



**LGA SA Community Wastewater Innovation Fund
(CWIF) Project CWMS-003: Understanding CWMS
retrofitting options to increase capacity, reduce
complexity and cost**

For: Yorke Peninsula Council



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Abbreviations

Abbreviation	Description
BOD ₅	5-day biochemical oxygen demand
CWMS	Community wastewater management system
d	Day
DLR	Design Loading Rate
h	Hour
kL	Kilolitre
L	litre
LCA	Land Capability Assessment
m	Metre
m ²	Metre squared
ML	Megalitre
O&M	Operation and Maintenance
p	Person
STEDS	Septic tank effluent disposal scheme
TSS	Total Suspended Solids
y	Year

Executive Summary

This report presents the findings and outcomes of LGA South Australia Community Wastewater Innovation Fund (CWIF) funded project CWMS-003: Understanding CWMS retrofitting options to increase capacity, reduce complexity and cost. The project was undertaken by Fluid Environmental Pty Ltd in collaboration with Yorke Peninsula Council.

The project undertook a strategic review of Yorke Peninsula Council's major CWMS to understand how each site was configured, operated relative to design parameters, as well as gain an understanding the operational and maintenance costs for each site with the aim of looking for future savings from alternative retrofitting solutions. In consultation with council, a shortlist of three priority CWMS sites (Rogues Point, combined Sultana Point and Edithburgh, and Chinaman Wells) were selected for more in-depth focus and detailed site assessment to understand the potential feasibility and benefits of retrofitting these sites to operate with a passive (non-mechanical) wastewater treatment technology.

The project identified that the majority of council's CWMS are very much under-loaded relative to their ultimate approved design flow capacity. This under-loading means that council is often spending money operating plants that are much larger and more costly than required. This operating environment presents opportunities for council to save on future operating costs by retrofitting existing wastewater systems with high performance passive treatment technologies which can deliver the required treatment outcomes at lower operating costs. Such passive retrofit technologies can also unlock additional CWMS treatment capacity, further avoiding or delaying capital expenditure from plant upgrades where existing treatment capacity is constrained.

Detailed assessments were undertaken for the priority CWMS sites of Rogues Point Sultana Point and Edithburgh (combined) and Chinaman Wells, with in-depth cost assessments undertaken using council-supplied data, together with full Land Capability Assessments of site soils to understand the capacity of each site to accept a passive retrofit conversion using the ABSORBS™ technology as an exemplar.

Due to persistent under-loading in particular at the Rogues Point and Chinaman Wells sites where average wastewater flows were just 6% and 12% of the respective approved plant design capacities, the cost of treating wastewater at these sites was extremely high at some \$19/kL at Rogues Point and \$28/kL for Chinaman Wells. Treatment costs were as high as \$40–53/kL for some of the smallest plants receiving very low wastewater flows <1 kL/d. This is compared to equivalent costs at the council's largest CWMS treatment plants of between \$2–5/kL due to efficiency gains achieved by operating these plants at flow rates closer to their design capacity.

Detailed Land Capability Assessments (LCAs) were undertaken for the three priority CWMS sites to determine the suitability of site soils to receive wastewater via an alternate sub-surface passive treatment and dispersal solution. LCAs for all three sites confirmed that site soils were suitable for sub-surface wastewater treatment and dispersal at moderate to high design loading rates for secondary effluent application of between 30–50 L/m²/d, making all sites well suited to retrofitting with alternate sub-surface passive wastewater treatment and disposal solutions.

Following the site-specific LCAs and in consultation with council, a wastewater engineer was commissioned to undertake a detailed design for a prospective sub-surface passive wastewater treatment and disposal retrofit solution for the Rogues Point CWMS. The wastewater engineer specified that an existing 48 kL of treatment tanks in the existing mechanical aerobic system could be repurposed and retrofitted to function as a series of septic tanks for primary treatment in a new 500 m² ABSORBS™ unlined sand filter system. This alternate system design would satisfy all SA

Health On-site Wastewater Systems Code requirements and delivers to deliver advanced secondary treatment with sub-surface effluent dispersal in a system design that is incrementally scalable to accommodate additional plant flows in the future.

By adding a new secondary treatment stage within the wastewater dispersal field and converting the existing CWMS treatment tanks from current mechanical aerobic operation to a primary only treatment stage, the capacity of the CWMS can also be conservatively increased to 150% that of the existing system without adding any more hydraulic capacity (i.e. no new tanks required). By modifying default assumptions regarding the rates of average and peak occupancy within the system, and using more realistic assumptions regarding the rates of sludge accumulation within the wastewater STEDS scheme, CWMS capacity can be further increased to between approx. 175–250 that of the current system, unlocking significant additional treatment capacity with no new capital investment.

Operational cost savings were also estimated for prospective passive system retrofits across the three priority sites. Conservatively, it was estimated that the combined annual operations and maintenance cost savings across the three sites is in the order of \$36,500 per year, with this figure likely to be an underestimate of the likely savings figure due to uncertainties in some cost data provided by council and conservative operating design flow assumptions for the passive retrofit technology compared to the existing mechanical plants which are largely under-loaded.

To complement operational cost information, an assessment of capital expenditure (CAPEX) costs was also done for passive treatment system retrofitting at two of the three priority sites. This showed that for Rogues Point and Chinaman Wells, the capital cost of retrofitting is similar at both sites (\$170,000 ex-GST) despite the two sites having very different design flows. This was due to differences in soil properties at each site which resulted in the required passive treatment system being the same size at both sites. Based on this cost, it was estimated that the ‘payback period’ on capital outlay as a result of avoided operating costs over time was in the order of 12 years for Chinaman Wells and 13 years for Rogues Point for a wastewater system treating 100% of the approved design flows. Due to the under-loading of these treatment plants, CAPEX assessments were done for retrofits based on a more realistic design volume of 200% of recorded peak daily flow at each site. Based on this more practical scaled-down retrofit design, CAPEX payback periods were much shorter at some 8 years for Chinaman Wells and 11 years for Rogues Point. Overall, the combined operational and capital cost assessments demonstrated that retrofitting existing mechanical aerobic systems with passive wastewater treatment solutions can present an effective pathway for councils to reduce CWMS complexity while also reducing their CWMS expenditure over attractive time horizons.

The project culminated with a works approval application lodged to SA Health for the proposed passive system retrofit design at Rogues Point. The project team at Fluid Environmental plans to continue working with Yorke Peninsula Council following the end of the project to progress the Rogues Point CWMS retrofit installation in line with council requirements, while also looking at other CWMS sites to explore opportunities to undertake similar retrofits for O&M cost savings, or to increase system capacity for CWMS schemes that are constrained in treatment capacity by the existing plant infrastructure.

1 Introduction

Yorke Peninsula Council's Community Wastewater Management Systems (CWMS) network comprises 18 schemes across the council's area (Figure 1) with some 41 pump stations and 17 wastewater treatment plants. Treated effluent from the CWMS schemes is most commonly disposed of adjacent to wastewater treatment plants via irrigation dispersal areas or is provided to local communities for beneficial irrigation. A summary of the key site and operating data for each CWMS scheme is provided in Table 1 with the average daily flow rates for each site given in Figure 2.



Figure 1. Map showing CWMS scheme locations on Yorke Peninsula (Source: Government of South Australia, 2023)

During the project, a shortlist of priority CWMS sites was selected for more detailed focus and investigation as part of the project works, namely Rogues Point, Sultana Point and Edithburgh (combined CWMS) and Chinaman Wells. These are the CWMS sites of focus for this report. Council also expressed a desire to increase the volume of beneficial wastewater reuse across its CWMS operations and this is something that was beyond the scope of the current project but will be explored further during future interactions with council.

Table 1. Summary of Yorke Peninsula Council CWMS scheme daily flows (average, seasonal and peak) and approval capacities (priority sites highlighted in orange).

Scheme No.	Town	Yearly average (2021)		Winter (May-Nov)		Summer (Nov-May)		Peak loads		Treatment plant capacity as per DOH approval	
		ML/y	L/day	L/day	% of approval	L/day	% of approval	L/day	Time of peak	L/day	BOD ₅ (kg/day)
1	Ardrossan	78.5	211,642	210,000	116	213,110	118	264,600	Australia Day	180,000	48
2	Tiddy Widdy	Combined with Ardrossan (water sent to Ardrossan for processing and reuse)									
3	Maitland	57.7	155,593	173,094	96	138,921	77	220,000	End of winter, Stormwater ingress	190,000	56
4	Rogues Point	0.6	1,685	1,379	9	2,005	13	4,500	Mid-January	14,560	
5	Black Point	8	21,698	15,315	13	27,779	24	64,000	Mid-January	115,500	38.5
6	Port Vincent	13.1	40,466	32,657	22	47,905	33	68,000	Australia D	147,000	62
7	Stansbury	10.7	29,027	21,237	30	36,447	53	53,000	Australia Day	69,000	27
8	Sultana Point	2.9	8,075	6,381	15	9,689	23	17,350	Australia Day	41,480	9.76
9	Edithburgh	Combined with Sultana Point (water sent to Sultana Point for processing and reuse)									
10	Yorke town	31	83,811	84,055	49	83,579	49	120,000	End of winter, Stormwater ingress	170,000	
11	Foul Bay	0.25	679	508	3	832	5	2,500	Early January	17,680	
12	Point Turton #1	1.4	3,873	3,149	17	4,563	25	6,500	January	18,360	
13	Point Turton #2	8.2	22,315	18,685	11	25,774	15	32,000	January	167,000	59
14	Hardwicke Bay	1.3	3,525	2,740	11	4,274	17	6,400	January	23,700	
15	Bluff Beach	0.9	2,501	2,038	7	2,942	10	5,300	January	28,500	
16	Port Victoria	9.8	26,588	20,928	21	31,979	32	51,000	January	100,000	30
17	Chinaman Wells	0.5	1,364	1,326	5	2,000	8	4,500	January	24,480	8.64
18	Port Julia	0.2	768	580	3	947	5	1,300	Easter	18,750	
19	Balgowan	0.3	863	674	6	1,042	9	2,800	January	11,300	3.35
Schemes on Yorke Peninsula not under council control											
1	Marion Bay									46,410	
2	The Dipper	0.3	976								

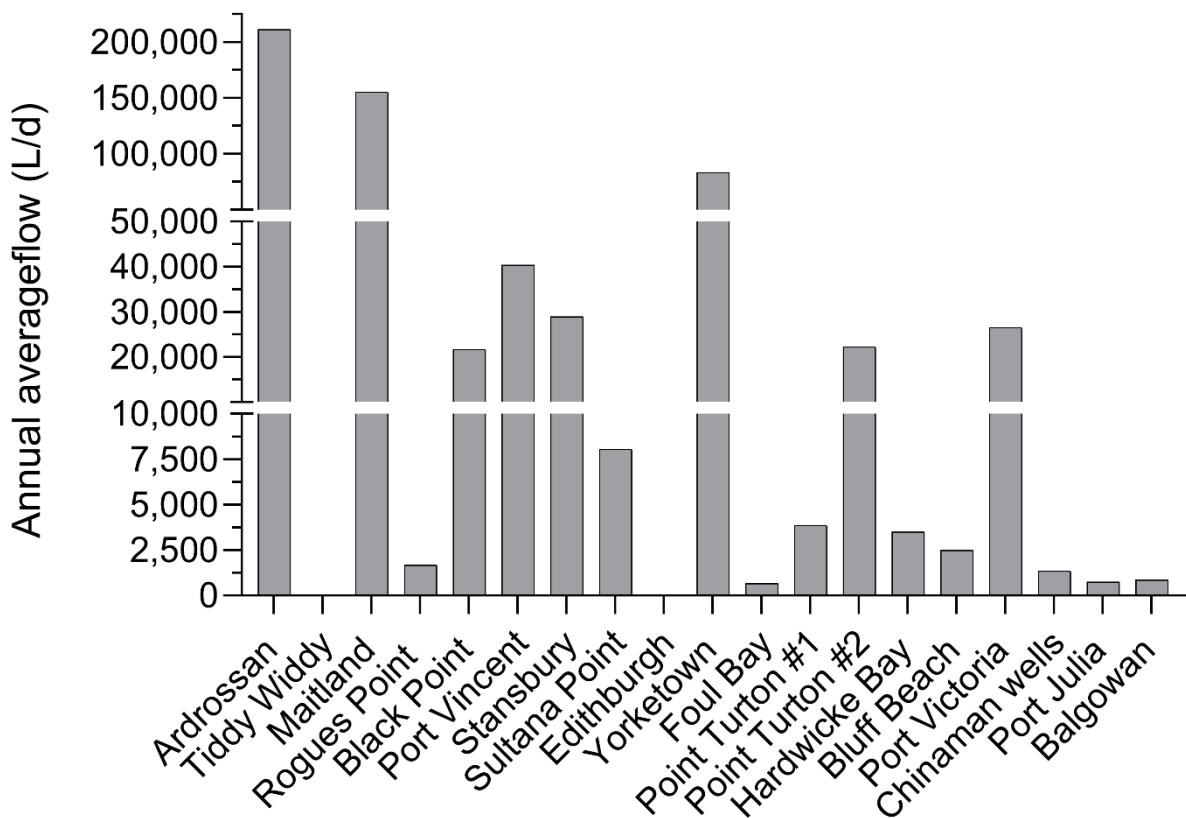


Figure 2. Annual average daily wastewater flows (L/d) entering Yorke Peninsula Council's CWMS schemes (note varying y-axis scale).

2 Recap on Milestone 2 Interim Report deliverables

The Interim Milestone 2 report presented an overview of the 15 CWMS schemes visited during the initial two-day tour in November 2024. The interim report also included a Land Capability Assessment for the first priority CWMS retrofit site (Rogues Point) as identified during discussions with council. A copy of this interim report is included as Appendix C.

