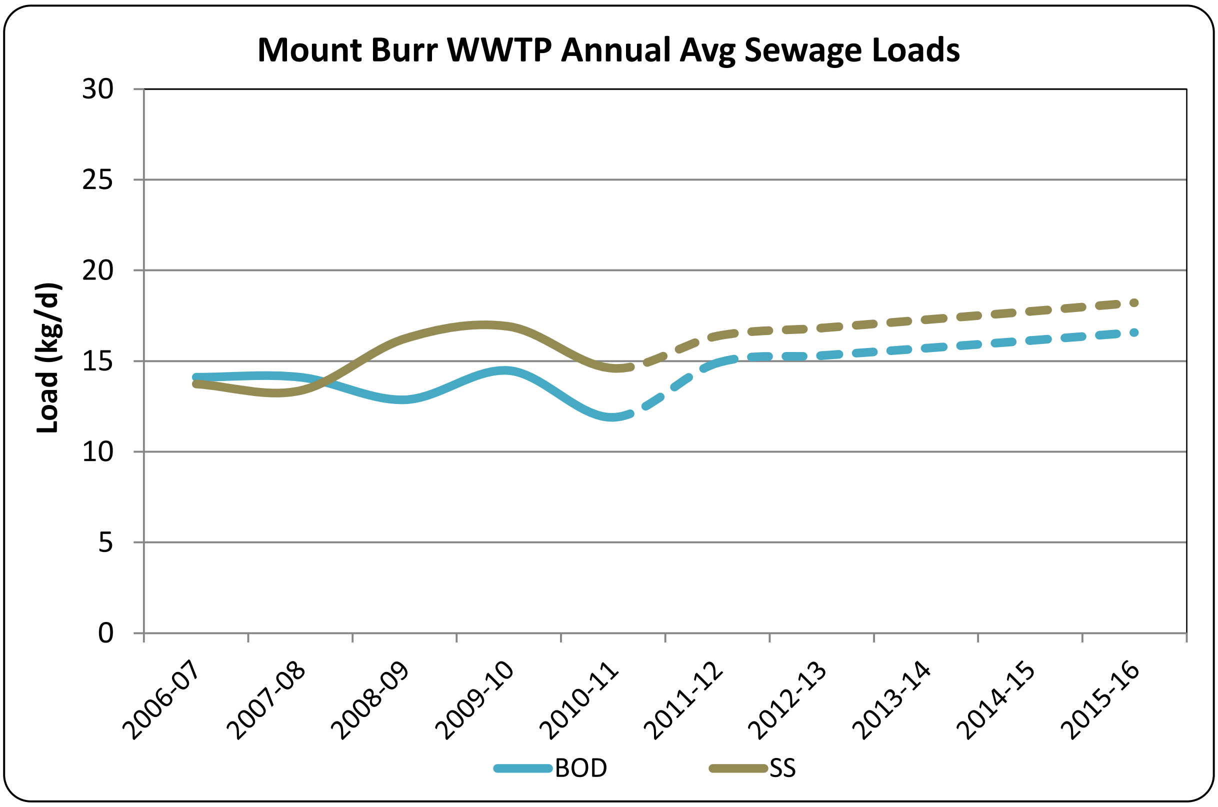
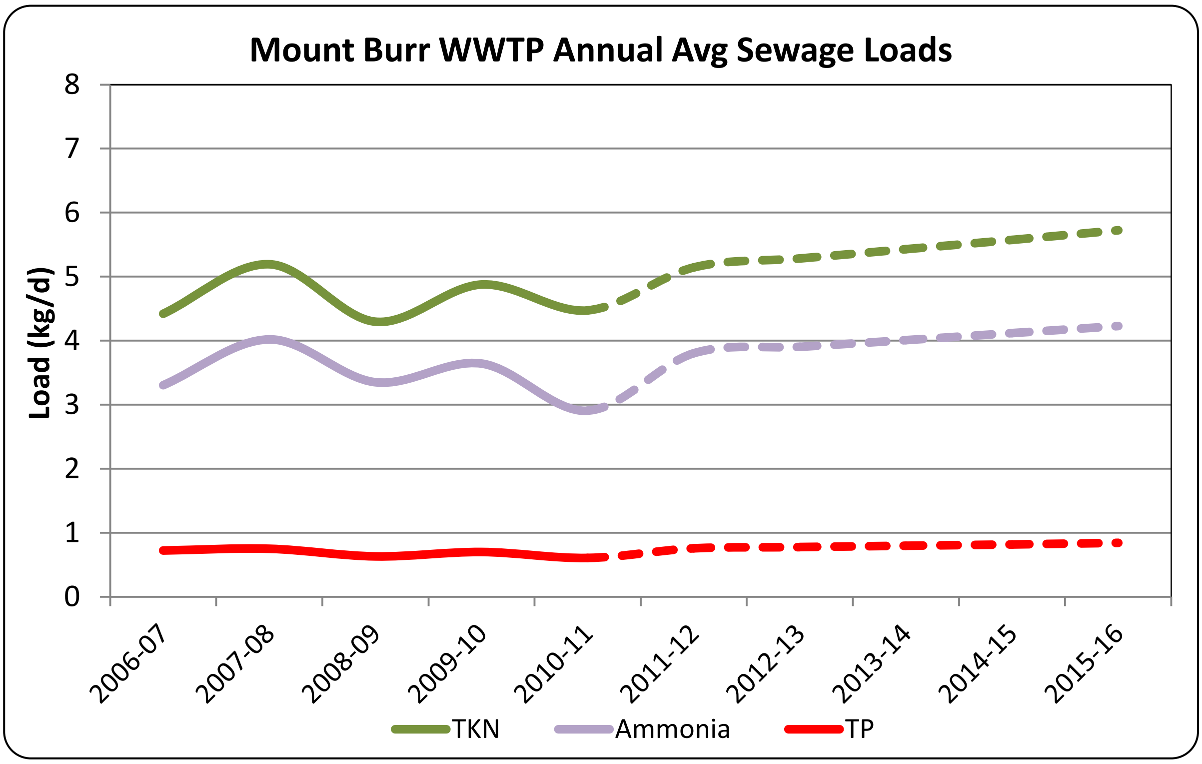


Figure 126



17.2. Key points

- The Mount Burr wastewater treatment plant was commissioned in 1963 and operated by the Woods and Forests Department until 1992, when SA Water took control of the Mount Burr sewerage system.
- The plant uses conventional primary and secondary treatment processes. Sewage is pumped into an Imhoff tank in which primary sedimentation and sludge digestion takes place. Primary effluent then gravitates to a biological (trickling) filter. Secondary effluent gravitates to a polishing lagoon or is recycled to the head of the plant by the pumping station. Treated, unchlorinated sewage then overflows the lagoon into the adjacent pine forest.
- Sludge withdrawn from the Imhoff tanks is sent to two sludge drying beds. Dry sludge is mechanically removed and stockpiled on site at the Millicent or Finger Point WWTPs for eventual reuse on farm land. Much of the treated sewage seeps into the ground in the earth-lined channel between the polishing lagoon and the natural wetland.

Key points - future:

- Population growth in the Mount Burr township is low and there are no issues with plant capacity.
- Mount Burr wastewater treatment plant is ranked as a "tier 2"[31] treatment plant by the EPA. Under the current licence there is a requirement to implement an EIP. The EPA has issues with disposal of the treated wastewater to the natural wetland and potential impacts on groundwater. SA Water continues to negotiate with EPA on a strategy for reducing impacts on groundwater. The groundwater is the source for the SA Water drinking water supply to the town.

[31] Refer to notes to the attachment.

18. Murray Bridge Wastewater Treatment Plant

18.1. Summary

Commissioned: The Murray Bridge wastewater treatment plant started operating in 1970.

Treatment process: Conventional primary and secondary treatment processes. Sewage enters the plant through four Imhoff Tanks, operating in parallel, in which primary sedimentation and sludge digestion take place. Primary effluent then gravitates to aeration Lagoon 1. Four duty and two standby mechanical surface aerators provide mixing and oxygen for secondary treatment. Flow then continues to Lagoon 2, which polishes the treated sewage.

Disposal of treated wastewater: Un-chlorinated treated sewage is pumped from Lagoon 2 via a pipeline under the River Murray to a wetland east of Murray Bridge, where it is all recycled.

Figure 127 Murray Bridge wastewater treatment plant

Parameter	Original Design	Actual (2010-11)
Flows (Megalitres per day ; ML/d)		
Average dry weather	1.81	2.37
Average annual	2.12	2.56
Peak month average	2.56	2.74
Peak day flow	3.60	5.05
Peak wet weather	5.40	n/a
Avg Influent Concentration (mg/L)		
Biochemical Oxygen Demand (BOD)	360	382
Suspended Solids (SS)	305	377
Total Kjeldahi Nitrogen (TKN)	n/a	74
Ammonia (NH_3-N)	n/a	48
Total Phosphorous (TP)	n/a	12
Avg Raw Wastewater Load (kg/dy)		
Biochemical Oxygen Demand (BOD)*	764	941
Suspended Solids (SS)	645	915
Total Kjeldahl Nitrogen (TKN)	n/a	188
Ammonia (NH_3-N)	n/a	122
Total Phosphorous (TP)	n/a	31

**The design figures quoted above are the original hydraulic parameters. The mechanical aerators installed in 2006 (operating in conjunction with the Imhoff Tanks), provide an increase in the capacity of the plant.*

Population served[32]

2006 Census	2011 Census
14,048	13,892

Note: the forecast in Murray Bridge drainage area population growth was initially undertaken in 2010 and revised in 2011. Growth forecasts used 2008-09 as the base year, with an equivalent population of 25,800 forecast for 2038. Figure 130 uses historical flow information, up to and including 2011-12. The growth forecast includes the Giffords Hill development, south of the Freeway, but does not include connection of any properties on the eastern side of the River Murray. The Local Council's Infrastructure Plan released earlier this year includes higher growth targets than those in the 30 Year Plan for Greater Adelaide.

[32] Indicative figures for catchment areas based on Australian Bureau of Statistics, 2006 (Murray Bridge - Urban Centre/Locality) and 2011 (Murray Bridge - Gazetted Locality) Census data, www.abs.gov.au.

Figure 128 Murray Bridge plant schematics

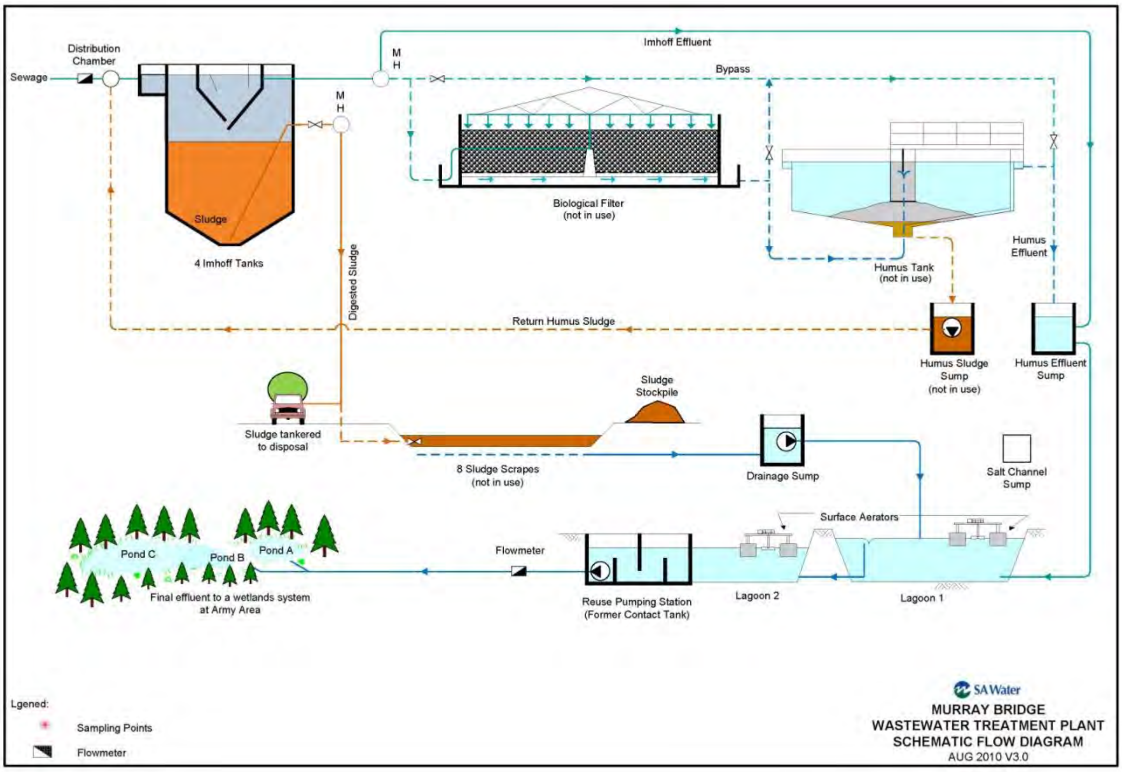


Figure 129 Murray Bridge drainage area

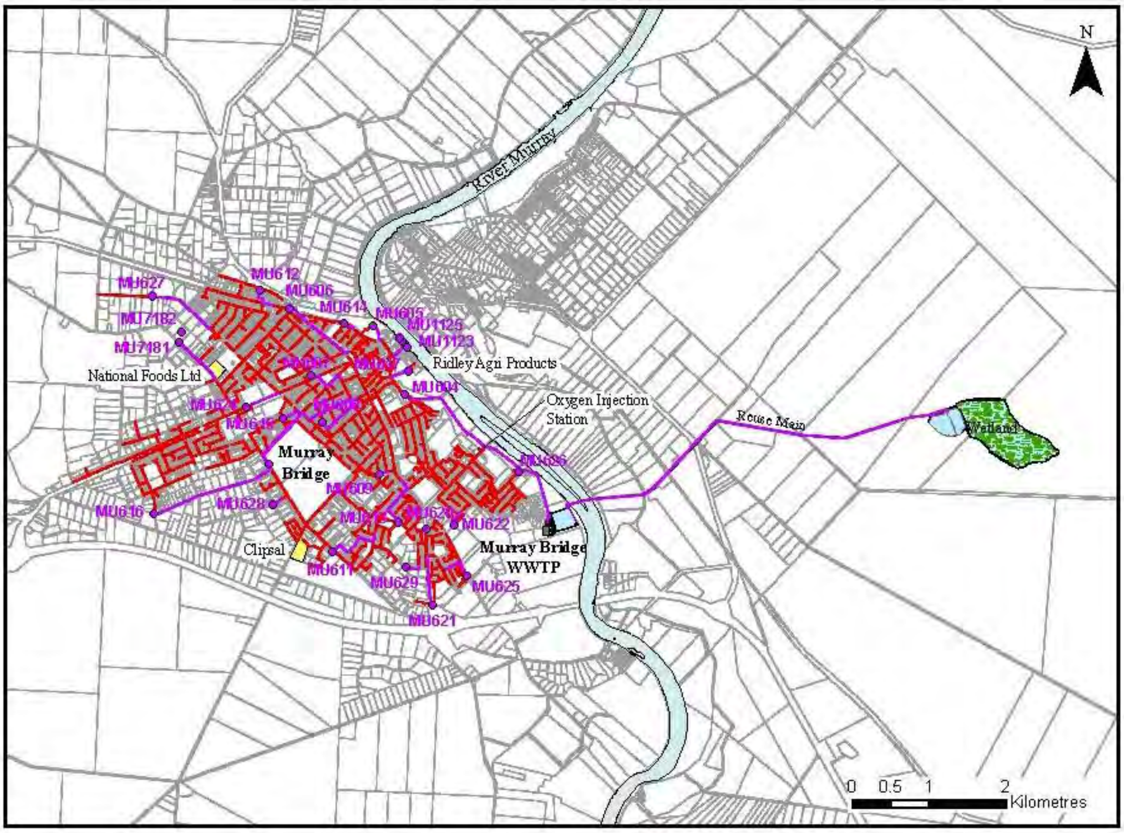


Figure 130

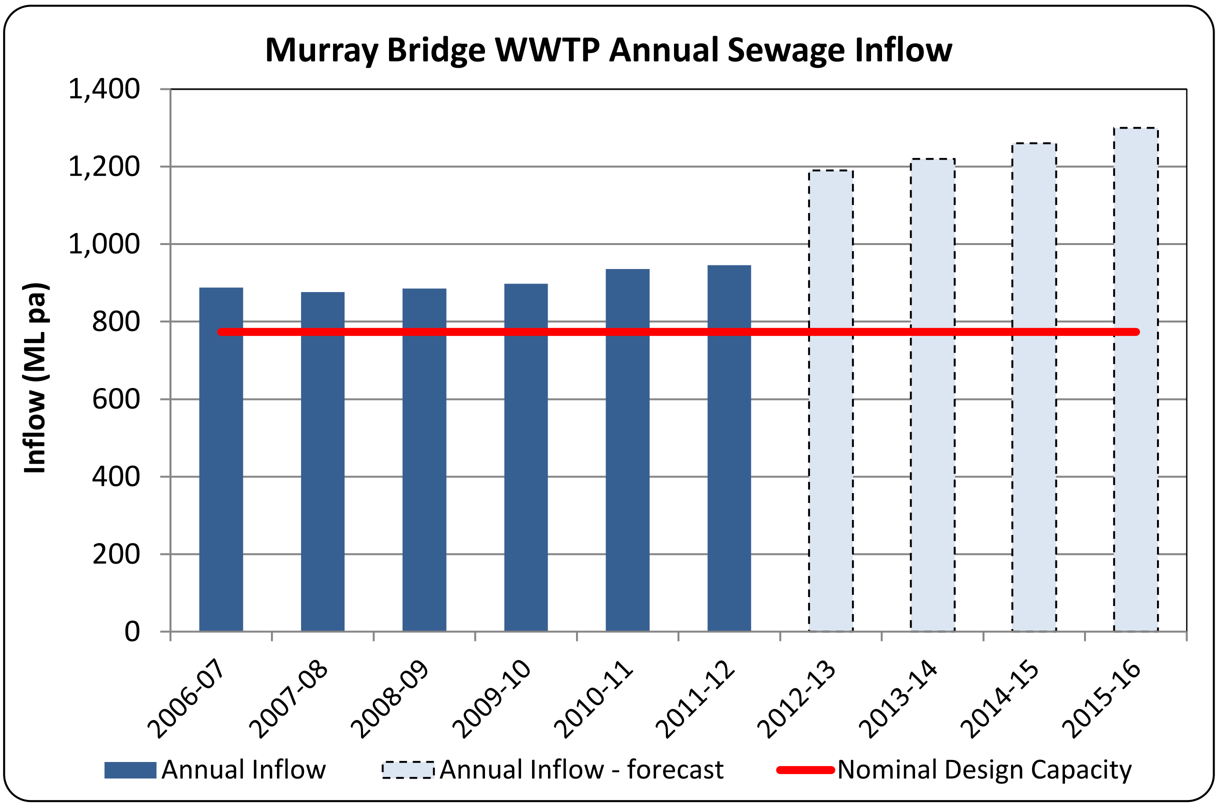


Figure 131

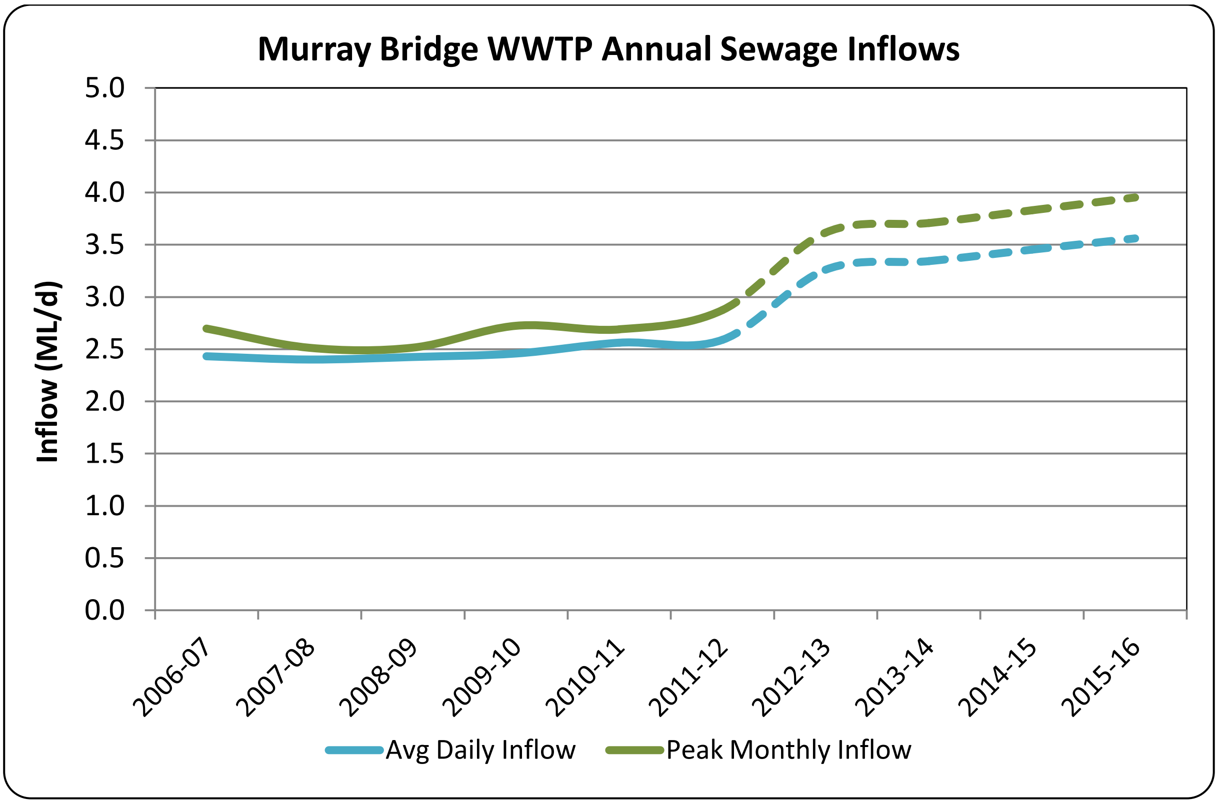


Figure 132

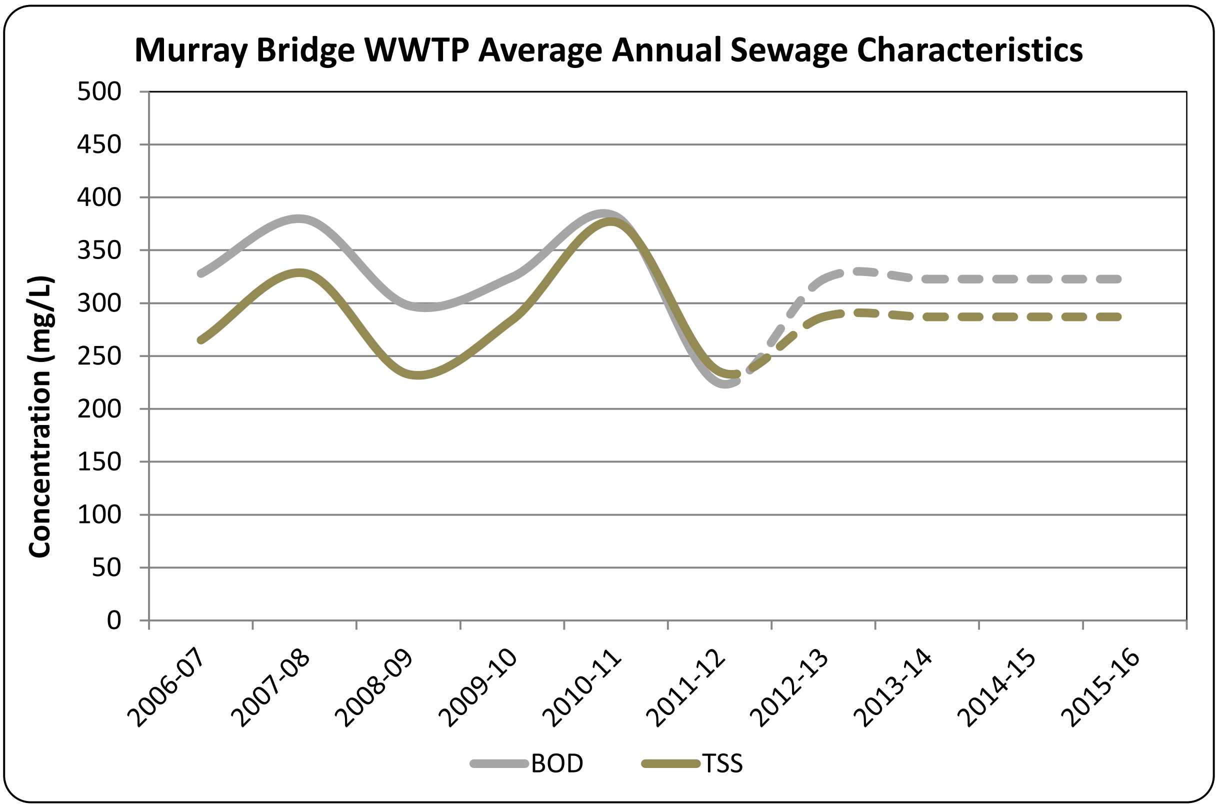


Figure 133

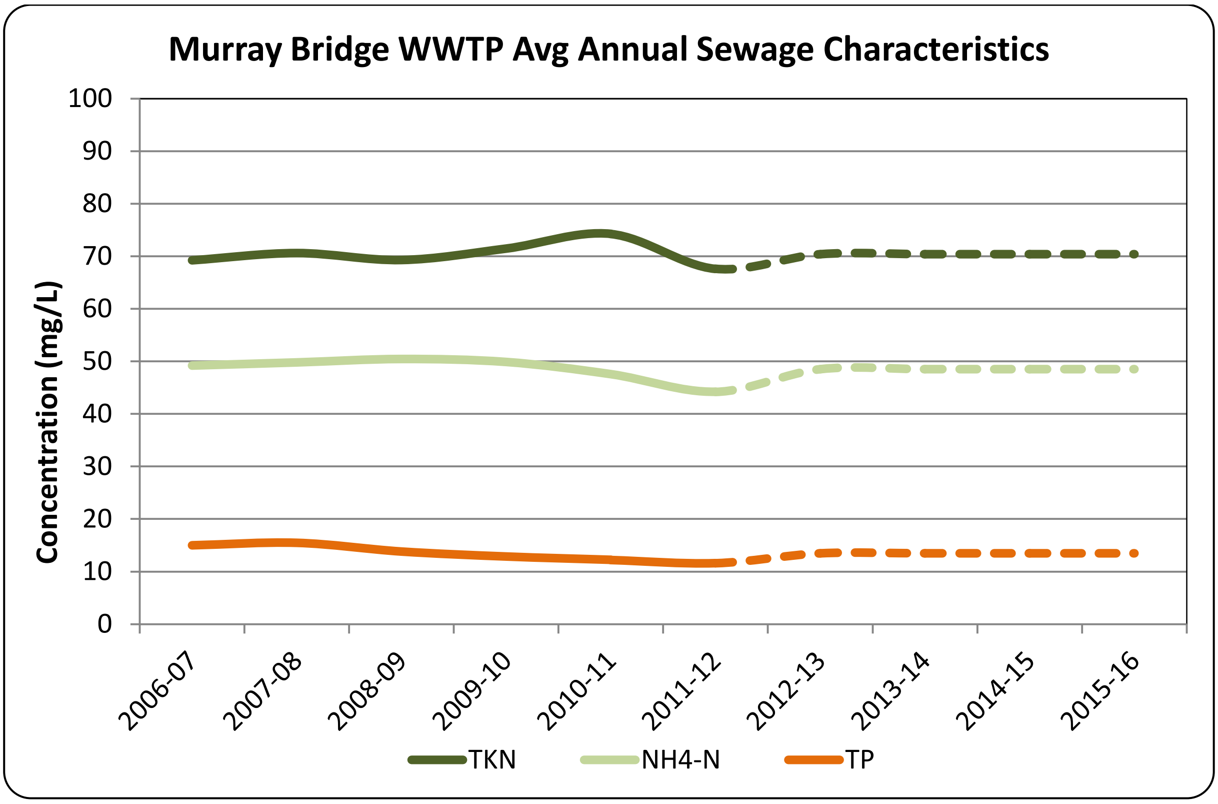


Figure 134

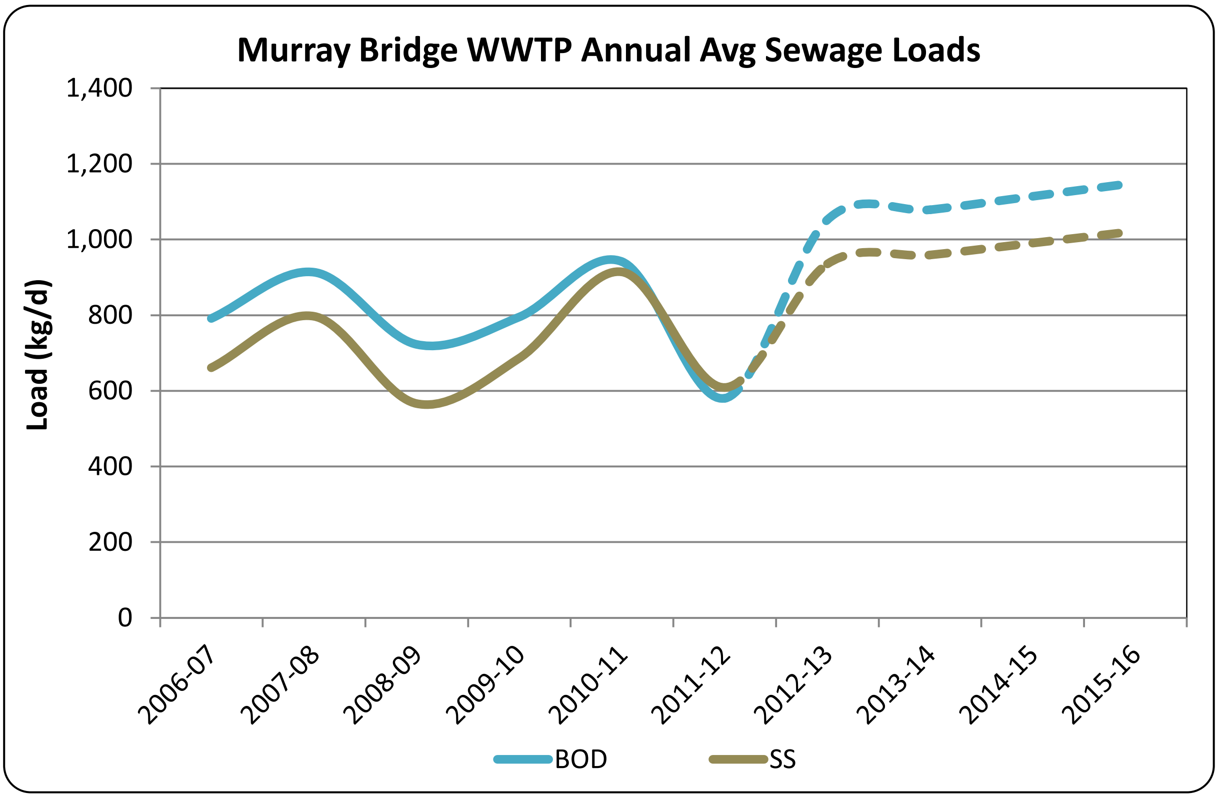
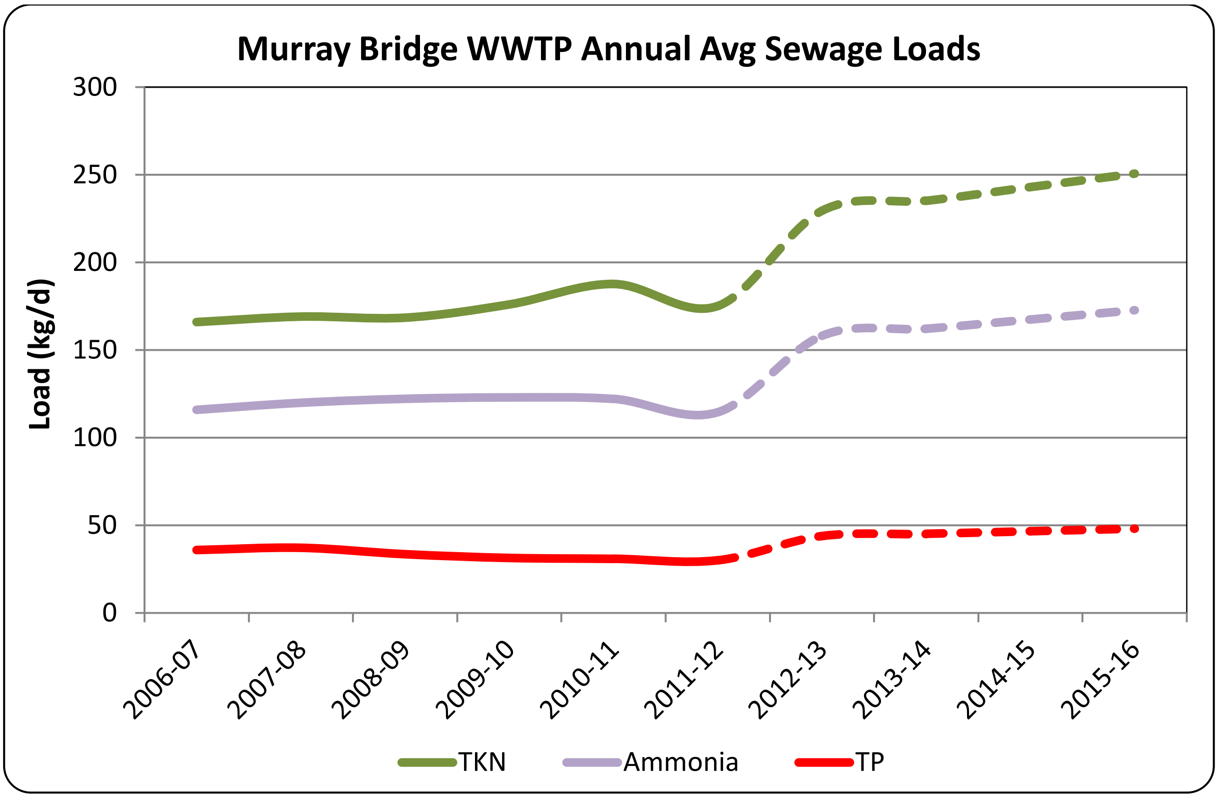


Figure 135



18.2. Key points

- The Murray Bridge wastewater treatment plant was commissioned in 1970 and receives domestic and industrial sewage from the Rural City of Murray Bridge.

- Originally, treated sewage was pumped to the adjacent River Murray. From December 1992, treated un-chlorinated sewage has been pumped 7km from Lagoon 2, through a 300mm diameter pipeline under the River Murray, to a 71 ha constructed wetland and evaporation pond at the Murray Bridge Army Training Area. This was modified in 2010 with conversion of part of Lagoon A to three in-series lined basins and storage in only Pond B to improve treated wastewater quality and overcome a leakage issue in Pond A.

- Some treated wastewater is irrigated at the Army Range and most of the remainder is pumped to the Kepa Road piggery for further detention and mixing with high strength piggery wastewater for irrigation disposal.

- The plant originally employed four Imhoff tanks, a biological (trickling) filter, with solids removed through a humus tank, followed by two polishing lagoons. Following a series of odour incidents and complaints from nearby residents with associated resultant environmental incidents, the biological filter and humus tank were taken out of commission. Further odour issues occurred and following a direction from the EPA to urgently deal with the issue, six new mechanical aerators were installed into Lagoon 1 to maintain plant treatment capacity and mitigate odours.

Key points - future:

- In recent times, homes have been built within 35m of the Imhoff tanks, on land zoned *Rural Living.* The plant is also next door to a marina with mooring facilities and permanent residences.

- Lagoons 1 and 2 were constructed on the River Murray flood plain and are at risk of being overtopped when the river floods. This location is in contravention of government policy that treatment facilities should be located above the 1956 flood level. The main wastewater pump station serving the treatment plant is heavily loaded and represents a high risk for environmental overflows.

- Murray Bridge has also grown significantly since the existing plant was constructed. To accommodate growth, an area to the South East of the current town known as Giffords Hill (and South of the Freeway) has been rezoned residential and is subject to development. Growth forecasts from this area - along with new developments within the townships - are factored into inflow forecasts shown in Figure 130.

- As a result of these numerous issues, SA Water has identified the need to develop a new larger plant and associated infrastructure to provide a long term sustainable solution for Murray Bridge. This includes the potential for the replacement of the Murray Bridge plant to be incorporated into solutions for providing sewerage services to the identified nearby growth area of Mount Barker.

- Murray Bridge Waste WWTP is ranked as a “tier 2”[33] treatment plant by the EPA. Under the current licence there is no requirement for an EIP.

[33] Refer to notes to the attachment.

19. Myponga Wastewater Treatment Plant

19.1. Summary

Commissioned:	Myponga wastewater treatment plant was commissioned in 1963.
Treatment process:	An Imhoff tank and five lagoons.
Disposal of treated wastewater:	Irrigation of adjacent pasture with overhead sprinklers.

Figure 136 Myponga wastewater treatment plant

Parameter	Original Design	Actual (2010-11)
Flows (Megalitres per day; ML/d)		
Average dry weather	0.046	0.047
Average annual	0.053	0.113
Peak month average	0.064	0.193
Peak day flow	0.091	n/a
Peak wet weather	0.136	n/a
Avg Influent Concentration (mg/L)		
Biochemical Oxygen Demand (BOD)	n/a	185
Suspended Solids (SS)	n/a	184
Avg Raw Wastewater Load (kg/dy)		
Biochemical Oxygen Demand (BOD)	15.9	27
Suspended Solids (SS)	n/a	50

Note: median raw sewage characteristics have been reported above as there is doubt as to the accuracy of some of the monitoring and flow information.

Population served[34]

2006 Census	2011 Census
540	595

[34] Indicative figures for catchment areas based on Australian Bureau of Statistics, 2006 (Myponga - State Suburb) and 2011 (Myponga - Gazetted Locality) Census data, www.abs.gov.au.