3 Priority Site 1 – Rogues Point

Rogues Point is a small settlement located to the south of Ardrossan on the eastern coastline of Yorke Peninsula, with shacks running along the shoreline and no shops (i.e. purely domestic wastewater).

Key points for the site include:

- Largely a holiday community with domestic sewage influent
- The wastewater treatment plant was installed by Environmental Waste Services
- Blowers are 3.5 kW/hr and they operated 6–8 hours per day.
- Total utility costs are between \$3–4 K per year (largely for operating electricity)
- The dispersal field is in need of an upgrade as evidenced by the uneven flow resulting in uneven growth (see below image).
- Treatment plant is within the confines of the town and nuisance noise is a potential problem for residents
- Plant has adequate capacity and does not need an upgrade to meet current demand
- There are properties within Rogues Point that could be connected to the CWMS system
 - James Well to the north could be added to the CWMS scheme in future. If James Well were to be connected it would potentially increase flows by as much as 4-fold.
 - Total connected dwellings would be in the order of 200

Rogues Point CWMS (Figure 3) has an approved design flow of 14,560 L/day which is equivalent to 40 dwellings under the CWMS Code daily design flow allowance of 364 L/dwelling/day (non-reticulated water supply). Data supplied by council indicates that currently the system has 31 connections and so is approaching its design capacity from a connections basis under the CWMS Code. However, based on council's wastewater flow data for Rogues Point, the daily wastewater flows are actually considerably lower than the nominated approved plant design flow (Table 2) which suggests that there is still some spare capacity within the system based on the hydraulic loads (but not necessarily organic/BOD₅ loads).

Table 2. Rogues Point CWMS flow data¹

WWTP design capacity as per SA Health approval	WWTP annual average flow rate	Peak daily flow rate	Seasonal average flow rate (winter May–Nov)	Seasonal average flow rate (summer Nov–May)
L/day	L/day	L/day	L/day	L/day
14,560	1,685	4,500	1,379	2,005

¹ Based on information provided by Yorke Peninsula Council

The chronic under-loading of the WWTP can create issues for aerobic treatment plants which may not operate effectively with variable and low intermittent inflows, potentially resulting in the production of poorly treated effluent. Discussions with council also identified that the existing land application area consisting of surface sprinklers was not operating effectively, with the sprinklers observed to be blocked with snails, leading to poor uniformity of water application within the irrigation dispersal field.



Figure 3. Aerial image of the Rogues Point township showing wastewater dispersal area (inset).

4 Priority Site 2 – Sultana Point + Edithburgh

Sultana Point and Edithburgh are located on the heel of Yorke Peninsula, just south of Edithburgh. The townships are increasingly popular with holiday tourists. There are no shops at Sultana Point but Edithburgh has some commercial premises and so is not purely domestic wastewater. Wastewater from Edithburgh is pumped via a pressure sewer main to the Sultana Point WWTP.

Key points for the site include:

- Sultana Point is an established water treatment plant and dispersal area
- The wastewater treatment plant was installed by Environmental Waste Services
- Site has a peak daily flow 17,350 L/d or 42% of the nominated peak design flow (41,480 L/d)
- Currently there are two rising mains from 1) Sultana Point and 2) Edithburgh, to separate primary tanks at the treatment plant.
- The primary streams feed to a single secondary chamber and then 3 aeration chambers
- STEDS from Sultana Point and full sewer from Edithburgh
- It appears that the dispersal area, irrigated woodlot, has a low uniformity of distribution. The potential area of the woodlot is approximately 4,900m²
- Future expansion is being planned for:
 - A new housing development in Edithburgh: Counting from Satellite imagery, there are >40 subdivided blocks to be developed from Panfry Road South to Sultana Point. Using the CWMS (>20 houses calculation) this would be an additional 20,000L/d
 - Bringing the Edithburgh Caravan Park on to the system. The caravan park (counting from Google Earth) have >100 sites, at 3.5 people per site at 100 L/p/d + accommodation cabins, there could be as much as 60,000 L/d peak design flow (or 1.5-times Sultana Point WWTP capacity)
- Total theoretical wastewater generation to meet current demand (Sultana Point, Edithburgh Caravan Park, and available development to the south of Edithburgh) the total could be in the order of 100/kL/d.

The Sultana Point CWMS (Figure 4) currently has approx. 99 connections and so is close to its design capacity from a connections basis under the CWMS Code (based on daily design flow allowance of 442 L/dwelling for reticulated water supply). However, based on council's wastewater flow data for Sultana Point and similarly to Rogues Point, the daily wastewater flows are much lower than the nominated plant design flows (Table 3) which suggests that there is still some spare capacity within the system based on the hydraulic loads (but not necessarily organic/BOD₅ loads). Flows to Sultana Point CWMS are less seasonal than for Rogues Point as there are more permanent residents within the connected communities of Sultana Point and Edithburgh than at Rogues Point which is more seasonal in nature.

Table 3. Sultana Point CWMS flow data¹

WWTP design capacity as per SA Health approval	WWTP annual average flow rate	Peak daily flow rate	Seasonal average flow rate (winter May–Nov)	Seasonal average flow rate (summer Nov–May)
L/day	L/day	L/day	L/day	L/day
41,480	8,075	17,350	6,381	9,689

¹ Based on information provided by Yorke Peninsula Council



Figure 4. Aerial image of the Sultana Point and Edithburgh townships showing wastewater treatment and dispersal area (inset).

5 Priority Site 3 – Chinaman Wells

Chinaman Wells is located on the western coastline of Yorke Peninsula, with 37 dwellings in the community and no commercial premises (i.e. purely domestic wastewater).

Key points for the site include:

- Aeroflow style wastewater treatment plant installed
- Approved peak design capacity of 24,480 L/day, with an average flow of 1,364 and peak daily flow of 4,500 L/d
 - Plant is significantly underloaded (operating at <10% of design capacity on average)
- Cost of WWTP operations is high relative to the size of the plant and number of connections
 - Annual operating costs approx \$14 K/year for just 37 connections

The Chinaman Wells CWMS (Figure 5) currently has 37 connections and an approved WWTP design capacity of 24,480 L/d which is equivalent to 67 dwellings based on 364 L/dwelling/day for non-reticulated water supply under the CWMS Code. On a connections basis, the plant only at 55% of its design capacity, enabling existing vacant allotments within the community to be developed and connected to the CWMS in the future. Like the other two sites, daily wastewater flows to Chinaman Wells are considerably lower than the nominated approved plant design flows (Table 4), confirming that there is considerable spare capacity within the system based on the hydraulic loads and most likely also organic/BOD₅ loads. Given the dramatic over-design/under-loading of the WWTP, there are excellent opportunities at this site for retrofitting of the wastewater treatment system with a passive treatment solution.

Table 4. Chinaman Wells CWMS flow data¹

WWTP design capacity as per SA Health approval	WWTP annual average flow rate	Peak daily flow rate	Seasonal average flow rate (winter May–Nov)	Seasonal average flow rate (summer Nov–May)
L/day	L/day	L/day	L/day	L/day
24,480	1,364	4,500	1,326	2,000

¹ Based on information provided by Yorke Peninsula Council



Figure 5. Aerial image of the Chinaman Wells township showing wastewater treatment and dispersal area (inset).

6 Operating costs and capital asset values for CWMS schemes

Operational and maintenance cost data were obtained from council and also sourced from published asset management reports regarding the cost of operating the various CWMS schemes on Yorke Peninsula. These data are given in Table 5 for all CWMS schemes and in Table 6 for the three priority CWMS sites. Capital asset values for priority CWMS schemes are also given in Table 7.

As shown in Table 5, based on design flow rates for each site the annual operational and maintenance cost is similar across all sites at between approximately \$1.00–4.00 per kL of wastewater annual design flow. However, when these O&M costs are normalised to the actual average flows received at each site, these numbers are very different, ranging from approximately \$1–2 per kL of treated wastewater for the two largest schemes (Ardrossan and Maitland) to as high as \$40–50 per kL of treated wastewater for the smallest CWMS sites of Port Julia and Balgowan which receive less than 1 kL per day of flow on average.

This observation of lower flow-specific operating costs for larger plants (and *vice versa*) was not unexpected and is reported in the literature. For example, previous research into energy efficiency and energy performance benchmarking of wastewater treatment plants in South Australia showed that the larger metropolitan plants are generally more efficient and have lower energy use per unit of treatment throughput than smaller regional plants ([Krampe, 2010](#)). This is due to economies of scale effects for larger plants and efficiency gains in mechanical and electrical equipment operating at scale. This information will be useful for Council to inform decision making around prioritising sites for future retrofitting and conversion to passive treatment designs with considerably lower O&M cost requirements.

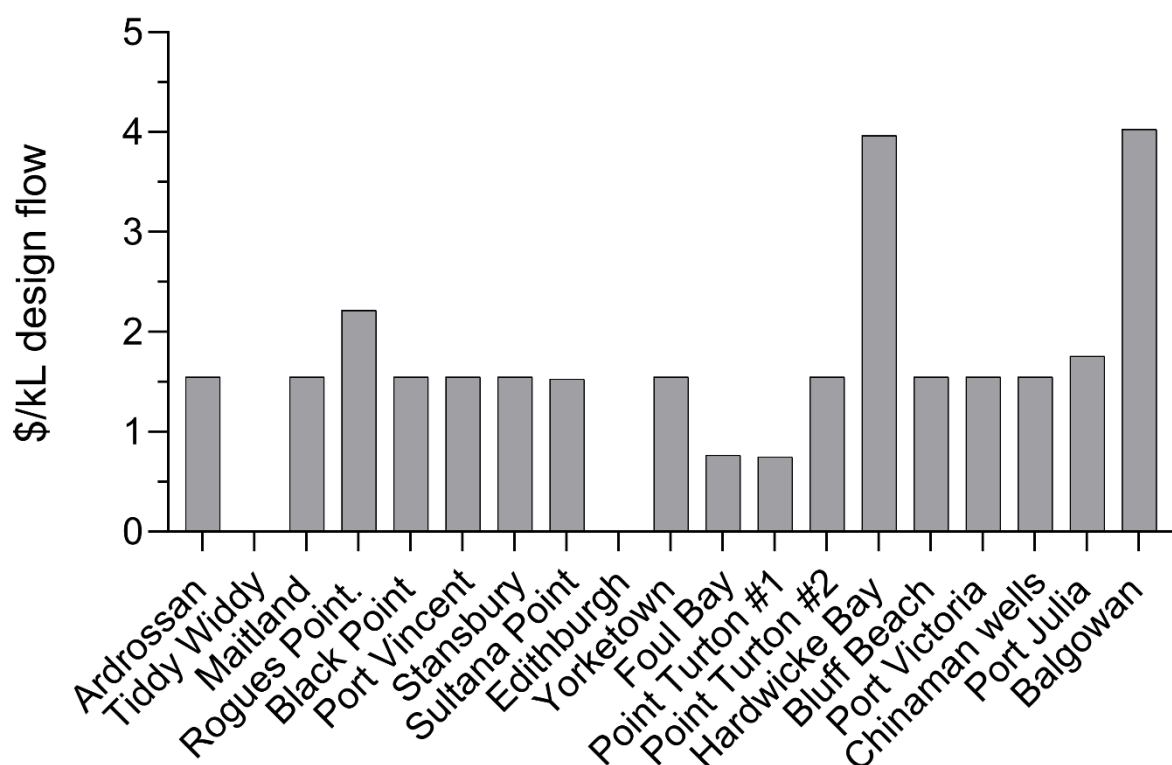


Figure 6. Normalised annual operation and maintenance costs for each CWMS plant normalised to plant design flow rate (\$ per kL plant design flow).

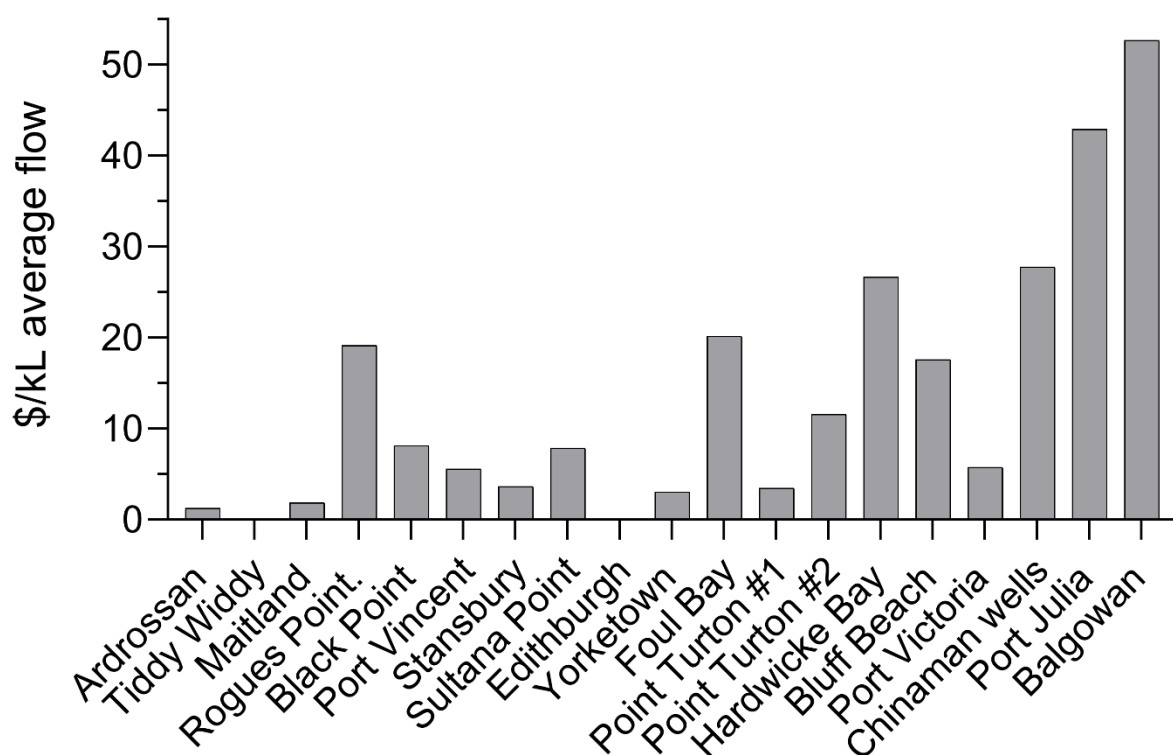


Figure 7. Normalised annual operation and maintenance costs for each CWMS plant normalised to actual average flow rate received at each site (\$ per kL plant average flow).