Figure 137 Myponga plant schematics

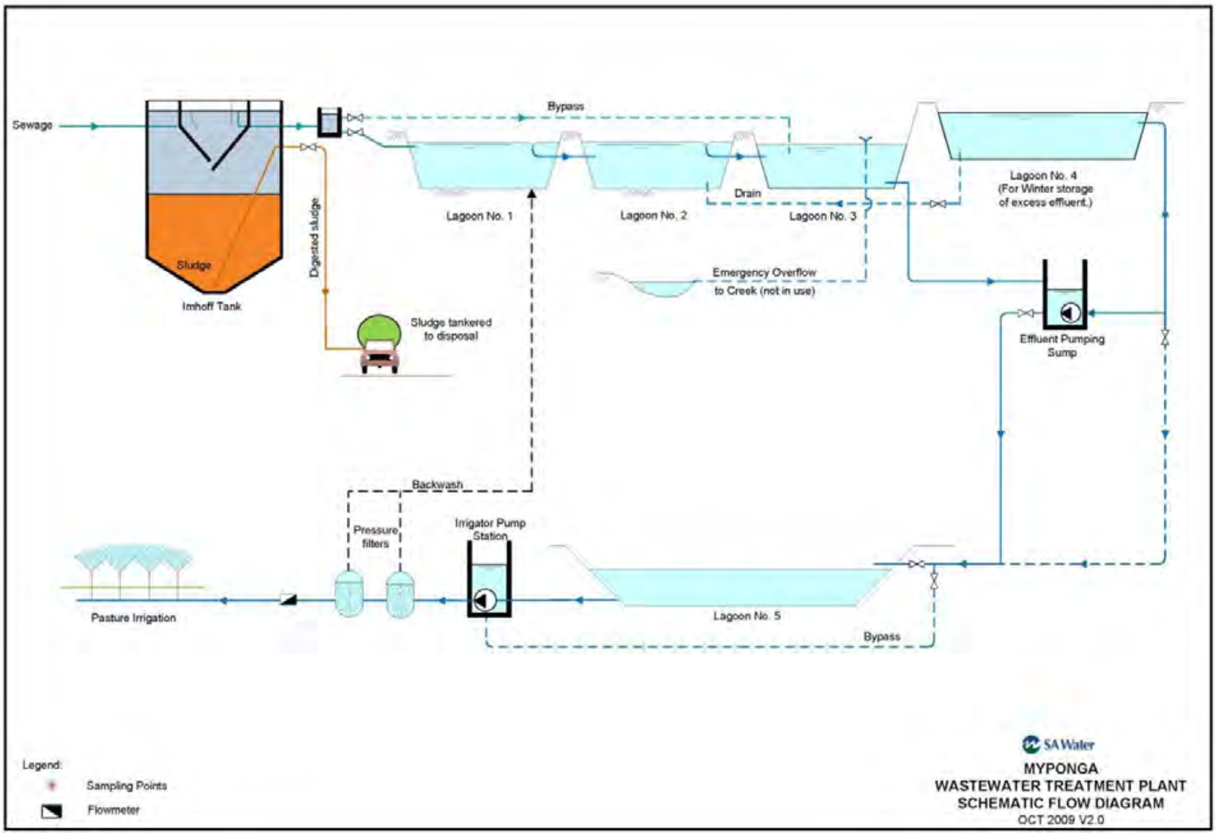


Figure 138 Myponga drainage area

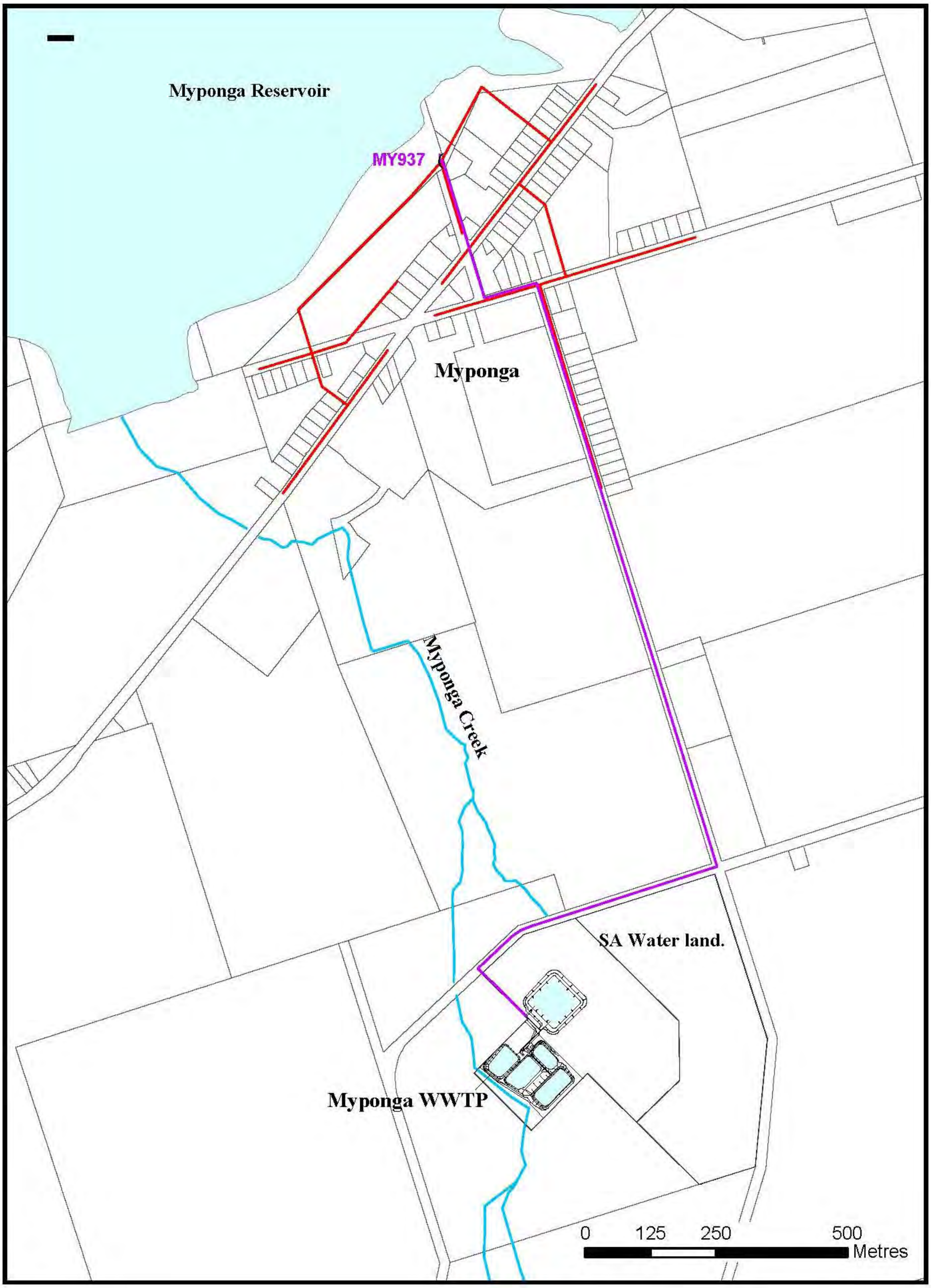
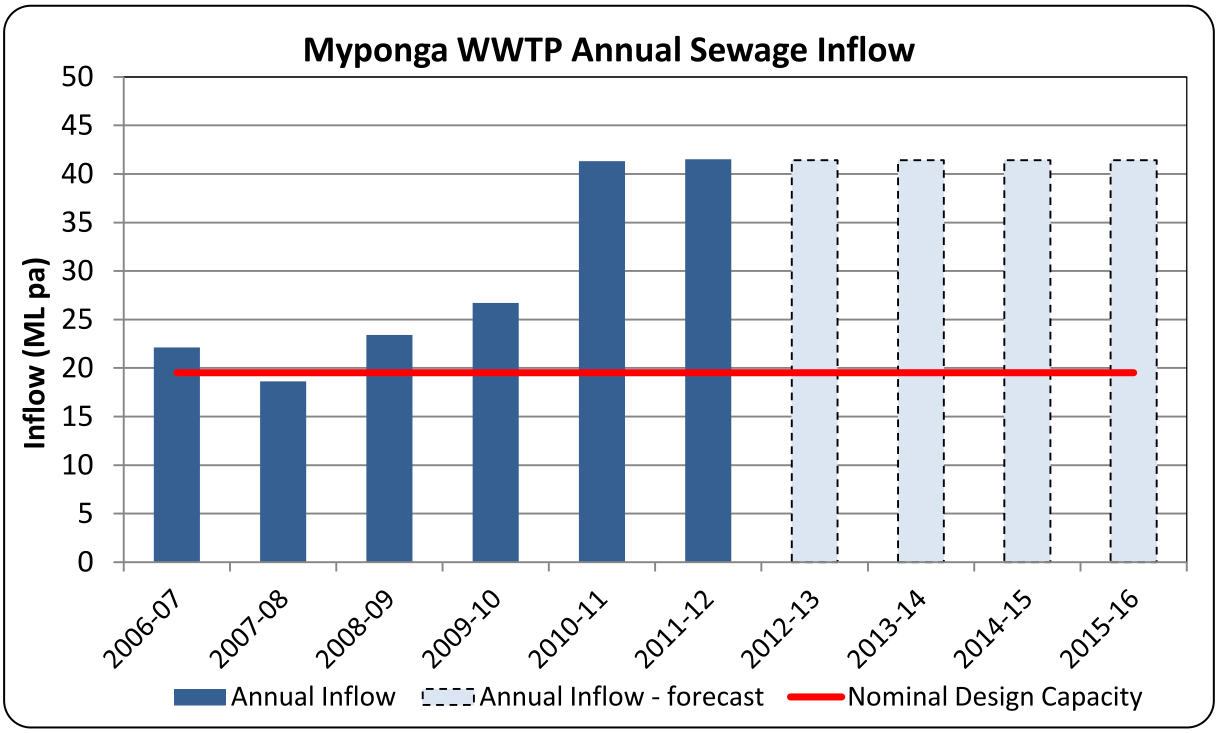


Figure 139



Note: rapid development in the township drainage area has resulted in a step increase in annual flows in 2010-11. This is expected to be sustained. Treated sewage quality has not been compromised. An additional 15ML balancing storage was constructed in 2009.

Figure 140

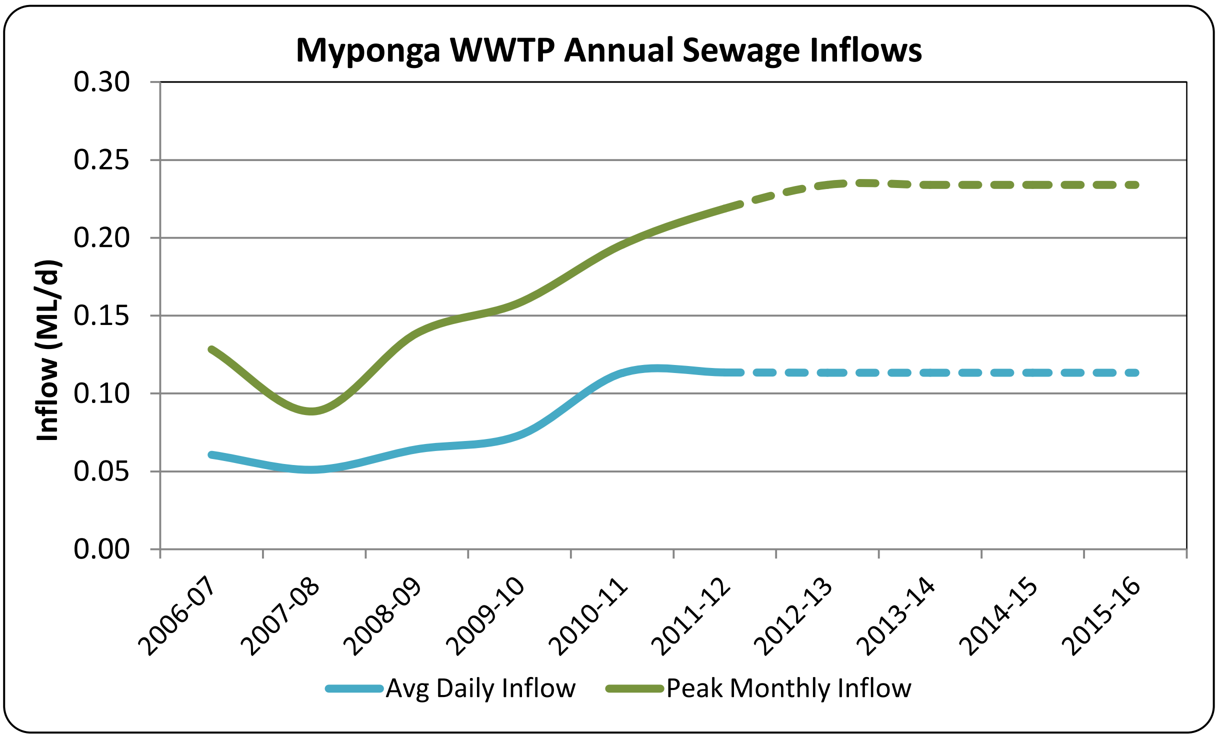


Figure 141

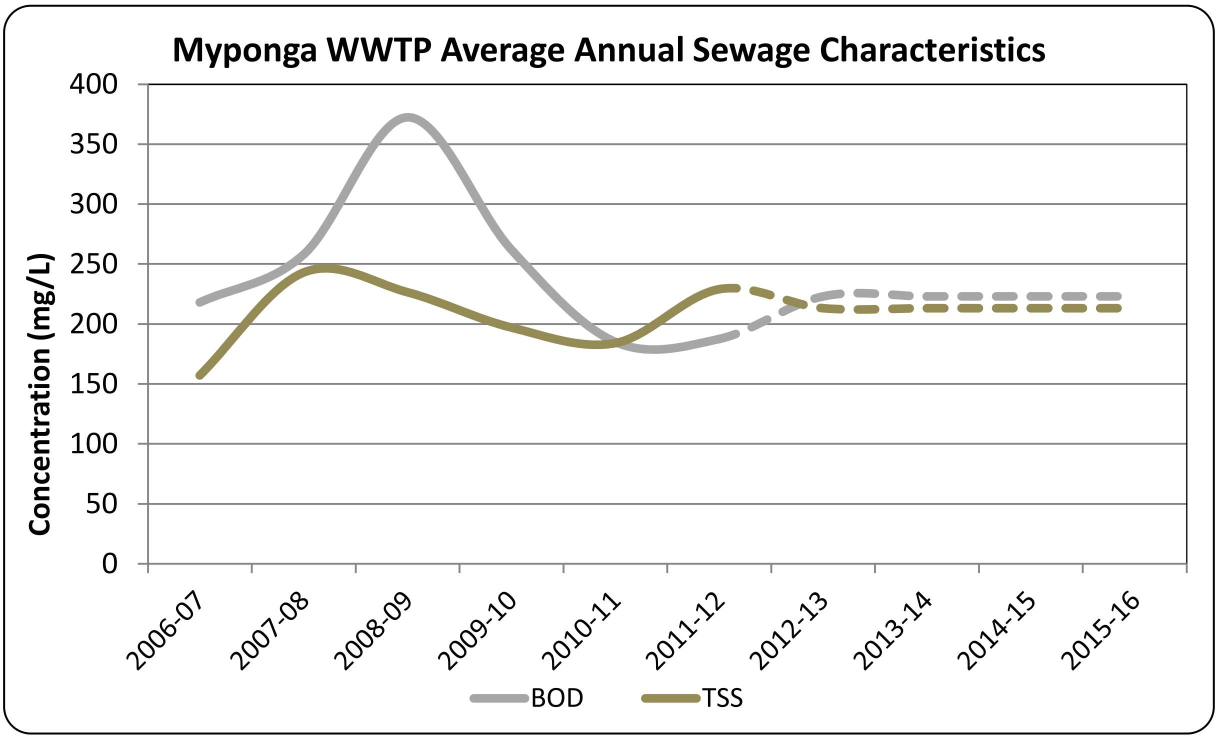


Figure 142

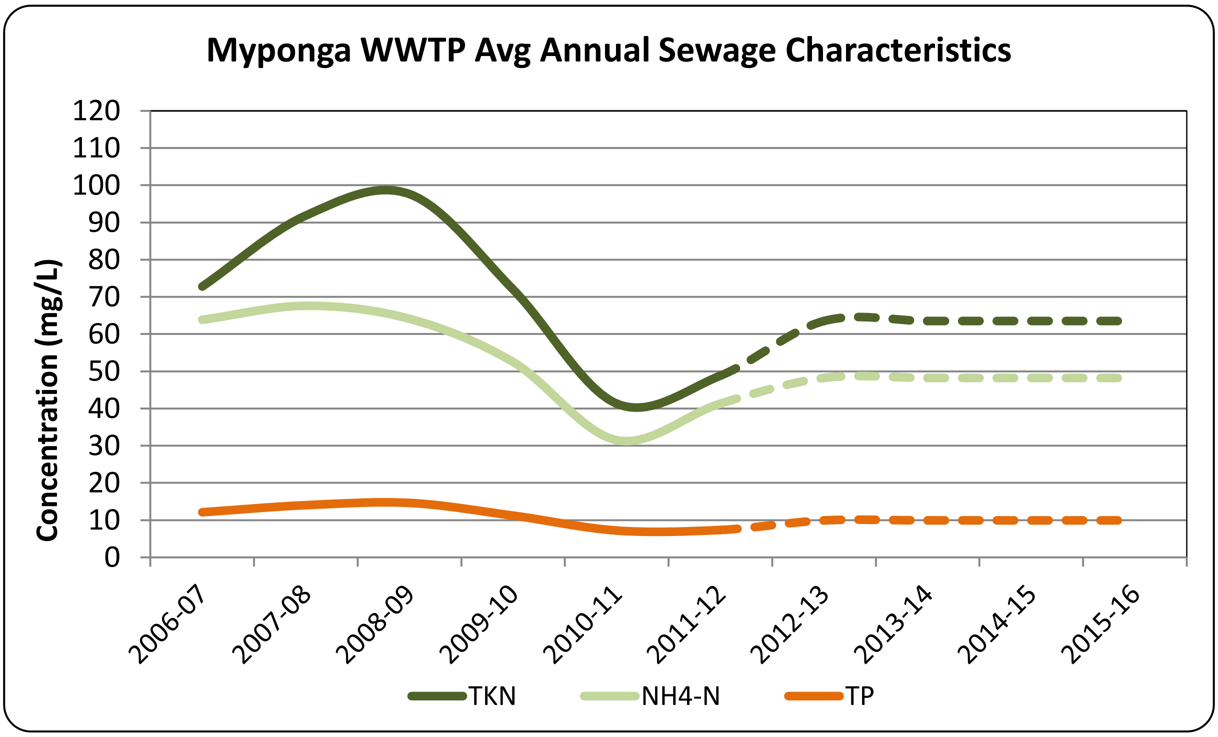


Figure 143

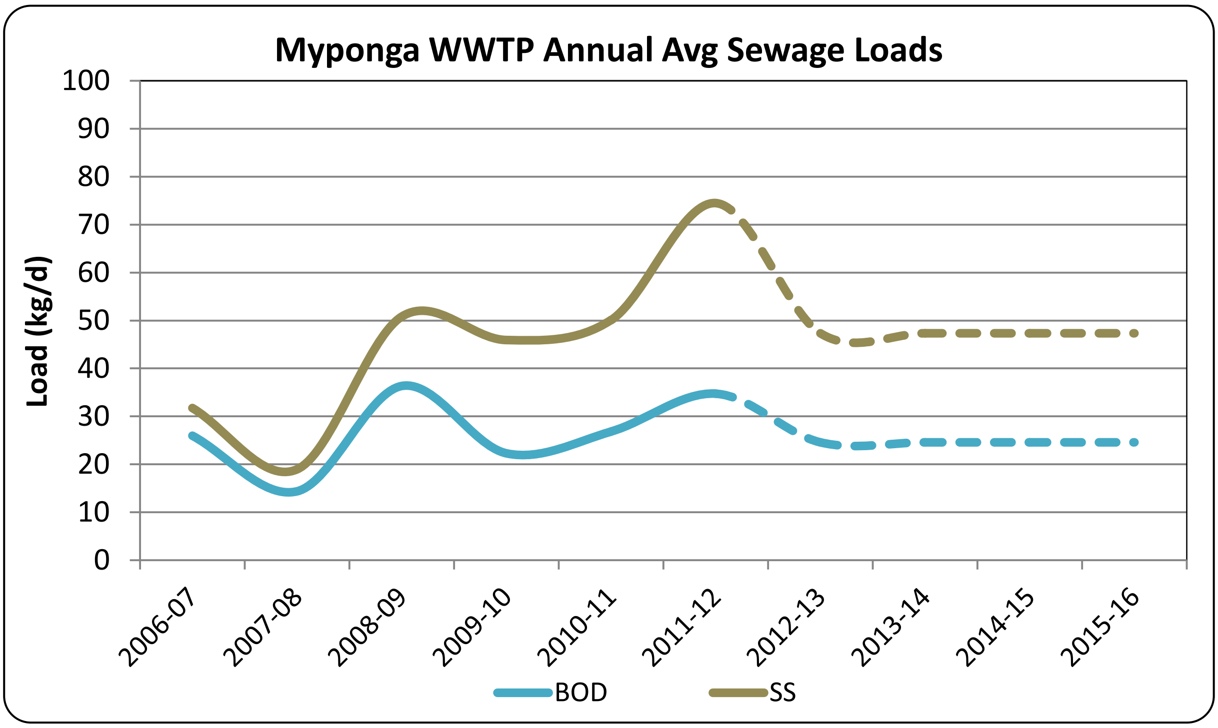
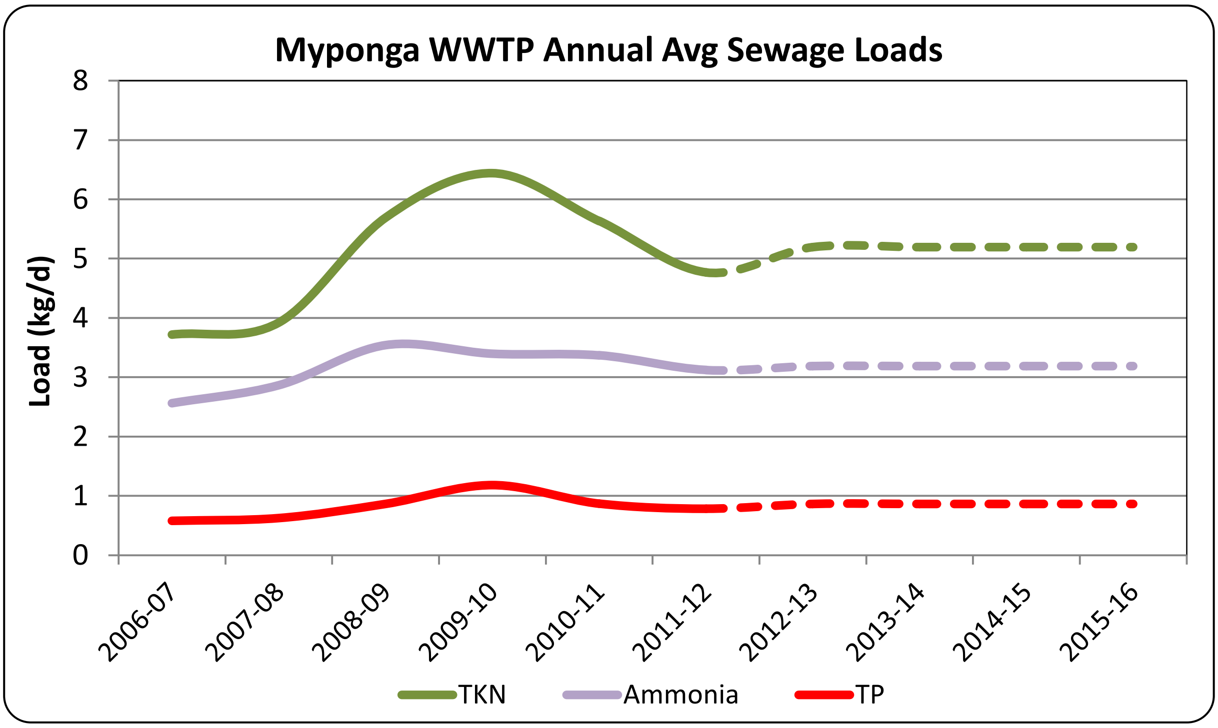


Figure 144



19.2. Key points

- The Myponga wastewater treatment plant was commissioned in 1963 and receives domestic sewage from the township of Myponga. The plant is located about 2km east of the town and the Myponga Reservoir, which supplies drinking water to southern suburbs. Both the township and the Myponga WWTP are located within the water supply catchment of the Myponga Reservoir.
- The plant uses conventional primary and secondary treatment processes. Sewage is pumped into an Imhoff tank in which primary sedimentation and sludge digestion takes place. Primary effluent then gravitates to five stabilization (for further polishing) and storage lagoons, with a total volume of 28.3 ML. Secondary treated sewage gravitates to a pumping station where it is pumped through pressure filters and reused on adjacent pasture.
- Originally, treated sewage was chlorinated and discharged into the adjacent Myponga Creek. The creek is a tributary to Myponga Reservoir. Under the *Water Resources Act 1990*, the effluent discharge from the Myponga WWTP to Myponga Creek was licensed by Department of Water Resources (before establishment of the EPA). The first license (which expired in 1992) required investigations into land based disposal and nutrient reduction to be undertaken. Subsequently a Future Operating Strategy for Myponga WWTP was developed. It recommended that land-based disposal of effluent by pasture irrigation be pursued.
- SA Water commissioned a reuse scheme in November 1997, and since then there has been no discharge to the creek, as treated sewage is stored on site in winter or used for irrigation of nearby pastures in summer. Lagoons numbers 4 and 5 are used as winter storage of effluent for the irrigation scheme. There is provision to overflow excess treated sewage to Myponga Creek.
- All irrigation occurs on SA Water land, with a minimum 50m buffer distance maintained between dwellings and public roads. The current irrigation area is approximately 9.5 ha. The effluent is filtered to control *Taenia saginata,* a micro-organism that affects beef cattle. Reuse from the Myponga WWTP is subject to a 1996 Irrigation Management Plan. The IMP is an EPA license condition and DHA has approved the on-site irrigation.
- There has been a “step change” in annual inflows of raw wastewater entering the Myponga plant in 2010-11. This has been attributed to residential developments in the town drainage area. Population increased from 540 persons in the 2006 census to 595 persons in the 2011 census. However, the number of connections (GIPs) has increased from 102 in 2005 to 183 in 2012.
- Imhoff tank sludge is removed approximately monthly and tankered to the Heathfield WWTP.

Key points - future:

- Annual sewage inflows to the Myponga plant have been increasing over recent years with new sub-divisions being developed in the Myponga township. A large development area within the catchment boundary has also been identified.
- Infiltration of stormwater and groundwater is likely to have increased winter flows recently. Investigations are underway to identify possible remedial measures.
- Myponga WWTP is ranked as a “tier 3”[35] treatment plant by the EPA. Under the current licence there is no requirement for an Environmental Improvement Plan.
- Work is under way to increase capacity for irrigation using treated wastewater from the plant. Improvements in irrigated area and winter storage are required to ensure no discharge from the site. The Myponga Creek discharges into Myponga Reservoir which is a drinking water supply.

[35] Refer to note to the attachment.

20. Nangwarry Wastewater Treatment Plant

20.1. Summary

Commissioned:	Nangwarry WWTP was commissioned in 1962.
Treatment process:	Imhoff tank, biological (trickling) filter, followed by a single polishing lagoon.
Disposal of treated wastewater:	Discharged into a nearby natural wetland in the forest plantation.

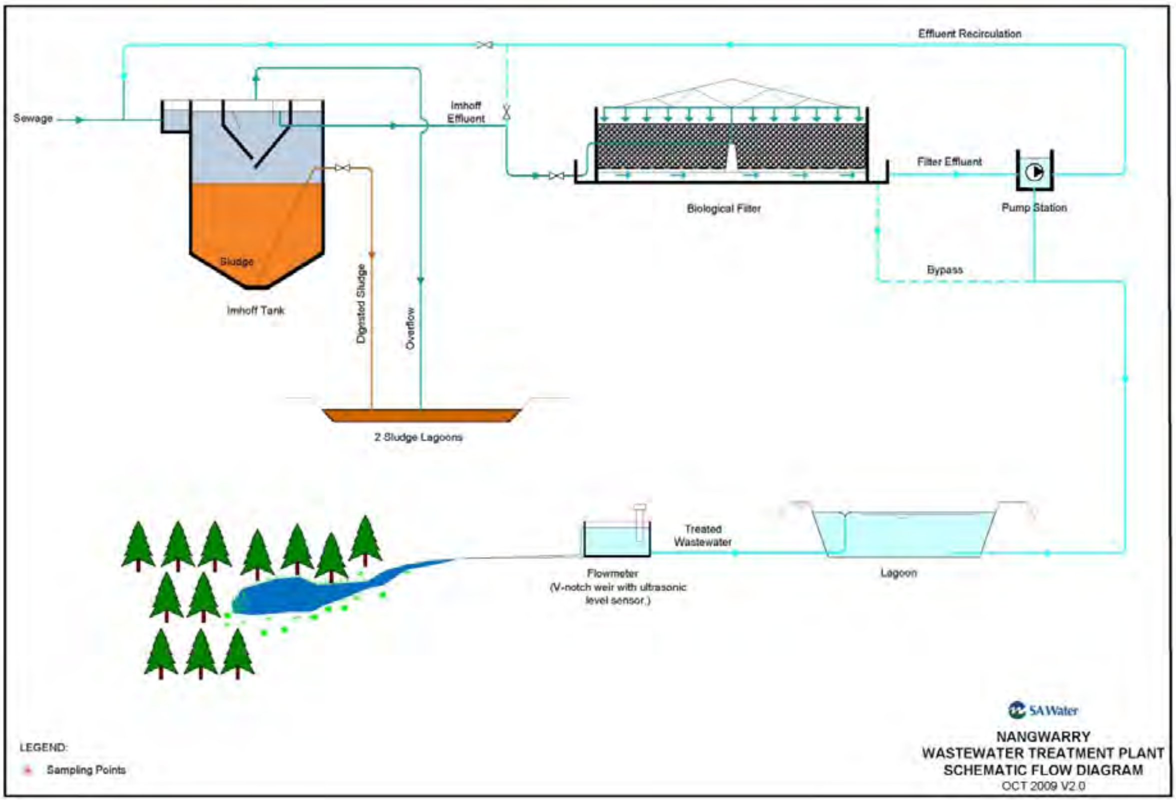
Figure 145 Nangwarry wastewater treatment plant

Parameter	Design	Actual (2010-11)
Flows (Megalitres per day; ML/d)		
Average dry weather	0.200	0.085
Average annual	0.235	0.104
Peak month average	0.282	0.114
Peak day flow	0.400	0.246
Peak wet weather	0.600	n/a
Avg Influent Concentration (mg/L)		
Biochemical Oxygen Demand (BOD)	n/a	172
Suspended Solids (SS)	n/a	150
Avg Raw Wastewater Load (kg/dy)		
Biochemical Oxygen Demand (BOD)	73.5	21.5
Suspended Solids (SS)	n/a	18.8

Population served[36]

2006 Census	2011 Census
504	514

Figure 146 Nangwarry plant schematics



[36] Indicative figures for catchment areas based on Australian Bureau of Statistics Census data, www.abs.gov.au.

Figure 147 Nangwarry drainage area

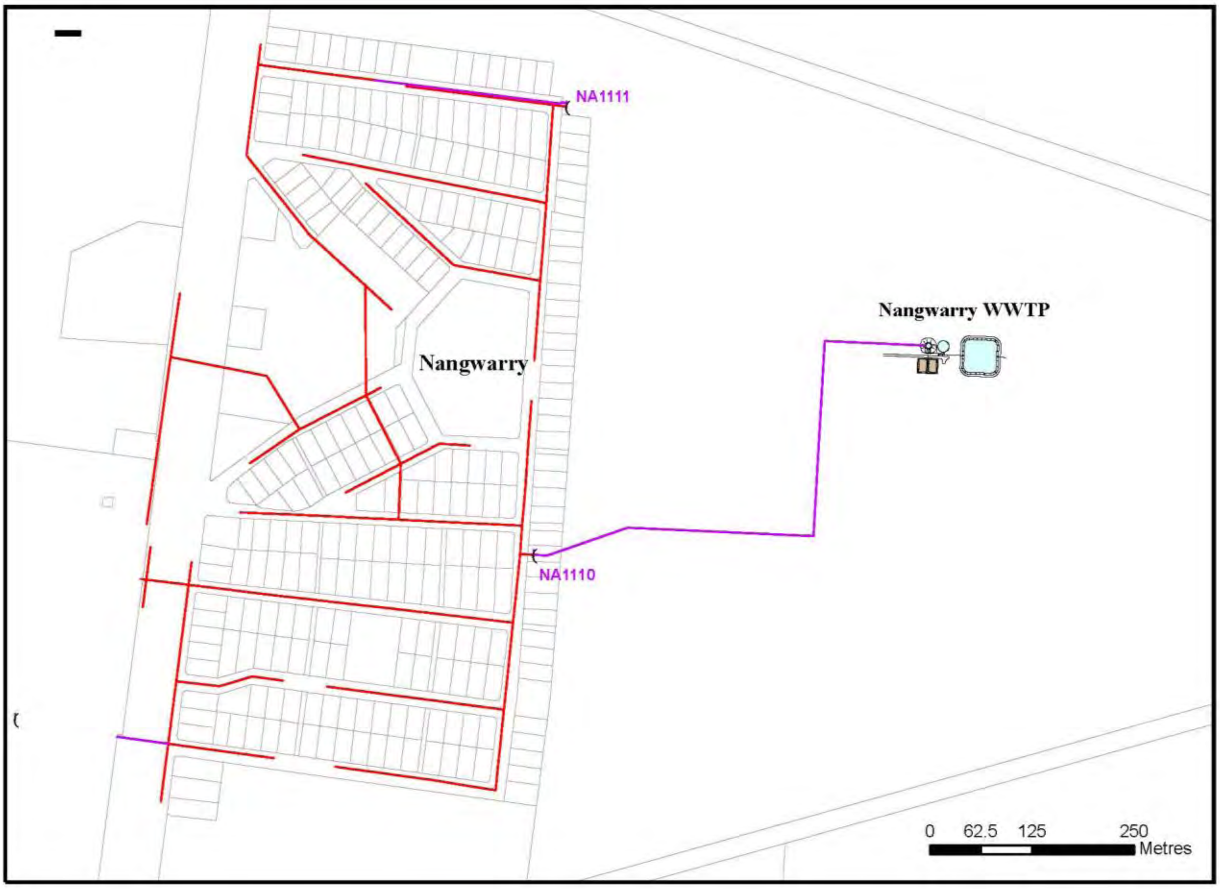


Figure 148

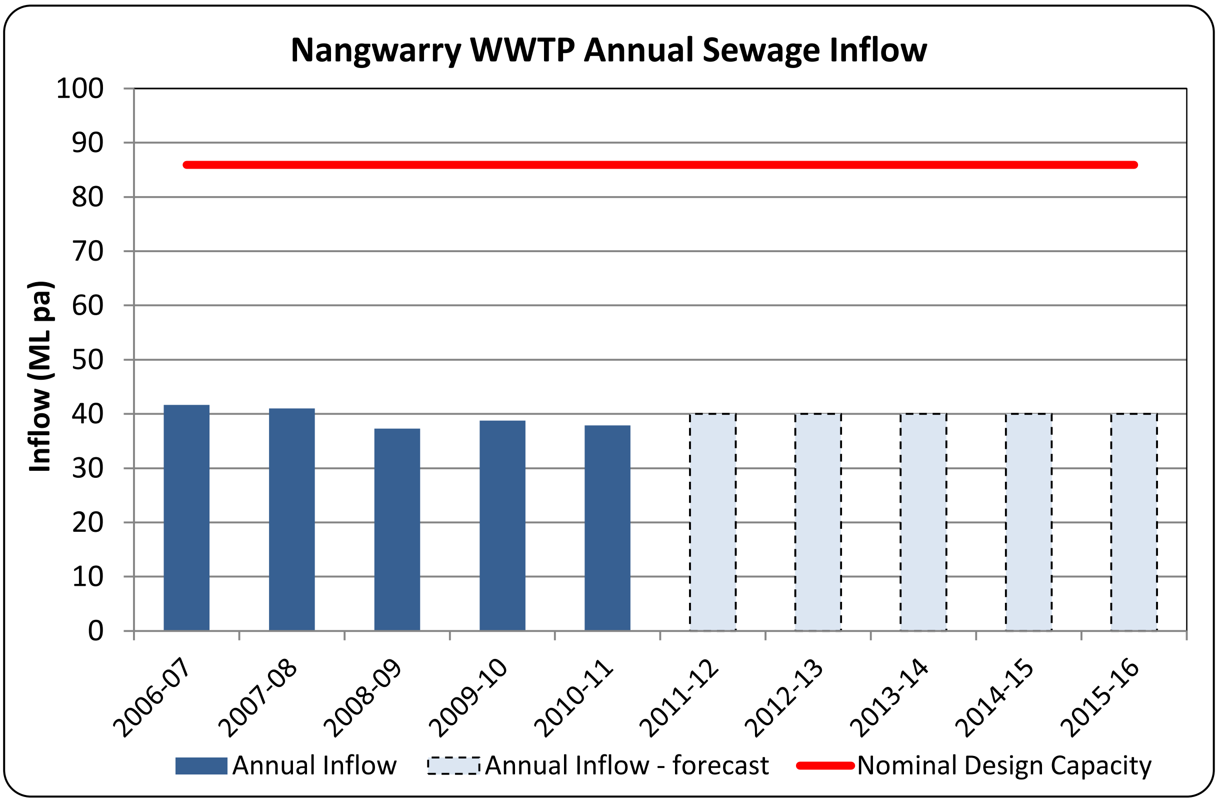


Figure 149

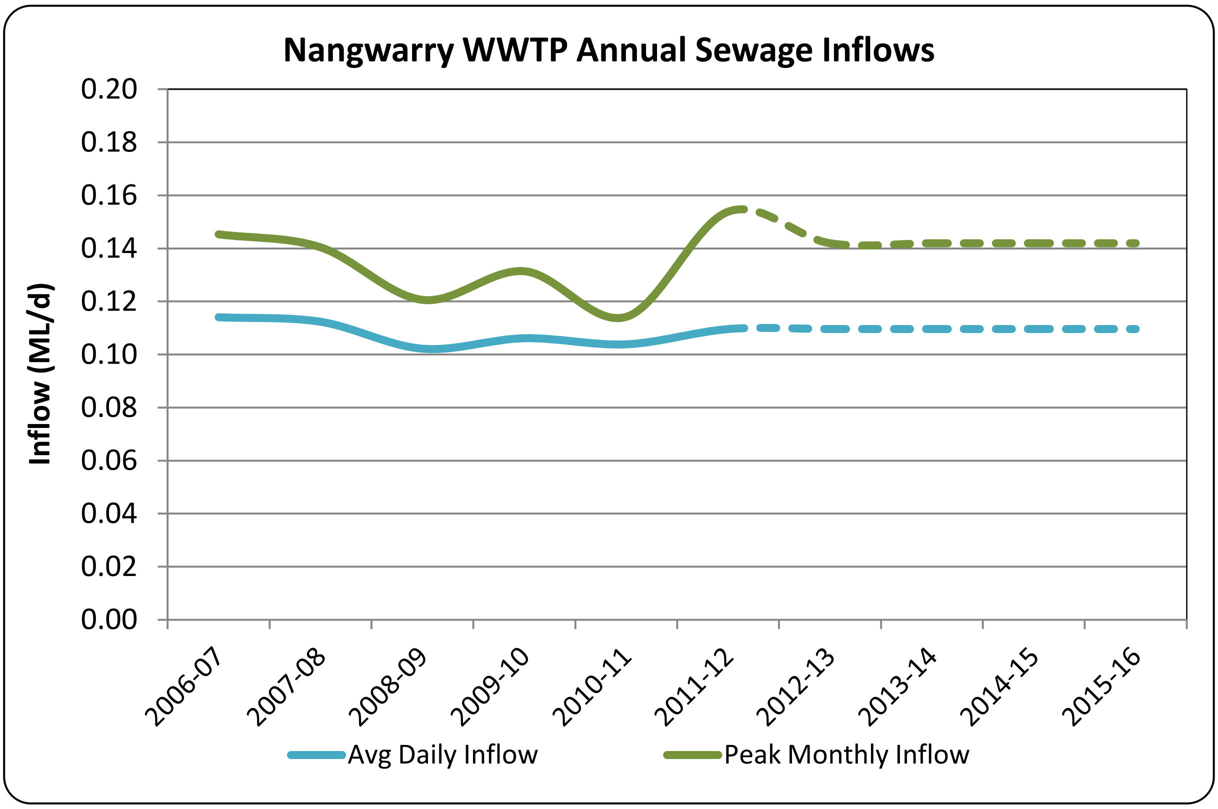
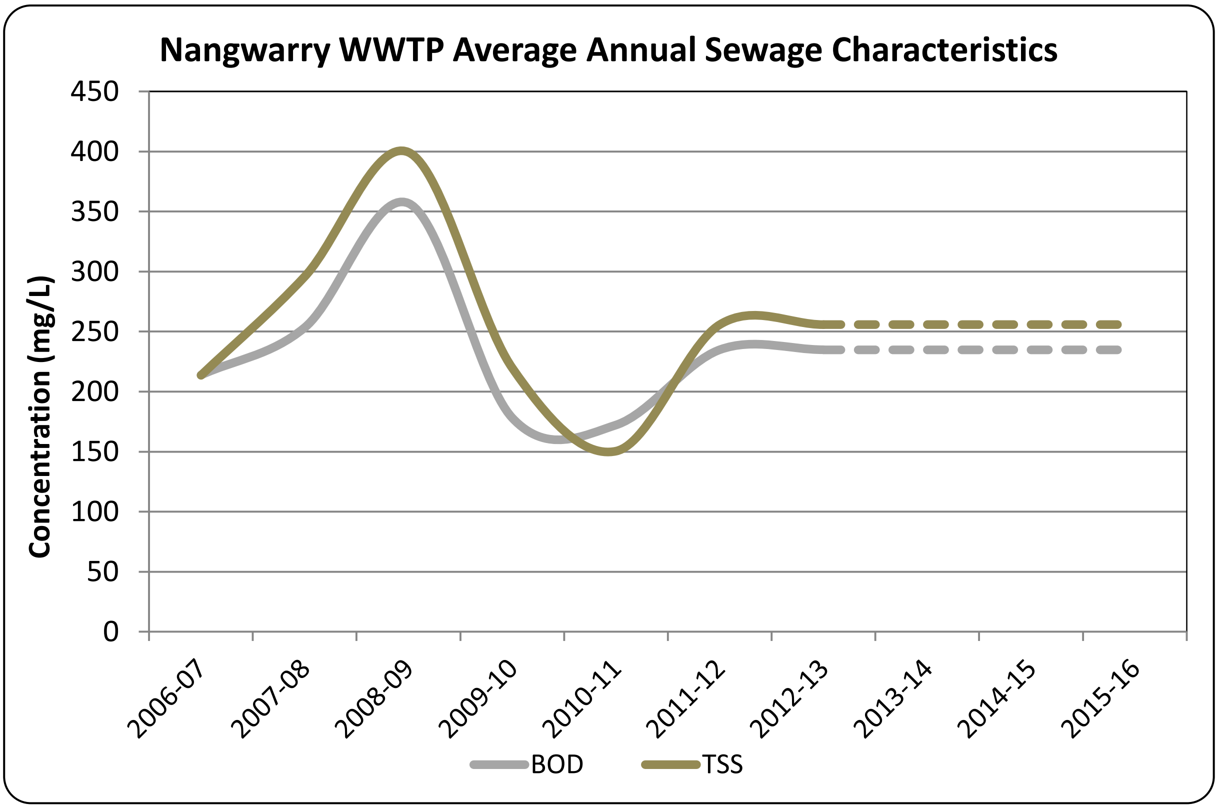


Figure 150



Note: for unknown reasons a number of sewage samples in 2008 were higher in BOD and SS concentration than typical for the plant. This produced the concentration and load peaks for these parameters shown in Figure 150. High rainfall in 2010-11 may have diluted sewage strength in this period.