Table 5. Operation and CWMS operational and maintenance costs relative to design and operating flows (priority sites highlighted in orange).

Scheme Number	Town	Treatment plant capacity as per DOH approval	Treatment plant yearly average flow	Treatment plant operational & maintenance cost	Treatment plant operational & maintenance cost	Treatment plant operational & maintenance cost
		L/day	L/day	\$/yr	\$/kL design capacity/yr	\$/kL average annual flow/yr
1	Ardrossan	180,000	211,642	\$101,605 ²	\$1.55	\$1.30
2	Tiddy Widdy beach	Combined with Ardrossan (water sent to Ardrossan for processing and reuse)				
3	Maitland	190,000	155,593	\$107,250 ²	\$1.55	\$1.90
4	Rogues Point	14,560	1,685	\$11,781 ¹	\$2.22	\$19.20
5	Black Point	115,500	21,698	\$65,197 ²	\$1.55	\$8.20
6	Port Vincent	147,000	40,466	\$82,978 ²	\$1.55	\$5.60
7	Stansbury	69,000	29,027	\$38,949 ²	\$1.55	\$3.70
8	Sultana Point	41,480	8,075	\$23,219 ¹	\$1.53	\$7.90
9	Edithburgh	Combined with Sultana Point (water sent to Sultana Point for processing and reuse)				
10	Yorke town	170,000	83,811	\$95,961 ²	\$1.55	\$3.10
11	Foul Bay	17,680	679	\$4,999 ¹	\$0.77	\$20.20
12	Point Turton #1	18,360	3,873	\$4,999 ¹	\$0.75	\$3.50
13	Point Turton #2	167,000	22,315	\$94,267 ²	\$1.55	\$11.60
14	Hardwicke Bay	23,700	3,525	\$34,370 ¹	\$3.97	\$26.70
15	Bluff Beach	28,500	2,501	\$16,088 ²	\$1.55	\$17.60
16	Port Victoria	100,000	26,588	\$56,447 ²	\$1.55	\$5.80
17	Chinaman Wells	24,480	1,364	\$13,818 ²	\$1.55	\$27.80
18	Port Julia	18,750	768	\$12,035 ¹	\$1.76	\$42.90
19	Balgowan	11,300	863	\$16,609 ¹	\$4.03	\$52.70
TOTAL		1,337,310	614,473	\$862,888	-	-

¹ Based on data provided by Yorke Peninsula Council; ² Based on data interpolated from [Yorke Peninsula Council Strategic Asset Management Plan 2025–2034](#)

Table 6. Operation and maintenance costs for priority CWMS schemes on Yorke Peninsula.

CWMS scheme	Approved design flow (L/d)	Actual average flow (L/d)	Overall O&M Cost (\$/y)	Utilities cost (\$/y)	O&M costs per kL of plant design capacity (\$/kL)	O&M costs per kL average plant flow (\$/kL)	Utilities costs per kL of plant design capacity (\$/kL)	Utilities costs per kL average plant flow (\$/kL)
Rogues Point	14,560	1,685	\$11,781	\$3,571	\$2.22	\$19	\$0.67	\$5.81
Sultana Point	41,480	8,075	\$23,219	\$7,043	\$1.53	\$8	\$0.47	\$2.39
Chinaman Wells	24,480	1,364	\$13,818	\$4,189	\$1.55	\$28	\$0.47	\$8.41
TOTAL	80,520	11,124	\$48,818	\$14,803	-	-	-	-

Table 7. Capital asset values as at 30 June 2024 for priority CWMS schemes on Yorke Peninsula (values are for wastewater treatment plants only, excluding collection systems).

CWMS scheme	Total asset replacement cost (\$)	Civil assets (\$)	Electrical assets (\$)	Mechanical assets (\$)	Total accumulated depreciation (\$)	Written-down value (\$)
Rogues Point	\$223,921	\$97,007	\$45,971	\$80,943	\$149,816	\$74,105
Sultana Point	\$637,929	\$276,363	\$130,967	\$230,599	-	-
Chinaman Wells	\$258,789	\$110,010	\$64,431	\$84,348	\$131,616	\$127,173

7 Comparative operating and maintenance cost assessment for priority sites and opportunities for retrofitting CWMS systems

Across the three priority sites of Rogues Point, Sultana Point (and Edithburgh) and Chinaman Wells, the annual O&M cost burden to council is approximately \$49,000 (Table 6). Within this overall O&M cost, the cost of utilities (electricity) across the three sites is some \$15,000, representing 30% of total O&M costs, with the remaining 70% associated with labour and asset maintenance/replacement costs, and possibly SA Health monitoring and compliance costs for effluent water quality (Table 6).

There are opportunities at each of the priority sites to reconfigure the treatment plants and redevelop the irrigation/dispersal fields to more passive treatment systems with much lower ongoing O&M costs (e.g. [Hydroscape's ABSORBS™](#) technology). This retrofitting approach would provide many benefits to council including:

- Reduced treatment cost, as there is no requirement for aeration blowers or disinfection chemicals (i.e. very low operating energy use and low maintenance oversight requirements);
- No new infrastructure required at wastewater treatment plants (existing aerobic tanks can be retrofitted to function as anaerobic pre-treatment septic tanks to feed downstream passive secondary treatment systems);
- Likely improvement in treated effluent water quality through the use of advanced secondary performing passive treatment systems which are validated to produce effluent quality at ≤ 10 mg/L 5-day biochemical oxygen demand (BOD₅) and ≤ 10 mg/L total suspended solids (TSS);
- No SA Health compliance monitoring costs for treated effluent water quality monitoring and compliance reporting, because treated effluent is disposed of underground (i.e. human health risk from wastewater dispersal is mitigated);
- Improved public amenity to local community (little to no noise from the passive treatment system operations as compared to the existing mechanical aerobic treatment plant; no surface irrigation, eliminating potential for nuisance odours and/or aerosol vectors);
- Lower greenhouse gas emissions 'carbon footprint' due to no mechanical aeration and an underground aerobic stage mitigating the potential for wastewater-related greenhouse gas emissions (methane and nitrous oxide) to reach the atmosphere;
- Highly scalable retrofit technologies could be installed in as little as 10 house increments, effectively deferring upfront capital costs for council (scalability increments will depend on Council requirements).

For comparison, Table 8 shows the O&M costs of an equivalent aerobic mechanical treatment plant and a passive treatment system treating the same design flows using Rogues Point as an example. As shown in Table 8, the potential O&M savings from a retrofit conversion of the existing Rogues Point aerobic treatment plant to a passive treatment process are approximately \$8,800 per year.

Table 8. Comparative operation and maintenance costs for an aerobic mechanical treatment plant versus an equivalent passive ABSORBS™ treatment system treating 14.56 kL/d design flows for Rogues Point.

Wastewater treatment plant design	TOTAL (\$/y)	Utilities (\$/y) ¹	Labour (\$/y) ²	Chemicals (\$/y)	Desludging (\$) ³
Conventional aerobic mechanical	11,781	3,571		8,210	
Passive treatment system (ABSORBS™)	2,978	478	1,000	0	1,500

1. Calculated based on \$0.45/kWh; 2. Assumed personnel cost of \$1,000/day and 6 monthly servicing interval; 3. Assumed desludging interval of every 2 years and a desludging event cost of \$3,000.

If we assume proportional O&M savings for the other two priority sites at Sultana Point and Chinaman Wells, the total potential O&M savings across the three priority sites is the order of \$36,500 per year. It should be emphasised that this savings estimate is likely to be conservative of what is achievable in reality, since the septic tank desludging interval in the passive treatment system is likely to be less frequent than every 2 years because these CWMS schemes are STEDS systems whereby each connected property has its own septic tank on site and so the accumulation rates of sludge in the CWMS septic tanks will be greatly reduced compared to a full sewer (raw sewage) system (this is discussed in Section 9 below). For example, increasing the desludging frequency to once every 4 years would halve the cost of sludge management and increase the cost toal savings commensurately.

Also it is unclear to what extent other costs like desludging and personnel labour costs are included in the annual CWMS O&M cost data provided by council, so this represents another area of possible conservatism in the cost savings presented here. Furthermore, there are additional costs for maintaining and/or replacing mechanical and electrical equipment in the existing CWMS (i.e. aeration blowers, chlorine dosing pumps, recirculation pumps, electrical switchboards and programmable logic controllers) that would not apply to a retrofitted passive system and so are not captured in the comparative O&M cost assessment here. Based on the asset replacement values for this equipment in council data, these auxiliary costs are likely to be in the order of \$7–10K per year for Rogues Point and Chinaman Wells, thereby more than doubling the estimated annual cost savings for operating and maintaining the retrofitted passive systems.

Additionally, because the existing CWMS treatment plant is chronically under-loaded relative to its design flow (operating at <15% of design capacity on average) the utility and chemicals costs provided by council for existing mechanical aerobic plant operations will be lower than what the plant would use if operating at full design flow. For comparison, the O&M costs for utilities in the alternative passive treatment system scenario are based on the plant continuously operating at 100% of the treatment plant's design flow, so operating a retrofitted passive treatment system at 15% of this capacity would reduce the operating utility costs commensurately.

8 Capital cost assessment for retrofitting CWMS systems

Capital expenditure (CAPEX) costs for retrofitting of existing priority CWMS with a passive treatment and dispersal technology (i.e. ABSORBS™) were compared for the Rogues Point and Chinaman Wells sites. Costings were done according to the wastewater engineer's design specifications for the Rogues Point retrofit system (Appendix B) applying the same design approach to Chinaman Wells, while taking into consideration the different soil types and design loading rates identified in the LCA report (Appendix A). Retrofitting cost assessments (excluding GST) were done based on each site's maximum approved design flows as well as a more realistic 200% of daily peak flow rate, given both sites are substantially under-loaded and are unlikely to exceed 200% of current peak flows for many years to come (Table 9).

These two sites were assessed at the exclusion of Sultana Point, since they are comparable in terms of recorded daily average and peak flows (i.e. 4,500 L/d) but have different soil properties in their dispersal fields which affects the size and cost of passive technology retrofits such as ABSORBS™. Additionally, there are broader issues currently under consideration regarding the Sultana Point CWMS relating to potential future customer connections in Edithburgh and so it was decided to exclude this site for CAPEX assessments here; however, the outcomes of the CAPEX assessment will be broadly applicable to Sultana Point as well as other sites throughout Yorke Peninsula and beyond.

A key assumption of the CAPEX assessment is that the existing treatment tanks at the CWMS treatment plants are of suitable condition and capacity to be reused as primary treatment tanks in the retrofit system design. This assumption is considered valid based on council's positive asset condition assessments and also wastewater engineer's capacity assessments at Rogues Point (Appendix B). Accordingly, any costs associated with reconfiguration and/or replumbing of existing tanks at each CWMS site are excluded from the assessment. In reality there are likely to be some additional costs for this reconfiguration work, but should be a relatively minor additional cost relative to the cost of the major retrofitting works as captured in our assessment here. Additionally, costs for any electrical works required for the retrofit are excluded from the CAPEX assessment.

Table 9. CAPEX cost estimates (ex-GST) for passive treatment technology retrofits at priority CWMS sites on Yorke Peninsula.

CWMS scheme	Approved design flow (L/d)	Actual peak flow (L/d)	Retrofit CAPEX cost for 100% approved design flow (\$)¹	Retrofit CAPEX cost for 200% actual peak daily flow (\$)¹	Cumulative O&M cost savings after 15 years²
Rogues Point	14,560	4,500	170,000	125,000	196,000
Chinaman Wells	24,480	4,500	170,000	95,000	230,000

1. CAPEX costs exclude new primary treatment tanks and assume that existing tanks are of suitable capacity and condition to be reused as part of the retrofit design; 2. Interest on O&M cost savings compounded monthly at 5%.

As shown in Table 9 and despite Chinaman Wells having an approved design flow some 68% greater than Rogues Point, the estimated cost of retrofitting based on maximum design flow is the same at \$170,000 (ex-GST). This is because the soil texture at the Chinaman Wells wastewater treatment plant site is Category 1 sand which can accommodate a 67% higher wastewater design loading rate than the less permeable Category 3B/4A soils at Rogues Point, making the ABSORBS™ systems the same size at both sites (i.e. 500 m²). This highlights the site-specific nature of retrofitting CAPEX costs and reiterates the need for detailed site-specific land capability assessments and wastewater engineering to be undertaken in order to size and cost these alternate passive system designs.