Figure 151

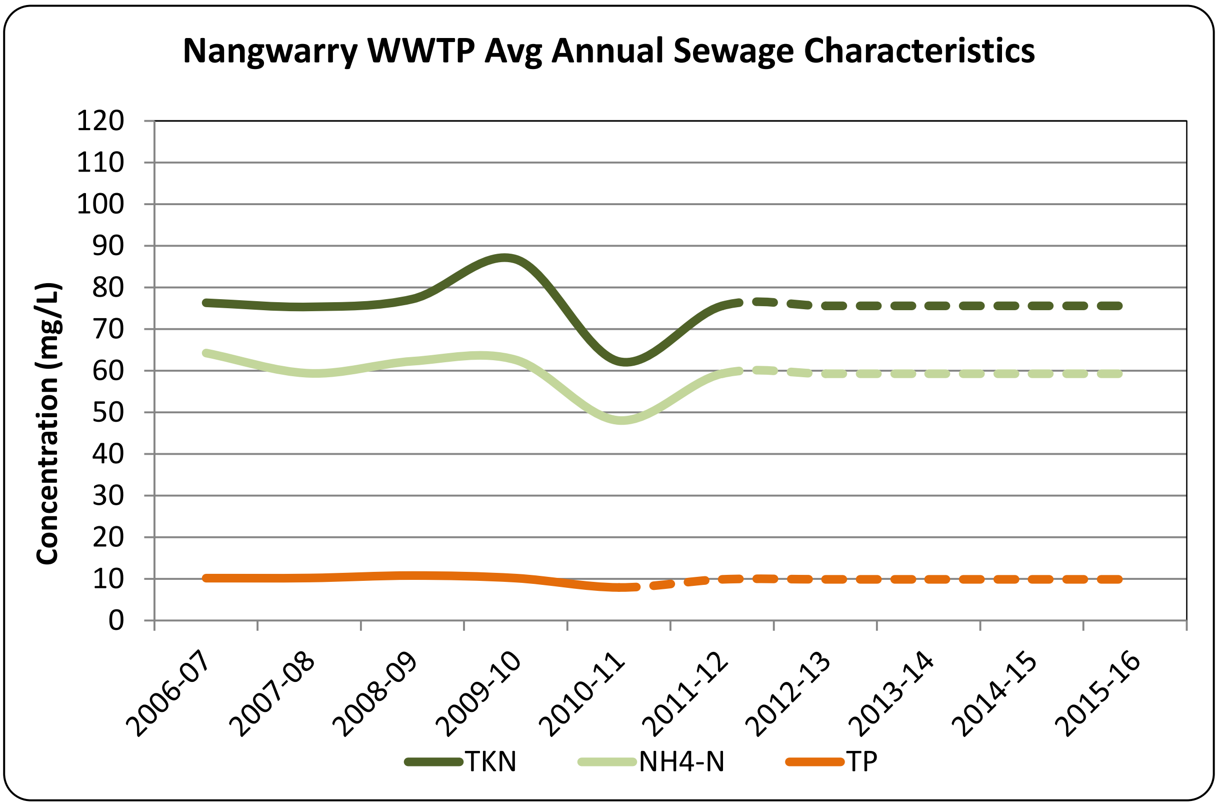


Figure 152

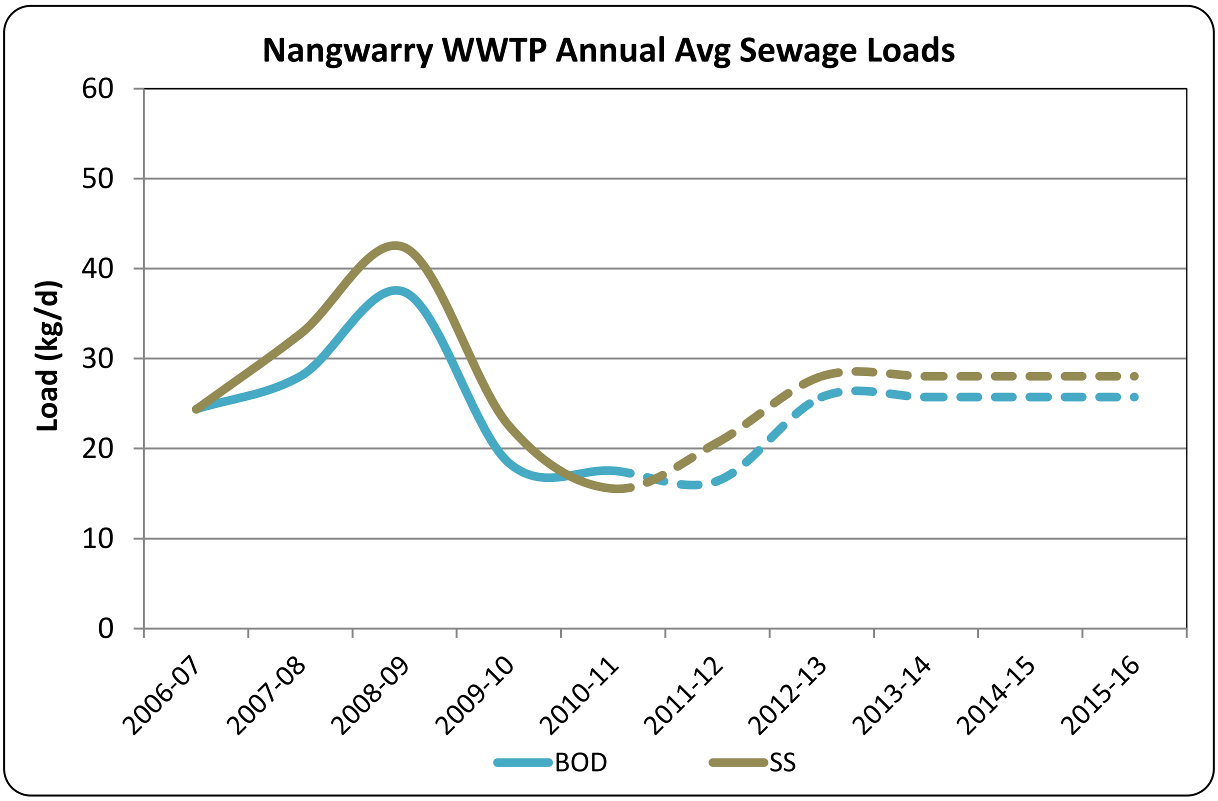
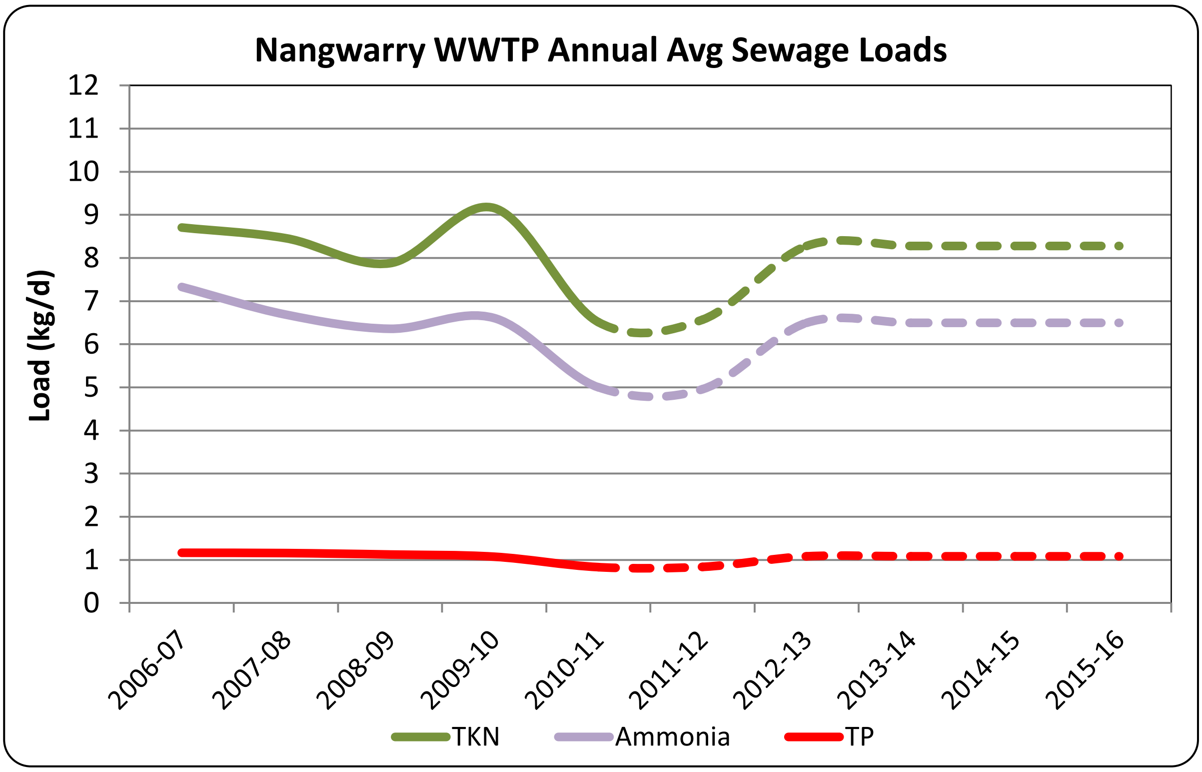


Figure 153



20.2. Key points

- The Nangwarry wastewater treatment plant was commissioned in 1963 and operated by the Woods and Forests Department until 1992, when SA Water took control of the Nangwarry township sewerage system. The plant was designed to serve a population of 1,250 persons, but the current population is only about 514 (2011 census).
- The plant uses conventional primary and secondary treatment processes. Wastewater is pumped into an Imhoff tank in which primary sedimentation and sludge digestion takes place. Primary effluent then gravitates to a biological (trickling) filter. Secondary effluent gravitates to an aerobic polishing lagoon and a portion is recycled to the head of the plant.
- Treated unchlorinated sewage overflows from the lagoon to a shallow channel and gravitates about 800m before discharging into a large wetland in the adjacent pine forest. Sludge withdrawn from the Imhoff tanks gravitates to two sludge drying beds. Dry sludge is currently removed from site and stored at Millicent or Finger Point WWTPs.

Key points - future:

- The population is relatively static and the wastewater treatment plant capacity is sufficient.
- Nangwarry WWTP is ranked as a “tier 2”[37] treatment plant by the EPA. Under the current licence there is a requirement to implement an EIP. However, the EPA has issues with the potential impacts on groundwater from the treated wastewater discharge and SA Water continues to negotiate with the EPA on a strategy for reducing impacts on groundwater.

[37] Refer to note to the attachment.

21. Naracoorte Wastewater Treatment Plant

21.1. Summary

Commissioned: The Naracoorte wastewater treatment plant was commissioned in 1962.

Treatment process: Screening and grit removal, followed by sedimentation, biological (trickling) filter for secondary treatment. Cold digestion of sludge in tanks.

Disposal of treated wastewater: Treated sewage is discharged into a natural lagoon which overflows into Naracoorte Creek.

Figure 154 Naracoorte wastewater treatment plant

Parameter	Design	Actual (2011-12)
Flows (Megalitres per day; ML/d)		
Average dry weather	1.310	0.788
Average annual	1.541	1.006
Peak month average	1.850	1.251
Peak day flow	2.620	2.392
Peak wet weather	3.930	n/a
Avg Influent Concentration (mg/L)		
Biochemical Oxygen Demand (BOD)	330	177
Suspended Solids (SS)	370	222
Total Kjeldahi Nitrogen (TKN)	n/a	65
Ammonia (NH_3-N)	n/a	48
Total Phosphorous (TP)	n/a	10
Avg Raw Wastewater Load (kg/dy)	n/a	
Biochemical Oxygen Demand (BOD)	508	188
Suspended Solids (SS)	572	234
Total Kjeldahl Nitrogen (TKN)	n/a	65
Ammonia (NH_3-N)	n/a	49

Population served[38]

2006 Census	2011 Census
4888	5691

[38] Indicative figures calculated for catchment area based on Australian Bureau of Statistics, 2006 (Naracoorte Urban Centre/Locality) and 2011 (Naracoorte Gazetted Locality) Census data, www.abs.gov.au.

Figure 155 Naracoorte plant schematics

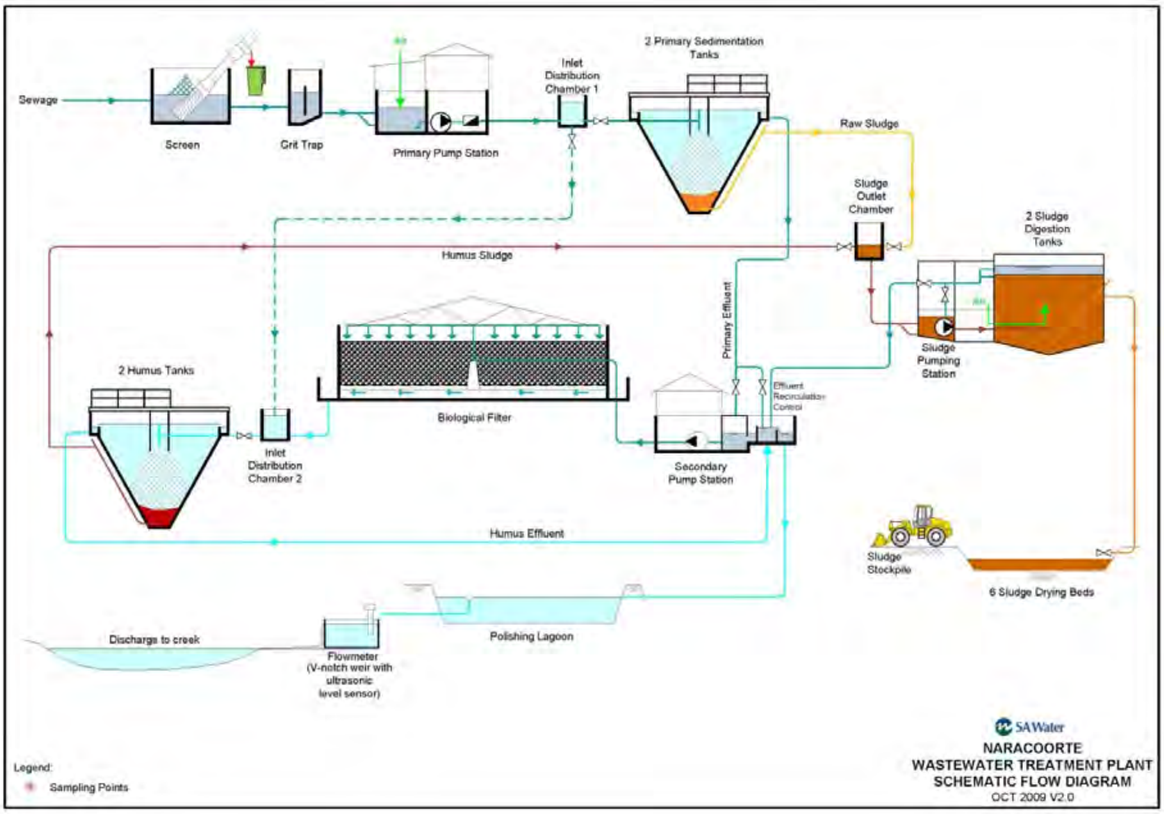


Figure 156 Naracoorte drainage area

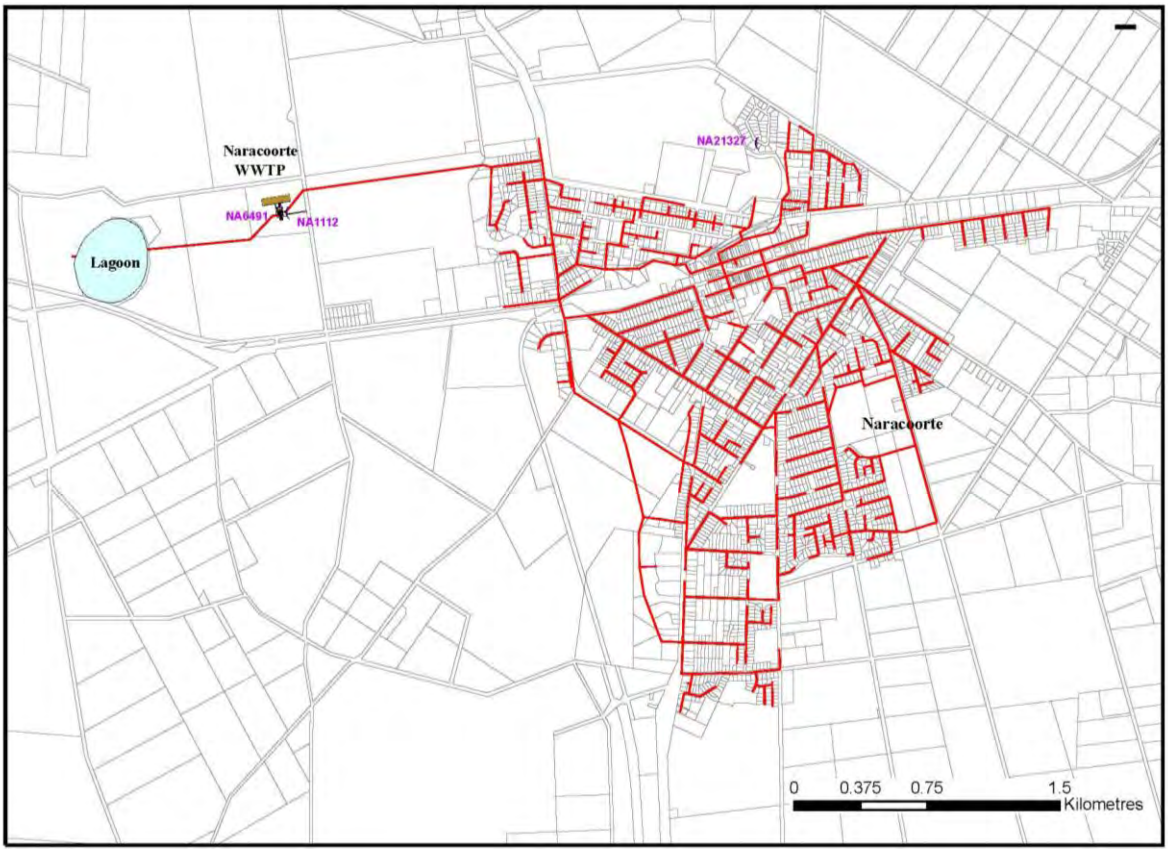


Figure 157

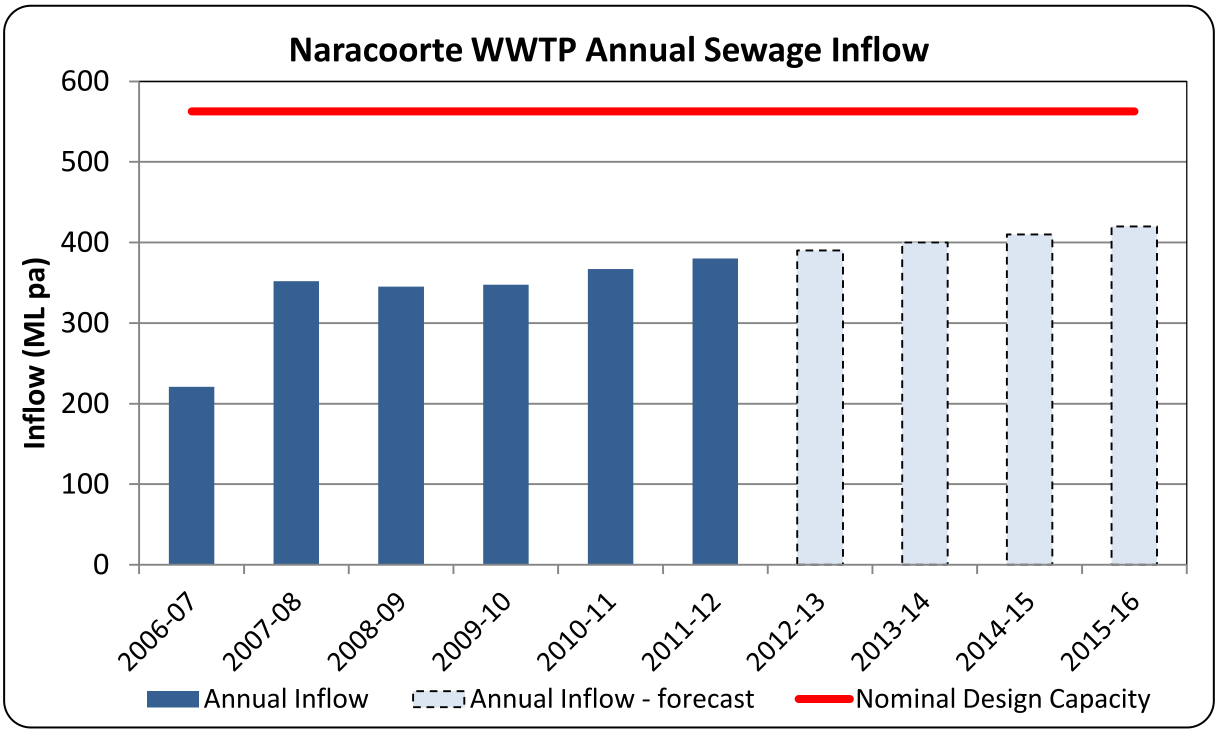


Figure 158

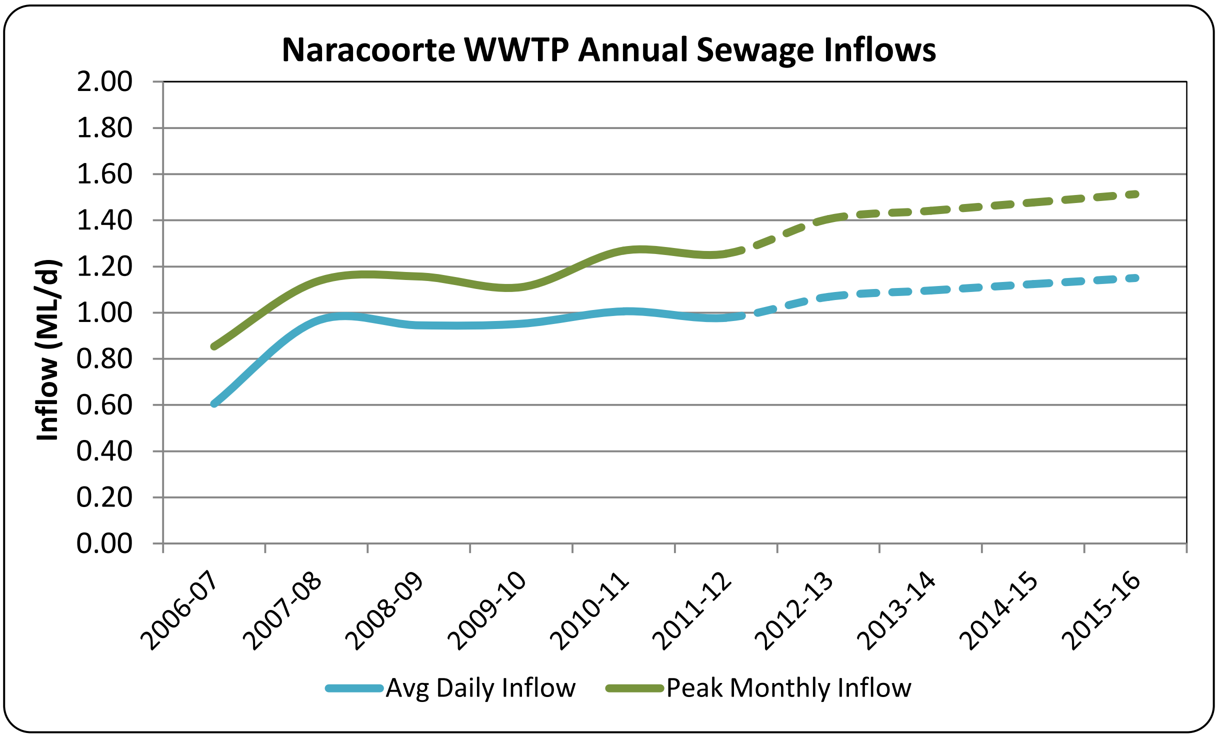


Figure 159

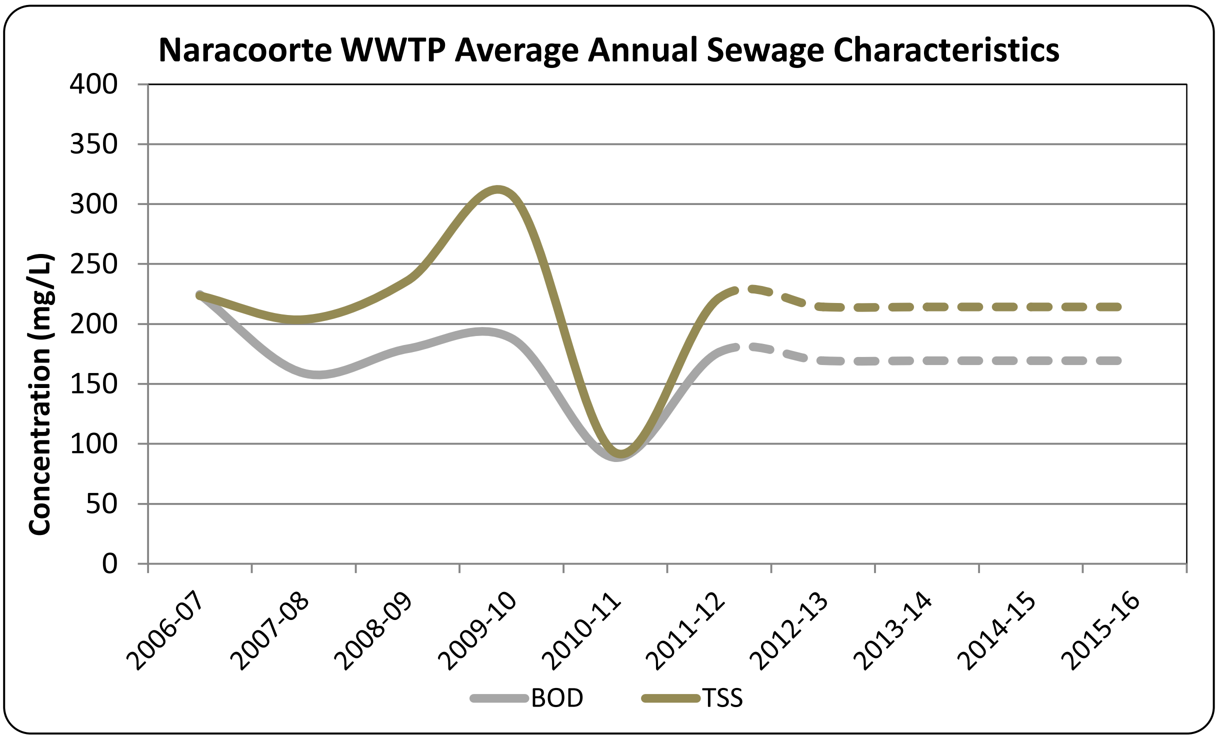


Figure 160

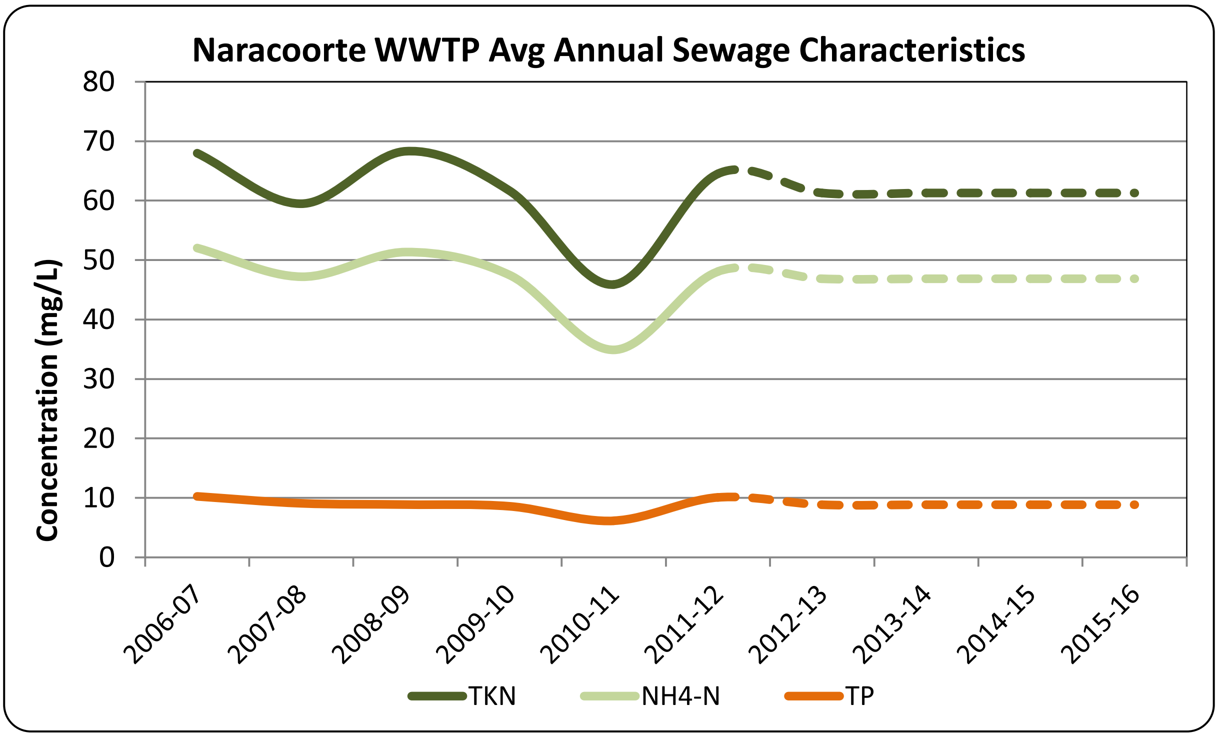


Figure 161

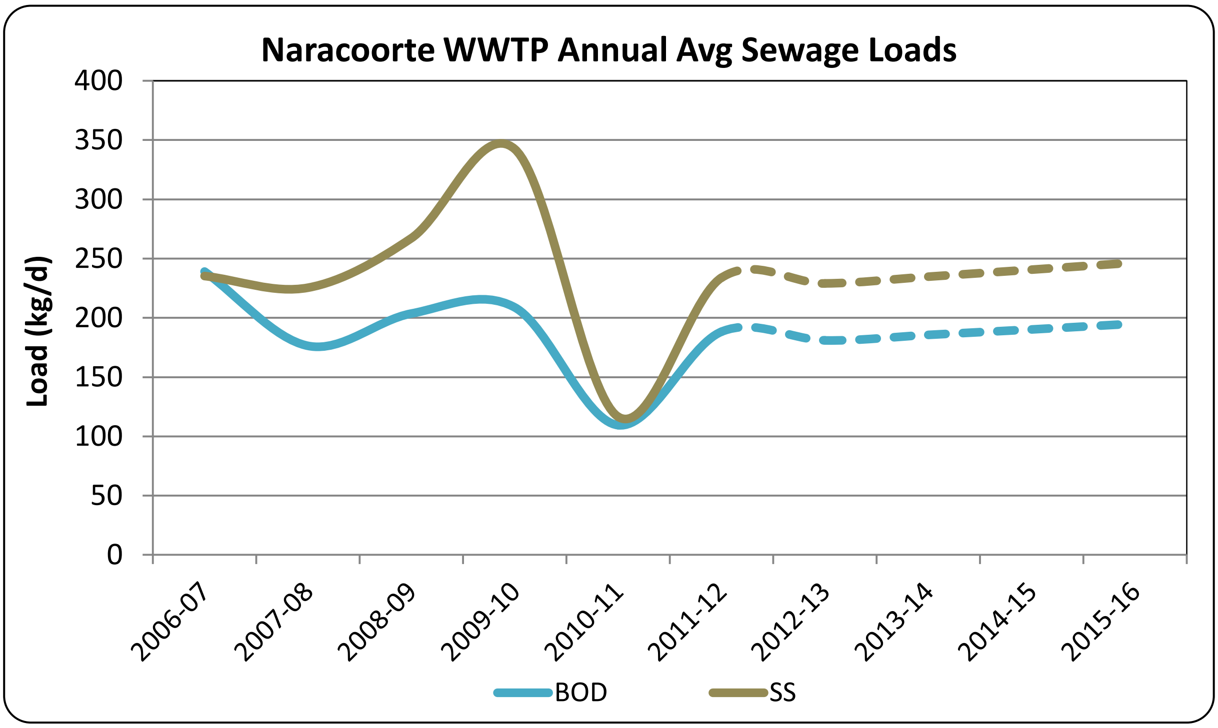
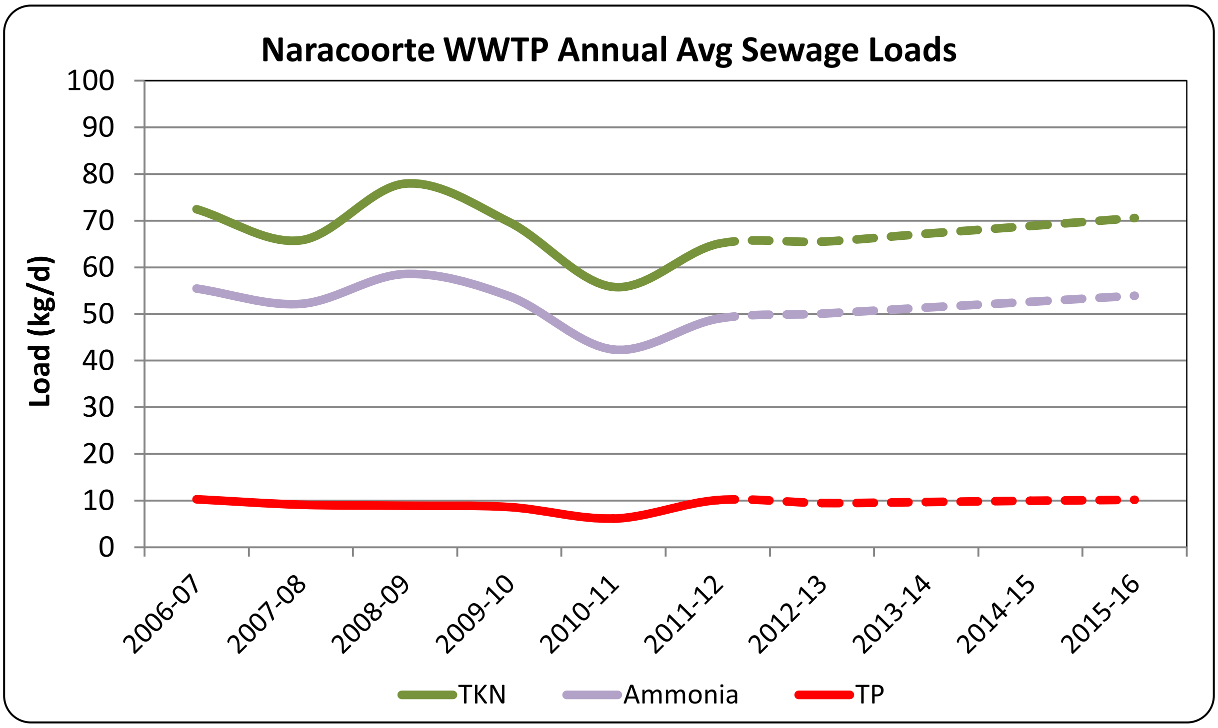


Figure 162



21.2. Key points

- The Naracoorte wastewater treatment plant was commissioned in 1962 and treats mainly domestic wastewater from the nearby township of Naracoorte. The plant was designed to serve a population of 9,000; however the town population was only 5,691 in the 2011 Census.