Given the scale of under-loading at these two priority sites, CAPEX cost assessments were also done for retrofits based on a more realistic design volume of 200% of recorded peak daily flow at each site (i.e. 9,000 L/d) (Table 9). In this case, the cost of retrofitting at Chinaman Wells (\$95,000) is considerably less than for Rogues Point (\$125,000) because the sandy soils enable a higher wastewater design loading rate to be applied, making the ABSORBS™ system at Chinaman Wells much smaller (180 m²) than that required for Rogues Point (300 m²) for the same CWMS design flow of 9,000 L/d. It should be highlighted that the relative capital retrofit costs are not a direct reflection of ABSORBS™ system sizes at each site, because there are some cost components that are not able to be reduced for smaller sized installations (e.g. the cost of common plant infrastructure, and cost of mobilisation for civil and plumbing trades and for earthmoving equipment).

To put these CAPEX costs into context, the value of future O&M cost savings from converting existing mechanical systems to passive systems are also presented for these two priority sites over a 15-year time horizon (Table 9) using the comparative annual O&M costs from Table 8. Cumulative O&M cost savings for the two sites are also presented annually to allow CAPEX 'payback periods' to be estimated (Figure 8). As can be seen in Figure 8, retrofit CAPEX cost payback periods are in the order of 12 years for Chinaman Wells and 13 years for Rogues Point based on retrofitted ABSORBS™ systems treating 100% of the approved design flows at each site and costing \$170,000. For the more realistic retrofit systems sized to treat 200% of peak daily flows, CAPEX payback periods are considerably less at some 8 years for Chinaman Wells and 11 years for Rogues Point.

This assessment demonstrates that by retrofit conversion of existing mechanical treatment plants to passive treatment technologies, CWMS that are currently an ongoing cost burden to council to operate and maintain become a source of substantial cumulative avoided costs (savings) with relatively short payback periods for the initial capital outlay required for the CWMS conversion. We should reiterate here that due to likely underestimates in our underlying O&M cost figures for the current mechanical treatment plants, retrofit CAPEX cost payback periods in reality are likely to be even shorter than those presented here for the two sites.

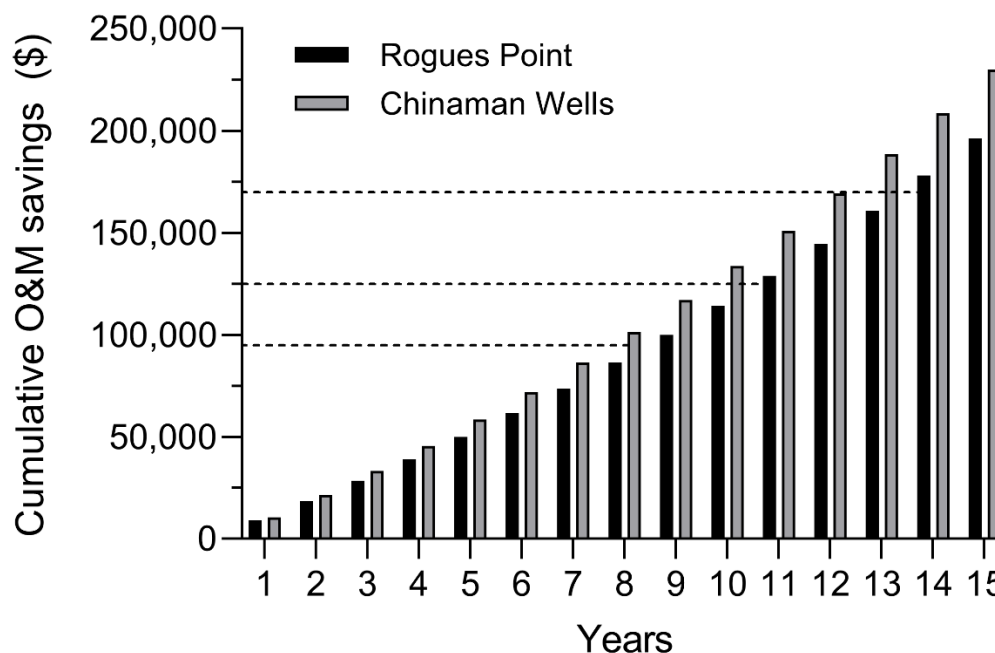


Figure 8. Cumulative O&M cost savings from passive technology retrofitting of existing mechanical treatment plants at Rogues Point and Chinaman Wells (savings compounded monthly at 5% annual interest rate). Dashed lines show the payback points for initial retrofit CAPEX investment at each site according to the different design flows of Table 9.

It should also be emphasized that these O&M cost savings do not include any potential cost benefits from having an increased CWMS treatment capacity (see Section 9 for a discussion on this aspect). As such, they are considered to be a conservative assessment of the likely cost savings to councils from retrofitting CWMS more broadly, since some CWMS will be capacity-limited and so in those cases the avoided CAPEX costs from increasing system capacity and delaying or avoiding plant upgrades will be much greater than just the O&M cost savings reported here. For new CWMS builds, the capital costs of installing a passive treatment system (e.g. ABSORBS™) will be the same or lower than the cost of building a new mechanical aerobic wastewater treatment plant of the same capacity, and so in those cases the cost savings realised from having lower O&M costs will deliver immediate and substantial benefits over the life of the community wastewater scheme.

Capital costs for lined ABSORBS™ schemes wishing to capture and reuse high quality recycled water will be different to those given here for simple retrofits of existing wastewater dispersal areas, as they will require additional infrastructure for capturing and redistributing the recycled water and possibly disinfection equipment upgrades depending on the desired end use(s) of the water and associated health risk(s). Wherever disinfection equipment already exists, it may be possible to reuse/repurpose to save on additional capital outlay; however, the cost implications of would need to be considered on a case-by-case basis for CMWS that wish to recycle and beneficially reuse the water.

9 Assessment of CWMS capacity upgrades from retrofitting existing mechanical aerobic treatment plants to passive treatment operations

While there are real cost savings to be realised from converting mechanical aerobic treatment plants to passive treatment systems, there are also plant treatment capacity gains achievable from this conversion which will be of benefit to CWMS sites that are at, or are approaching their approved design capacity. Using the Rogues Point CWMS as an example, we will demonstrate these potential capacity upgrades in the examples below.

Existing Rogues Point wastewater treatment plant:

- Mechanical aerobic treatment plant with a design flow of 14,560 L/d;
- Using the CWMS Code figures of 2.6 persons/household and 140 L/person/d for non-reticulated water supply, the plant capacity 40 dwellings (104 people);
- The wastewater plant has available treatment tank capacity of 48 kL available for conversion to septic tanks in a passive treatment retrofit (1 × 12 kL primary tank and 2 × 18 kL aeration tanks).

If we assume the worst case scenario that the site is a full (raw) sewerage treatment system, using the SA Health On-site Code (2013) formula for primary treatment/septic tank capacity sizing:

Minimum Effective Capacity (L) = $(P1 \times S \times Y) + (P2 \times DF)$, where:

P1 = Number of persons using the system (Average)

S = Sludge/scum accumulation rate in L/person/y

Y = Desludging frequency in years (recommended desludging frequency for larger wastewater systems is <5,000 L sludge/y = every 4 years, 5,000–10,000 L sludge/y = every 2 years and >10,000 L sludge/y = every 1 year)

P2 = Number of persons using the system (Peak)

DF = Daily flow in L/person/d (Peak Design Flow)

In the case of Rogues Point, using the above equation we can calculate by trial and error the maximum number of people (P2) that can be accommodated by the existing 48 kL tank capacity at the treatment plant:

P1 = P2 (default worst case assumption)

S = 80 L/person/y (raw sewage default)

Y = 2 years (recommended desludging frequency for tanks >10 kL)

P2 = 160 people

DF = 140 L/p/d

Accordingly, this shows that with 48 kL of existing tanks at the Rogues Point treatment plant, converting the site to a passive treatment system which repurposes the existing tanks to a series of septic tanks, wastewater from 160 people (equivalent to approx. 61 houses) can be treated at this site which represents a plant capacity of 152% compared to the existing system.

If we use more realistic assumptions in this calculation (i.e. assuming P1 is 75% of P2 which in the case of Rogues Point is justifiable given highly variable seasonal flows due to non-permanent/holiday nature of community occupancy; Table 1) we can again calculate by trial and error the maximum number of people (P2) that could be accommodated by the existing 48 kL tank capacity at the treatment plant by converting the site to a passive treatment system is 184 people (equivalent to 70 houses) which represents a plant capacity of 176% compared to the existing system:

$P1 = 75\% \times P2 = 135$ (real world scenario)
 $S = 80$ L/person/y (raw sewage default)
 $Y = 2$ years (recommended desludging frequency for tanks >10 kL)
P2 = 181 people
 $DF = 140$ L/p/d

This shows that with 48 kL of existing tanks at the Rogues Point site and a 2 yearly septic tank desludging interval, by converting to a passive treatment system the site can treat wastewater from up to 181 people (equivalent to approx. 70 houses) which represents a plant capacity of 175% compared to the existing system.

NB. The above calculations have assumed that the Rogues Point CWMS is a raw sewage system, yet we know that sludge accumulation rates at the treatment plant will be much lower than the SA Health raw sewage default value (i.e. $S = 80$ L/person/y) because this CWMS is a STEDS scheme where connected houses have their own septic tanks to perform primary treatment before pumping to the CWMS wastewater plant. If we use a more realistic sludge accumulation rate (e.g. 25% of the default 80 L/person/y, or $S = 20$ L/person/y) further plant capacity increases can potentially be realised for wastewater treatment of up to 266 people (102 houses), or 255% compared to the existing system's approved design capacity.

$P1 = P2$ (default worst case assumption)
 $S = 20$ L/person/y (realistic estimate for STEDS schemes)
 $Y = 2$ years (recommended desludging frequency for tanks >10 kL)
P2 = 266 people
 $DF = 140$ L/p/d

The assumption of 75% sludge reduction in household septic tanks is based on firsthand experience with monitoring the performance of septic tanks for removing raw sewage suspended solids at Fluid Environmental's [Hahndorf on-site wastewater systems facility](#). Actual sludge accumulation rates in practice can be easily measured and monitored at the Rogues Point CWMS to refine the value of S following any future passive retrofit conversion of the aerobic tanks to septic tanks, so this is an area for future refinement.

Overall this assessment has demonstrated that by converting the existing mechanical aerobic treatment plant to a passive treatment system, additional treatment capacity can be unlocked within the existing CWMS site infrastructure in a flexible way that would allow the plant to handle flows of anywhere from approx. 150% to 250% compared to the existing plant's approved peak design flow.

10 Land Capability Assessments for sustainable wastewater dispersal

During the project, several detailed Land Capability Assessments (LCAs) were undertaken for the three priority CWMS sites on Yorke Peninsula to determine the suitability of site soils to receive wastewater via an alternate passive treatment and dispersal solution (i.e. sub-surface passive treatment and disposal).

The LCA for Rogues Point CWMS site was included in the interim project report and the remaining two LCAs for the Sultana Point (and Edithburgh) and Chinaman Wells CWMS sites are appended to this report (Appendix A). Briefly, LCAs for all three sites confirmed that site soils within the existing CWMS land application areas are suitable for wastewater dispersal and free of major limitations.

Soils at all sites allowed for moderate to high design loading rates for secondary effluent application of 30 L/m²/d at Rogues Point and 50 L/m²/d for Sultana Point and Chinaman Wells. These relatively high wastewater application rates of 30–50 L/m²/d make all sites well suited to retrofitting with alternate sub-surface passive wastewater treatment and disposal solutions.

11 Wastewater Engineer's proposed wastewater system retrofit solution for Rogues Point

Mace Engineering Services were commissioned to undertake an assessment of the Rogues Point CWMS wastewater treatment plant and assess the suitability of the site and its existing infrastructure for a prospective redesign to retrofit its operation to an alternate passive wastewater treatment and dispersal system. A copy of the wastewater engineer's report (which includes the Rogues Point land capability assessment report) is given in Appendix B.

The wastewater engineer reports that the existing Rogues Point treatment plant tank assets (one 12,000 L primary tank, two 18,000 L aeration tanks, one 9,000 L pump sump) can be repurposed and retrofitted to function as a series of septic tanks for primary treatment, with the primary effluent pumped to a new 12,000 L pump sump at the land application area distributing water to a new 500 m² ABSORBS™ unlined sand filter to deliver secondary treatment prior to sub-surface effluent dispersal beneath the ABSORBS™ bed (Figure 9). This alternate system design satisfies all SA Health On-site Wastewater Systems Code requirements and delivers a system that is incrementally scalable should additional plant flows arise in the future from increased connections from Rogues Point and/or adjacent settlements (design layout shows the reserve area for a 50% increase in system capacity). NB. There are at least as many dwellings within Rogues Point that have independent on-site wastewater dispersal systems as there are those connected to the CWMS scheme, so having additional capacity in the wastewater treatment plant would allow these up to 35 new connections to occur at a much lower additional capital cost to council as compared to an equivalent upgrade to the existing mechanical aerobic treatment plant.

This capacity to incrementally upgrade the capacity of the wastewater treatment plant (where sufficient suitable land area is available) is something that is a unique feature of passive treatment systems such as the ABSORBS™ technology. For comparison, if the existing mechanical aerobic treatment plant at Rogues Point were to require a capacity upgrade, this would be both problematic and costly, due to:

- the limited site area available at the existing treatment plant location to accommodate additional tanks;
- mechanical aerobic treatment plants are much less flexible in terms of their incremental scalability. For example, wastewater treatment plants at Rogues Point and Chinaman Wells sites are designed and installed to peak design flows of some 14 and 24 kL per day respectively and have limited capacity to be upgraded in increments of less than this due to the nature of the plant infrastructure being of a fixed size (particularly at Chinaman Wells which has an Aeroflow style treatment plant with a single large aerobic reactor tank). Conversely for passive treatment systems such as the ABSORBS™ technology, the size of both the primary (septic tank) and secondary treatment stage (sand filter bed) can be easily scaled in small increments of as little as 10 houses. In reality the scalable increment size can be determined to meet individual site and council needs and could be smaller or larger than 10 houses, recognising that larger increment sizes will be more cost-effective than smaller ones.