- The plant uses conventional primary and secondary treatment processes. Wastewater is screened and grit is removed before being pumped into two primary sedimentation tanks in which some solids settle out. Primary effluent is then pumped to a biological filter when carbonaceous pollutants are removed.

- Secondary effluent gravitates from the filter to two Humus Tanks in which secondary sedimentation takes place. Clarified Humus effluent gravitates to a natural polishing lagoon and a portion is recycled to the biological filter.

- The lagoon (or “salina”) is located 750 metres to the west of the plant. Effluent from this lagoon overflows into Naracoorte Creek, which drains into Drain E, Marcollat watercourse, Tilley Swamp and ultimately the Coorong at Salt Creek.

- Sludge withdrawn from the primary sedimentation tanks is sent to six sludge drying beds. Dry sludge is mechanically removed and stored on site for at least three years then removed for land application.

Key points - future:

- The population served by Naracoorte WWTP is expected to rise slightly in the near future due to growth in the wine industry and a surge in housing development.

- Naracoorte Waste Water Treatment Plant is ranked as a “tier 1”[39] treatment plant by the EPA. Under the current licence there is a requirement to implement an EIP and capital works to meet obligations are proposed for the forthcoming regulatory period.

[39] Refer to notes to the attachment.

22. Port Augusta East Wastewater Treatment Plant

22.1. Summary

Commissioned: Port Augusta East WWTP was commissioned in 1980.

Treatment process: Two aerated lagoons (using mechanical surface aerators) and two polishing lagoons.

Disposal of treated wastewater: Discharge into a coastal mangroves in Spencers Gulf via a creek.

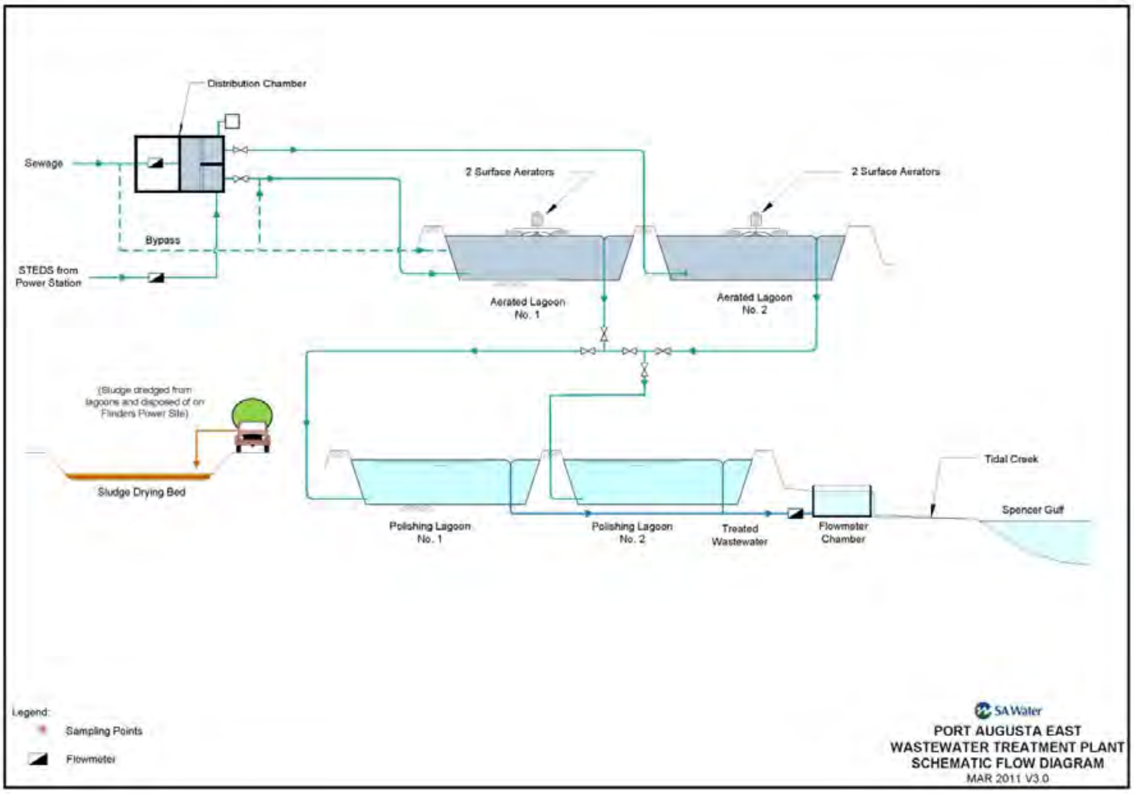
Figure 163 Port Augusta East wastewater treatment plant aerated lagoon

Parameter	Design	Actual (2010-11)
Flows (Megalitres per day; ML/d)		
Average dry weather	2.24	1.379
Average annual	2.66	1.514
Peak month average	3.19	1.595
Peak day flow	4.48	2.769
Peak wet weather	6.72	n/a
Avg Influent Concentration (mg/L)		
Biochemical Oxygen Demand (BOD)	375	154
Suspended Solids (SS)	375	115
Avg Raw Wastewater Load (kg/dy)		
Biochemical Oxygen Demand (BOD)	840	243
Suspended Solids (SS)	840	182

Population served (East and West WWTPs combined)[40]

2006 Census	2011 Census
13,874	13,985

Figure 164 Port Augusta East plant schematics



[40] Indicative figures for catchment area based on Australian Bureau of Statistics, 2006 and 2011 Census data, www.abs.gov.au.

Figure 165 Port Augusta East drainage area

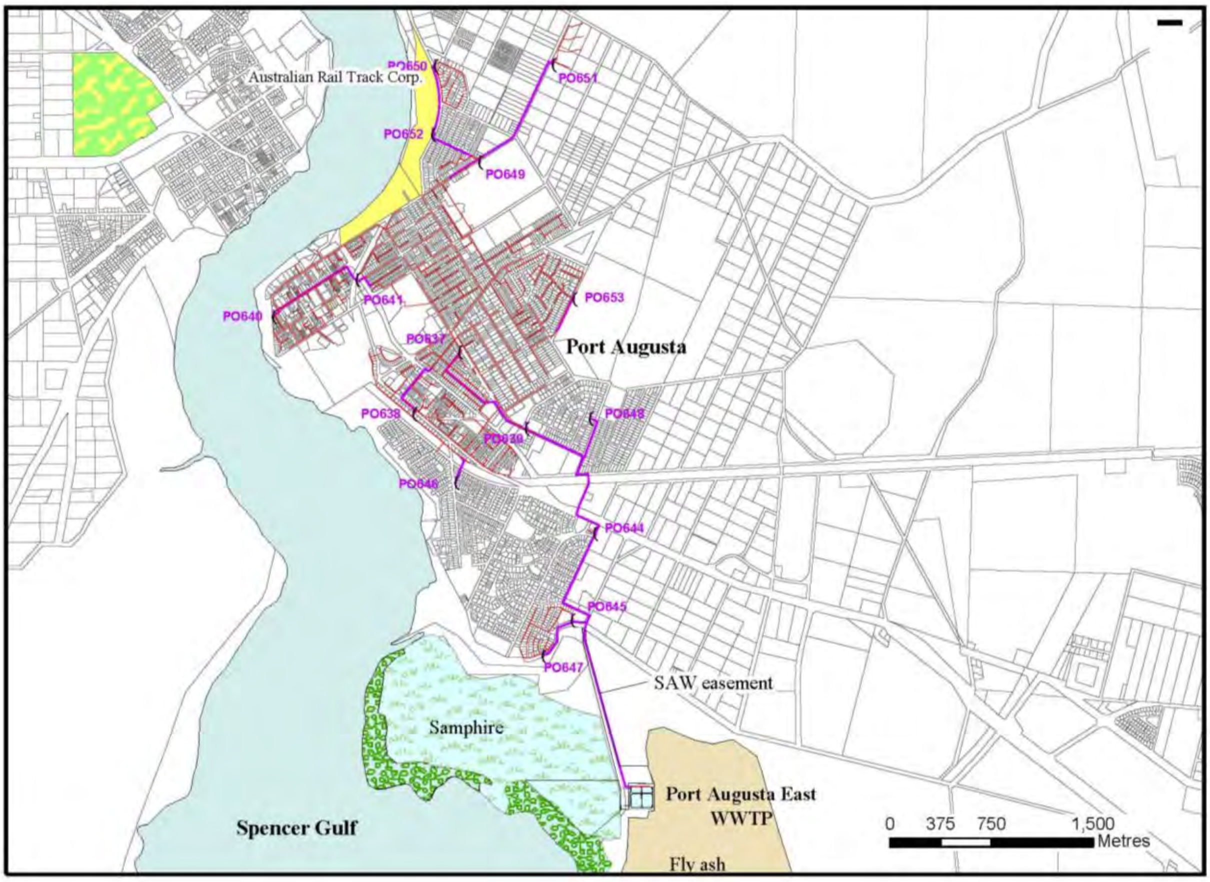


Figure 166

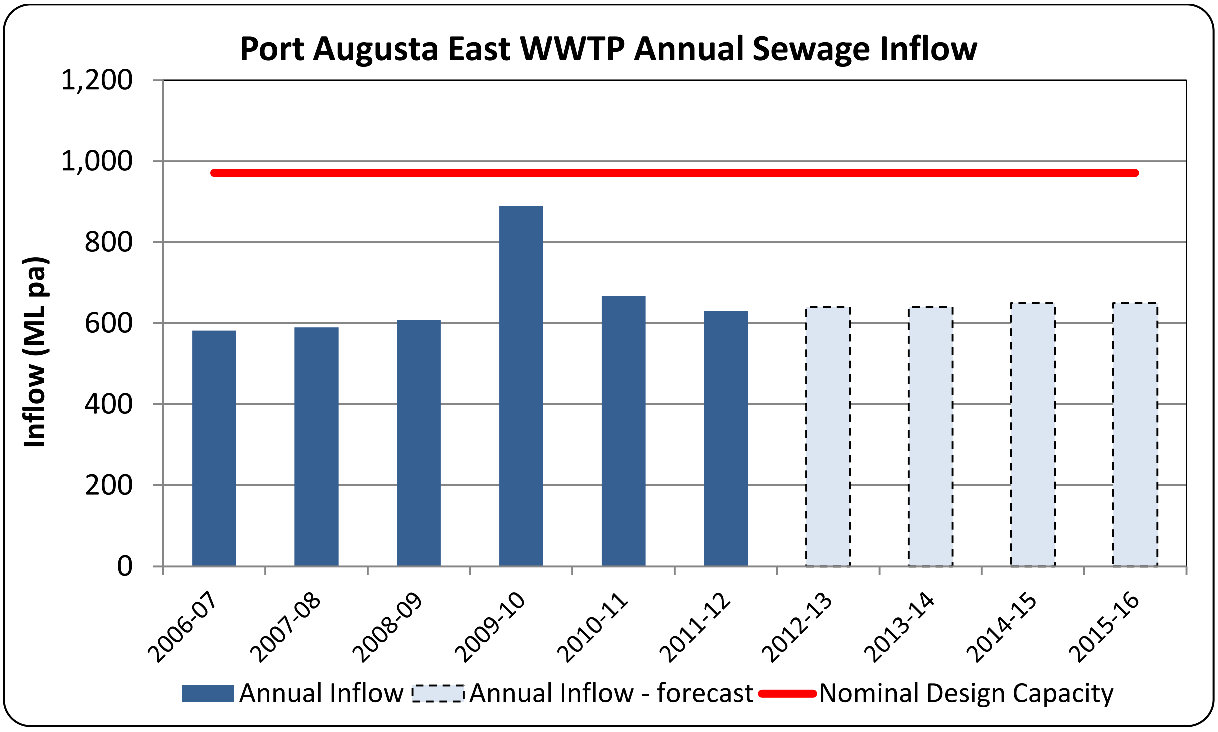


Figure 167

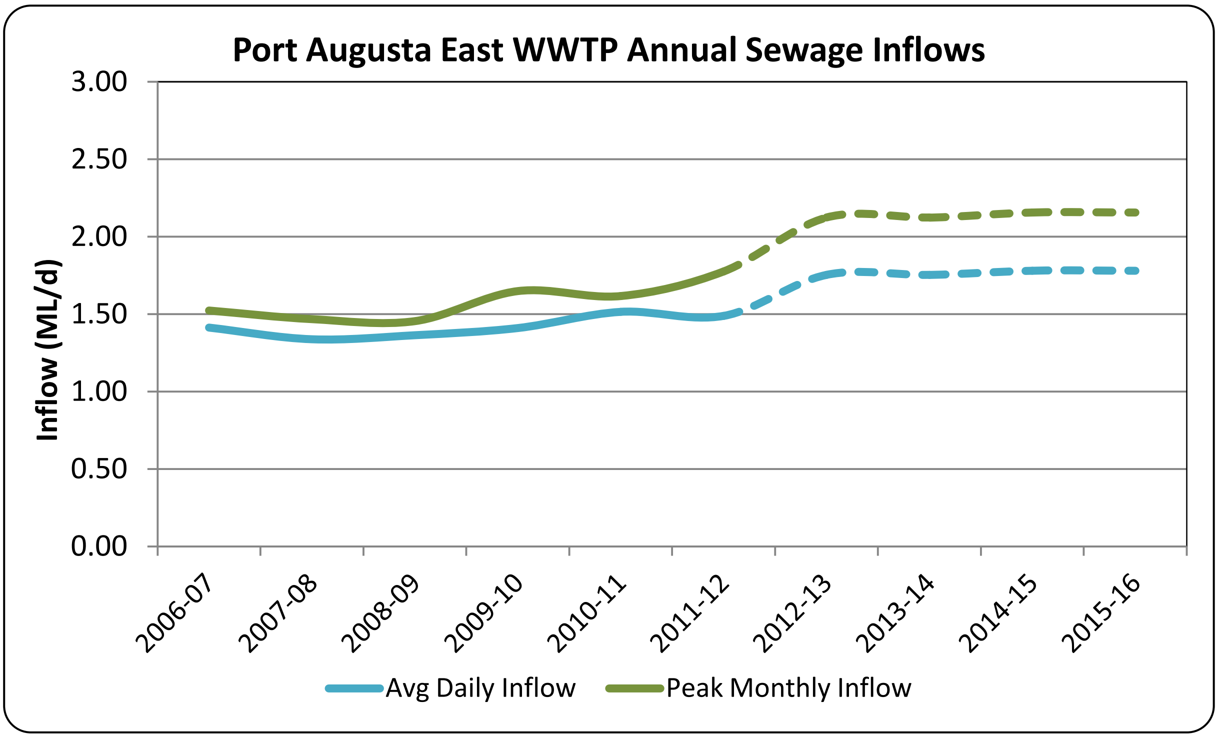


Figure 168

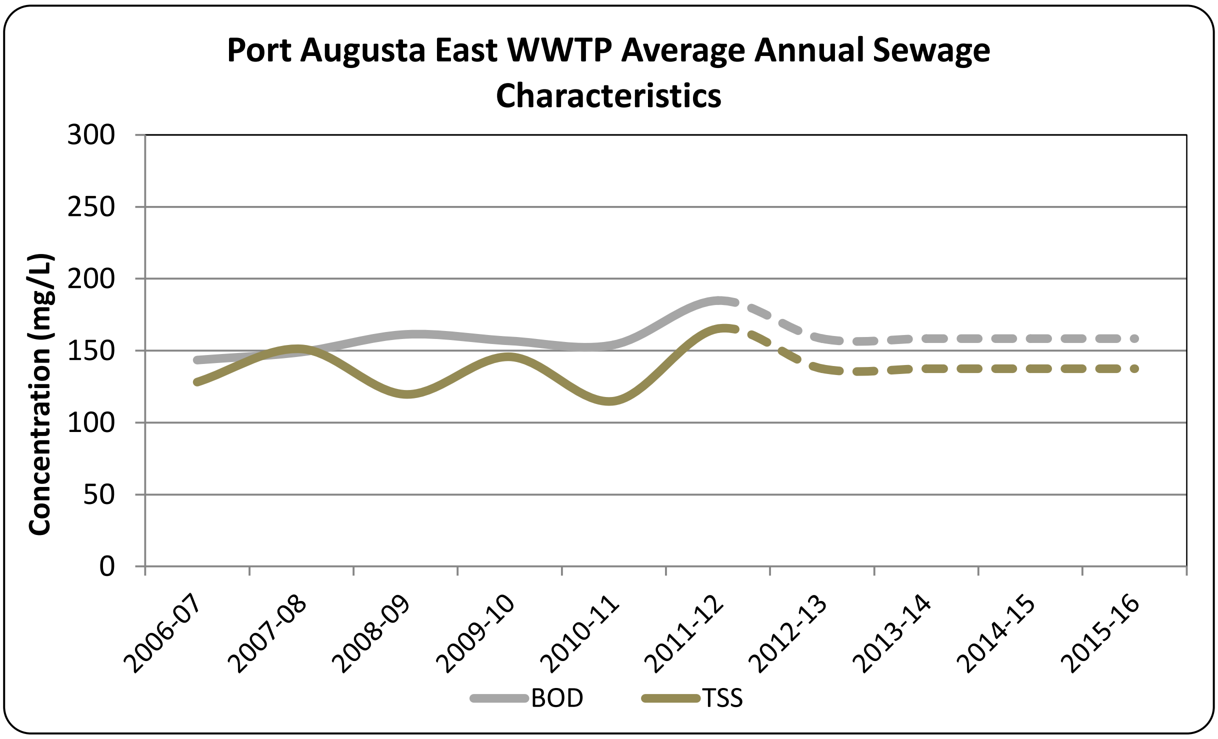


Figure 169

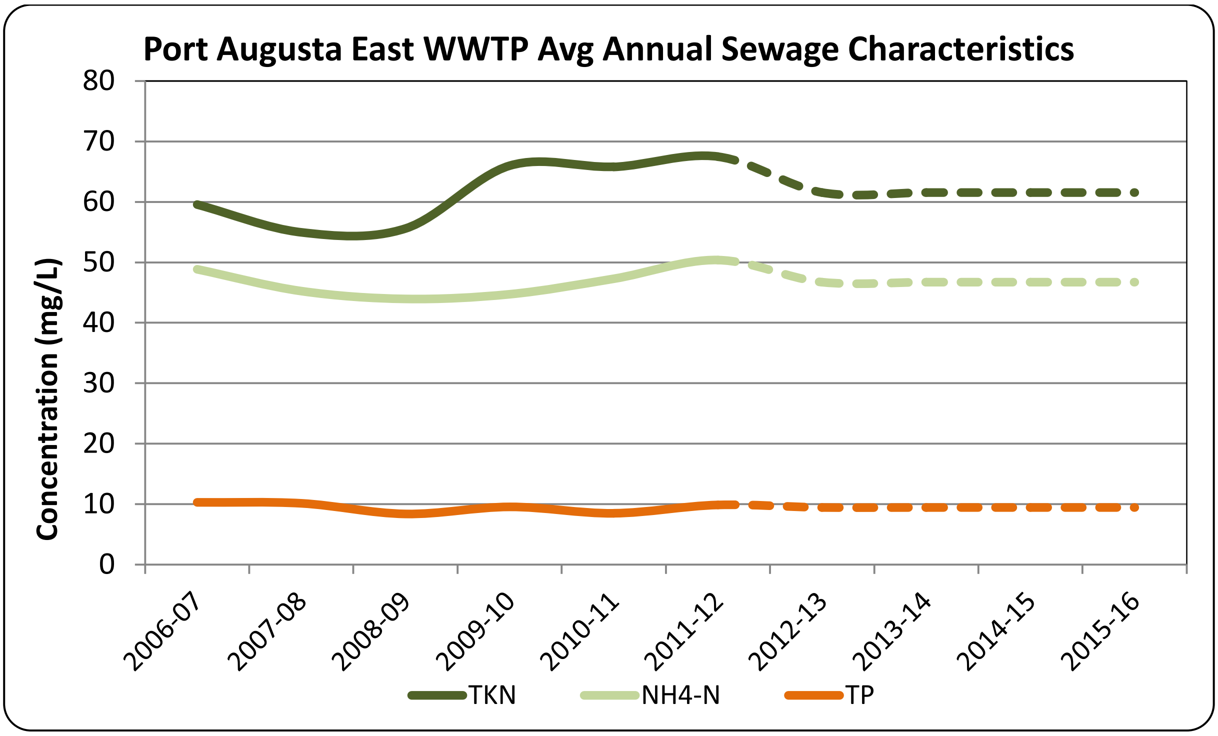


Figure 170

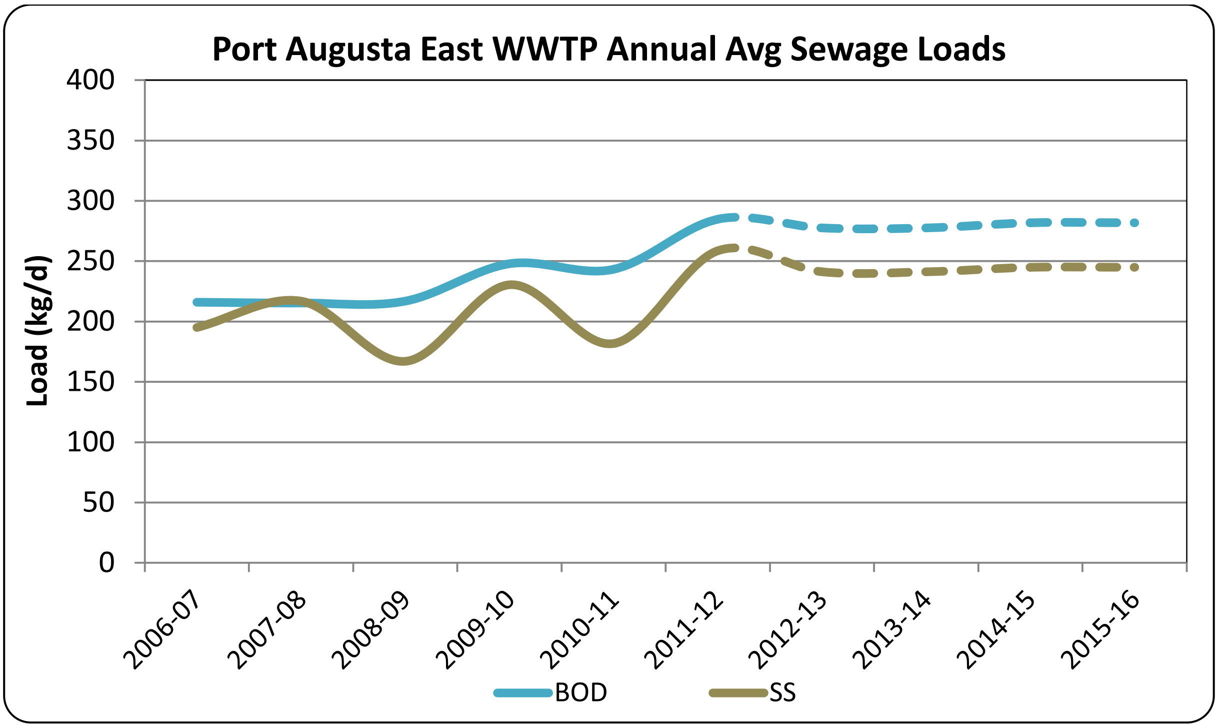
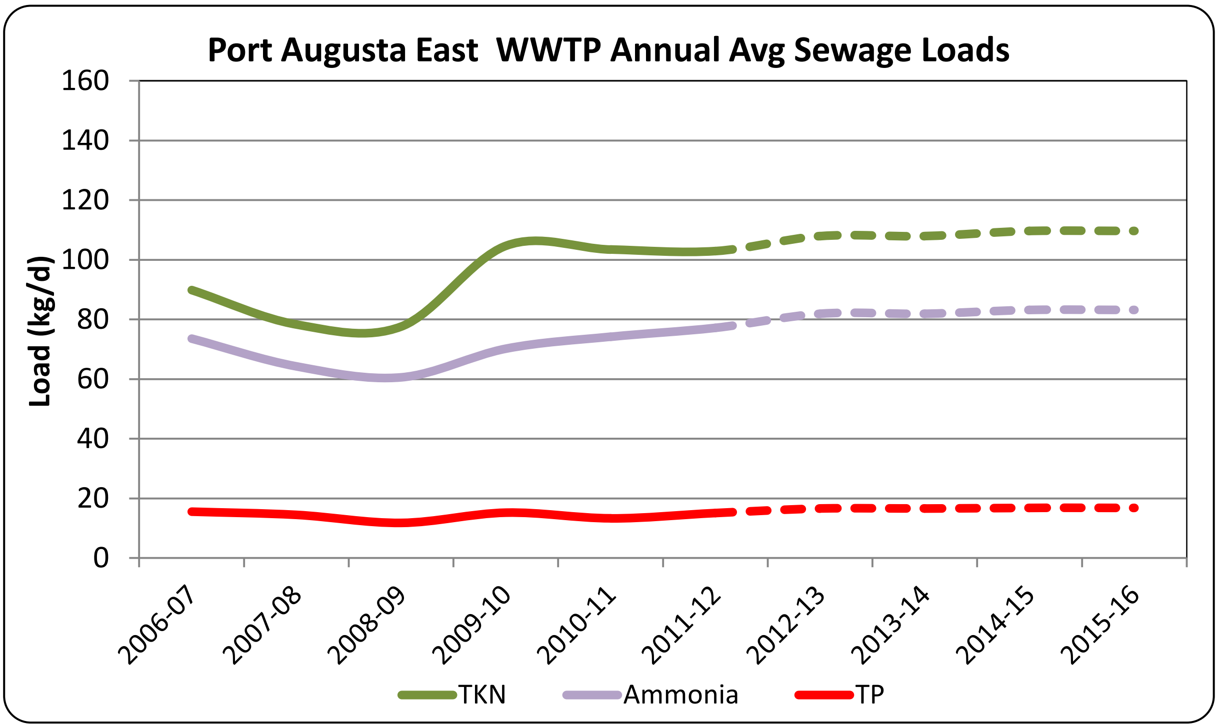


Figure 171



22.2. Key points

- The City of Port Augusta is situated on both sides of the Upper Spencer Gulf and separate sewerage systems and wastewater treatment plants serve each side. Port Augusta East wastewater treatment plant was commissioned in 1980 and receives domestic and commercial wastewater from the eastern side of the City of Port Augusta. Design capacity was for a population of 14,000 and the current population served is about 7,336 (2011 Census).

- The plant is located to the south of the city and is surrounded on three sides by land owned by Alinta Energy, which operates the nearby power generation station. Alinta Energy uses the surrounding land as a fly ash disposal area. SA Water holds easements on an access road owned by Alinta Energy and on a portion of land abutting the northern boundary of the plant which is used for sludge drying. SA Water owns a portion of the land to the west of the plant on which the treated wastewater is discharged and flows into a tidal creek, through an area of mangrove and samphire to Spencer Gulf, about 500m away.

- The plant consists of two aerated lagoons operating in parallel, and two facultative lagoons operating in parallel. Each of the aerated lagoons is aerated by two floating surface aerators in continuous operation. The facultative lagoons allow settling and anaerobic digestion of sludge solids on the lagoon floor.

- Facultative lagoons are periodically dredged and the solids pumped to an informal containment area in the ash adjacent to the wastewater treatment plant. Subsequent depositions of fly ash encapsulates the biosolids.

- Due to the dumping of fly ash on land around the WWTP site, the land height is increasing at a rate of about 300mm/year and, after any new sludge storage area is created, it has a maximum of only five years before rising fly ash covers the area.

- SA Water has an agreement with Alinta Energy to dispose of sludge on Alinta's land and an agreement with EPA to dispose of sludge on SA Water owned land. The EPA considers that the agreement does not extend to Alinta Energy owned land. If the EPA objects to sludge disposal adjacent to the plant, then sludge will have to be mechanically dewatered and trucked to Port Augusta West WWTP.

Key points - future:

- The local prison has been connected to the SA Water sewer network and the pumping infrastructure is in the process of being commissioned. Planned future residential developments in the Stirling North area may increase loads on the Port Augusta East WWTP, but an agreement on the network augmentation strategy and associated costs is yet to be reached. Planning SA and local government have indicated a potential for strong growth in the area.

- The fly ash disposal surrounding the plant limits the long-term use of the current Port Augusta East site and land for a future new plant has been purchased. Planning investigations have been undertaken regarding an appropriate long-term strategy for wastewater treatment and sludge disposal at Port Augusta and a project is proposed for the regulatory period to expand sludge handling and drying facilities within the Port Augusta area.

- Port Augusta East wastewater treatment plant is ranked as a "tier 2"[41] treatment plant by the EPA. Under the current licence there is no requirement for an EIP.

- EPA has expressed concern in the past, that sludge disposal into the fly ash is not acceptable. However, they have allowed the practice to continue.

- The EPA has recently expressed concern regarding the treated wastewater discharge pollutant concentrations and loads from Port Augusta East WWTP and the impacts of future population growth. Discussions are continuing.

[41] Refer to notes to the attachment.

23. Port Augusta West Wastewater Treatment Plant

23.1. Summary

Commissioned:	The Port Augusta West Wastewater Treatment Plant (WWTP) was commissioned in 1977.
Treatment process:	An aerated lagoon followed by two polishing lagoon. Lagoons are de-sludged periodically and sludge stored on site.
Disposal of treated wastewater:	Treated wastewater is reused to irrigate the nearby Port Augusta Golf Course. Surplus treated wastewater is disposed of to Dempsey's Lake.

Figure 172 Port Augusta West wastewater treatment plant

Figure 173 Port Augusta West wastewater treatment plant – mechanical aerator at end of walkway

Parameter	**Design**	**Actual (2010/11)**
Flows (Megalitres per day ; ML/d)		
Average dry weather	1.120	0.555
Average annual	1.260	0.752
Peak month average	1.512	0.847
Peak day flow	2.240	1.009
Peak wet weather	3.360	n/a
Avg Influent Concentration (mg/L)		
Biochemical Oxygen Demand (BOD)	375	261
Suspended Solids (SS)	375	248
Total Kjeldahi Nitrogen (TKN)	n/a	71
Ammonia (NH_3-N)	n/a	54
Total Phosphorous (TP)	n/a	12
Avg Raw Wastewater Load (kg/dy)		
Biochemical Oxygen Demand (BOD)	420	183
Suspended Solids (SS)	420	173
Total Kjeldahl Nitrogen (TKN)	n/a	49
Ammonia (NH_3-N)	n/a	8

Population served (East and West WWTPs combined)[42]

2006 Census	**2011 Census**
13,874	13,985

[42] Indicative figures for catchment area based on Australian Bureau of Statistics, 2006 and 2011 Census data, www.abs.gov.au.

Figure 174 Port Augusta West plant schematics

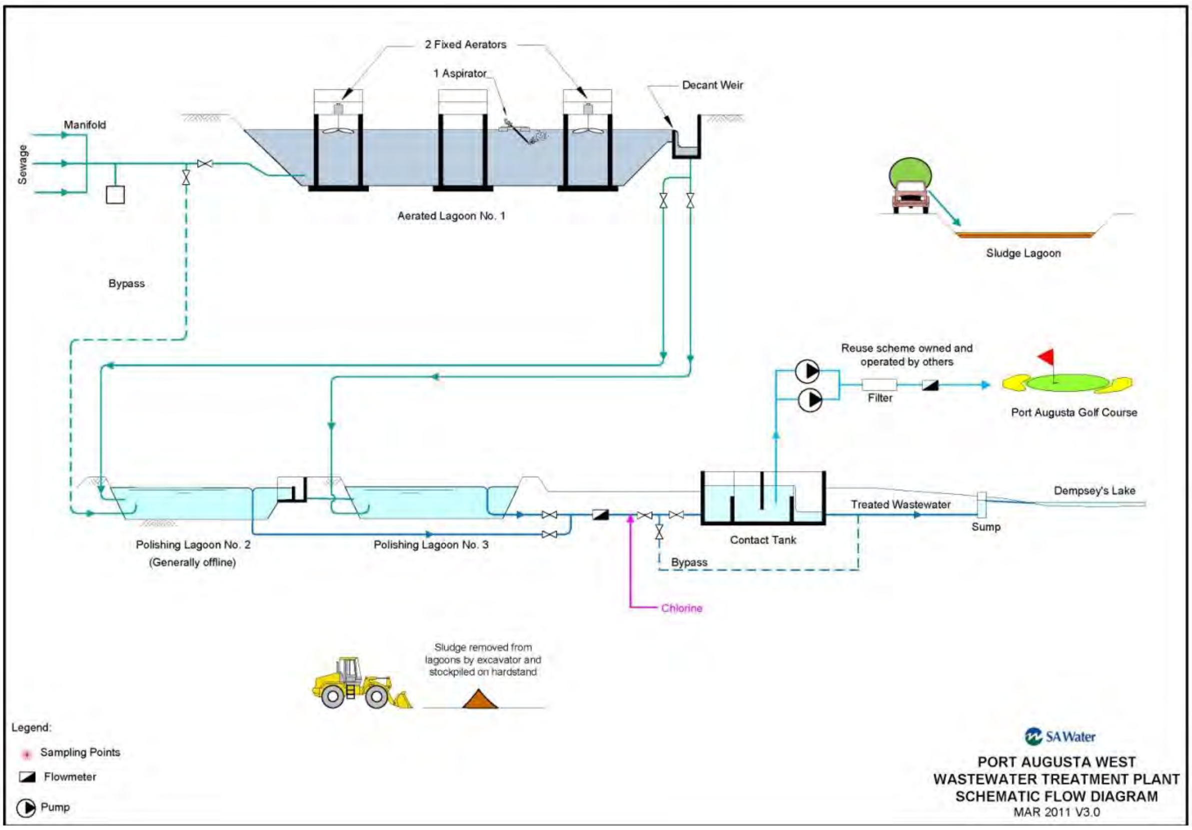


Figure 175 Port Augusta West drainage area

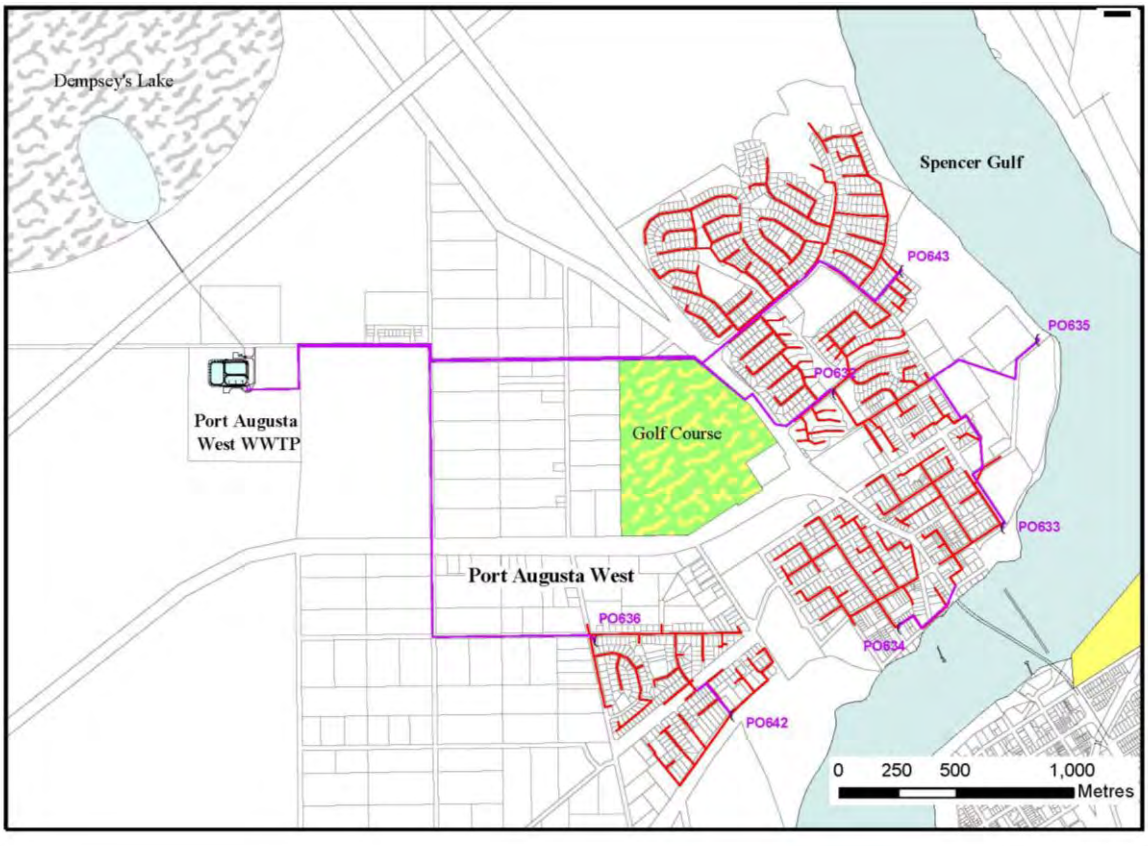


Figure 176

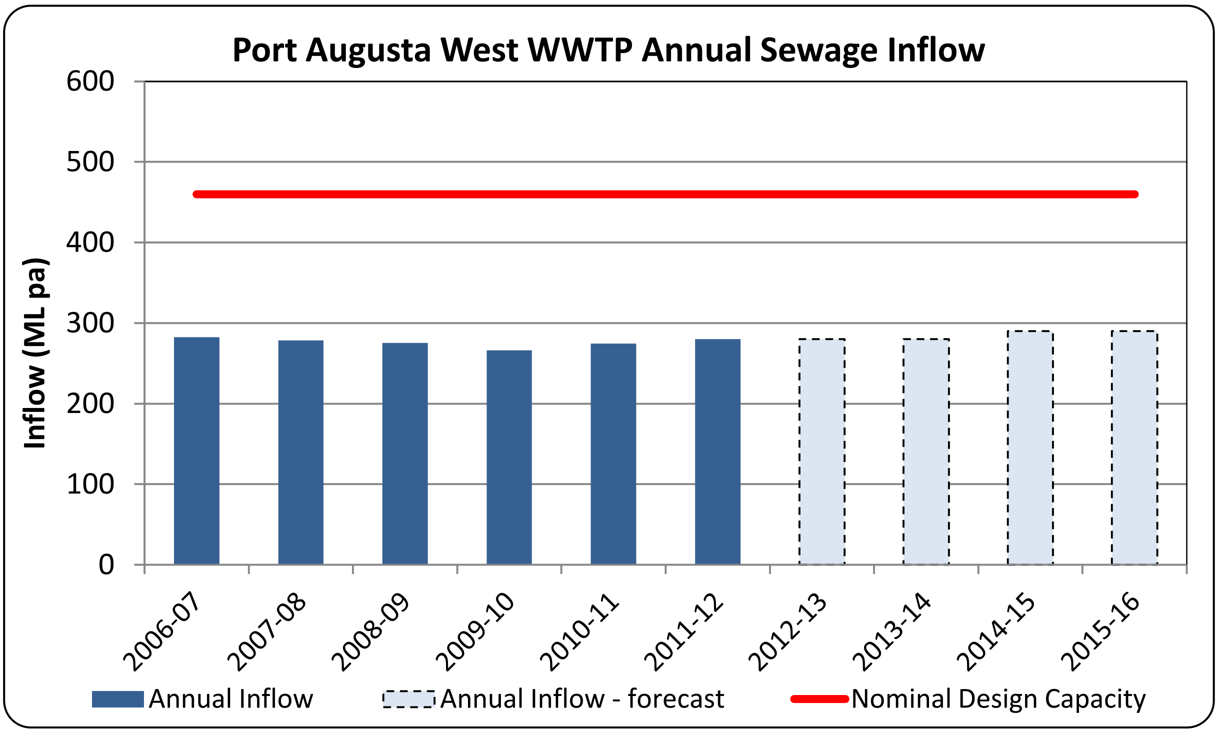


Figure 177

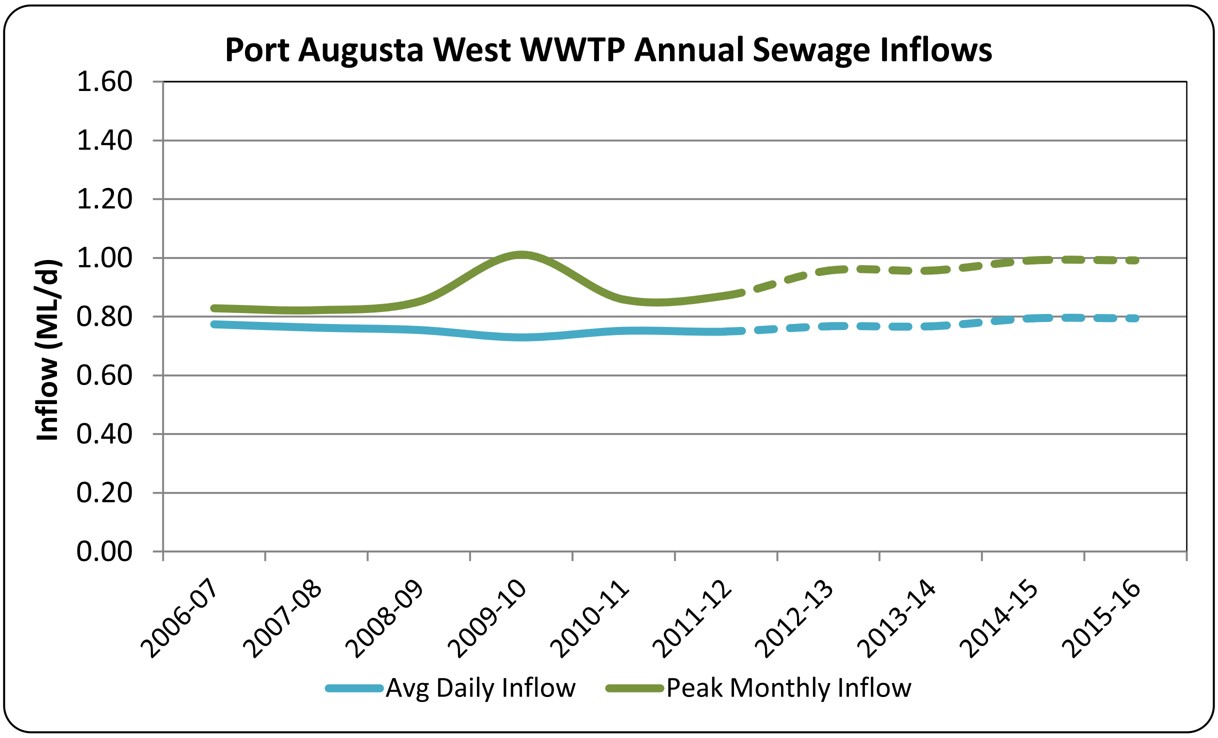


Figure 178

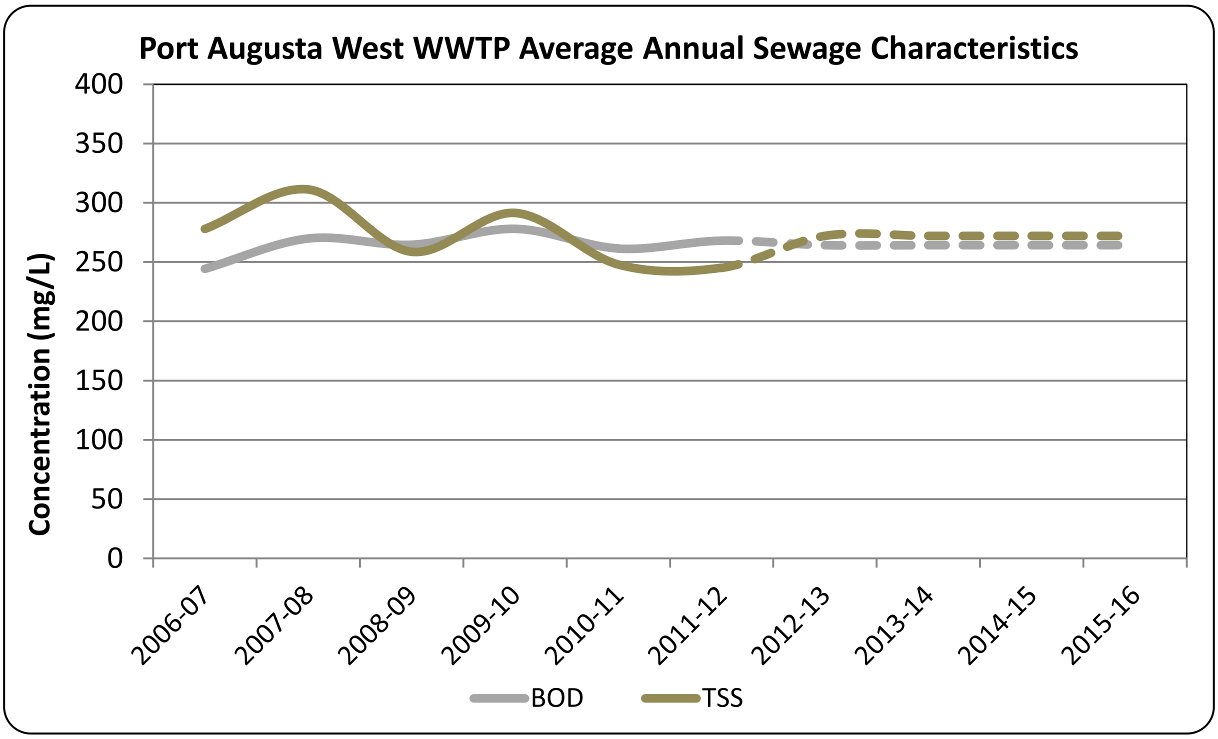


Figure 179

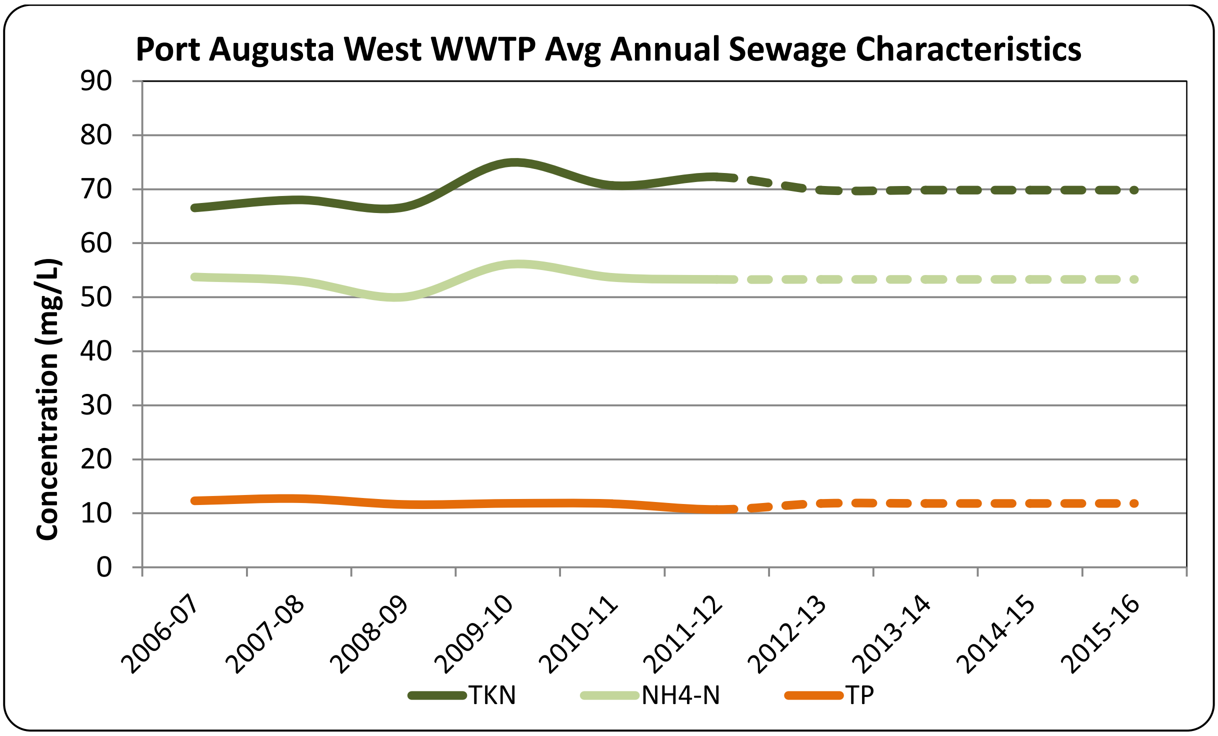


Figure 180

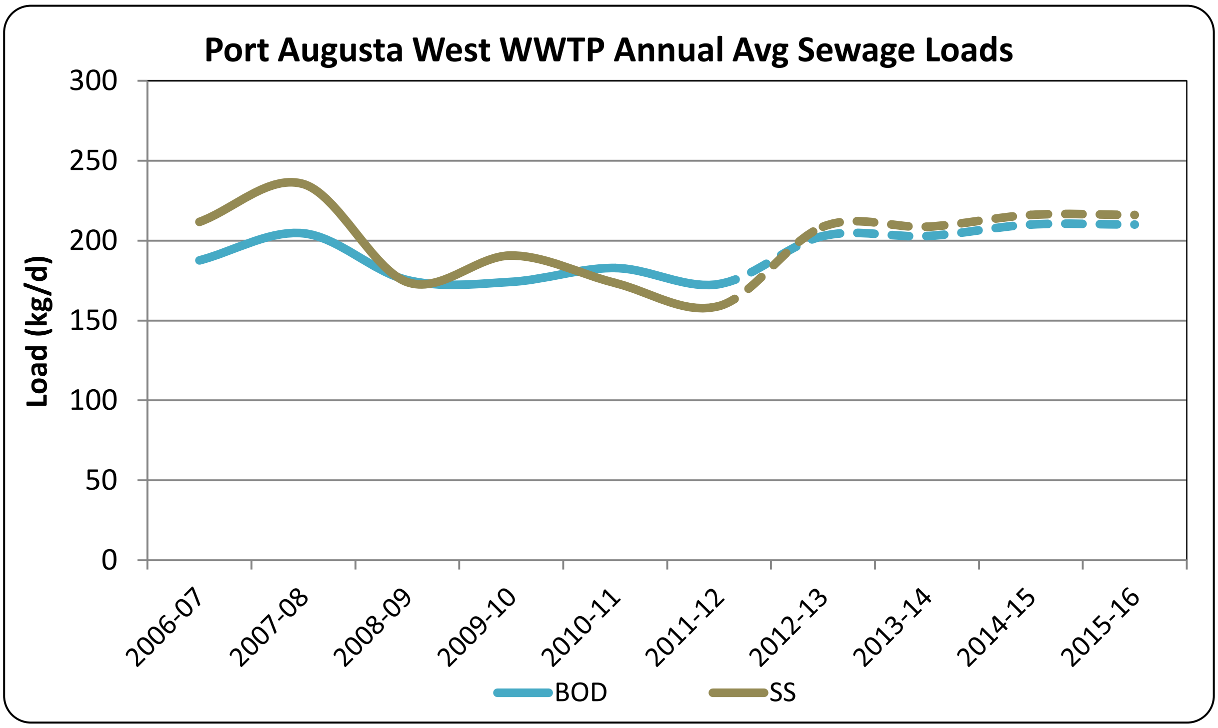
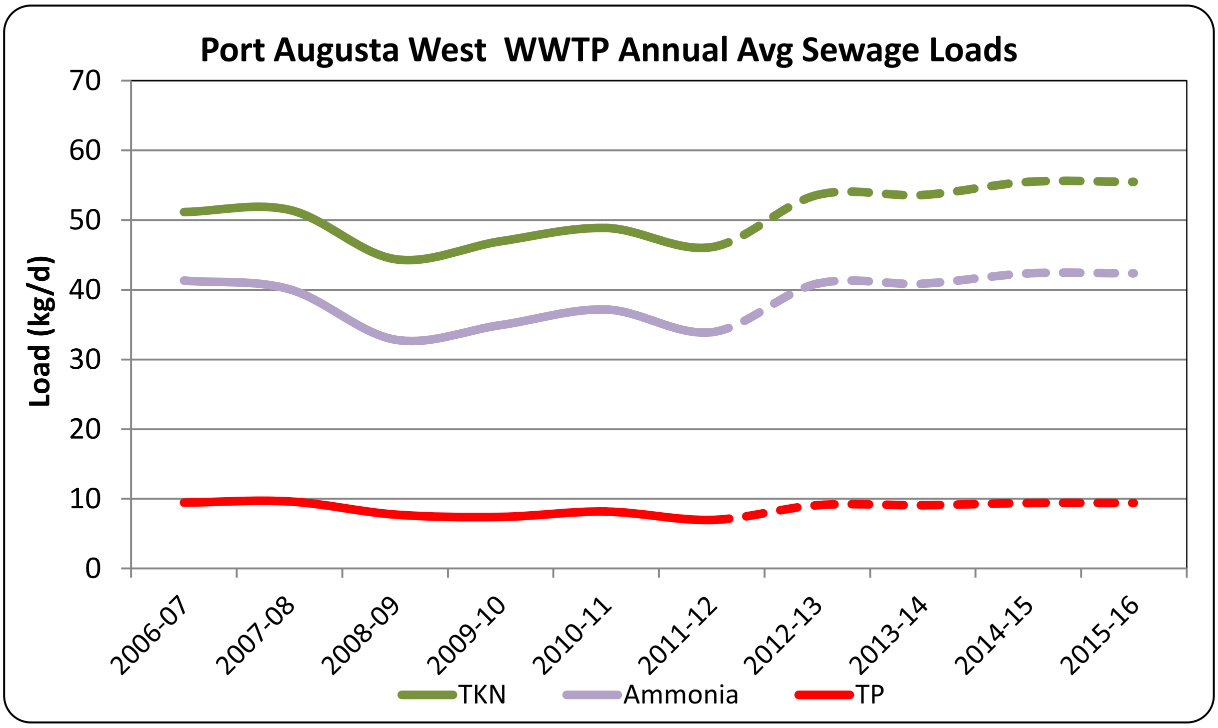


Figure 181



23.2. Key points

- The City of Port Augusta is situated on both sides of the Upper Spencer Gulf and separate sewerage systems and wastewater treatment plants serve each side. The Port Augusta West plant was commissioned in 1977 and receives domestic wastewater from the City of Port Augusta.

- The plant consists of a single aerated lagoon and two facultative lagoons. Aeration was originally provided by three platform mounted surface aerators designed to provide mixing that will maintain all biological solids in suspension, and allow some primary solids entering the lagoon to settle. The effluent gravitates to a facultative lagoon in which settling and anaerobic digestion of the sludge solids takes place on the lagoon floor. The second lagoon is drawn down over summer to maximise reuse and used to minimise discharges to Dempsey's Lake and provide a nearby golf course with additional water at the start of summer. Septic waste is currently received into an informal basin alongside the plant.

- Most of the treated wastewater is chlorinated and reused on a golf course, situated about 1.5km to the east. The golf club owns and operates the reuse scheme which includes a screen, pump and filter. Surplus reclaimed wastewater is chlorinated and discharged to Dempsey's Lake, a natural salt lake to the north-west, where it evaporates.

- One facultative lagoon is periodically taken out of service to enable the drying and removal of digested sludge. Sludge is removed, dried and stored on the western boundary of the plant for at least three years prior to removal for land application. A sludge storage hardstand area was constructed in 2010.

- The concrete walkways where the mechanical aerators are installed have deteriorated over time and it is considered unsafe for operators to access the equipment.

- The walkway mounted aerators also have reached the end of their service life. In 2012 three floating Aire-O_2 5.5 kW aerators were installed and moored to the walkways, but they quickly became fouled with a build up of rags (known as "ragging"). Lower power aerators have been substituted temporarily. It is planned to drain the aeration basin in the near future to remove the accumulated sludge and rags before installing the new aerators.

Key points - future:

- Historically, population growth in Port Augusta is small but steady. However, Planning SA and local government have indicated a potential for strong growth.

- The plant currently accepts unscreened raw wastewater. Installation of coarse screens to reduce the quantity of rags entering the aerated basin may be needed for the new aerators to perform in the long-term without ragging problems.

- Port Augusta West WWTP is ranked as a "tier 3"[43] treatment plant by the EPA. Under the current licence there is no requirement for an EIP. The reuse scheme approval conditions from the Department of Health and Ageing will be updated in the near future to ensure compliance with the 2006 Australian Guidelines for Water Recycling and a risk management plan will be prepared.

[43] Refer to notes to the attachment.

24. Port Lincoln Wastewater Treatment Plant

24.1. Summary

Commissioned: The Port Lincoln wastewater treatment plant was commissioned in 1994.

Treatment process: A screen and grit removal facility, followed by two aeration basins operated as an activated sludge intermittent decant extended aeration process, discharging into two polishing lagoons.

Disposal of treated wastewater: Discharge from the polishing lagoons enters coastal marine waters through an outfall pipe through a diffuser at a water depth of about 6 metres. Some treated wastewater undergoes tertiary treatment through a Council owned filtration plant operated by SA Water and is reused for irrigation of playing fields by the Port Lincoln City Council.

Figure 182 Port Lincoln wastewater treatment plant

Parameter	Design	Actual (2010-11)
Flows (Megalitres per day; ML/d)		
Average dry weather	3.40	2.70
Average annual	4.00	3.10
Peak month average	4.80	3.47
Peak day flow	6.80	5.47
Peak wet weather	9.00	n/a
Avg Influent Concentration (mg/L)		
Biochemical Oxygen Demand (BOD)	250	259
Suspended Solids (SS)	300	298
Total Kjeldahi Nitrogen (TKN)	n/a	67
Ammonia (NH_3-N)	n/a	46
Total Phosphorous (TP)	n/a	10
Avg Raw Wastewater Load (kg/dy)		
Biochemical Oxygen Demand (BOD)	1,000	966
Suspended Solids (SS)	1,200	1,145
Total Kjeldahl Nitrogen (TKN)	n/a	254
Ammonia (NH_3-N)	n/a	174
Total Phosphorous (TP)	n/a	38

Population served[44]

2006 Census	2011 Census
13,603	14,088

[44] Indicative figures for catchment area based on Australian Bureau of Statistics, 2006 and 2011 Census data (Port Lincoln - State Suburb), www.abs.gov.au.

Figure 183 Port Lincoln plant schematics

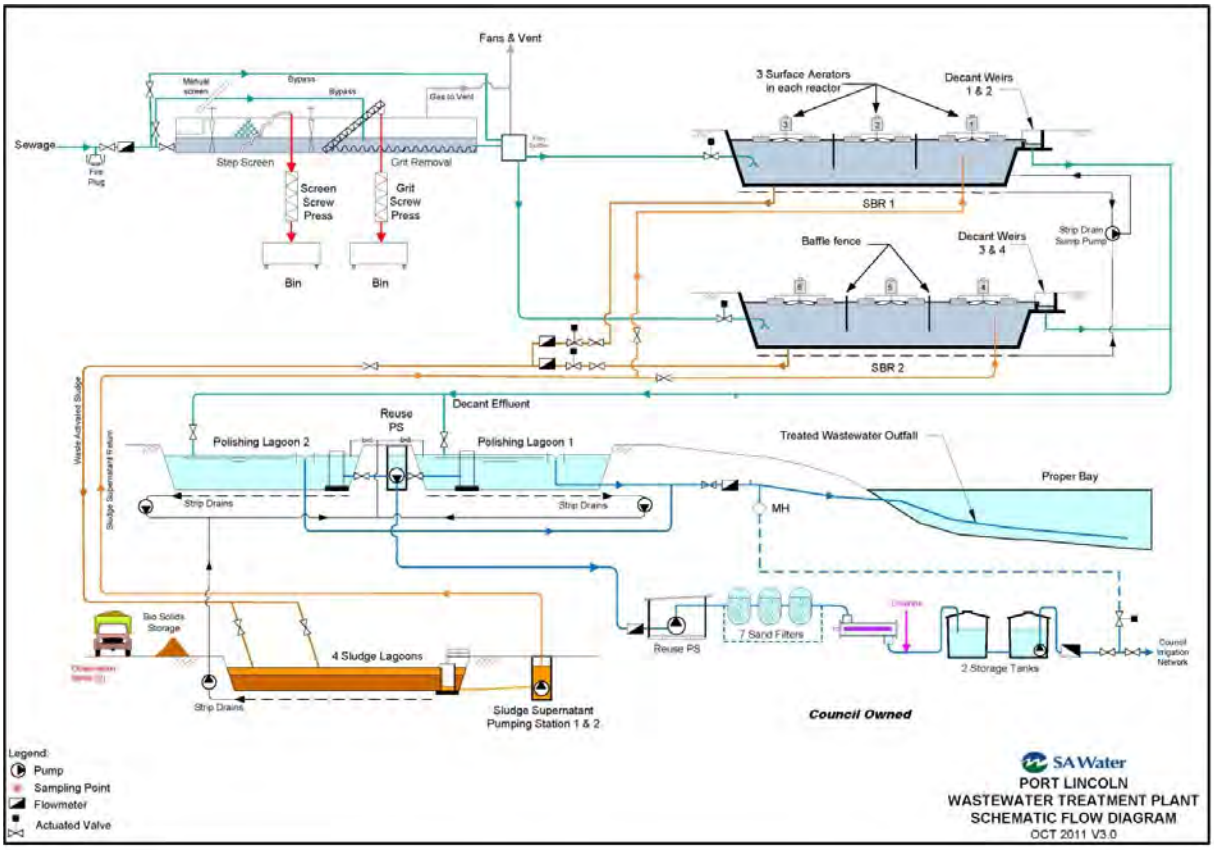


Figure 184 Port Lincoln drainage area

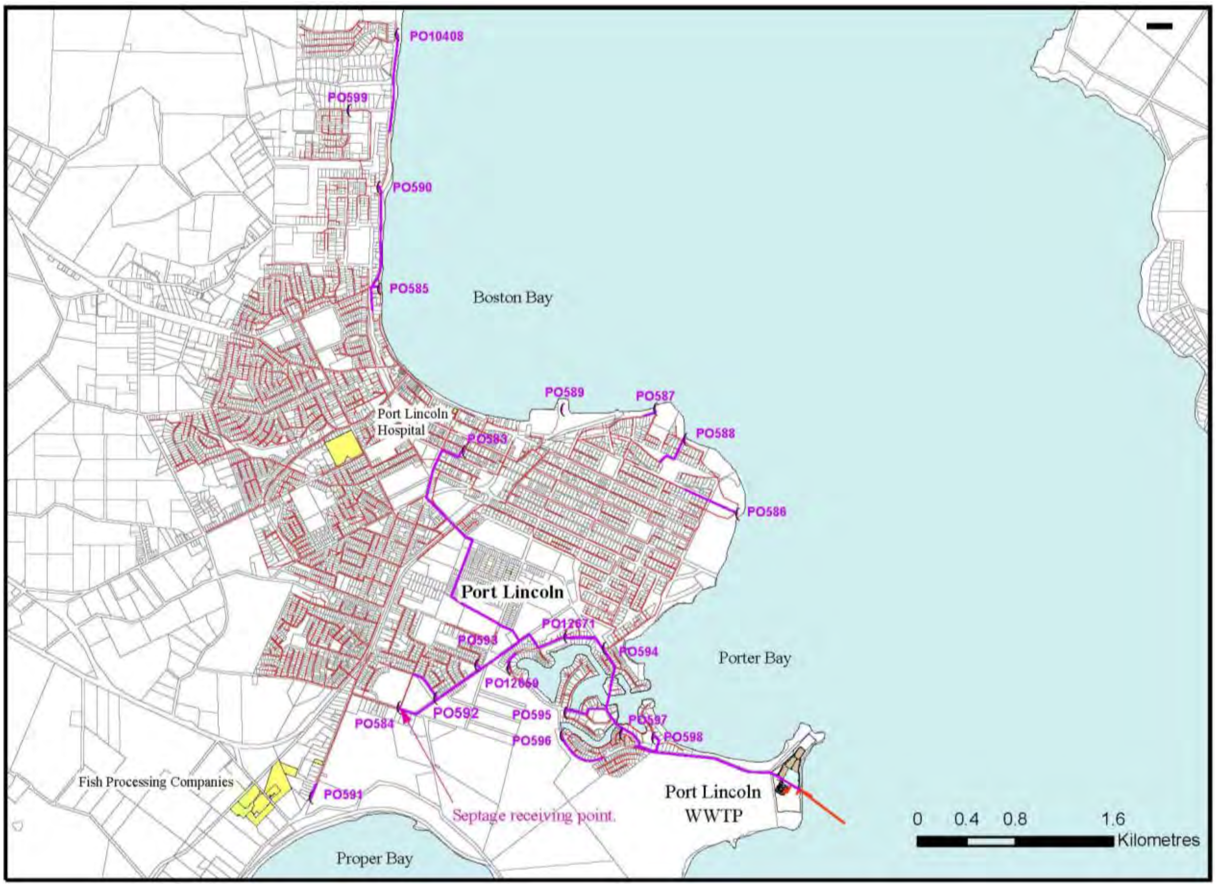


Figure 185

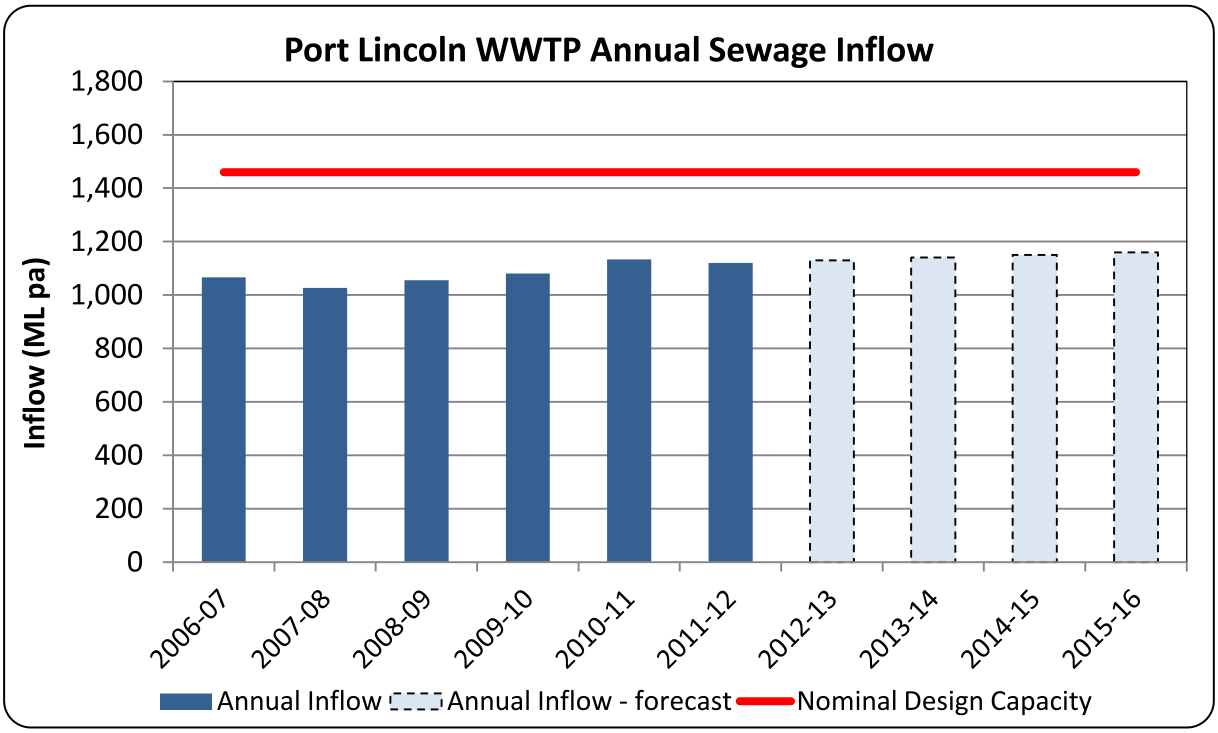


Figure 186

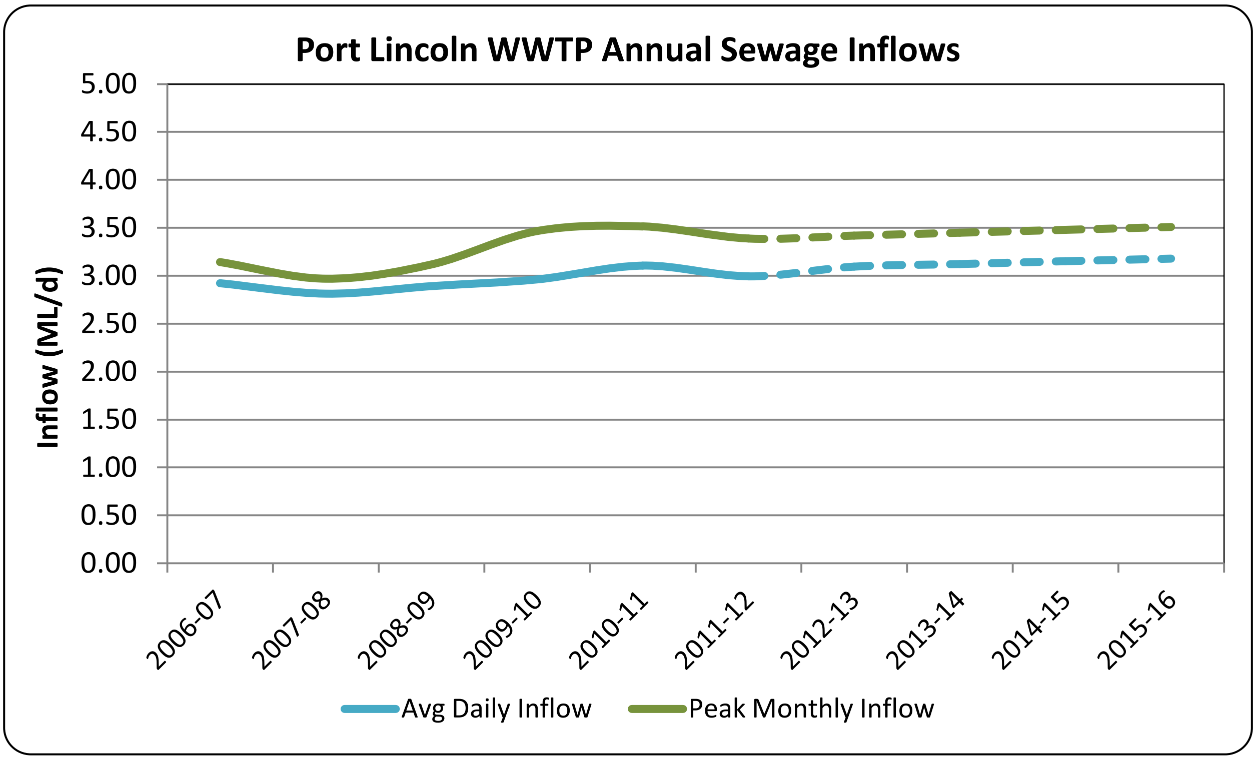


Figure 187

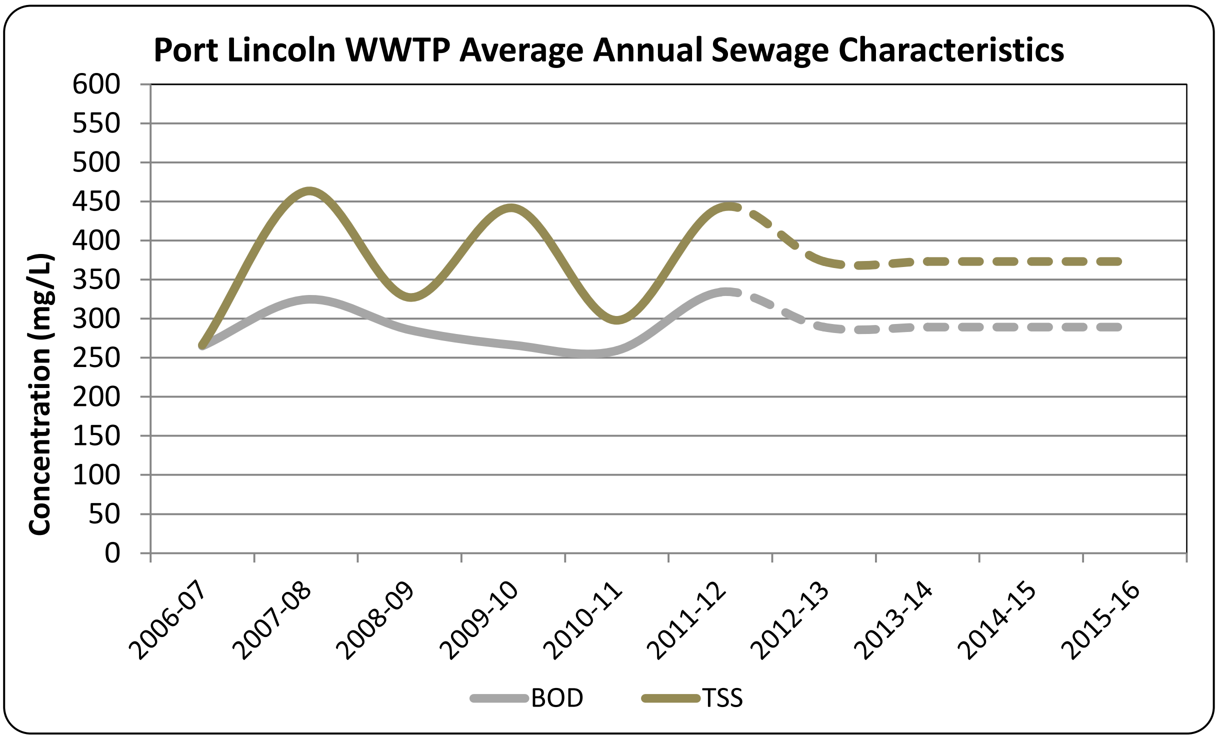


Figure 188

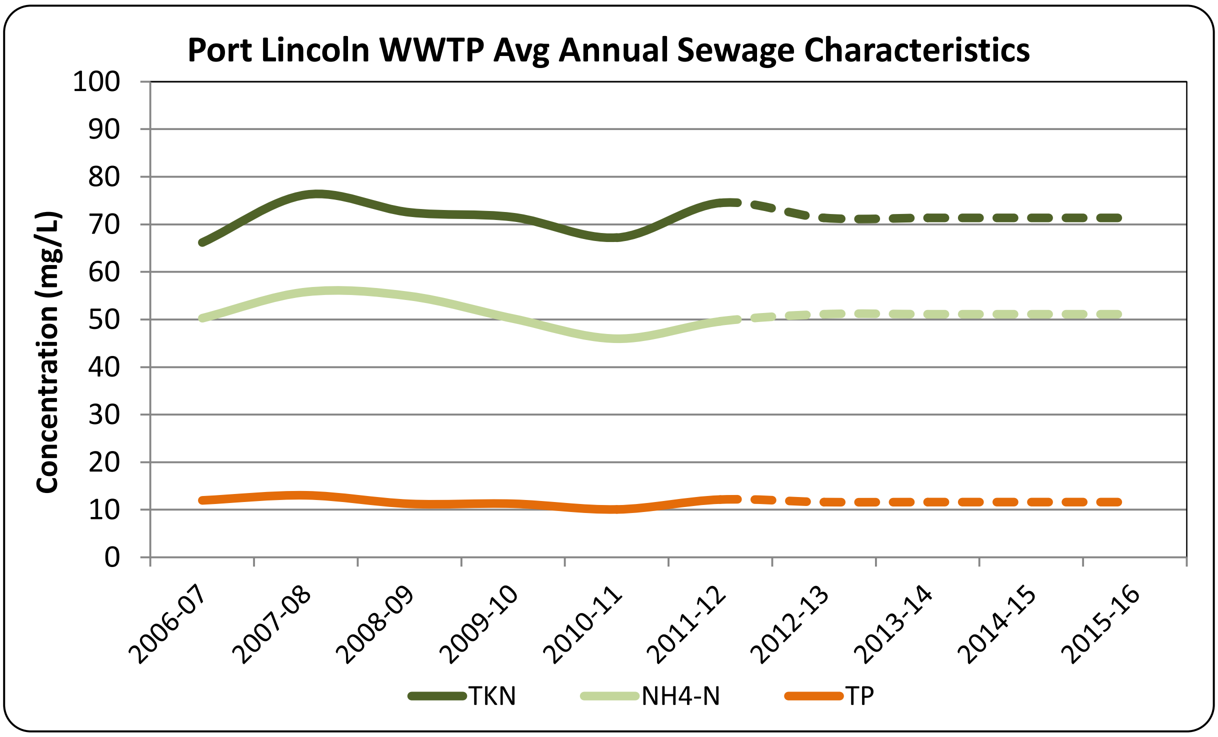
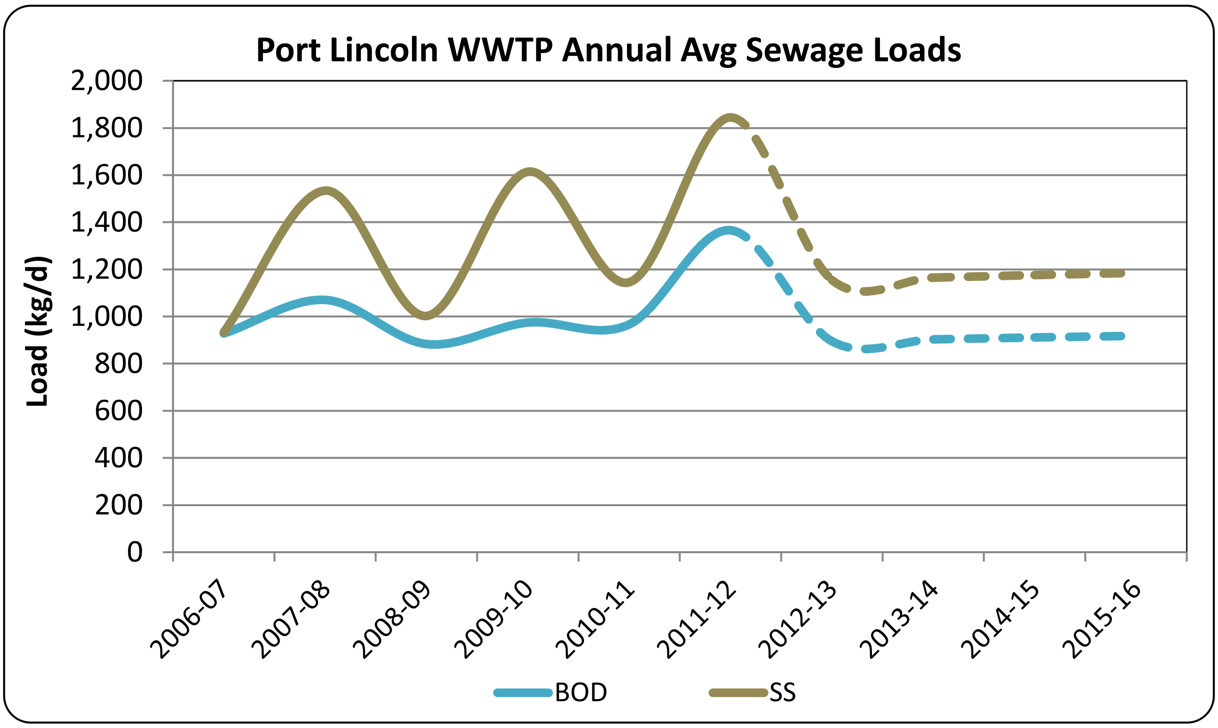
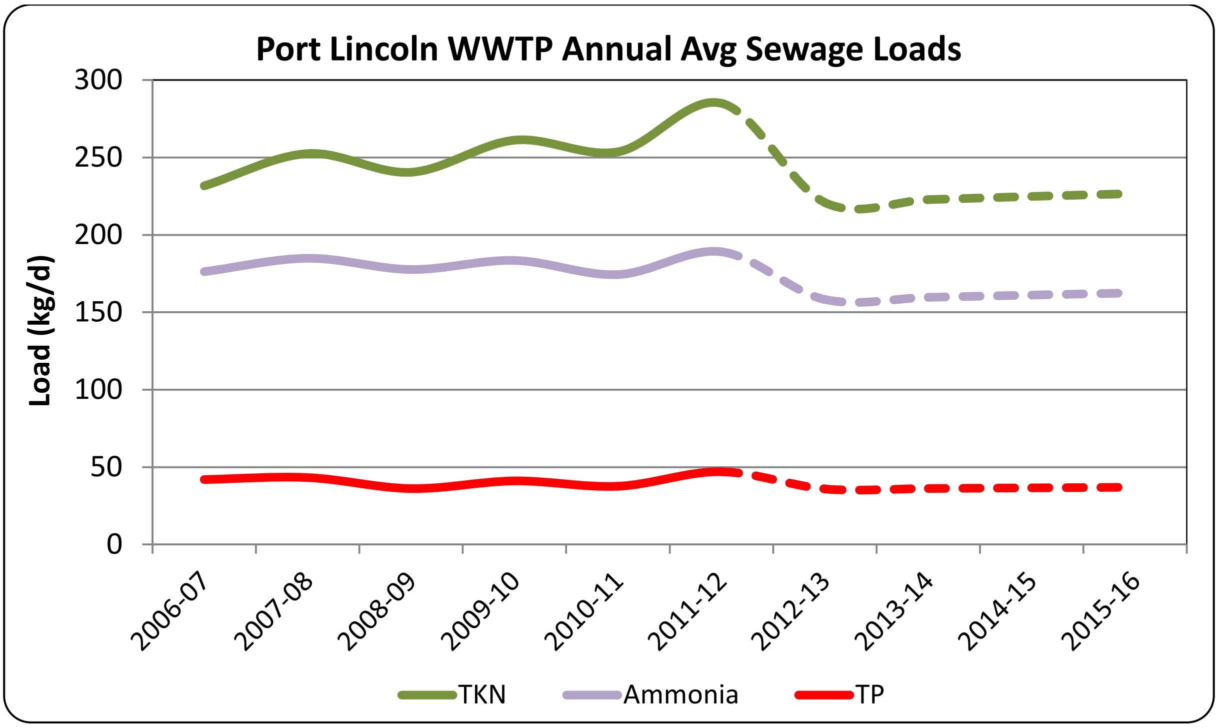


Figure 189



Note: biochemical oxygen demand (BOD) and suspended solids (SS) peak in 2011-12. This may be attributable to a changed sewage sampling regime in that year. SS is not a key process design capacity criteria. Again, numerous small trade waste customers (fish processing factories) connected to the sewer network account for the seasonal load variations.