12 Future work

In line with the wastewater engineer's report (Appendix B) and with support from Yorke Peninsula Council, we have recently prepared and submitted an application to SA Health to seek approval for implementing the proposed Rogues Point CWMS retrofit design. As at the date of this report, the outcome of this application is pending.

Beyond the end date of this project, we will continue working with Yorke Peninsula Council to:

- progress the Rogues Point CWMS retrofit installation in line with council requirements;
- refine O&M cost estimates and cost savings to get a clearer picture of the true scale of financial benefits from passive treatment system retrofitting of existing mechanical treatment plants within Yorke Peninsula and more broadly;
- look to other CWMS sites to explore opportunities to undertake similar retrofits for O&M cost savings, or to increase system capacity for CWMS schemes that are constrained in treatment capacity by the existing plant infrastructure.

13 References

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Appendix A Land Capability Assessment for Sultana Point and Chinaman Wells wastewater treatment plant dispersal areas



Land Capability Assessment for Sustainable Wastewater Management at Sultana Point and Chinaman Wells, Yorke Peninsula SA

For: Yorke Peninsula Council



5th May 2025

Version	Date	Author/s	Reviewed	Issued By
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Name of Document	Land Capability Report for Sustainable Wastewater Management at Sultana Point and Chinaman Wells SA	
Project Number		
Document Version	Final	
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Abbreviations

Abbreviation	Description
µm	micrometre
%	percentage
ATU	Aerobic Treatment Unit
cm	centimetre
cm ³	centimetre cubed
d	day
DLR	Design Loading Rate
hr	hour
H	hole height
kg	kilogram
K _{sat}	Saturated Hydraulic Conductivity
L	litre
LCL	Lower Confidence Level
m	metre
m ²	metre squared
min	minute
mL	millilitre
mm	millimetre
Q	infiltration rate
r	hole radius
s	second

1 Executive Summary

The Yorke Peninsula Council owns and operates the wastewater treatment plant at Sultana Point and Chinaman Wells South Australia (Figure 1 and Figure 2). The ongoing operation and maintenance cost is the major concern for the Council as both plants are aerobic treatment systems and have a relatively high energy requirement and currently operate well within their peak design flow (PDF): Sultana Point WWTP is operating at 42% PDF (peak) and Chinaman Wells WWTP is operating at 18% of PDF.



Figure 1 Sultana Point wastewater treatment plant (aerial view and horizontal view)



Figure 2 Chinaman Wells wastewater treatment plant (aerial view and horizontal view)

Fluid Environmental has been working with the Council to find a more sustainable and affordable solution to treat wastewater and match treatment system capacity more closely with flow. The first step has been to assess what other treatment and dispersal options are open to the Council at Sultana Point and Chinaman Wells. The assessment of dispersal options will inform the discussion on wastewater treatment options. This in turn will inform the discussion of the treatment options while being mindful of the current treatment plant and process, and facilitate the treatment plant redesign for a more sustainable solution.

A Land Capability Assessment (LCA) has been undertaken in line with the requirements of the SA Health On-site Wastewater Management Code 2013 to inform about the nature of the receiving environment in an onsite treatment and dispersion option was chosen. Infiltration tests were performed at both locations at the depth of 30cm where the base of the dispersal bed would sit and

soil pits were also dug to a depth of approximately 200cm or where water table presents. to assess the soil profile for suitability for wastewater dispersal, and to ensure there are no severe limitations deeper in the soil profile below the 30cm application depth.

Two methods have been used to assess the nature of the soil with respect to water infiltration: textural assessment by hand texturing of the soil below the beds and measuring infiltration rates. Both sets of results have supported the assignment of a design loading rate of 50mm/day (Table 4) for secondary treated effluent dispersal or 35mm/d for primary treated effluent, at both sites.

1.1 The Land Capability Assessment

The purpose is to assess the capability of the site to sustainably utilise and manage wastewater within the allotment boundaries:

- Assess the capability of land to sustainably utilise and manage wastewater within the boundary of the dedicated dispersal area;
- Determine high risk and sensitive areas in the vicinity and the mitigation of those risks;
- Gather the relevant geographical information to adequately inform the process of designing the best practicable and most sustainable onsite wastewater treatment and effluent recycling/dispersal system to minimise the health and environmental impacts of onsite wastewater management.
- Formulate a sustainable wastewater management plan to be developed by a suitably qualified Wastewater Engineer in accordance with the SA Health Onsite Wastewater Systems Code (2013) conditions.

2 Introduction

At Sultana Point and Chinaman Wells, the Yorke Peninsula Council owns and operates wastewater treatment facility consisting of a bespoke aerobic treatment plant and a surface spray irrigation area which is used for the dispersal of secondary treated and disinfected effluent.

The location of Sultana Point wastewater treatment plant and dispersal area (Sultana Point Road) is on the east coast of Yorke Peninsula about 0.5km north of Sultana Point (Figure 3). There is a dispersal area that is currently being used for wastewater dispersal, using surface irrigation application. The area is approximately 3,000m².



Figure 3 Location map of Sultana Point treatment plant wastewater dispersal area

The location of Chinaman Wells wastewater treatment plant and dispersal area (Chinaman Wells Road) is on the west coast of Yorke Peninsula in the middle of township (Figure 4). The dispersal area available at this treatment plant is approximately 7,000m².

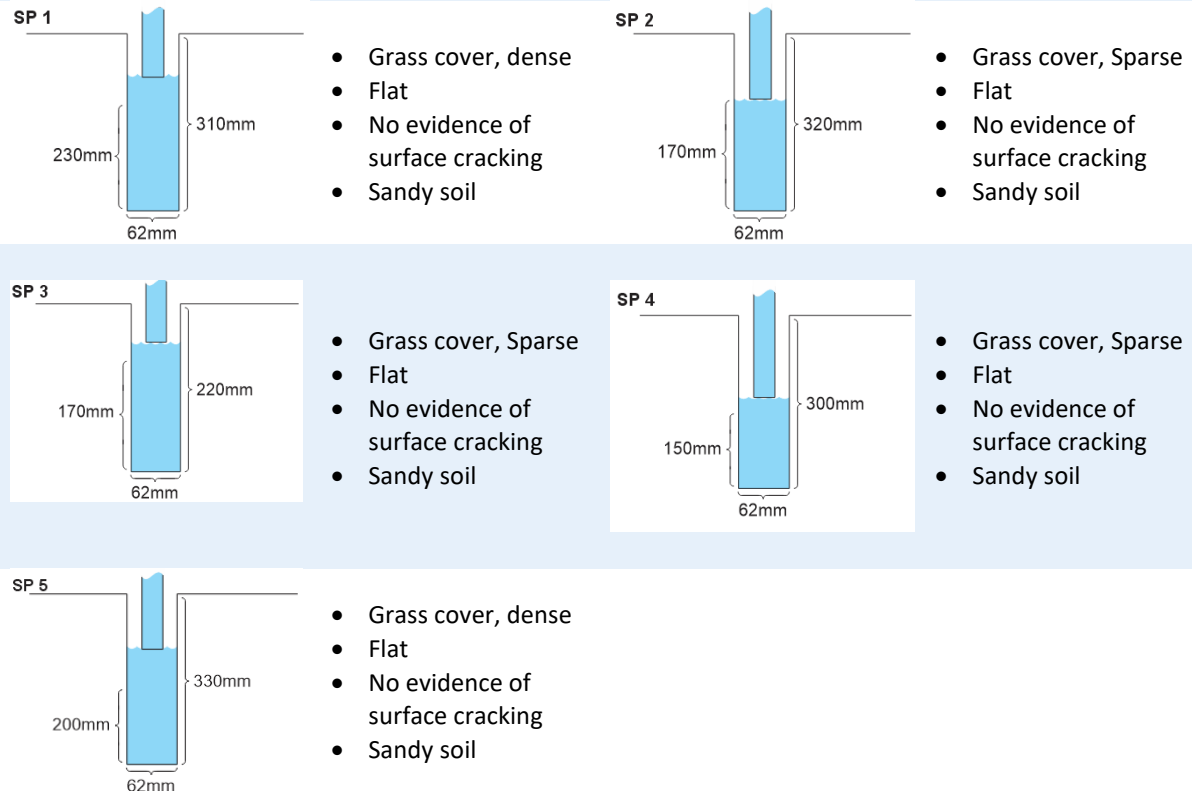


Figure 4 Location map of Chinaman Wells treatment plant wastewater dispersal area

3 Records

Location:	Sultana Point & Chinaman Wells, South Australia, 35°06' S, 137°44' E, AHD 7m; 34°22' S, 137°28' E, AHD 6m
Person:	Shan Huang & Matt Kelly, Fluid Environmental Pty Ltd
Date:	7 th & 8 th April 2025
Depth hole:	See Figure 5
Depth of water in the hole (cm):	See Figure 5
Location of infiltration sites:	See Figure 6
Radius:	3.05cm
Depth to impermeable layer:	Not found
Depth to watertable:	Not found >1.5m at Sultana Point; Approximately 1.4m at Chinaman Wells
Vegetation on site:	Sparse grass and native vegetation cover. Small shrubs and trees have been planted onsite. Currently under surface irrigation.
Surface water:	Not found
Environmental constraints:	No significant constraints • No rock outcrops or significant rock throughout the profile • Good soil drainage • Watertable at 1.4m in Chinaman Wells
Topography:	<2% slope. Low risk of significant runoff, sandy soil has high infiltration rate mitigating risk of rainfall runoff
Current land use:	Site is currently used for wastewater dispersal through surface irrigation
Climate:	Mediterranean climate dominated with hot dry summers and cold wet winters. With an annual rainfall of approximately 370mm
Soil condition:	Dry. Soil moist to dry. At the depth that the infiltration test was undertaken, soil would not form a bolus.
Comments:	• Excavation to 1.5m, or where watertable presents. ○ No evidence of watertable and/or water logging at Sultana Point. ○ Watertable presents at 1.4m at Chinaman Wells. Infiltrating measurement was undertaken at depth of 30cm as this will be the receiving environment for effluent dispersal. • The soil was a structureless sand.

Sultana Point



Chinaman Wells

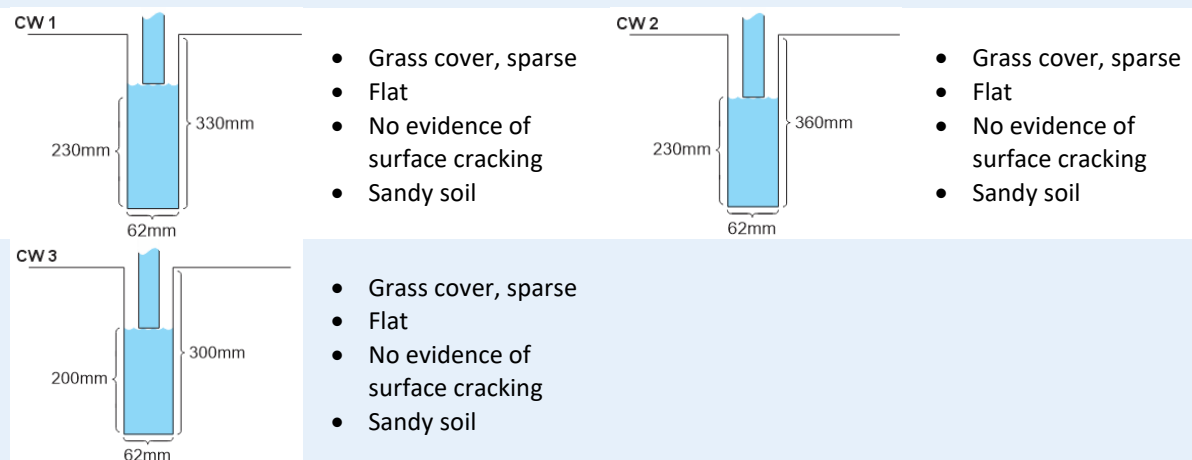


Figure 5 Schematic showing depth of boreholes, depth of water, diameter of hole and location

Five soil sampling sites were selected at Sultana Point and four sites were investigated at Chinaman Wells. At both locations, the site was first walked and hand samples were taken to assess the homogeneity of the site. At both locations, surface samples were textured and found to be sand. It was determined that there was a high degree of homogeneity so the assessment sites were spaced evenly over the site where practically possible. The homogeneity of the site was further supported when soil pits were inspected (Figure 9).

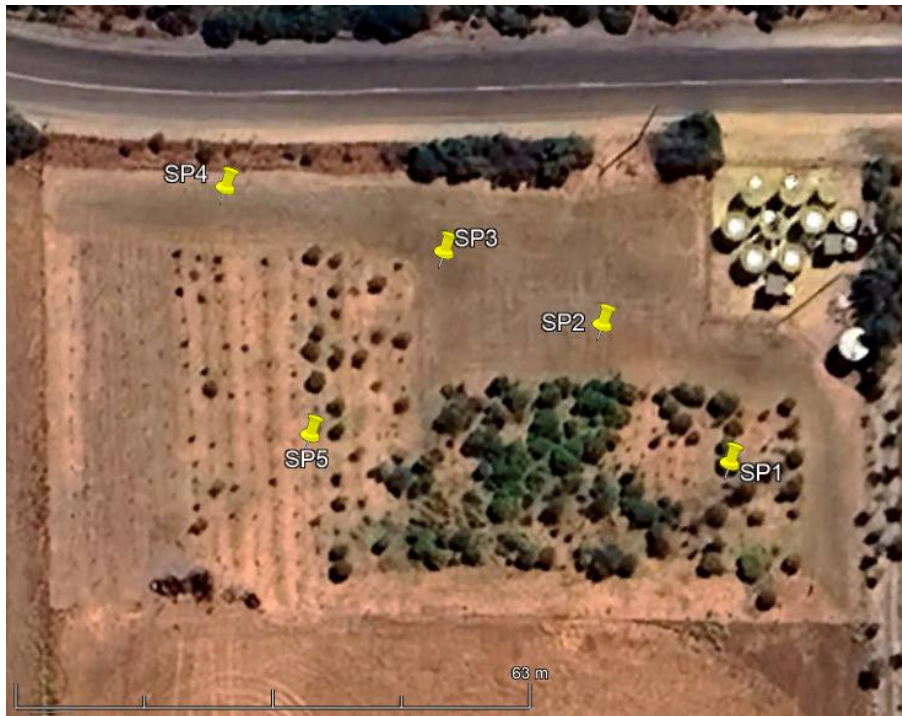


Figure 6 Layout of soil sampling sites at Sultana Point



Figure 7 Layout of soil sampling sites at Chinaman Wells

4 Infiltration Rate Assessment

The method used is as per the requirement of AS/NZS1547:2012 (G4) where six holes have been evaluated and in situ infiltration measurements taken using a constant head infiltrometer for calculation of infiltration rate.

Process:

- equipment used is a 60mm soil auger to create holes;
- holes to the depth of the proposed infiltration beds;
- electronic data logging permeameter;
- results are recorded every 30 seconds;
- steady state flow is established;
- regression used to calculate steady state infiltration rate;
- infiltration rates statistically analysed to calculate the LCL (at the 95% confidence level).

Equation for calculation of soil saturated hydraulic conductivity:

Equation 1:

$$K_{sat} = \frac{4.4Q \left[0.5 \sinh^{-1} \left(\frac{H}{2r} \right) - \sqrt{\left\{ \left(\frac{r}{H} \right)^2 + 0.25 \right\}} + \frac{r}{H} \right]}{2\pi H^2}$$

Where: K_{sat} = Saturated Hydraulic Conductivity of the soil in cm^3/min
 4.4 = Correction factor for a systematic underestimate of soil permeability
 Q = rate of water loss from reservoir in cm^3/min
 H = depth of water in hole in cm
 r = radius of hole in cm

Infiltration rate has been measured using a data logging permeameter. Data is plotted to establish steady state flow and linear regression is used to calculate steady state flow using Equation 1 for each hole; results are given in Table 1. Infiltration rate (Q) is calculated from the raw data displayed in Figure 8. It can also be seen the period of steady state infiltration from which Q and K_{sat} is calculated.

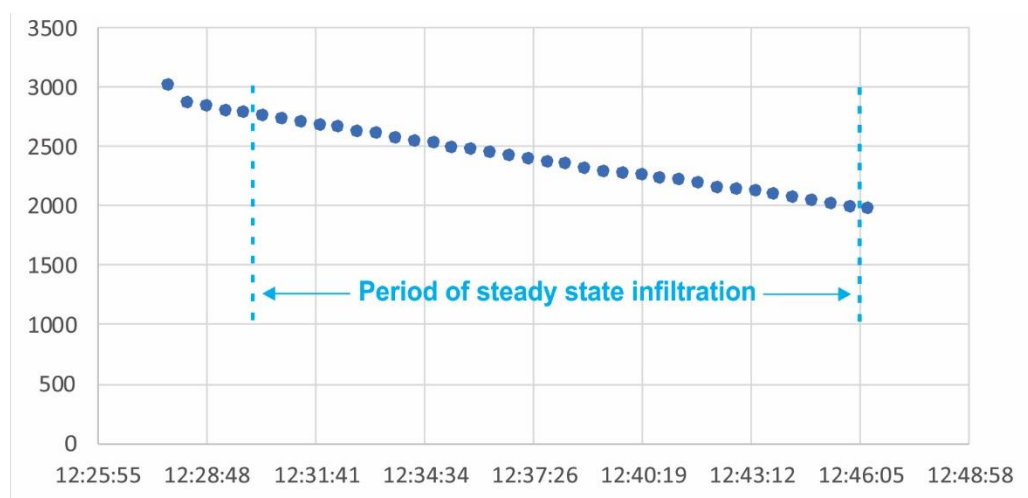


Figure 8 Shows example plot of infiltration in mL against time

Table 1 Soil infiltration rate calculation

Parameter	Sultana Point					Chinaman Wells		
	SP 1	SP 2	SP 3	SP 4	SP 5	CW 1	CW 2	CW3
Steady State Flow (cm ³ /min)	150.9	2291.1	1773.4	1401.6	1240.6	2126.1	1576.3	1708.6
H (cm)	23	17	17	15	20	23	23	20
r (cm)	3.05	3.05	3.05	3.05	3.05	3.05	3.05	3.05
K _{sat} (mm/hr)	75.3	1649.4	1332.7	1253.4	746.5	1029.2	740.8	977.8
K _{sat} (m/d)	1.81	39.58	31.99	30.08	17.92	24.70	17.8	23.5
Average K_{sat} (m/d)	24.27					21.98		

Five infiltration tests were performed at Sultana Point next to each soil sampling sites, and three were performed at Chinaman Wells. Using the data in Table 1, the average infiltration rate at Sultana Point is calculated to be 24.27m/d and 21.98m/d at Chinaman Wells.

It can be seen in Table 2 the relationship between infiltration rate and soil textural class. When comparing the measured infiltration rate with the theoretical infiltration rate for apedal sand (Table 3), the rate is in the range expected.

Table 2 Theoretical infiltration rates per soil textural class

Texture	Structure	Infiltration	Permeability (mm/hr)
Sand	Apedal	Very rapid	>120, >250 can be measured
Sandy Loam	Weakly pedal	Very rapid	>120
	Apedal	Rapid	60-120
Loam	Peds evident	Rapid	60-120
	Weakly pedal	Moderately rapid	20-60
	Apedal	Moderately rapid	20-60
Clay Loam	Peds evident	Moderately rapid	20-70
	Weakly pedal	Moderate	5-20
	Apedal	Slow	2.5-5
Light Clay	Highly pedal	Moderate	5-50*
	Peds evident	Slow	2.5-10
	Weakly pedal	Very slow	<2.5
Medium to heavy Clay	Highly pedal	Low to moderate	2.5-50*
	Peds evident	Very slow	<5.0
	Weakly pedal	Very slow	<2.5
Clay	Sodic and saline	Moderate	8.0
	Sodic	Very slow	<2.5
	Highly sodic	Extremely slow	<1.0

* Strongly structured polyhedral subsoils, eg Krasnozom or Red Ferrosol/Red Dermosol.
The values shown are estimates only, and should be used with caution.

Source Hazelton, Murphy 2016

5 Soil Assessment (Physical)

Under the requirements of the SA Health Code and AS1547:2012, Design Loading Rate (DLR) can be calculated for an assessment of wastewater quality, dispersal method and condition of the receiving environment.

5.1 Soil Pit Assessment

Soil pits were dug to a depth of approximately 1500mm for description and infiltration testing were performed at depth of 300mm at both locations. Both locations showed a high level of homogeneity. The soil profile appeared to be sand from surface to bottom at both locations. No watertable is present at Sultana Point at depth of 1500mm however watertable presents at approximately 1400mm at Chinaman Wells.

The nature of soil being sand throughout the profile shows it being ideal for wastewater dispersal. There was no evidence of poor drainage at both sites. There was no surface washing or rills evident on the surface, and no evidence of mottling associated with waterlogging under irrigation down the profile. This soil and profile are free draining and free of major limitations, and are suitable for the intended purpose: wastewater dispersal. The major potential limitation at Chinaman Wells is the presence of watertable at 1400mm depth.

Site	Image	Description
SP 1		• Grass cover • 0-30cm sand • No coarse fragments
SP 2		• 0-20cm weakly structured sand with organic matter (OM) • 20-45cm structureless sand with less OM • 45+cm structureless sand • No coarse fragments present • No watertable present at 1500mm

SP 3



- 0-25cm weakly structured sand with organic matter (OM)
- 25-40cm structureless sand with less OM
- 40+cm structureless sand
- Rooting depth 90cm
- No coarse fragments present
- No watertable present at 1500mm

SP 4



- 0-20cm weakly structured sand with organic matter (OM)
- 20+cm structureless sand
- Rooting depth 120cm
- No coarse fragments present
- No watertable present at 1500mm

SP 5



- Grass cover
- 0-30cm sand
- No coarse fragments

Site	Image	Description
CW 1		• Native vegetation cover • 0-30cm sand • Shell present
CW 2		• Bare ground with native vegetation nearby • 0-40cm sand with large amount of shell present • 40+cm sand with less shell • Watertable presents at depth of 1450mm

CW 3



- Bare ground with native vegetation nearby
- 0-50cm sand with large amount of shell present
- 50+cm sand with less shell
- Watertable presents at depth of 1400mm

CW 4



- Bare ground with native vegetation nearby
- 0-30cm sand with some shell present
- 30-60cm shell layer
- 60+cm sand with some shell present
- Watertable presents at depth of 1700mm

Figure 9 Soil pit images

A visual inspection of both locations and soil pits dug did not identify any overt visual issues. Both sites are currently being surface irrigated by secondary treated wastewater.

5.2 Soil texture

Samples were taken from the layer involved with wastewater dispersal, approximately 30-60cm. Soil samples collected from each site at both locations have been hand-textured. Using soil texture, the DLR can be gained from Table 4 (SA Health, 2013).

Table 3 Sampled soil textural class

Location and Site	Textural Class	Location and Site	Textural Class
SP 1	Sand	CW 1	Sand
SP 2	Sand	CW 2	Sand
SP 3	Sand	CW 3	Sand
SP 4	Sand	CW 4	Sand
SP 5	Sand		

Soil pits at both locations were excavated to a depth of 1500mm to assess the soil profile and potential site limitations. There were no significant limitations for the soil profiles at Sultana Point but at Chinaman Wells the watertable was present at a depth of 1400mm (visual assessment).

Table 4 Recommended Design Loading Rates for trenches and beds

Soil category	Soil texture	Structure	Indicative permeability (K _{sat})(m/d)	Design loading rate (DLR) (mm/d)			ETA/ETS beds and trenches
				Trenches and beds		Secondary treated effluent	
				Primary treated effluent			
				Conservative rate	Maximum rate		
1	Gravels and sands	Structureless (massive)	>3.0	20 (see Note 1)	35 (see Note 1)	50 (see Note 1)	(see Note 4)
2	Sandy loams	Weakly structured	>3.0	20 (see Note 1)	30 (see Note 1)	50 (see Note 1)	
		Massive	1.4 – 3.0	15	25	50	
3	Loams	High/moderate structured	1.5 – 3.0	15	25	50	
		Weakly structured or massive	0.5 – 1.5	10	15	30	
4	Clay loams	High/moderate structured	0.5 – 1.5	10	15	30	12
		Weakly Structured	0.12 – 0.5	6	10	20	8
		Massive	0.06 – 0.12	4	5	10	5
5	Light clays	Strongly structured	0.12 – 0.5	5	8	12	8
		Moderately structured	0.06 – 0.12		5	10	5 (see Notes 2, 3 & 5)
		Weakly structured or massive	<0.06			8	
6	Medium to heavy clays	Strongly structured	0.06 – 0.5	(see Notes 2 & 3)			
		Moderately structured	<0.06				
		Weakly structured or massive	<0.06				

NOTES:

1. The treatment capacity of the soil and not the hydraulic capacity of the soil or the growth of the clogging layer govern the effluent loading rate in Category 1 and weakly structured Category 2 soils. Land application systems in these soils require design by a suitably qualified and experienced person, and distribution techniques to help achieve even distribution of effluent over the full design surface (see L6.2 and Figure L4 for recommended discharge method by discharge control trench). These soils have low nutrient retention capacities, often allowing accession of nutrients to groundwater.
2. To enable use of such soils for on-site wastewater land application systems, special design requirements and distribution techniques or soil modification procedures will be necessary. For any system designed for these soils, the effluent absorption rate shall be based upon soil permeability testing. Specialist soils advice and special design techniques will be required for clay dominated soils having dispersive (sodic) or shrink/swell behaviour. Such soils shall be treated as Category 6 soils. In most situations, the design will need to rely on more processes than just absorption by the soil.
3. If $K_{sat} < 0.06$ m/d, a full water balance for the land application can be used to calculate trench/bed size (see Appendix Q).
4. ETA/ETS systems are not normally used on soil Categories 1 to 3.
5. For Category 6 soils ETA/ETS systems are suitable only for use with secondary treated effluent.

Source: AS/NZS 1547:2012

6 Area Suitable for Wastewater Dispersal

WWTP at both locations have suitable area for wastewater dispersal and free of major limitations. The soil profile is structureless sand Category 1 soil with:

- Maximum primary treated effluent DLR of 35mm/d (Table 4).
- Secondary treated effluent DLR of 50mm/d (Table 4).

7 Discussion

The purpose of this LCA is to explore the possibility of a more sustainable wastewater treatment and dispersal system for the Sultana Point and Chinaman Wells wastewater treatment plant.

The survey of both locations indicates the soil is free draining and free of major limitations and is therefore suitable for the dispersal of primary or secondary treated wastewater with a DLR of 35 or 50mm/day respectively.