Figure 190



24.2. Key points

- The Port Lincoln wastewater treatment plant was commissioned in 1994 and receives domestic wastewater and trade wastes from the City of Port Lincoln. Septic tank waste is accepted at the pumping station in Windsor Avenue.

- The WWTP uses an intermittent decant extended aeration (IDEA) activated sludge process. Wastewater is pumped into two intermittently aerated lagoons operating in parallel, in which primary sedimentation, biological oxidation and secondary settlement takes place, as well as nitrification and de-nitrification. Raw wastewater flows into the basin and is held for about four hours. The typical cycle consists of two hours aeration with raw wastewater inflow, one hour settling after inflows cease, followed by one hour of decant of clarified treated wastewater. While one basin is being aerated the other is settling then decanting. One basin is always accepting raw wastewater inflows.

- The clarified effluent is decanted into one or two polishing lagoons that provide additional settling. Treated, un-chlorinated effluent is discharged via a 434 metres long outfall pipe to Proper Bay. It is equipped with a diffuser located in a water depth of about 6 metres.

- A step screen and grit removal facility was constructed in 2007. With this in operation, there now should be no need to take an aeration basin off-line for a short period every two years to remove the accumulated grit and other solids.

- Waste sludge is stabilised and dried in four sludge lagoons, each approximately 3,000 square metres and 1m deep. Sludge dewatering is provided by air drying and supernatant return to an aeration basin. Drains beneath the lagoon banks control groundwater and seepage. Dewatered sludge is stored on site for three years, after which it is supplied for conditioning farm soils.

- The EPA recommends a buffer distance of 300m for mechanical/biological units for WWTPs designed for an equivalent population of 20,000 or less. There is a separation distance of about 500m between the Port Lincoln WWTP and the nearest residential area. The plant has been the subject of several odor complaints from the sludge lagoons, leading to operational adjustments and the use of reclaimed water to cap the sludge lagoons.

Key points - future:

- Development in the vicinity of the plant is expected to occur in the near future. Proposed development on land west of the plant and gradually encroaching residential developments to the north threaten the long term viability of the site and significant investment for upgrades may be needed to address the conflict between land uses.

- Consultation with industries and the local community has been undertaken over several years concerning potential solutions and funding options. While no final decision has been made on the approach for Port Lincoln, a project is under way to review the capacity and performance of the plant in more detail to determine the preferred solutions.

- Port Lincoln WWTP is ranked as a “tier 2”[45] treatment plant by the EPA. Under the current licence there is no requirement for an EIP.

[45] Refer to notes to the attachment.

25. Port Pirie Wastewater Treatment Plant

25.1. Summary

Commissioned: The Port Pirie wastewater treatment plant was commissioned in 1971 and upgraded in 2004.

Treatment process: Screen and vortex grit removal facility followed by an activated sludge SBR (sequencing batch reactor) process, then polishing lagoons.

Disposal of treated wastewater: Discharge to tidal Second Creek and to Spencer Gulf.

Figure 191 Port Pirie wastewater treatment plant

Figure 192 Port Pirie wastewater treatment plant SBR tank

Parameter	Design	Actual (2010-11)
Flows (Megalitres per day; ML/d)		
Average dry weather	3.53	2.50
Average annual	4.10	4.63
Peak month average	-	6.16
Peak day flow	5.74	9.32
Peak wet weather	11.23	n/a
Median Influent Concentration (mg/L)		
Biochemical Oxygen Demand (BOD)	305	150
Chemical Oxygen Demand (COD)	671	330 (estimated)
Suspended Solids (SS)	305	224
Total Kjeldahi Nitrogen (TKN)	66	51
Ammonia (NH_3-N)	46	29
Total Phosphorous (TP)	13	7
Median Raw Wastewater Load (kg/dy)		
Biochemical Oxygen Demand (BOD)	960	681
Chemical Oxygen Demand (COD)	2,112	1,498 (estimated)
Suspended Solids (SS)	960	1,032
Total Kjeldahl Nitrogen (TKN)	208	230
Ammonia (NH_3-N)	144	29
Total Phosphorous (TP)	42	30

Note: the design of the Port Pirie activated sludge WWTP was undertaken using median and 90th percentile sewage concentrations and loads, rather than averages. The above table reflects this. Median COD concentrations and loads for 2010-11 were estimated from the COD = 2.2 x BOD relationship established from raw wastewater monitoring during the upgrade pre-design phase.

Population served[46]

2006 Census	2011 Census
13,610	13,825

[46] Indicative figures for catchment areas based on Australian Bureau of Statistics, 2006 and 2011 Census data (Port Pirie - C Dists (M)), www.abs.gov.au.

Figure 193 Port Pirie plant schematics

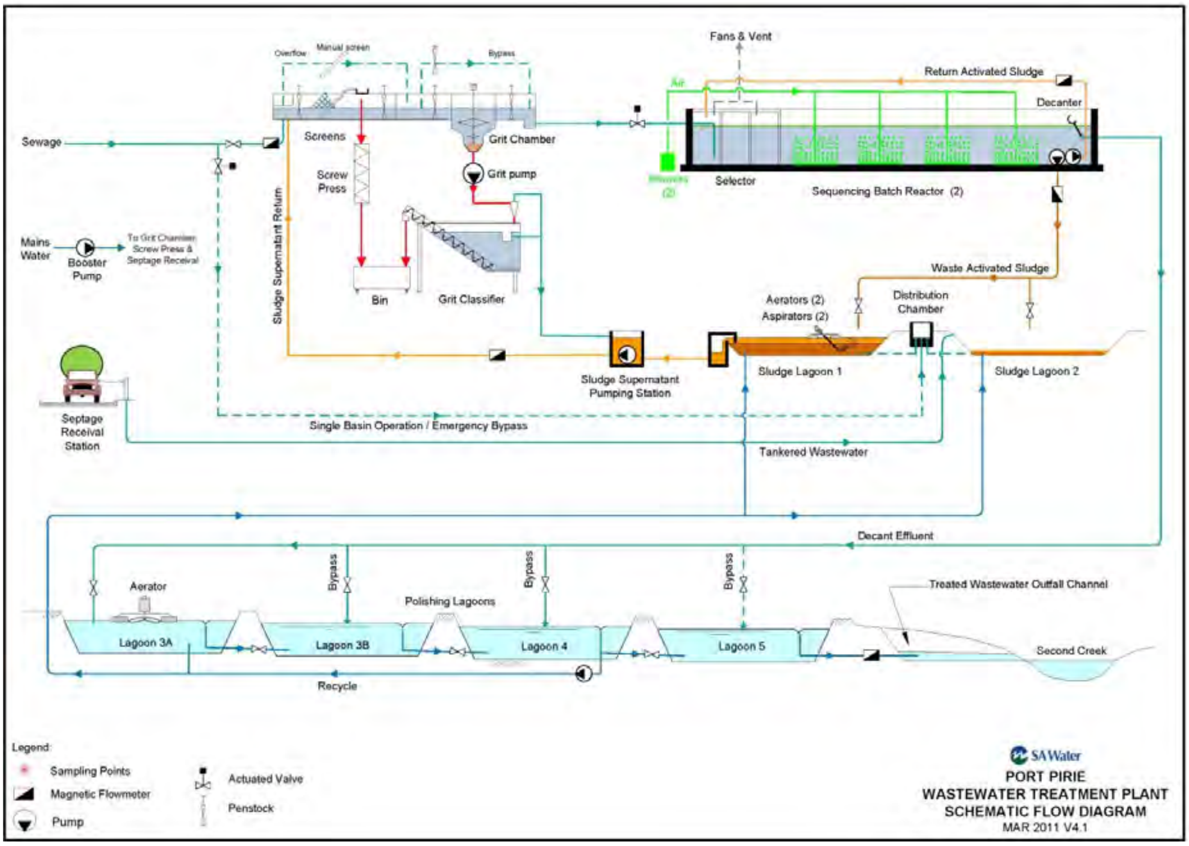


Figure 194 Port Pirie drainage area

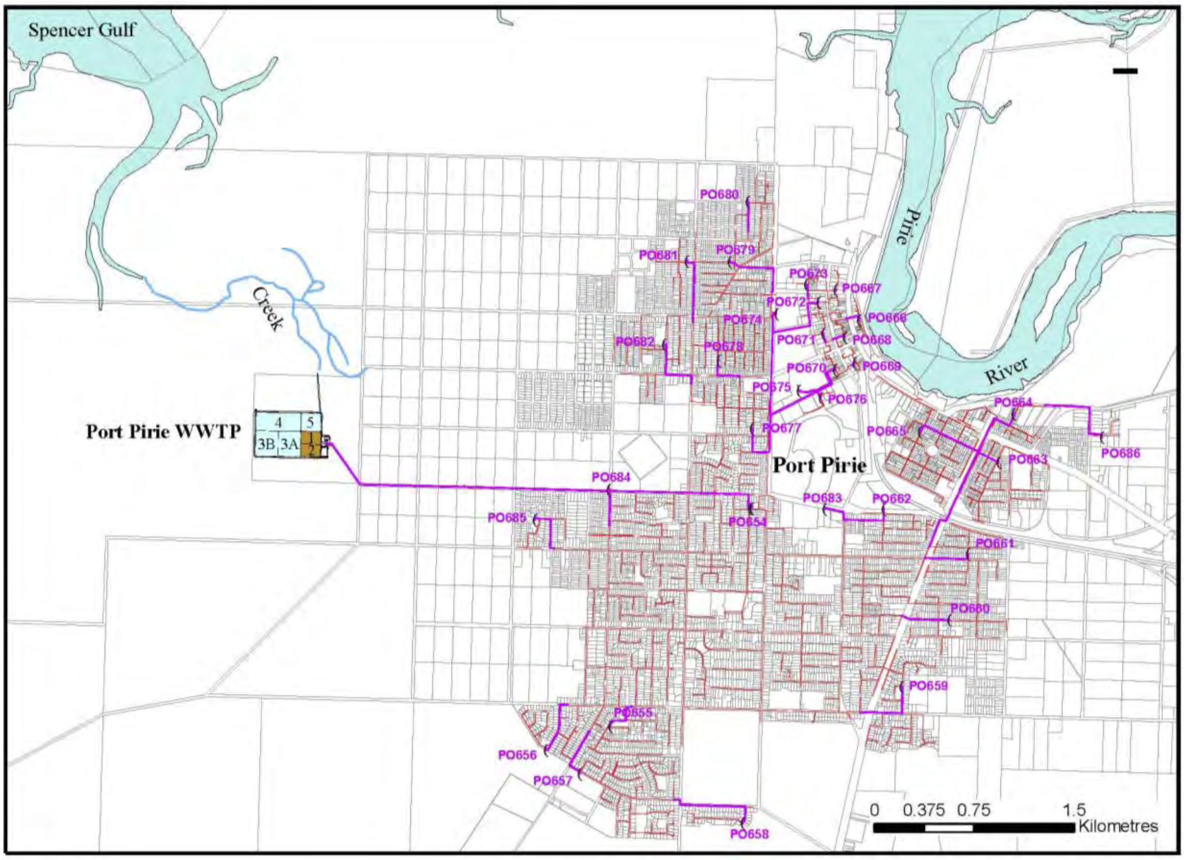


Figure 195

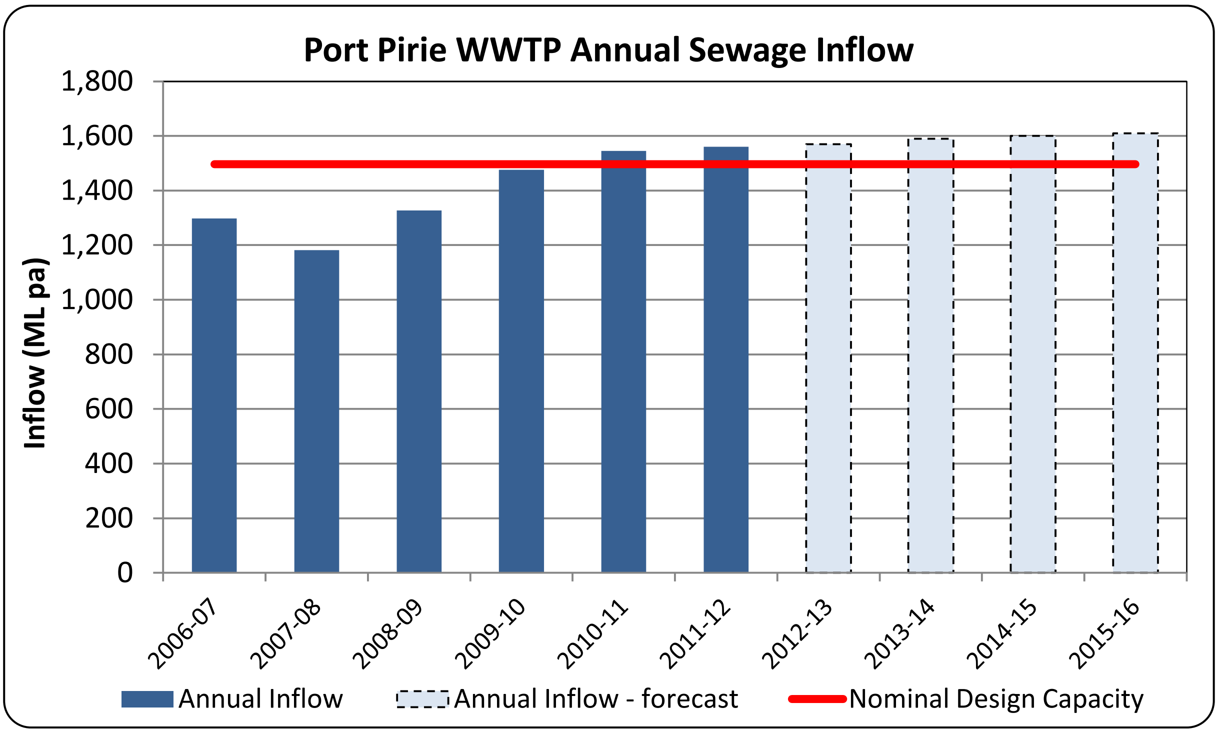


Figure 196

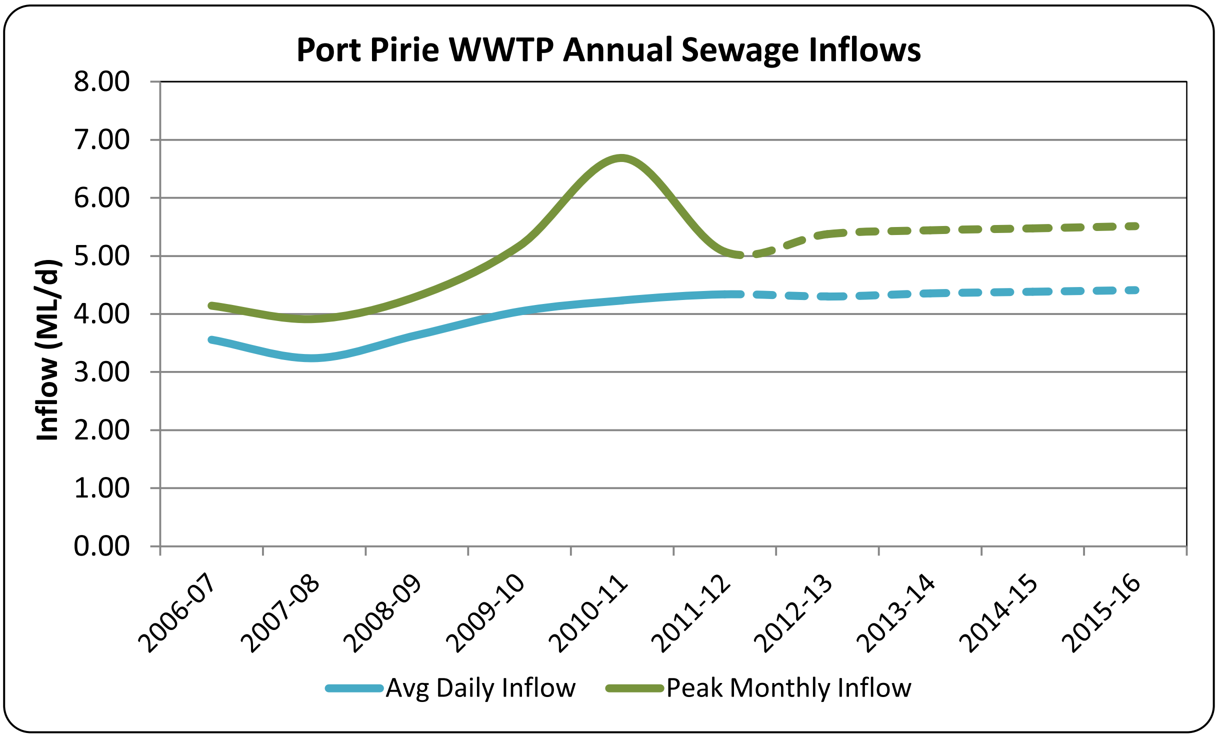


Figure 197

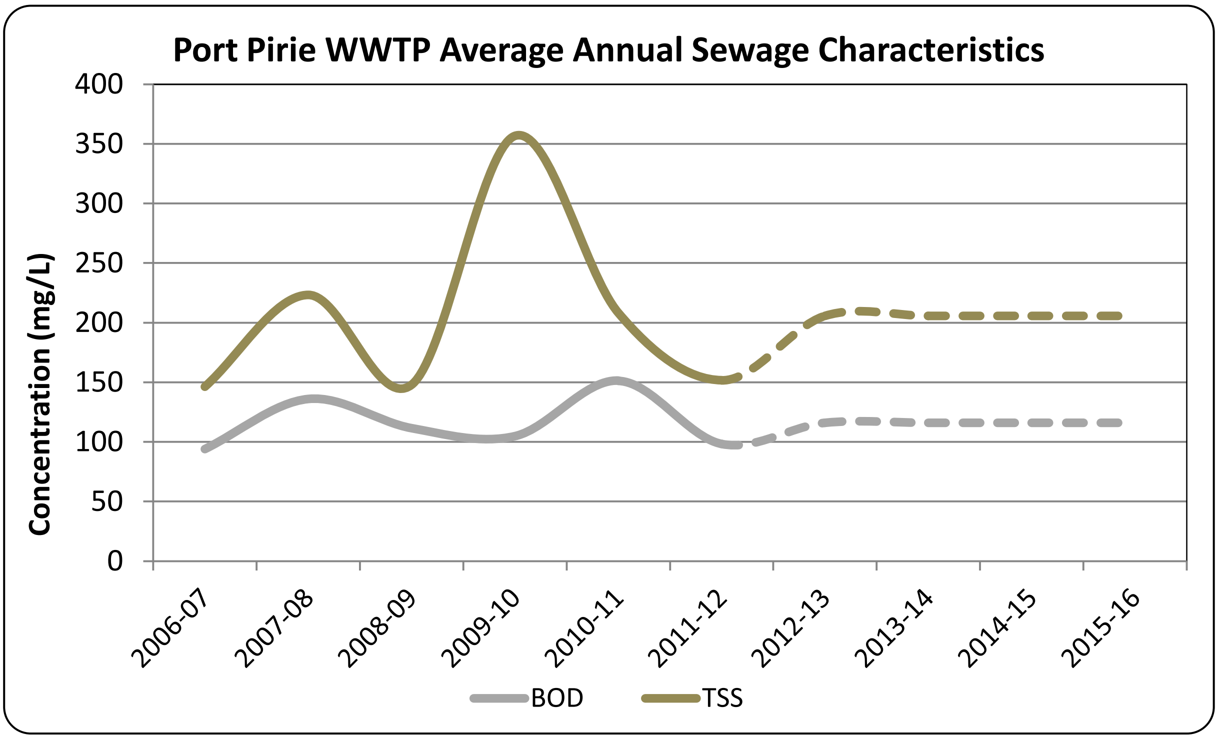


Figure 198

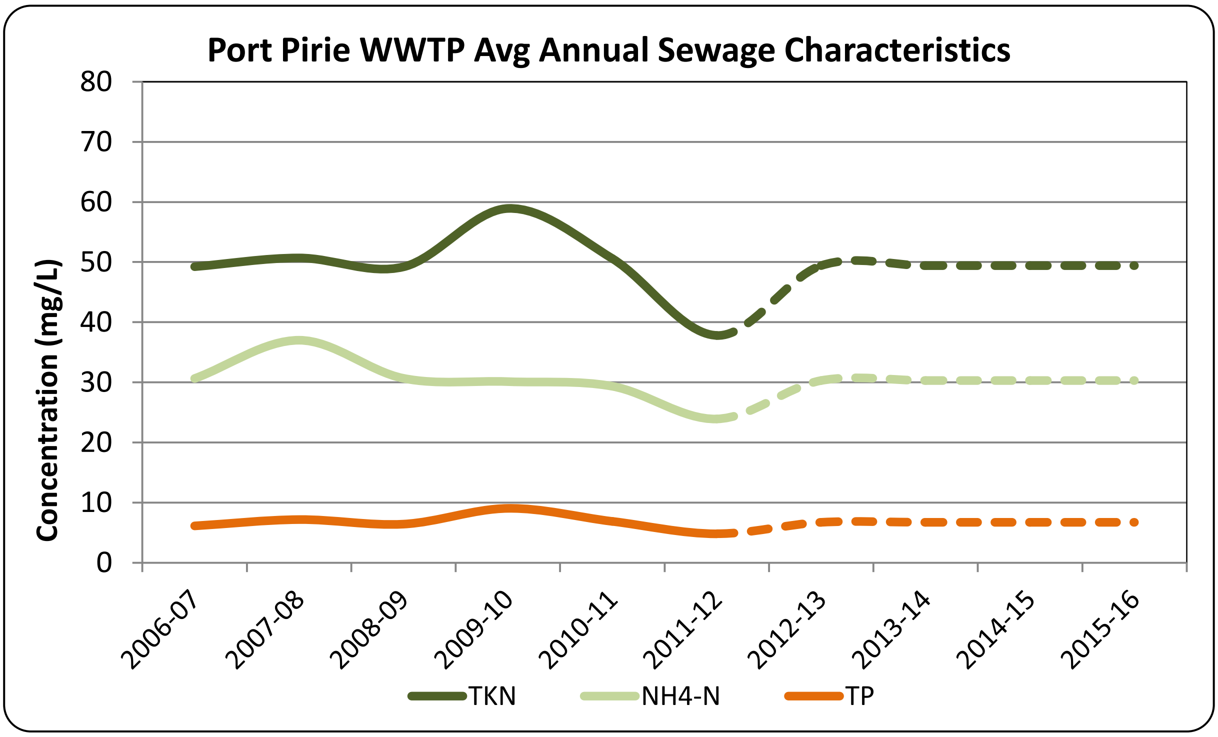


Figure 199

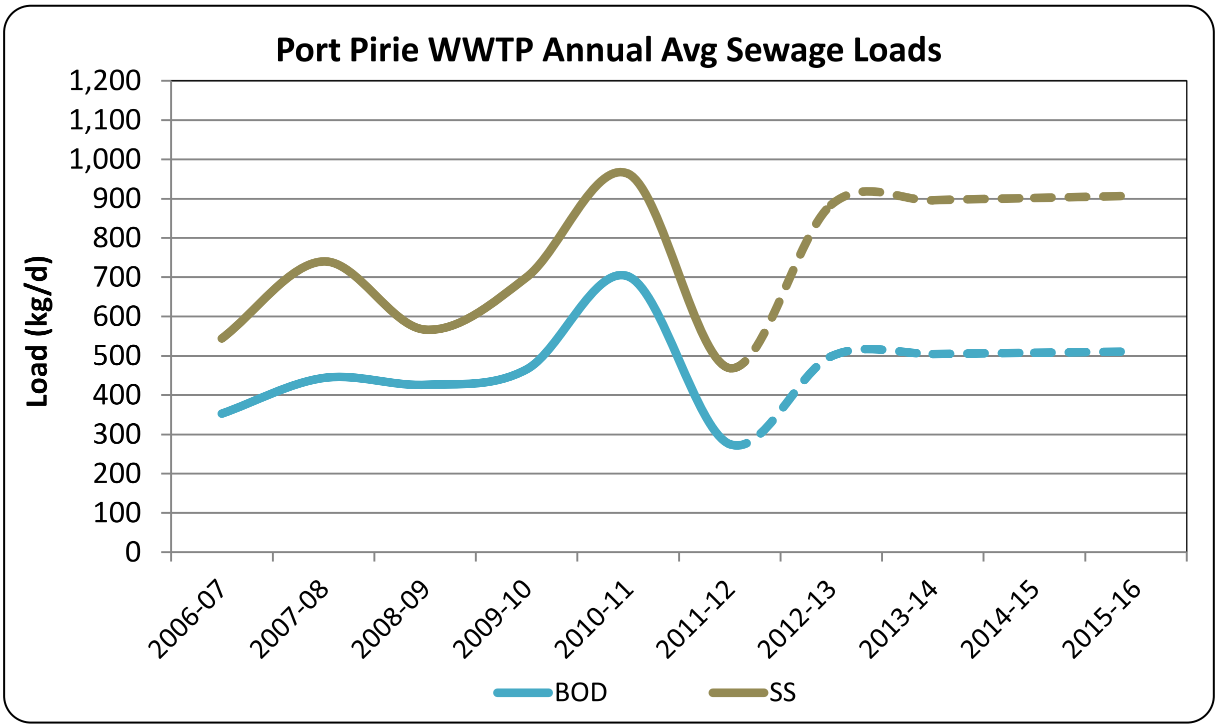
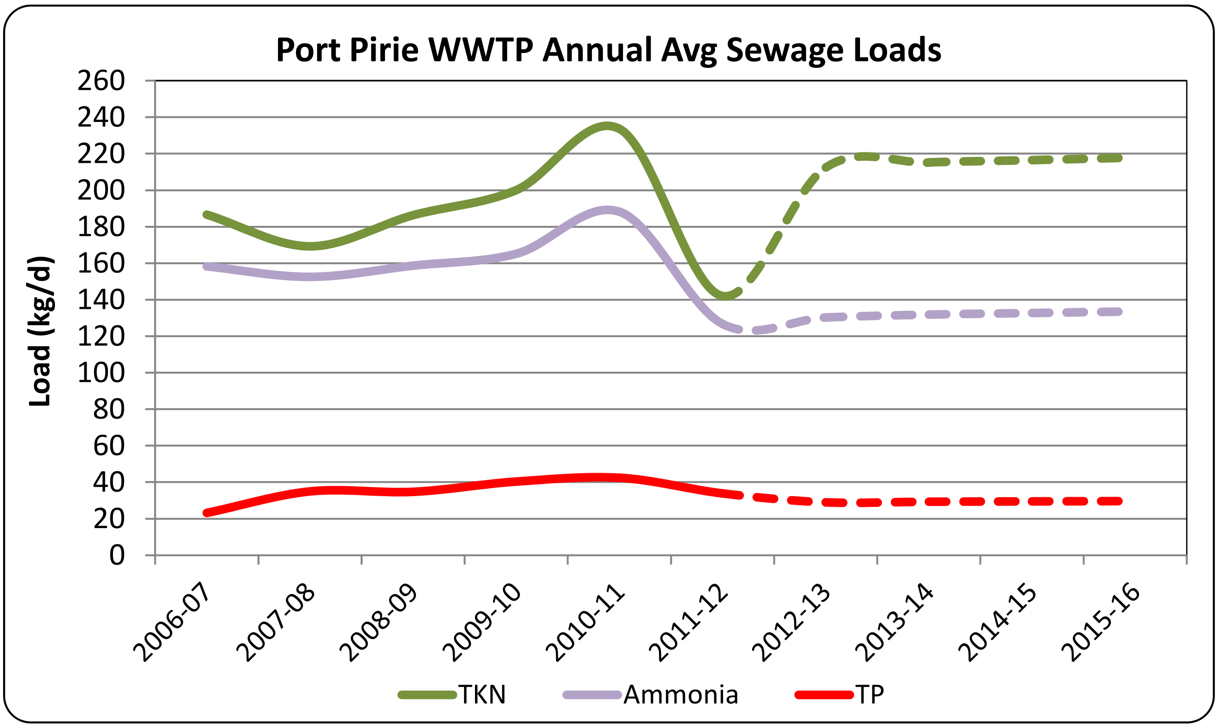


Figure 200



25.2. Key points

- The Port Pirie wastewater treatment plant receives domestic and industrial wastewater from the City of Port Pirie, situated on the eastern side of Spencer Gulf, about 240km north of Adelaide.
- The WWTP was upgraded in early 2004 with the construction of an activated sludge sequencing batch reactor (SBR) to serve an equivalent population (EP) of 17,000. This replaced the original combination of aerated and settling lagoons. Two lagoons were converted to accept waste sludge and the others used for natural disinfection.
- The plant consists of an inlet screen system, a grit system, two SBR basins, four disinfection lagoons and two sludge lagoons. The screen removes any large items such as rags and drops them into the screw press and then the screenings bin. Grit is collected from the bottom of a conical tank and pumped to the grit classifier where it is separated from the water.
- The SBR basin runs a sequential period of aeration, settling and effluent withdrawal. At any one time, one basin should be filling while the other is settling and decanting. The SBRs are intended to run on a nominal four hour cycle.
- The original aeration diffuser system suffered from precipitation of solids, backflow and rapid deterioration due to the nature of the wastewater. It was initially replaced with an OKI aeration system in 2010. However, the system was undersized and underperforming and was replaced with a new grid diffuser aeration system, at the supplier’s cost, in October 2011. The diffuser system’s performance has been found acceptable and the project was completed in May 2012.
- Effluent is withdrawn from the SBR by a stainless steel movable weir which is lowered slowly into the clarified effluent. Effluent is transferred to four disinfection lagoons in series and then discharged to a 300m outfall channel and into the tidal Second Creek, which meanders for about 6km north-west to the Spencer Gulf. The effluent’s salinity level is close to that of seawater as infiltration of hyper-saline shallow groundwater into the sewer system is a problem.
- There is a separation distance of about 1,500m between the Port Pirie WWTP and the nearest residential area. The plant is surrounded by tidal swamp land and there have been no odor complaints for a number of years. An oxygen injection plant was installed on the sewage pumping main about 20 years ago and continues to operate.
- Dry sludge has been air dried and used on-site for landfill. Since the WWTP began operations, no sludge has left the site until recently. Biosolids produced has high salinity, lead and zinc, restricting potential reuse.

Key points - future:

- Sewage inflows to the plant have been steadily increasing over the past five years and a Future Operating Strategy is being planned for the Port Pirie WWTP to ensure that process performance and capacity are maintained. Works proposed for the forthcoming regulatory period include investigation to determine the preferred option for increasing capacity of the plant.
- Port Pirie WWTP is ranked as a “tier 2”[47] treatment plant by the EPA. Under the current licence there is no requirement for an EIP.

[47] Refer to notes to the attachment.

26. Victor Harbor Wastewater Treatment Plant

26.1. Summary

Commissioned:	The original Victor Harbor wastewater treatment plant was commissioned in 1972. In 2005, an upgraded plant at a new site commenced operations.
Treatment process:	Screening and grit removal ahead of a membrane bioreactor activated sludge plant designed for biological nutrient reduction. Filtered wastewater is disinfected by a UV system and chlorinated.
Disposal of treated wastewater:	Treated wastewater is recycled at a number of irrigation sites in and around Victor Harbour. Surplus treated wastewater is stored in Hindmarsh Valley Reservoir for reuse in summer or discharge to the Inman River in winter.

Figure 201 Victor Harbor wastewater treatment plant

Parameter	Design (Stage I)*	Actual (2010-11)
Flows (Megalitres per day ; ML/d)		
Average dry weather	2.90	2.33
Average annual	3.40	2.59
Peak month average	4.08	3.04
Peak day flow	8.20	n/a
Peak wet weather	10.20	n/a
Avg Influent Concentration (mg/L)		
Biochemical Oxygen Demand (BOD)	290	255
Chemical Oxygen Demand (COD)	600	626
Suspended Solids (SS)	300	276
Total Kjeldahi Nitrogen (TKN)	60	73
Ammonia (NH_3-N)	n/a	51
Total Phosphorous (TP)	11	11
Avg Raw Wastewater Load (kg/dy)		
Biochemical Oxygen Demand (BOD)	990	659
Chemical Oxygen Demand (COD)	2,040	1,617
Suspended Solids (SS)	1,020	715
Total Kjeldahl Nitrogen (TKN)	205	188
Ammonia (NH_3-N)	n/a	132
Total Phosphorous (TP)	38	29

** Original Stage I design parameters. Design average influent concentrations have been interpolated from design loads. An expansion of the MBR plant planned for 2023 in the existing contract will provide for 5.4 ML/d AAF treatment capacity.*

Population served[48]

2006 Census	2011 Census
10,380	12,483

[48] Indicative figures for catchment area based on Australian Bureau of Statistics, 2006 and 2011 Census data, www.abs.gov.au. For 2006 this was defined as Victor Harbor (Urban Centre/Locality) and for 2011, the State Suburbs of Victor Harbor, Encounter Bay, McCracken, Hayborough.