The soil assessment identified the predominant soil textural class, into which treated wastewater will be applied, to be sand **Category 1** soil from surface to depth of 1.5m. The saturated infiltration rate (K_{sat}) assessment was measured to be much greater than 3m/d.

Albeit the soil is free of major limitation, it is recommended that the presence of watertable at 1.4m needs to be considered when designing the dispersal system at Chinaman Wells.

There are many drivers and considerations that have been considered in the assessment of a practical solution to meet the evolving needs of Sultana Point and Chinaman Wells wastewater management system. It can be seen that passive treatment and dispersal system will provide many benefits to the council.

8 References

Standards Australia (2012) **AS/NZS 1547 On-site domestic wastewater management**

https://infostore.saiglobal.com/en-us/Standards/AS-NZS-1547-2012-117631_SAIG_AS_AS_267605/

SA Health (2013) **On-site Wastewater Systems Code.**

https://www.sahealth.sa.gov.au/wps/wcm/connect/ba6ead0048f0d8ab828287f25a3eb7d6/2013SAHealth_On-site_Wastewater_Systems_Code_April.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-ba6ead0048f0d8ab828287f25a3eb7d6-mMH7r2z

SA Health, Local Government Association (2019) **South Australian Community Wastewater Management System (CWMS): Design Criteria.**

<https://www.sahealth.sa.gov.au/wps/wcm/connect/6120cfd6-659f-4346-a04b-c37eb73fa4b7/South+Australian+Community+Wastewater+Management+System+%28CWMS%29+-+Design+Criteria.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-6120cfd6-659f-4346-a04b-c37eb73fa4b7-mOdpcmH>

Fluid enviro



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Appendix B Mace Engineering Wastewater Design Report for Rogues Point Retrofit Solution (incorporating Rogues Point Land Capability Assessment report)



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ON-SITE WASTEWATER MANAGEMENT REPORT

BUILDER/AGENT: Fluid Environmental Pty Ltd

OWNER: Yorke Peninsula Council

SITE: Lot 18 Rogues Point Road, Rogues Point

JOB NO: 15067

DATE: 28/6/2025

RECOMMENDED WASTEWATER MANAGEMENT SYSTEM:

Modified existing wastewater treatment system Rogues Point Township

- Each individual allotment within the Rogues Point township shall have a minimum 3000L septic tank with outlet filter with connection to existing WWTP (not part of this report)
- Existing WWTP tank infrastructure consisting of 12,000L primary tank plus 2 x 18,000L tanks with 9000L pump sump. The remaining components of the existing WWTP shall be decommissioned (aerators, chlorinators etc).
- New dual Pedrollo D30-N pumps (duty and standby) and existing DN50 rising main to land application area

Land Application Area

- Minimum 12,000L pump sump with dual Pedrollo D30-N pumps, dual pump controller and high-level alarm.
- 500m² ABSORBSM unlined sand filter. Base of sand filter beds shall be ripped to 1200mm deep and gypsum shall be applied at a rate of 1kg/m².

ENCLOSURES:

SITE AND SOIL CHARACTERISTICS
SYSTEM REQUIREMENTS
CALCULATIONS SEPTIC TANK AND SOAKAGE SIZING
RECOMMENDED WASTE-WATER MANAGEMENT SYSTEM
SETBACK DISTANCES
DESCRIPTION OF INVESTIGATIVE TECHNIQUES
GENERAL NOTES
APPENDIX A
FLUID ENVIRONMENTAL "LAND CAPABILITY ASSESSMENT FOR
WASTEWATER DISPERSAL SYSTEM" AT ROGUES POINT, FOR
YORKE PENINSULA COUNCIL
SITE PLAN

1. SITE CHARACTERISTICS

Site Location:	Lot 18 Rogues Point Road, Rogues Point
Land Use:	Community
Area of Allotment:	Approximately 23920m ²
Land Slope:	Approximately 1 in 30
Distance to Watercourse:	Greater than 50m. There is a watercourse which passes through the allotment. The land application area will be positioned to achieve a 50m setback distance from the watercourse
Distance to Wells / Dams / Bores:	Greater than 50m
Surface Drainage:	Average
Flooding / Floodplain:	No
Distance to Coast High Water Mark:	Greater than 100m away
Climate / Rainfall:	Approximately 350 mm/year
Evaporation:	Approximately 1949 mm/year
Rocks / Rocky Outcrops:	No
Erosion Potential:	Minor
Vegetation Type:	Pasture, Isolated trees

2. SOIL CHARACTERISTICS

Refer to Fluid Environmental Land Capability Assessment Report

Soil Classification (AS 1547):	Category 3B/ 4A
Depth to Water Table:	Greater than 2.0 metres
Depth to Refusal:	Greater than 2.0 metres
Soil Type:	Medium plasticity clay loam topsoil overlaying low plasticity sandy loam and gravels.
Permeability Classification	
Design Loading Rate:	DLR = 30mm/day (secondary treated effluent via aerobic bottomless sand filter)

3. WASTEWATER SYSTEM DESIGN REQUIREMENTS

Yorke Peninsula Council currently operate and maintain the Rogues Point wastewater treatment plant. The existing wastewater treatment plant consists of a bespoke aerobic treatment plant and a surface spray irrigation area which is used for the dispersal of secondary treated and disinfected effluent. The existing wastewater treatment system has an approval which was granted in 2009 to process 14,560L of effluent each day. The Rogues Point township has 35 residential house allotments and considering that each house may generate 442L of wastewater each day (SA CWMS daily flow rate of 2.6 persons per household, generating 170L/person/day), this would be a daily wastewater generation of volume of 13,702L/day.

The wastewater system upgrade outlined in this report has been designed for the greater of these two wastewater volumes i.e. 14,560L / day, which is equivalent to 35 residential housing allotments.

Yorke Peninsula Council have also provided wastewater volumes passing through the treatment from 2021. During the May to November period, an average daily wastewater volume of 1379L/day was recorded. This increased to an average of 2005 L/day from November to May, with a peak in mid-January 2021 of 4,500L/day. The wastewater volume passing through the Rogues Point wastewater treatment plant is significantly below the approved capacity of the system. This can create issues for aerobic wastewater treatment plants, which typically do not operate effectively with variable and intermittent loading conditions, potentially resulting in undertreated wastewater. It was also identified that the existing land application area consisting of surface sprinklers was not operating effectively, with the sprinklers observed to be blocked with snails, and only covering a small area around the sprinklers

It is proposed that the existing wastewater treatment plant be modified such that it operates as a series of large septic tanks. The existing pump sump of the existing wastewater treatment plant and the existing rising main to the land application area would be utilised, however new pumps suitable to pump dirty water would be required as it is possible that the primary treated wastewater may have more suspended solids than the existing secondary treated wastewater that is currently being produced. A new pump sump is proposed to be installed at the site of the land application area to distribute the wastewater to the ABSORBS™. The ABSORBS™ beds will produce secondary treated wastewater via an unlined single pass sand filter, which then disperses to the underlying soil profile.

4. SEPTIC TANK SIZING CALCULATIONS

$$\begin{aligned}\text{Annual sludge / scum accumulation rate } S &= 91 \times 2.6 \times 35 \\ &= 8281 \text{ L/ year}\end{aligned}$$

Desludging Frequency: 2 years

$$\begin{aligned}\text{Minimum Effective Capacity (L)} &= (S \times P1 \times Y) + (P2 \times DF) \\ &= (91 \times 91 \times 2) + (91 \times 170) \\ &= \mathbf{32,032L}\end{aligned}$$

ADOPT: Minimum 40,000L septic tank capacity.

The existing AWTs consists of 1 x 12,000L primary tank, followed by 2 x 18,000L aeration tanks and a 9000L pump sump. The combined septic tank capacity of the primary tank and the 2 aeration

tanks is 48,000L. As each individual allotment has a minimum 3000L septic tank, the majority of the sludge / scum would be captured by this tank, and hence the 12,000L septic tank is considered appropriate for the primary chamber of the septic tank series. The combined volume of the primary tank and the two aeration tanks provides sufficient septic tank capacity to produce primary treated wastewater.

5. HYDRAULIC FLOW CALCULATIONS

Daily Flow Rate: = 14,560L/day (85EP)

As the hydraulic flow exceeds 40PE, this system will require SA Health Approval

6. ORGANIC CAPACITY

The biochemical oxygen demand has been factored from the SA Health On-Site Wastewater Systems Code value of 50g/person/day following septic tank treatment for the increase wastewater generation volume of 170L/person/day. This equates to 57g/person/day.

$$\begin{aligned}\text{Organic Capacity BOD}_5 \text{ (g/day)} &= (P2 \times \text{BOD}_5) \\ &= (85 \times 57) \\ &= \mathbf{4845 \text{ grams/day (85 EP)}}$$

As the organic capacity exceeds 40 EP, this system will require SA Health approval.

7. SAND FILTER CALCULATIONS

Hydraulic Load = 14,560L per day

- Maximum hydraulic load to sand filter = 40 litres/m²
- Required area of sand filter for hydraulic load = $14,560/40$
= 364m²

Organic Load = 4845 grams per day

- Maximum BOD₅ organic load to sand filter = 18.5g/m²
- Required area of sand filter for organic load = $4845/18.5$
= 262m²

⇒ Adopt minimum size of top of sand filter = 364m²

8. LAND APPLICATION AREA

The sand filter will be constructed as a bottomless sand filter, with the basal area of the sand filter sized in accordance with AS1547-2012 Appendix L 'Trenches and Beds'

Table L1, secondary treated effluent DLR = 30mm/day (refer to Fluid Environmental Land Capability Assessment Report)

$$\begin{aligned}\text{Required soakage contact area (m}^2\text{)} &= P2 \times \text{DF/DLR} \\ &= 14560/30 \\ &= 486\text{m}^2\end{aligned}$$

The DLR governs the size of the land application area and therefore a 500m² ABSORBSTTM bed area will be adopted.

9. RECOMMENDED WASTEWATER MANAGEMENT SYSTEM

Based on this assessment of system loading and percolation rate of the site soil, the following effluent disposal system is recommended for this site:

Modified existing wastewater treatment system Rogues Point Township

- Each individual allotment within the Rogues Point township shall have a minimum 3000L septic tank with outlet filter with connection to existing WWTP (not part of this report)
- Existing WWTP tank infrastructure consisting of 12,000L primary tank plus 2 x 18,000L tanks with 9000L pump sump. The remaining components of the existing WWTP can be decommissioned.
- New dual Pedrollo D30-N pumps (duty and standby) and existing DN50 rising main to land application area

Land Application Area

- Minimum 12,000L pump sump with dual Pedrollo D30-N pumps, dual pump controller and high level alarm.
- 500m² ABSORBS™ unlined sand filter. Base of sand filter beds shall be ripped to 1200mm deep and gypsum shall be applied at a rate of 1kg/m².

It is a condition of the ABSORBS™ product approval with SA Health that all installations of the system be carried out by a licenced plumber engaged by the product owner (Fluid Environmental).

Setback Distances

Septic tank:-

- 2.5 m from any buildings or property boundary
- 10 m from water courses, wells, bores and dams

Sand Filter Bed:-

- 3.0 m from septic tank, pump sump, property boundary
- 3.0 m down slope from building or swimming pool
- 6.0 m upslope from building or swimming pool
- 50 m from any watercourse, well, bore or dam.

10. DESCRIPTION OF INVESTIGATIVE TECHNIQUES

The field work for the geotechnical assessment was carried out on 14th February 2025 by Fluid Environmental and comprised of a site inspection and soil sampling of five sites located within and adjacent to the proposed wastewater disposal area. Test pits were analysed and classified, and infiltration testing was undertaken.

Mace Engineering Services has undertaken a site inspection, and desktop research of aerial imagery and previously known soil surveys and geotechnical survey. Specific site features were noted and an understanding of the adjacent land was gained. Particular note was made of the fall of the land, current drainage paths and the proximity of any water sources. A summary of the site specific features can be seen on page 2 of this report.

11. GENERAL NOTES

The estimated percolation rate and soakage trench details are based on the soil profile shown in the attached borelogs. If the soil profile or site characteristics vary in any way, installation shall cease and this office shall be contacted to undertake further assessment of the current design and its suitability for use. The investigation and assessment has been carried out in accordance with Australian Standard AS/NZS 1547:2012

The septic tank and wastewater disposal system shall be installed in accordance with SA Health 'On-Site Wastewater Systems Code'

All soil, waste and vent pipes shall be installed in accordance with AS3500-2018.

The site has been classified as "Category 3" therefore flexible plumbing fittings will be required.

Site inspections by the Wastewater Engineer are recommended at the following stages of construction:

- Completion of the excavation of the ABSORBS™ beds to ensure the soil profile is as described in soil borelogs
- During pre-commissioning testing of the system.

Note these inspections will incur additional fees and 24 hours notice is required when booking inspections.

12. SAFETY IN DESIGN

Mace Engineering Services has a strong focus on Work Health and Safety (WH&S), including Safety in Design. Safety in Design, is the consideration of the health and safety of all users of the infrastructure, from construction, operation, demolition and decommissioning has been considered in this design, in accordance with the Work Health and Safety Act 2012 (SA). Eliminating hazards improves Work Health and Safety outcomes and potentially reduces the long-term cost implications of remediating design oversights.

The construction of small-scale on-site wastewater treatment systems, if undertaken by a licensed contractor and to 'industry standard' techniques, is considered to be a low risk operation, and the subject site does not pose any unusual hazards. Excavations exceeding 1.5m in depth shall have shoring provided in accordance with Safe Work SA Excavation Work Code of Practice.

It is recommended that the contractor is licensed and experienced in on-site wastewater treatment system construction to further minimize construction hazards. Further advice should be sought during construction on the any aspects of the on-site wastewater management report if required.