Figure 202 Victor Harbor plant schematics

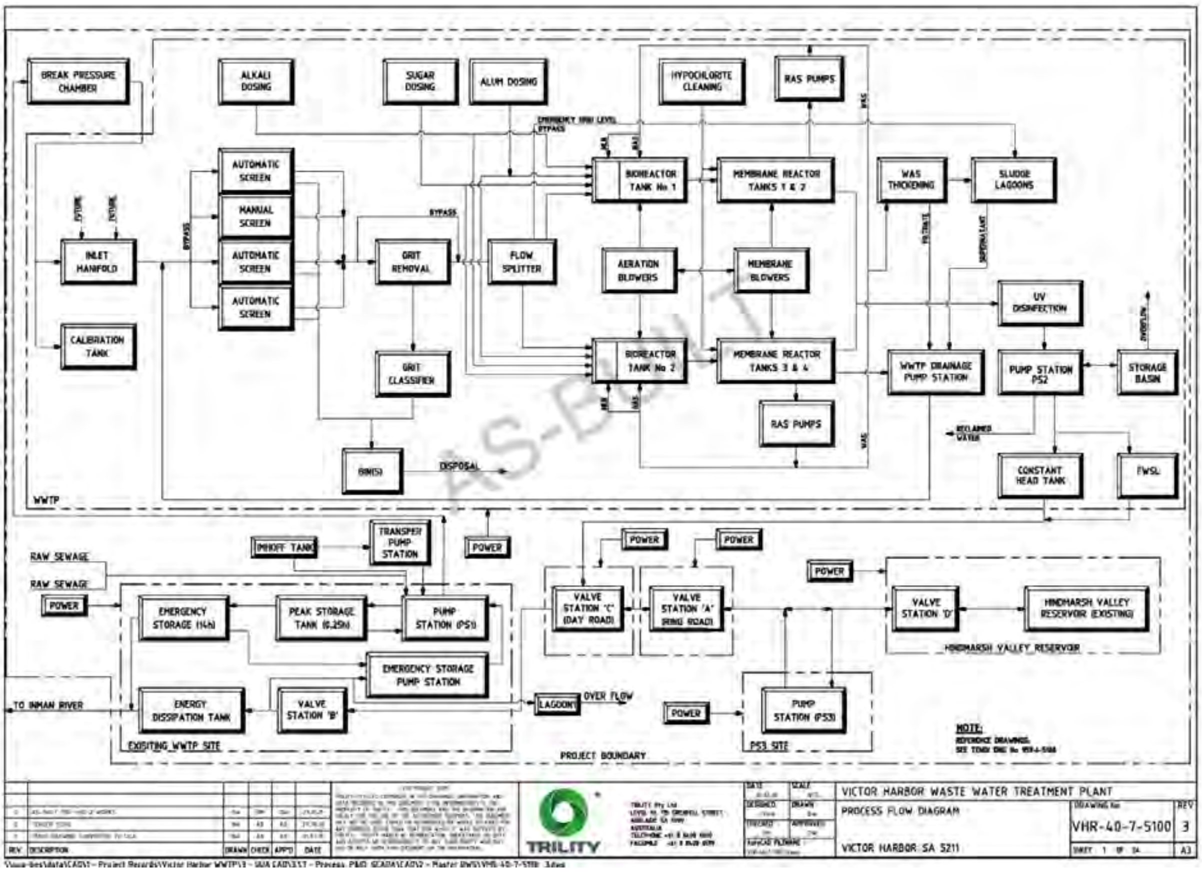


Figure 203 Victor Harbor drainage area and sewer network

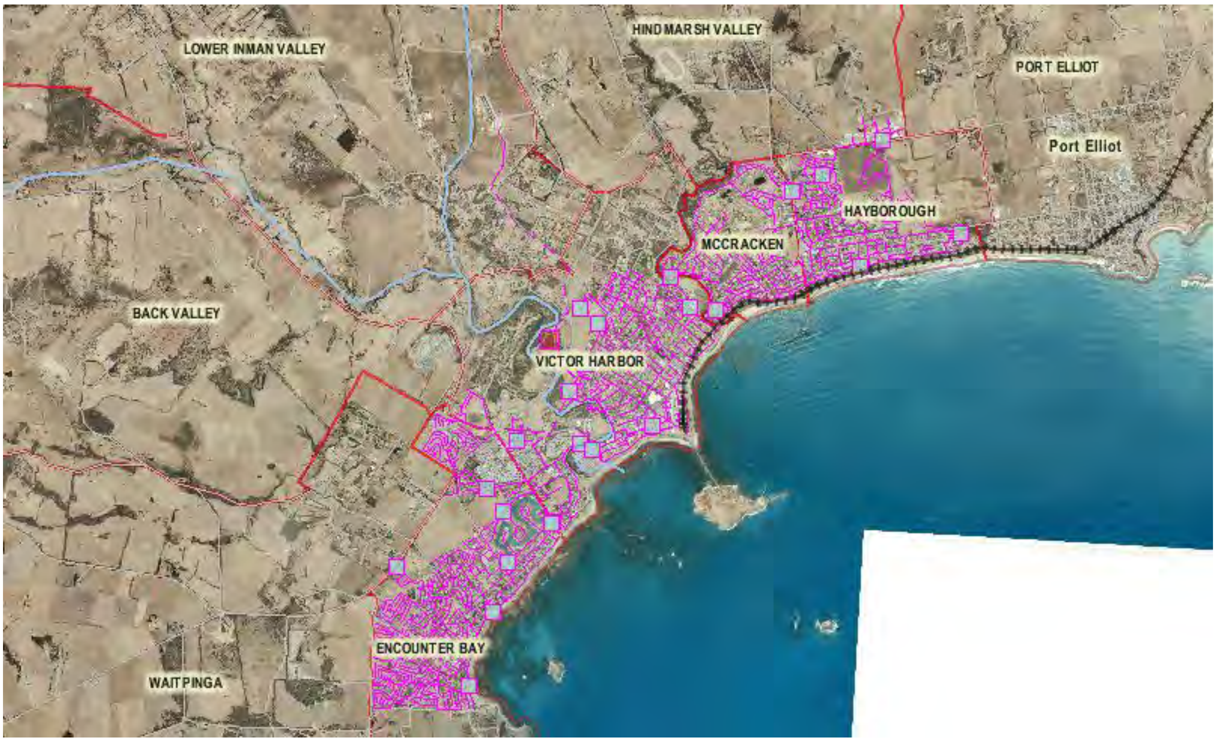


Figure 204 Victor Harbor WWTP annual sewage inflow

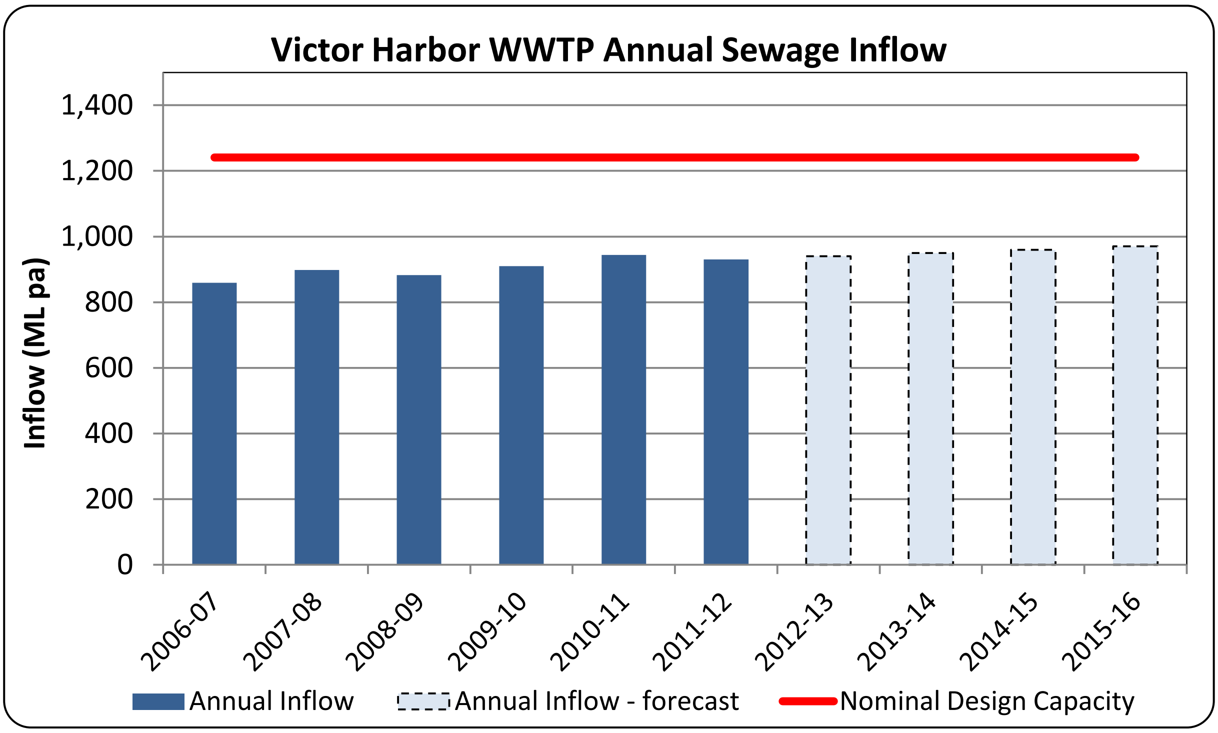


Figure 205

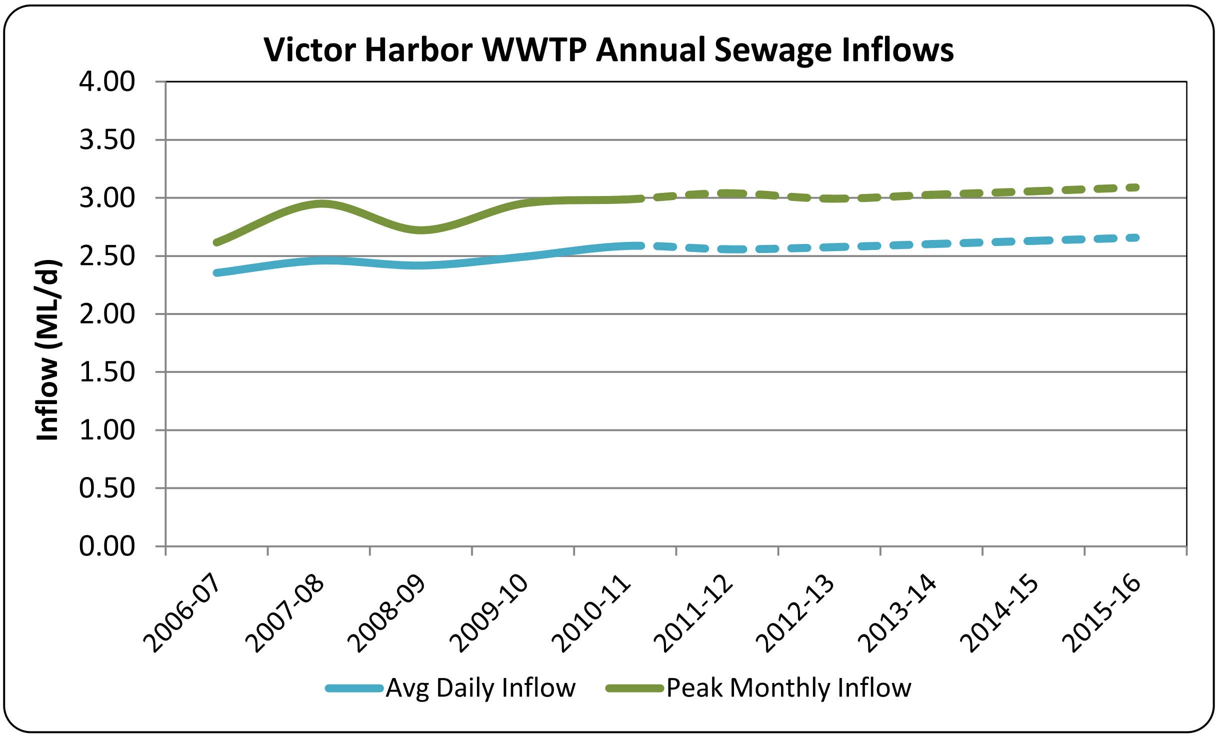


Figure 206

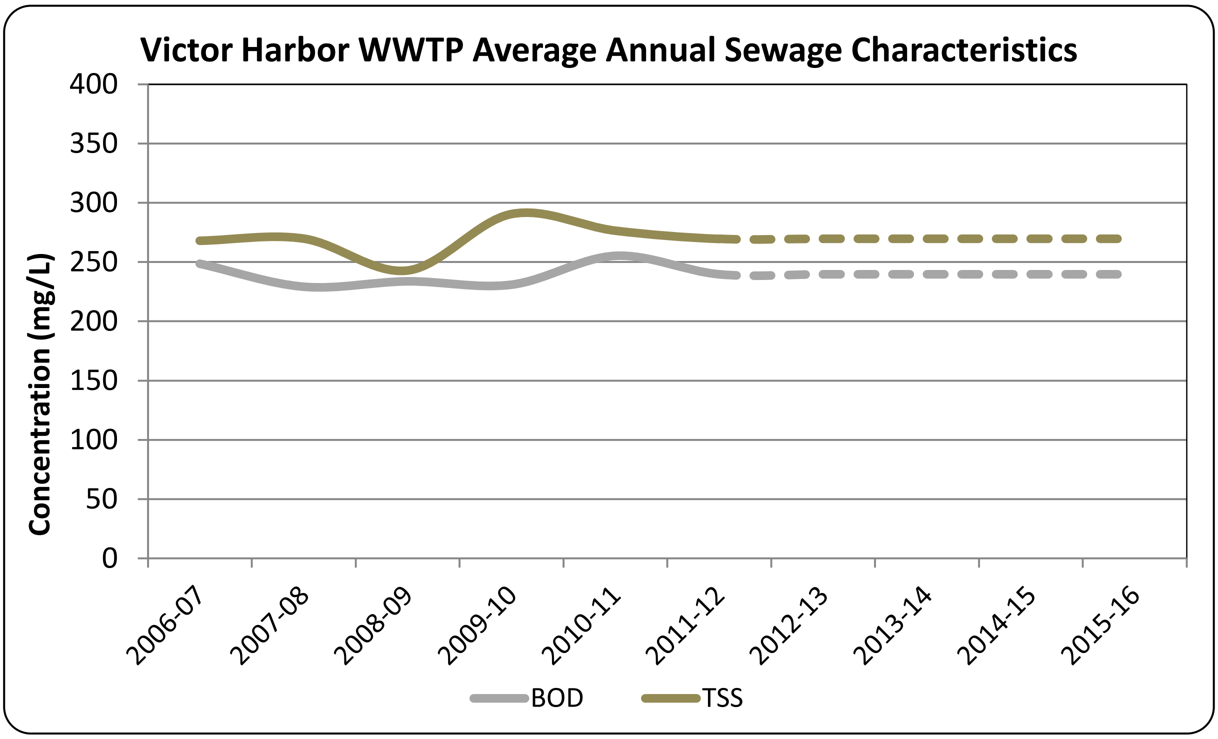


Figure 207

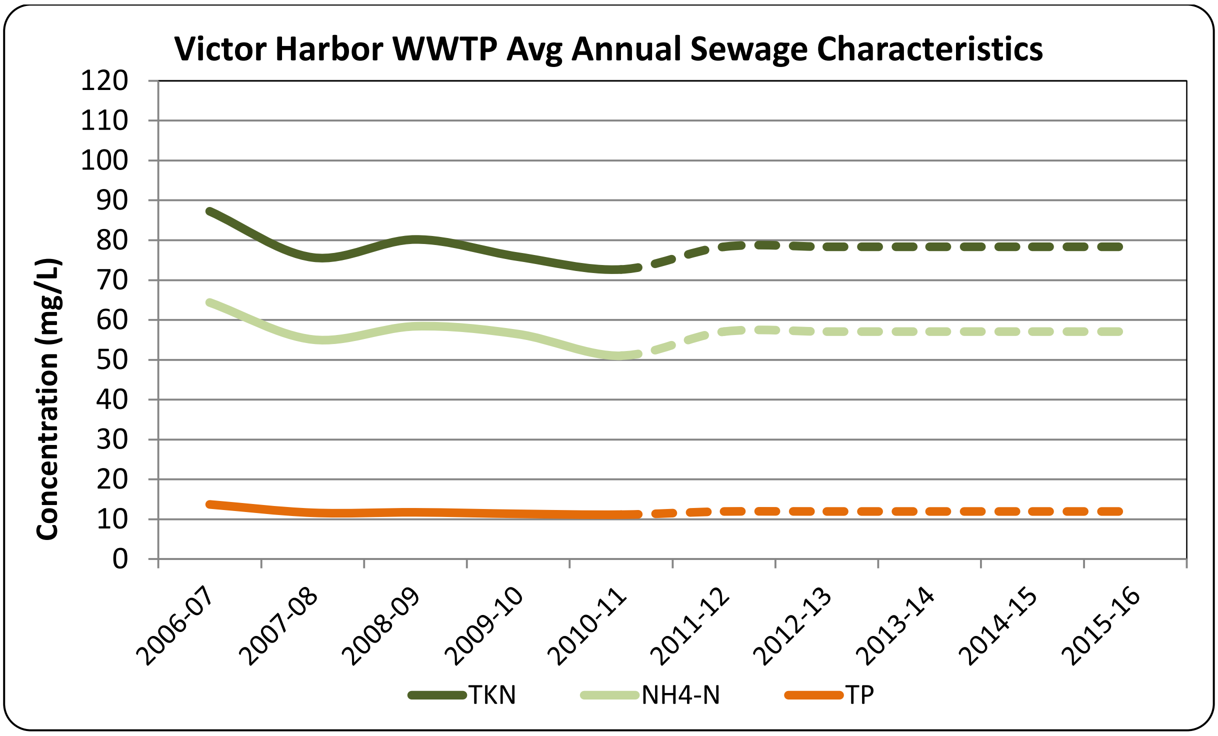


Figure 208

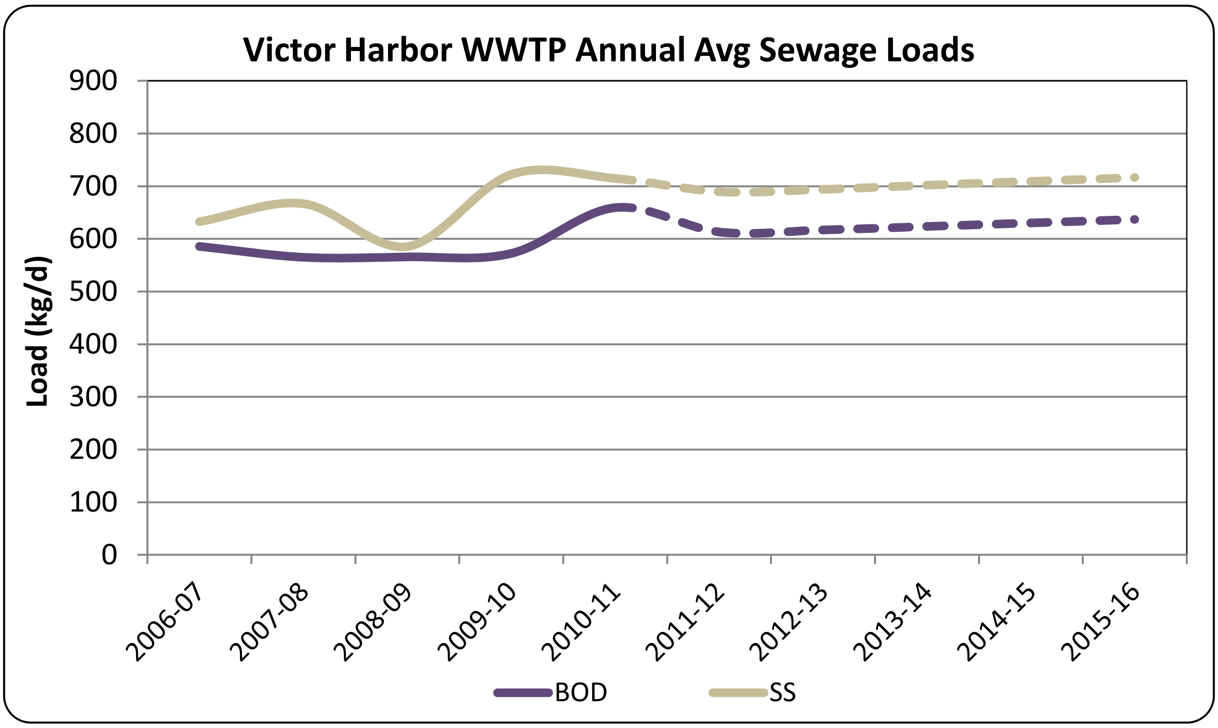
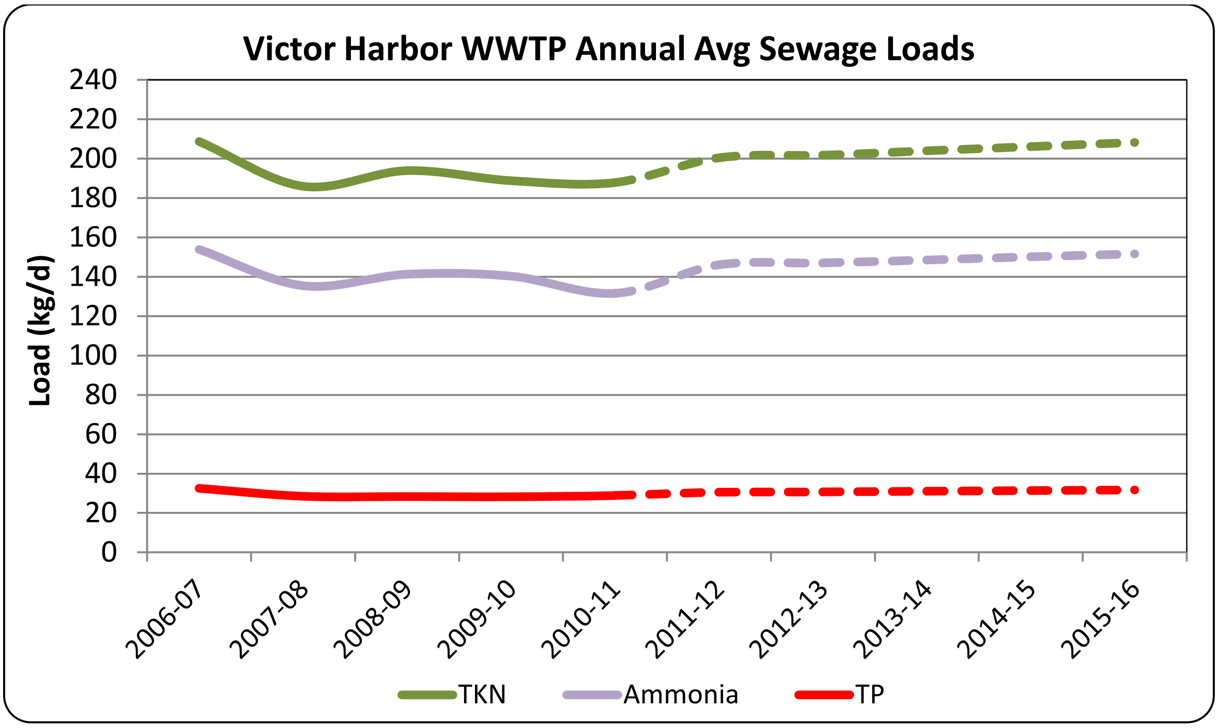


Figure 209



26.2. Key points

- The Victor Harbor Wastewater Treatment Plant was commissioned in 1972 to serve the growing coastal township of Victor Harbor on the south coast of Fleurieu Peninsula, south of Adelaide. The town is a popular holiday destination and the population of approximately 9,000 increases significantly during Christmas and Easter holiday periods each year.

- With the original plant, approximately 93% of the chlorinated treated wastewater flow was discharged into the Inman River, with the remainder being used for irrigation of fairways at the nearby Victor Harbor Golf Club. The original treatment process was not designed for nutrient reduction, caused odours and was reaching its rated design capacity by 2001. There were significant community concerns that the nutrient-rich discharge was having an adverse impact on the Inman River environment.

- Under the *Environment Protection Act 1993* operation of the original Victor Harbor WWTP was a prescribed activity requiring a licence to operate and discharge to the environment. A condition of the licence with the EPA required that an EIP be developed for the treatment of wastewater at Victor Harbor. EIPs are site specific and set out a program of works aimed at improving the environmental performance of a particular plant.

- Following engineering investigations and community consultation, it was decided a new plant was needed, but located away from the township boundary. Treated wastewater quality would need to have minimal impact on the Inman River and reuse should be increased to reduce discharge volumes.

- In October 2005, a new $32 million wastewater treatment plant, associated pipelines and pumping station began operations as part of implementation of the EIP. The plant and associated pumping stations and pipe mains are owned and operated by Trility Pty Ltd (originally United Utilities Pty Ltd) under a 20-year build, own, operate, transfer contract with SA Water.

- The scheme components include pumping station 1 at the old plant site and a pipeline to convey raw wastewater to the new plant that uses a continuous flow activated sludge membrane bioreactor. This consists of two parallel process trains, each incorporating: a bio-selector compartment, anoxic/aeration tank, ultrafiltration membrane tank and return sludge pumps.

- Pumping station 2 and associated pipelines transfer treated wastewater from the balancing storage to the Hindmarsh Valley Reservoir (HVR) in summer or Inman River (intermittently) in winter, while pumping station 3 enables stored wastewater from the reservoir to be transferred to the Inman River during winter.

- The membrane system was originally designed to be expandable to treat an ultimate average annual flow (AAF) of 5.4ML/d - an inflow that is forecast to be reached by 2023.

- The scheme included use of the surplus Hindmarsh Valley Reservoir (420ML capacity) as a seasonal balancing storage of treated wastewater. The reservoir serves two principal purposes: summer storage of treated wastewater to ensure no discharge to the Inman River during that period; and winter storage of reclaimed water to be used the following summer. The transfer pipelines also allow potential reclaimed water users ready access to water.

- The EPA plant licence now severely restricts the conditions under which treated wastewater discharges can be made to the Inman River and defines the treated wastewater quality that must be met at the plant outlet.

- The plant was designed to achieve very low nutrient levels in discharges to comply with the EPA license requirements and has the most stringent treated wastewater quality design targets for any plant in South Australia. The treated wastewater quality specification includes median concentrations of: ammonia <1 mg/L, total nitrogen <5 mg/L and total phosphorous <0.05 mg/L. Treated wastewater was also required to meet the Class A quality (*E. coli* <1 org/100 mL) for recycling under the 1999 "*SA Guidelines for the Reuse of Treated Effluent*", in order to facilitate increased reuse.

- With the introduction of the 2006 Australian Guidelines for Water Recycling, the SA Department for Health and Ageing required preparation of risk management plans for recycled water schemes. It was recognised that, under the new guidelines, the treatment process at Victor Harbor was not adequate to deliver treated wastewater with the required micro-biological quality for recycling for residential garden watering and unrestricted municipal open space irrigation - two of the principal uses required by existing and potential customers.

- Disinfection by chlorination of the treated wastewater after the UV unit started in 2009. However, during holiday periods, the concentration of nitrogen in the influent wastewater to the MBR plant was found to be significantly higher than the design specification, and the MBR plant was occasionally unable to produce treated wastewater to the contract specification.

- As additional customers required high quality recycled water, $2.7 million was invested in process modifications, replacement equipment and new infrastructure that was installed and commissioned in 2011.

- The upgraded plant went through a one-year performance trial period to June 2012 and is now consistently delivering high quality treated wastewater, low in ammonia and nitrogen in accordance with the original specification.

- The City of Victor Harbor constructed a $1.4 million recycled water distribution pipe system in 2009-10, which is now operational and irrigating ovals, parks and gardens. In addition, new rural living customers have been connected to recycled water.

Key points - future:

- Victor Harbor is a popular coastal holiday destination and town of choice for many retirees. Population growth may increase more rapidly than anticipated, bringing forward the need to increase plant hydraulic capacity.

- Increasing reuse and utilisation of stored water from the Hindmarsh Valley Reservoir should meet future reuse requirements and meet EPA expectations regarding reducing environmental impacts on the Inman River.

27. Whyalla Wastewater Treatment Plants

27.1. Summary

Commissioned:	Whyalla wastewater treatment plant (WWTP) was commissioned in 1966 and a second plant - with a reuse component - was commissioned in 2005, with screens and grit removal installed in 2008.
Treatment process:	Originally the Whyalla WWTP featured two parallel anaerobic lagoons, followed by five aerobic lagoons. The plant was modified in 1975 in response to odour complaints. Additional pipework changes were made in 2009. The second plant incorporates screening and vortex grit removal, followed by an activated sludge SBR with two bioreactors. Decanted treated wastewater is discharged into two lined balancing storage basins. Recycled effluent is disinfected by chlorination.
Disposal of treated wastewater:	Treated wastewater from the second plant is recycled for irrigation of a golf course and playing fields by the local council. Surplus effluent is discharged back into the sewer network. Whyalla WWTP discharges via a tidal channel to the mangrove swamp on the coast of Spencer Gulf.

Figure 210 Whyalla's second plant (top) and original wastewater treatment plant site

	Whyalla WWTP		Whyalla - second plant	
Parameter	**Original Design**	**Actual (2010-11)**	**Original Design**	**Actual (2010-11)**
Flows (Megalitres per day; ML/d)				
Average dry weather	3.31	3.05	3.15	1.57
Average annual	3.90	3.75	n/a	2.43
Peak month average	4.70	4.43	n/a	3.05
Peak day flow	6.60	9.83	7.88	2.99
Peak wet weather	8.28	n/a	n/a	n/a
Avg Influent Concentration (mg/L)				
Biochemical Oxygen Demand (BOD)	380	245	305	300
Chemical Oxygen Demand (COD)	n/a	n/a	671	n/a
Suspended Solids (SS)	n/a	327	305	497
Total Kjeldahi Nitrogen (TKN)	n/a	61	66	95
Ammonia (NH_3-N)	n/a	30	46	60
Total Phosphorous (TP)	n/a	14	13	15
Avg Raw Wastewater Load (kg/dy)				
Biochemical Oxygen Demand (BOD)	1,474	942	960	798
Chemical Oxygen Demand (COD)	n/a	n/a	2,112	n/a
Suspended Solids (SS)	n/a	1,249	960	1,307
Total Kjeldahl Nitrogen (TKN)	n/a	235	208	208
Ammonia (NH_3-N)	n/a	118	144	127
Total Phosphorous (TP)	n/a	52	42	34

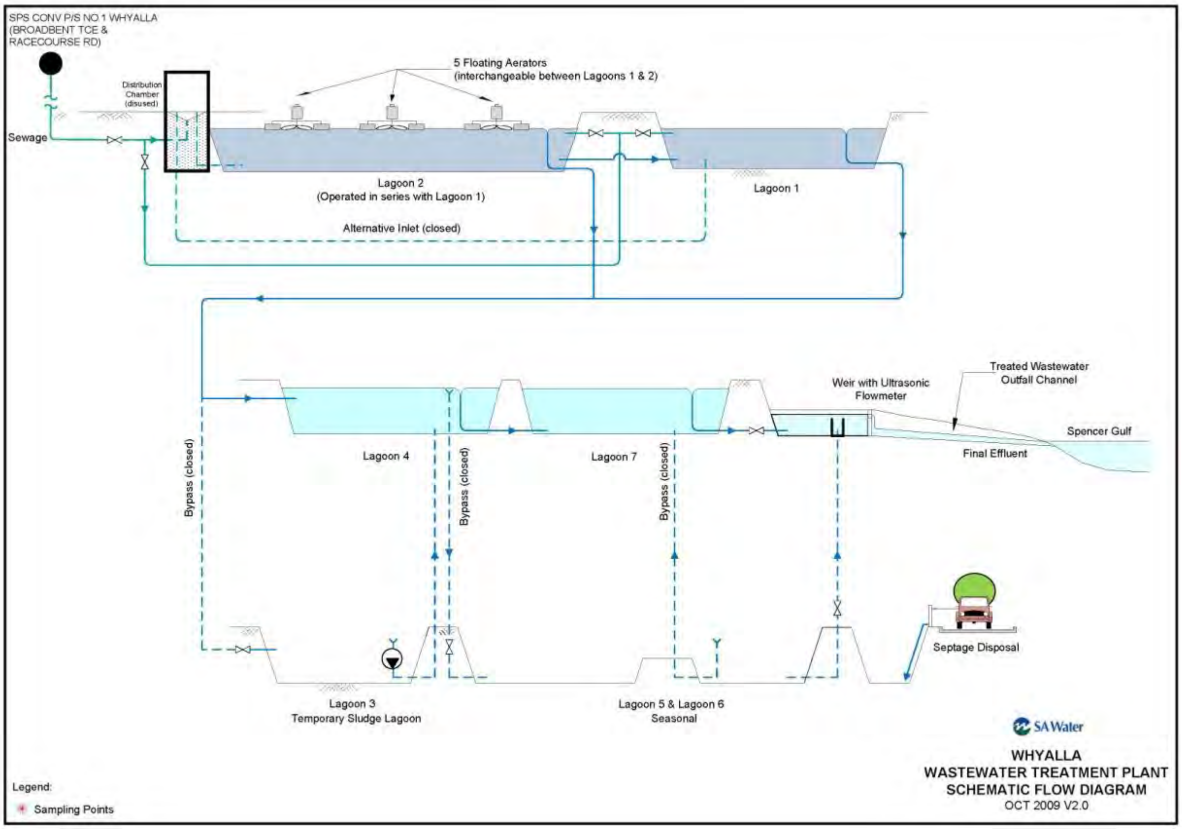
Note: due to the design of the second plant's sewer extraction system, the key design flow criteria are average dry weather flow and peak day flow. The plant is designed to accept all flows up to the capacity of the sewer extraction pumping stations to deliver.

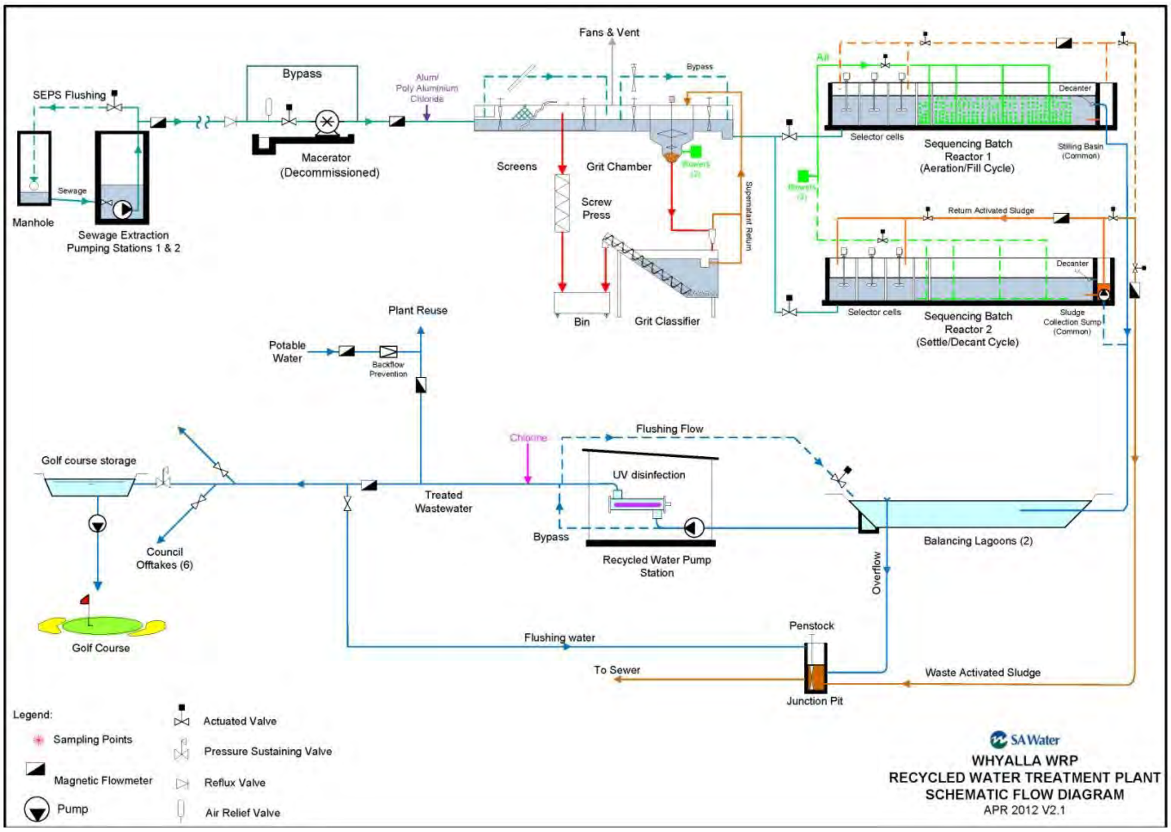
Population served[49]

2006 Census	2011 Census
21,416	22,088

[49] Indicative figures for catchment areas based on Australian Bureau of Statistics, 2006 and 2011 Census data (Whyalla Statistical Local Area), www.abs.gov.au.

Figure 211 Schematics for the original WWTP (top) and 2005 plant





Note: lagoons 5 & 6 used for summer storage are not shown.

212 Whyalla drainage area

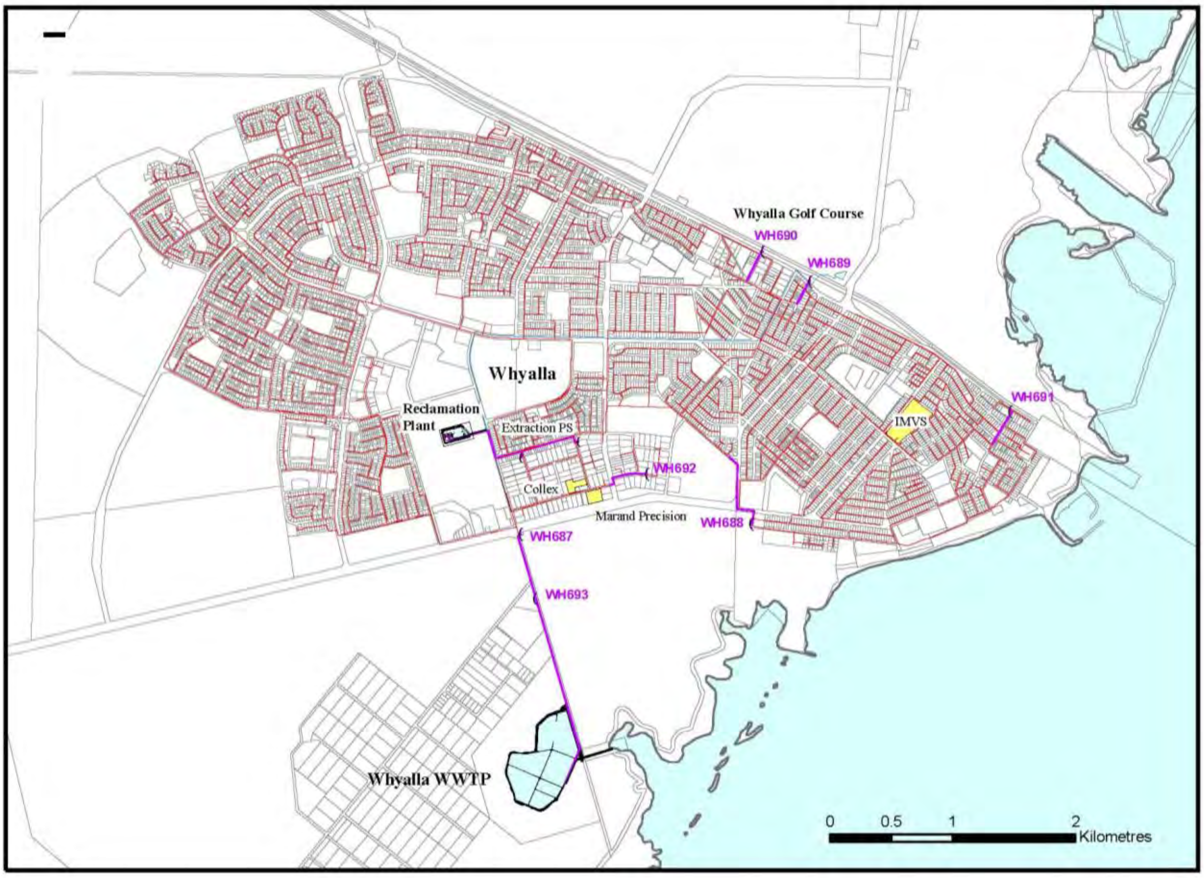
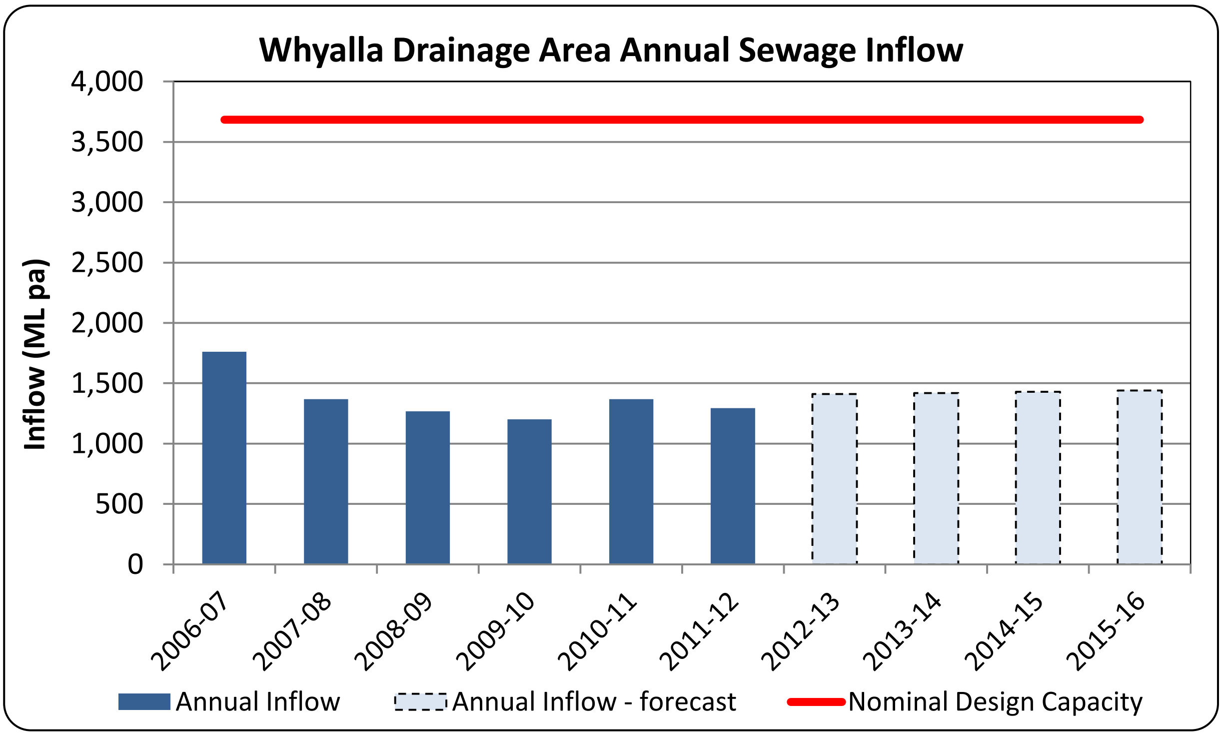


Figure 213



Note: nominal design capacity shown in the graph above is the combined plant capacity for both plants. Effluent discharges from the second plant - less quantity reused annually - is the inflow to Whyalla WWTP.

Figure 214

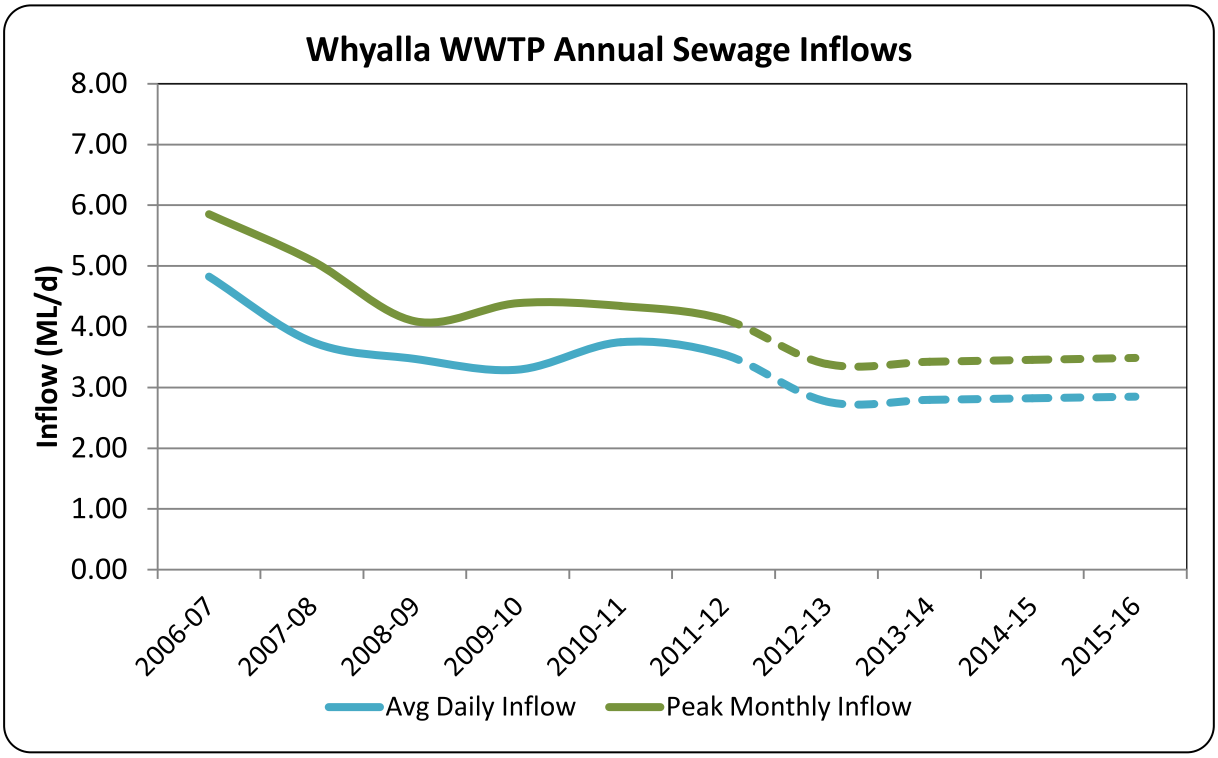


Figure 215

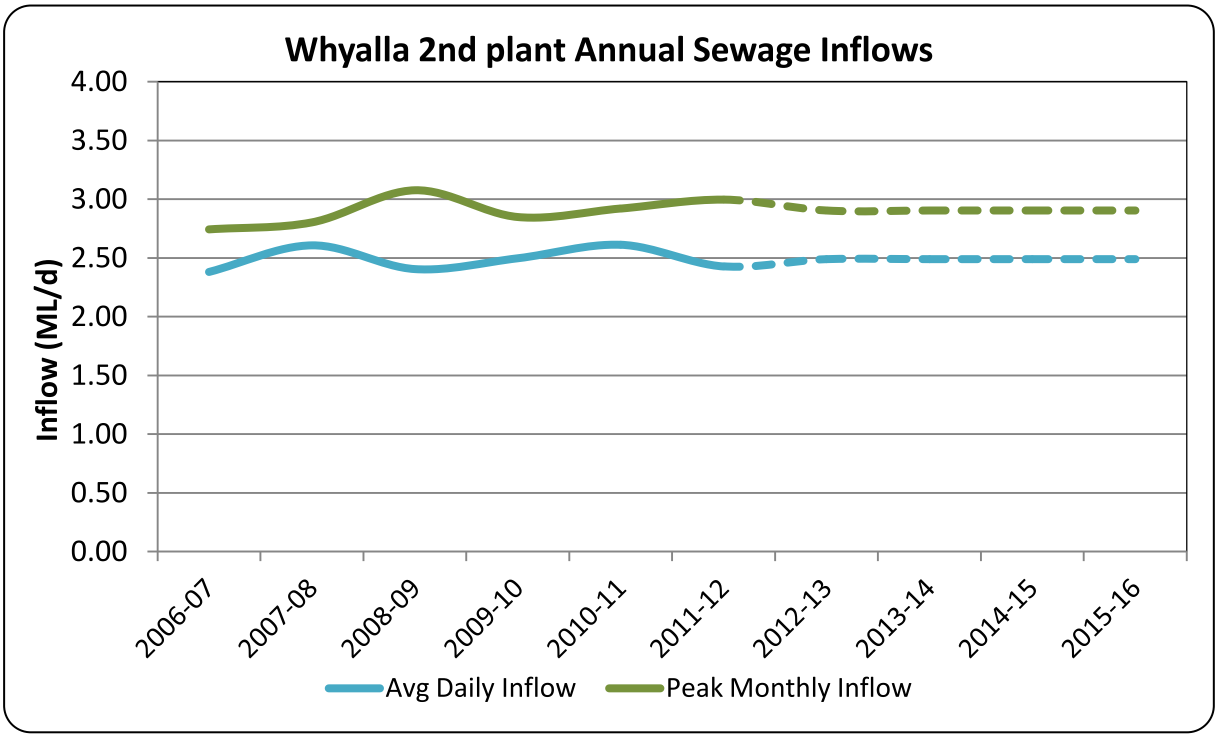


Figure 216

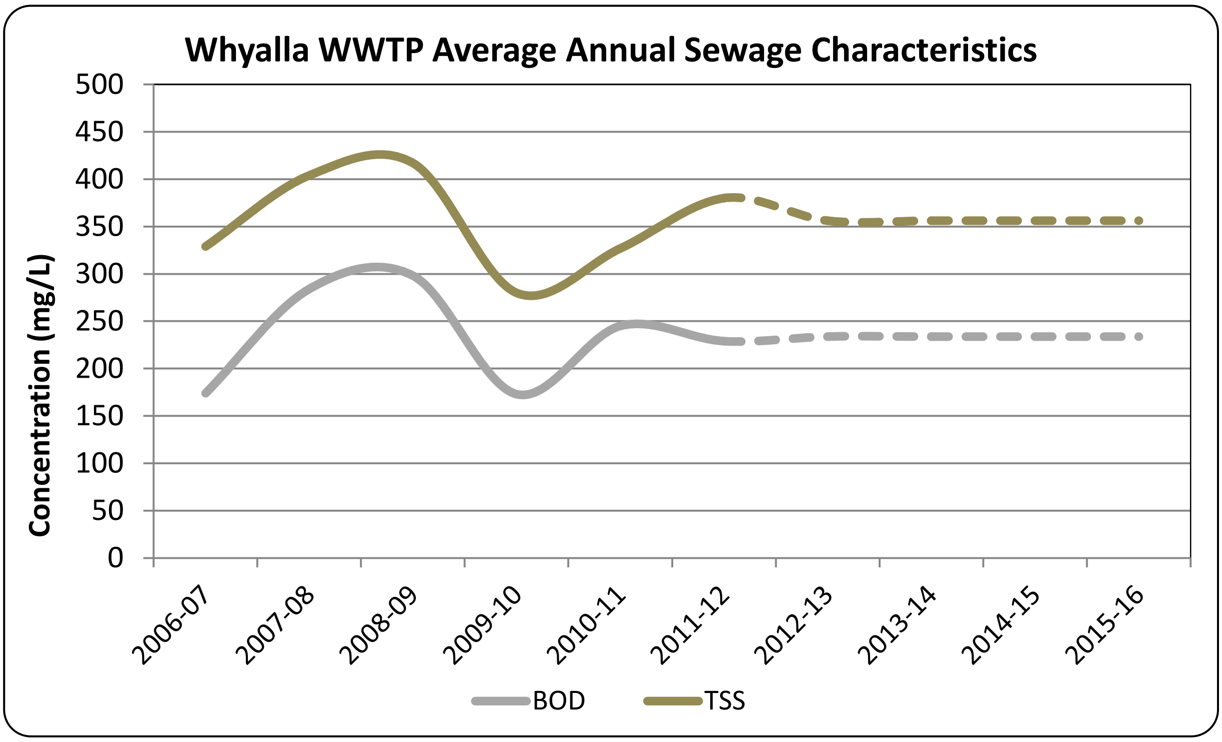
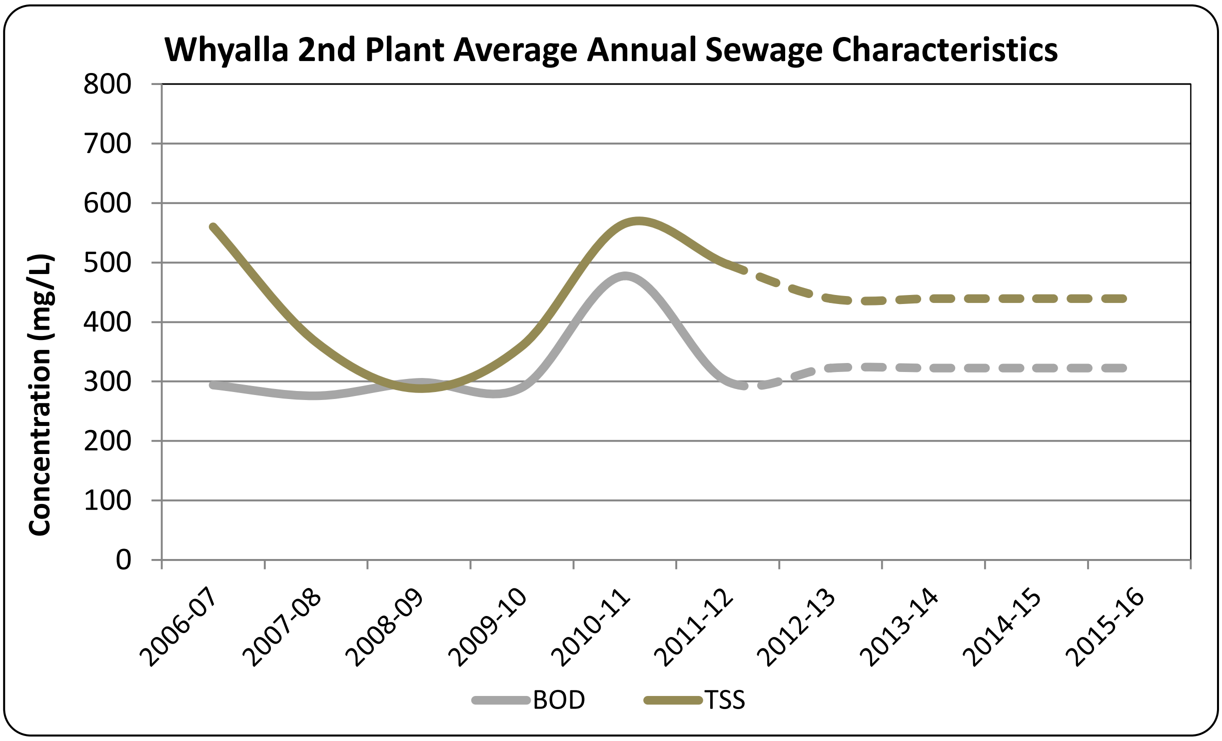


Figure 217



Note: monitoring has indicated that for several months in 2011, a quantity of relatively high strength raw wastewater entered the second plant (see TKN graphs below). The source has not been identified.

Figure 218

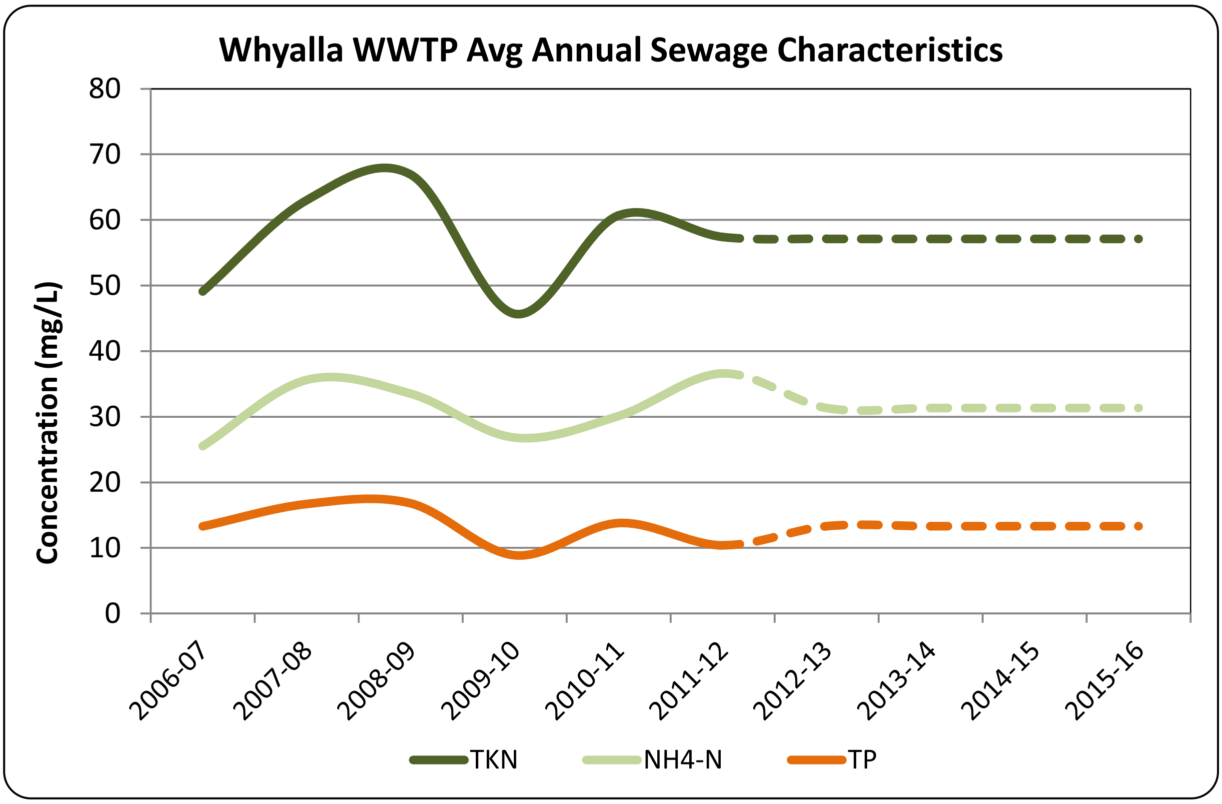


Figure 219

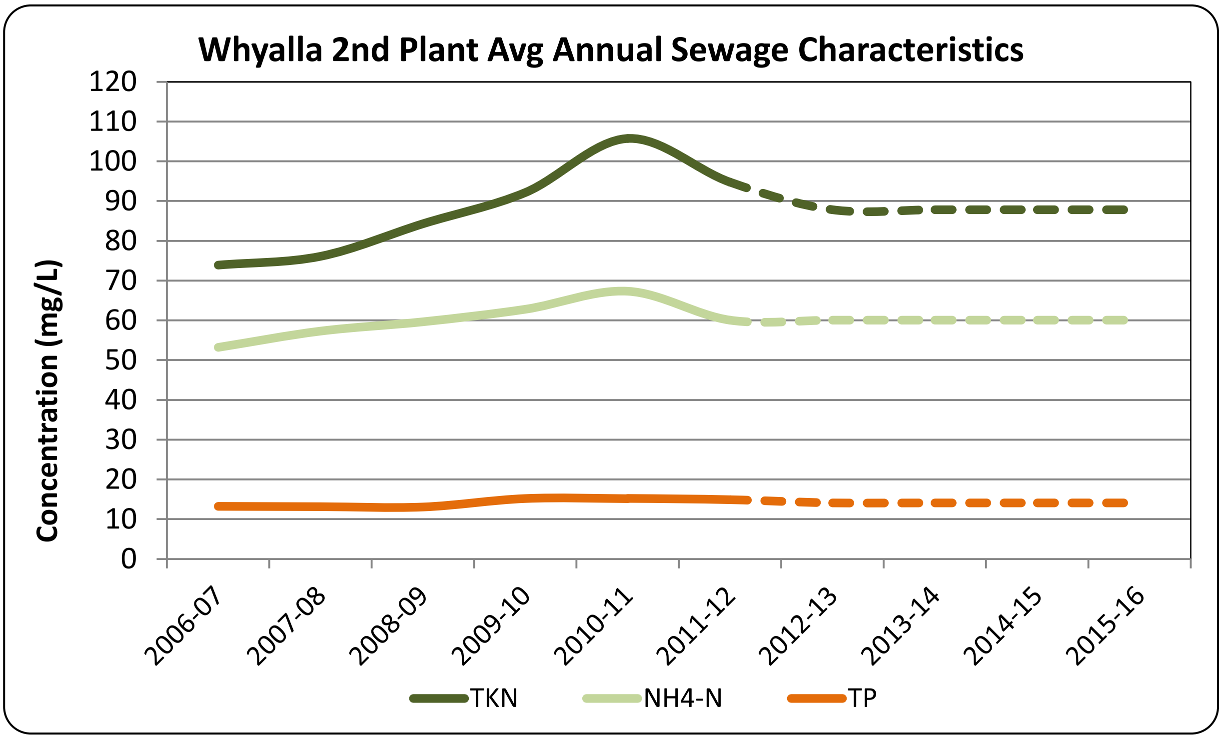
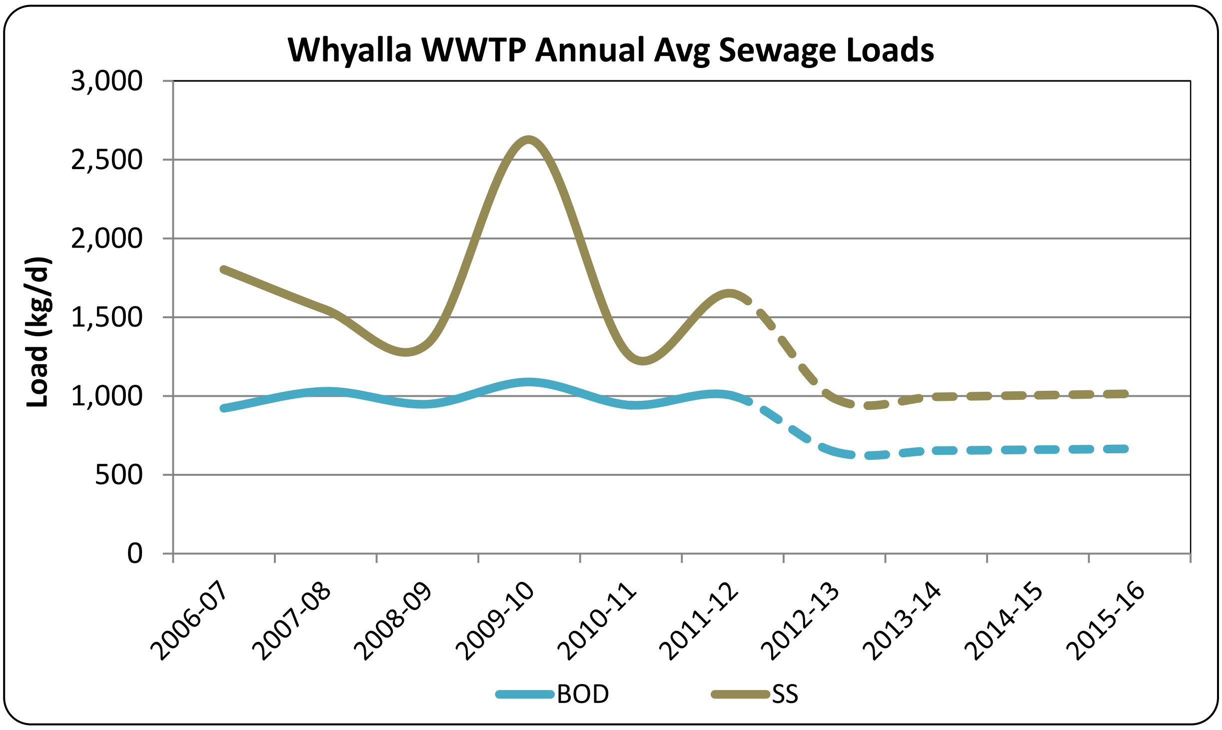


Figure 220



Note: the high load in 2009-10 may be a result of an isolated inaccurate daily flow or BOD concentration analysis.

Figure 221

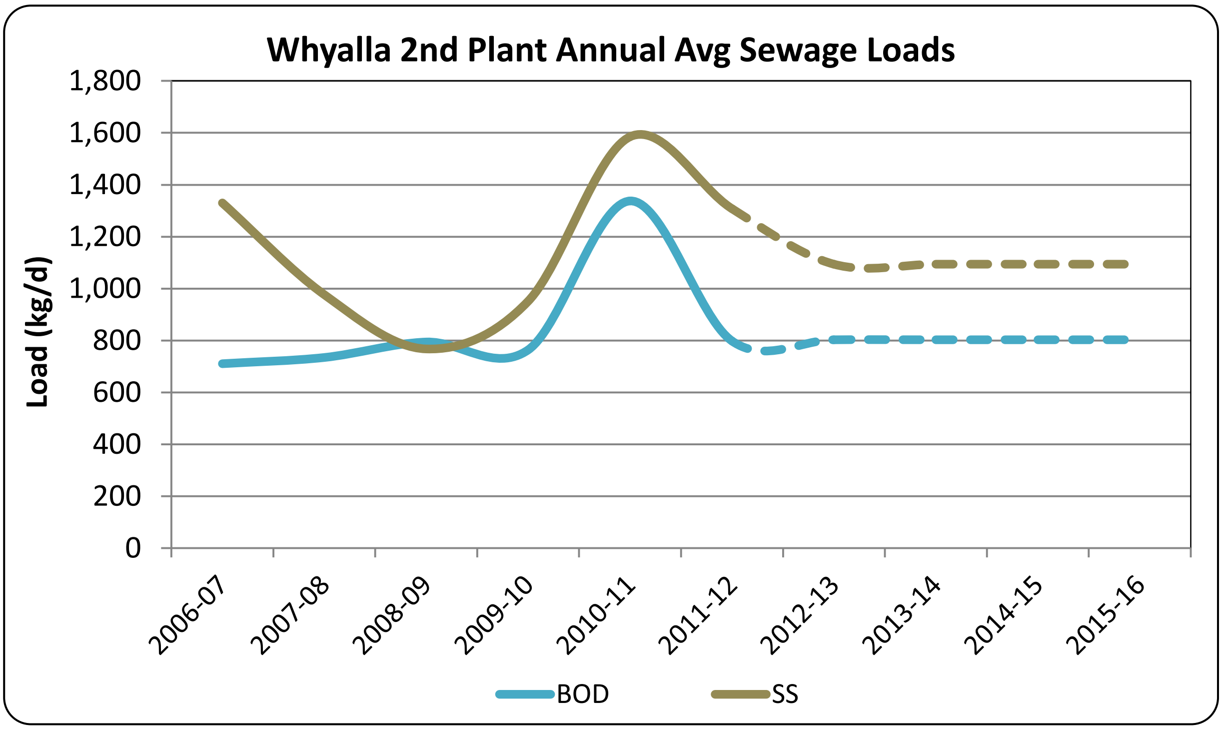


Figure 222

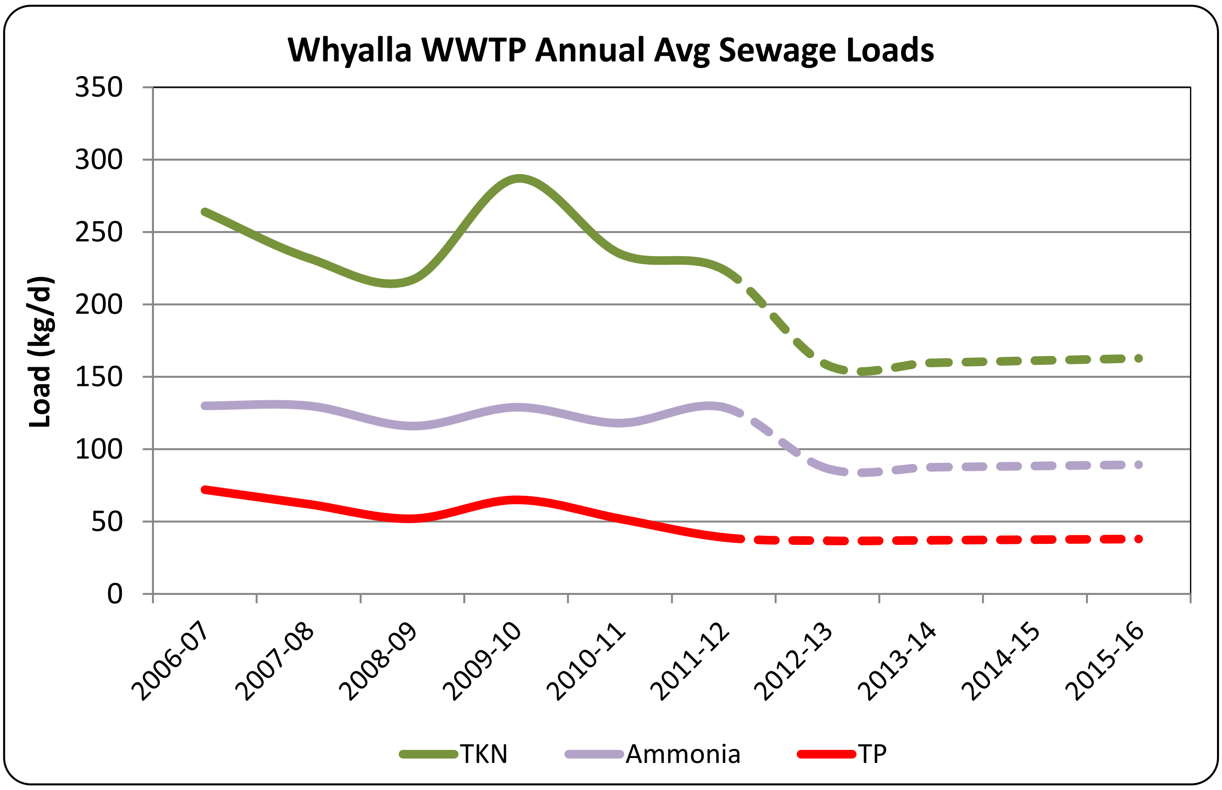
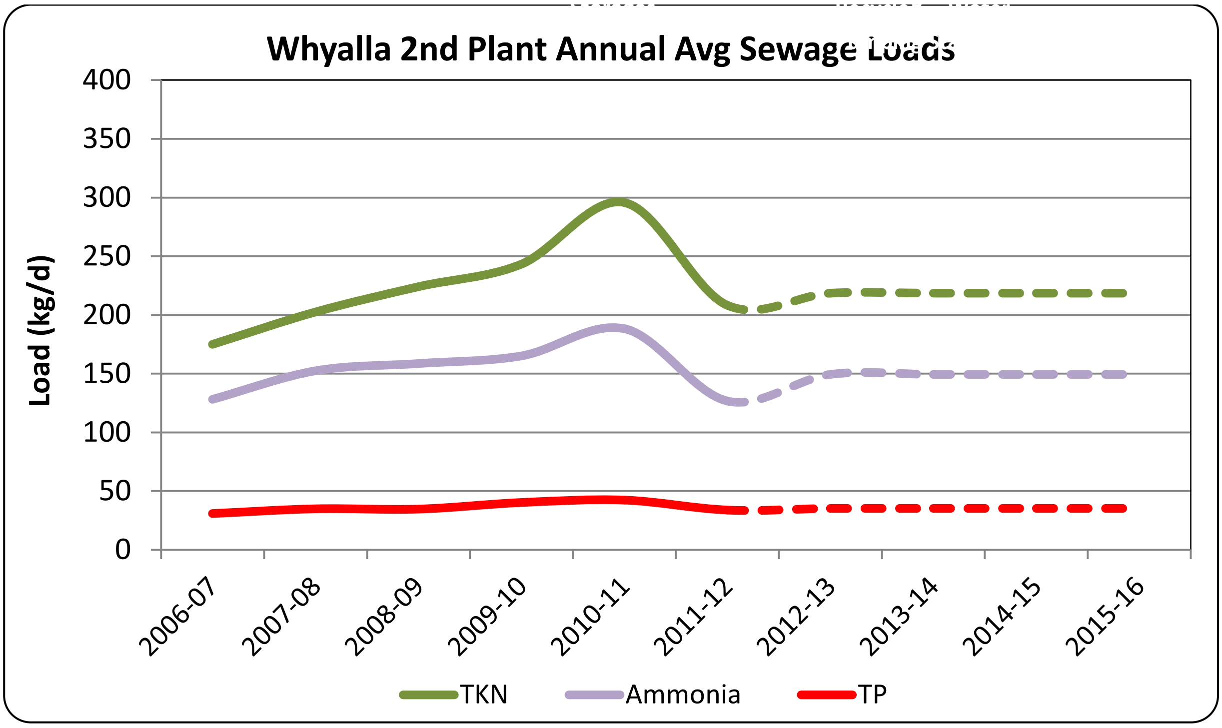


Figure 223



27.2. Key points

- The original Whyalla wastewater treatment plant was commissioned in 1966 and receives domestic and trade waste wastewater from the City of Whyalla, on the western shore of the Upper Spencer Gulf. Whyalla is the third largest city in South Australia, with its substantial industrial base including Arrium (Whyalla steelworks), industrial fabrication and transportation.

- The Whyalla WWTP was originally constructed with two anaerobic lagoons followed by three aerobic lagoons with a capacity to service an equivalent population (EP) of 25,000. Additional aerobic lagoons were constructed in 1968. In 1975, the anaerobic lagoons were bypassed following odour issues and seven aerators were placed in lagoon 3 to increase capacity to 50,000 EP. Further modifications were undertaken in 1978.

- However, the sewage was moderately saline due to saline groundwater infiltration into the sewage system and this precluded reuse.

- The plant now consists of 7 lagoons, ranging in size from 1.8 ha to 5.0 ha. Up to five mechanical aerators are located in Lagoon 1 or 2 depending on which is accepting raw wastewater. They are swapped over from time to time to allow removal of accumulated sludge. Treated, un-chlorinated wastewater is discharged to an outfall channel into a tidal creek, which flows into samphire and mangroves east to Spencer Gulf, about 2km from the plant and 3km from the nearest beach.

- The EPA recommends a buffer distance of 400m for aerated lagoons for WWTPs designed for an EP of 20,000 to 50,000. There is a separation distance of about 1,500m between the Whyalla WWTP and the nearest residential zone. Subdivision and development has occurred on the western boundary of the plant, where the land is zoned urban farmland and dwellings may be established only on land equal to or greater than 2ha. There is a separation distance of about 300m to this zone.

- Whyalla WWTP is ranked as a “tier 2”[50] treatment plant by the EPA. Under its licence there was a requirement to implement an EIP.

- The plant’s EIP, developed in 2003, is now largely complete. SA Water developed an innovative approach to sewer mine the majority of the wastewater before it became saline in the low lying areas of the town. This required a the construction of a new sequencing batch reactor (SBR) wastewater reclamation plant at a nearby racecourse, infrastructure to divert low salinity sewage to the new plant and a reuse pipeline to distribute recycled water to a number of irrigation sites. The second plant was commissioned in 2005. The original plant was also modified to allow storage of wastewater during summer, minimising marine impacts. The EIP also included a period of monitoring of the coastal waters receiving the discharge and this has been completed.

- This second plant mines sewage from part of the Whyalla township sewer network and treats it to a standard suitable for irrigation. Any treated sewage surplus to reuse demand is discharged back into the sewer system and conveyed to the WWTP. Treatment at Whyalla’s second plant continuously reduces the quantities of nitrogen and phosphorous discharged from the Whyalla sewage system to Spencers Gulf waters. This scheme has reduced the mass of nitrogen discharged to the Gulf by about 70% and restricted discharges in the summer season when environmental impacts are likely to be greatest.

[50] Refer to notes to the attachment.

- Since commissioning, periodic problems have been experienced with foaming and bulking sludge in the SBR bioreactors, leading to solids carry-over into the balancing storages and high UV transmissivity and turbidity in the recycled water. This compromises UV disinfection effectiveness and there is only a single duty UV unit. Consequently, chlorination was implemented in 2008 at a cost of $455,000 and is now used for primary disinfection. Solids carryover has also led to periodic cleaning of the balancing storages by contract and the installation of floating walkways to access the basins when drained.

- Whyalla's second plant is ranked as a "tier 3"[51] treatment plant by the EPA. The plant EPA licence does not require an EIP.

- Reclaimed water reuse in Whyalla is complicated by the high salinity of the wastewater. Studies undertaken in 1999-2000 found saline infiltration is concentrated in a relatively small part of the sewer network and about 70% of the total sewage flow had a salinity of approximately 1,000 mg/L and could be extracted from the sewers at two locations. Approximately 3.2 ML/d of the total design average sewer system flow of 4.6 ML/d was available for reuse by irrigation, based on this criterion.

Key points - future:

- The drying and removal of sludge from some of the Whyalla WWTP lagoons is problematic due to their size and the difficulties in using heavy machinery on the soft base of the lagoons. Lagoon 3 has been taken off-line in an attempt to de-sludge it. Some sludge was removed around the periphery with the aid of a dragline but the centre was too boggy to enter, making any further cleaning an expensive process. The small amount of sludge removed was used on site as landfill.

- SA Water is in the process of preparing a risk management plan for reuse to ensure compliance with the Australian Guidelines for Water Recycling. Microbiological water quality may be an issue and process modifications, including pre-disinfection filtration of the effluent, may be needed.

- Sludge bulking and foaming in the SBR results in variable carry-over of suspended solids into the two storage lagoons, which are the direct source water for the recycled water system. The amount of solids built up in the lagoons needs to be managed to maintain water quality and minimise odour issues for nearby residents. Various process changes have been trialled, without success, in the SBR to improve the quality of the decanted effluent and therefore the amount of suspended solids carry-over. A project is proposed for the regulatory period to address these issues and increase the availability of effluent for reuse.

- A project is also proposed for the forthcoming regulatory period to investigate ways of addressing odour issues and accelerated corrosion of infrastructure within the Whyalla sewer network.

[51] See footnote 2.