Considering the above, and providing all other parties associated with the design and construction undertake their duties in accordance with WH&S and other legislative requirements, to a professional and industry standard level, we cannot foresee any significant WH&S implications or hazards that can be avoided by design.



Michelle C Verco
DIRECTOR

FIEAust, CPEng NER

APPENDIX A



Land Capability Assessment for Sustainable Wastewater Management at Rogues Point SA

For: Yorke Peninsula Council



14th February 2025

Version	Date	Author/s	Reviewed	Issued By
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Client	Yorke Peninsula Council	
Name of Organisation	Yorke Peninsula Council	
Name of Project	CWMS upgrade plan for Yorke Peninsula, SA	
Name of Document	Land Capability Report for Sustainable Wastewater Management at Rogues Point SA	
Project Number		
Document Version	Final	
Cover		
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Abbreviations

Abbreviation	Description
µm	micrometre
%	percentage
ATU	Aerobic Treatment Unit
cm	centimetre
cm ³	centimetre cubed
d	day
DLR	Design Loading Rate
hr	hour
H	hole height
kg	kilogram
K _{sat}	Saturated Hydraulic Conductivity
L	litre
LCL	Lower Confidence Level
m	metre
m ²	metre squared
min	minute
mL	millilitre
mm	millimetre
Q	infiltration rate
r	hole radius
s	second

1 Executive Summary

The Yorke Peninsula Council owns and operates the wastewater treatment plant (Figure 1 and Figure 2) at Rogues Point South Australia. The ongoing growth of coastal communities on Yorke Peninsula has seen the production of wastewater exceed the design flow of a number of their wastewater treatment plants.



Figure 1 Rogues Gully wastewater treatment plant

Fluid Environmental has been working with the Council to find a solution for increased ability to treat wastewater utilising current infrastructure to as large an extent as possible.



Figure 2 Treatment Plant Layout

The first step has been to assess what treated wastewater dispersal options are open to the Council at Rogues Point. The assessment of dispersal options will inform the discussion on wastewater treatment options. This in turn will inform the discussion of the treatment options while being mindful of the current treatment plant and process, and facilitate the treatment plant redesign to significantly increase plant through put without a high upfront cost.

A Land Capability Assessment (LCA) has been undertaken in line with the requirements of the SA Health On-site Wastewater Management Code 2013. Six soil pits were dug to a depth of approximately 80cm, the depth of the base of the dispersal bed. Further, three pits were dug to a depth of approximately 200cm (2m) to assess the soil profile for suitability for wastewater dispersal, to ensure there are no severe limitations deeper in the soil profile below the 80cm application depth.

Two methods have been used to assess the receiving environment for suitability for acceptance of treated wastewater; particle size analysis (textural assessment) of the soil below the beds and measuring infiltration rates at the six sites. Both sets of results have supported the assignment of a design loading rate of 30mm/day (Table 4) for secondary treated effluent dispersal or 15mm/d for primary treated effluent.

1.1 The Land Capability Assessment

The purpose is to assess the capability of the site to sustainably utilise and manage wastewater within the allotment boundaries:

- Assess the capability of land to sustainably utilise and manage wastewater within the boundary of the dedicated dispersal area;
- Determine high risk and sensitive areas in the vicinity and the mitigation of those risks;
- Gather the relevant geographical information to adequately inform the process of designing the best practicable and most sustainable onsite wastewater treatment and effluent recycling/dispersal system to minimise the health and environmental impacts of onsite wastewater management.
- Formulate a sustainable wastewater management plan to be developed by a suitably qualified Wastewater Engineer in accordance with the SA Health Onsite Wastewater Systems Code (2013) conditions.

2 Introduction

At Rogues Point, the Yorke Peninsula Council owns and operates wastewater treatment facility consisting of a bespoke aerobic treatment plant and a surface spray irrigation area which is used for the dispersal of secondary treated and disinfected effluent.

The location of the Rogues Point wastewater treatment plant (Davey Road) and dispersal area (Lot 18 Rogues Point) is on the east coast of Yorke Peninsula about 10km south of Ardrossan (Figure 3). There is a dispersal area that is currently being used for wastewater dispersal, using surface irrigation application. The area is approximately 60m x 125m or 7,500m².

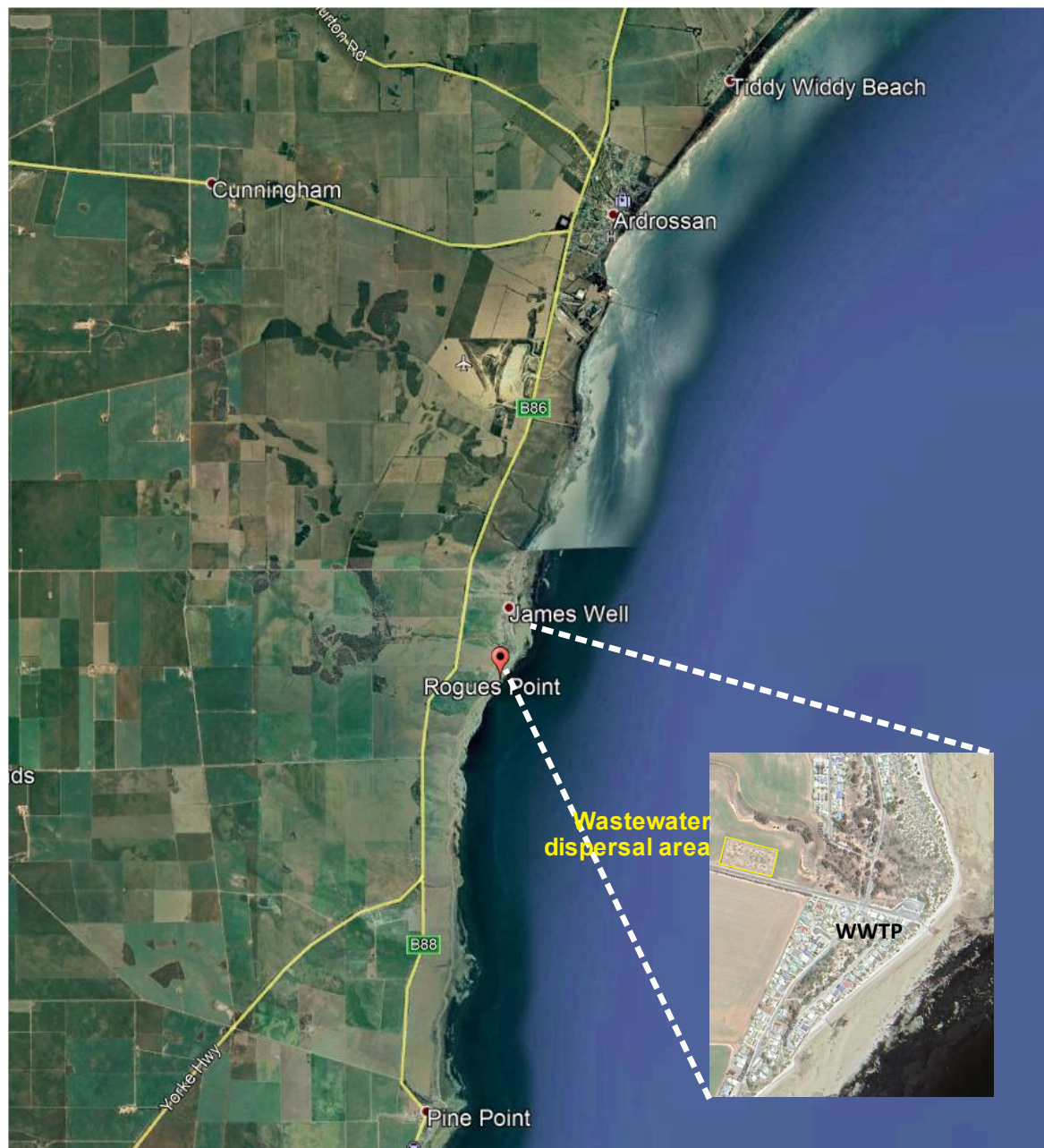


Figure 3 Location map of Rogues Point treatment plant wastewater dispersal area

3 Records

Location:	Rogues Point, South Australia, 34°29'35.51" S, 137°53'36.36" E, AHD 18m
Person:	Jim Kelly & Shan Huang, Fluid Environmental Pty Ltd
Date:	24 th January 2025
Depth hole:	See Figure 5
Depth of water in the hole (cm):	See Figure 5
Location of infiltration sites:	See Figure 6
Radius:	3.05cm
Depth to impermeable layer:	Not found
Depth to watertable:	Not found >2m
Vegetation on site:	Mown grass, cut short, dead or not actively growing. Small shrubs have been planted in rows. Site is managed with good coverage hence low risk of erosion
Surface water:	Ephemeral stormwater gully > 50m from proposed dispersal area (Figure 4)
Environmental constraints:	No significant constraints • Local flooding, negligible risk • Bushfire, agricultural land with low fuel load therefore low risk • Protected habitats, none identified • Water catchment, none recognised • Erosion, low risk of wind or water erosion • Native profile, no fill • No rock outcrops or significant rock throughout the profile • Good soil drainage
Topography:	<5% slope. Low risk of significant runoff, sandy loam surface soil has high infiltration rate mitigating risk of rainfall runoff
Current land use:	Site is currently used for wastewater dispersal through spray irrigation
Climate:	Mediterranean climate dominated with hot dry summers and cold wet winters. With an annual rainfall of approximately 350mm
Soil condition:	Dry, no pre-soaking. Soil moist to dry. At the depth that the infiltration test was undertaken, soil would not form a bolus; no consistency for reformed soil.
Comments:	• Excavation to 0.80m, no evidence of watertable and/or water logging. Infiltrating measurement was undertaken at this depth as this will be the receiving environment for effluent dispersal. • Further excavation to 2m deep with no evidence of water logging. It was noted that the holes were dug with a sand bucket, not a rock bucket, to the full depth of hole. • No impermeable layer 0 to 2m. • The soil was a structured sandy loam, broken calcareous layer, with B horizon either a loam to clay loam.



Figure 4 Site map showing wastewater dispersal area and Rogues Point wastewater treatment plant

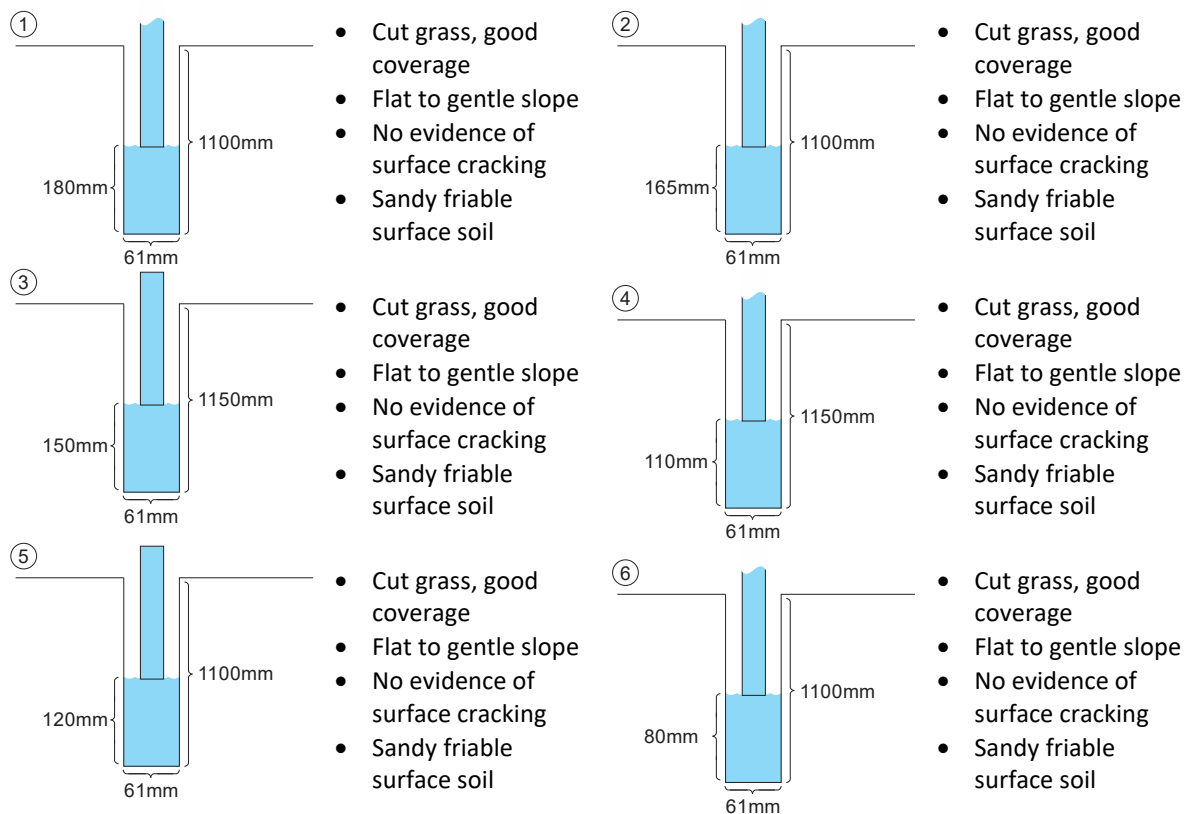


Figure 5 Schematic showing depth of boreholes, depth of water, diameter of hole and location

Six soil sampling sites were selected as part of the LCA. The site was first walked and hand samples were taken to assess the homogeneity of the site. Surface samples were textured and found to be sandy loam. It was determined that there was a high degree of homogeneity so the assessment sites were spaced evenly over the site. The homogeneity of the site was further supported when soil pits were inspected (Figure 8).

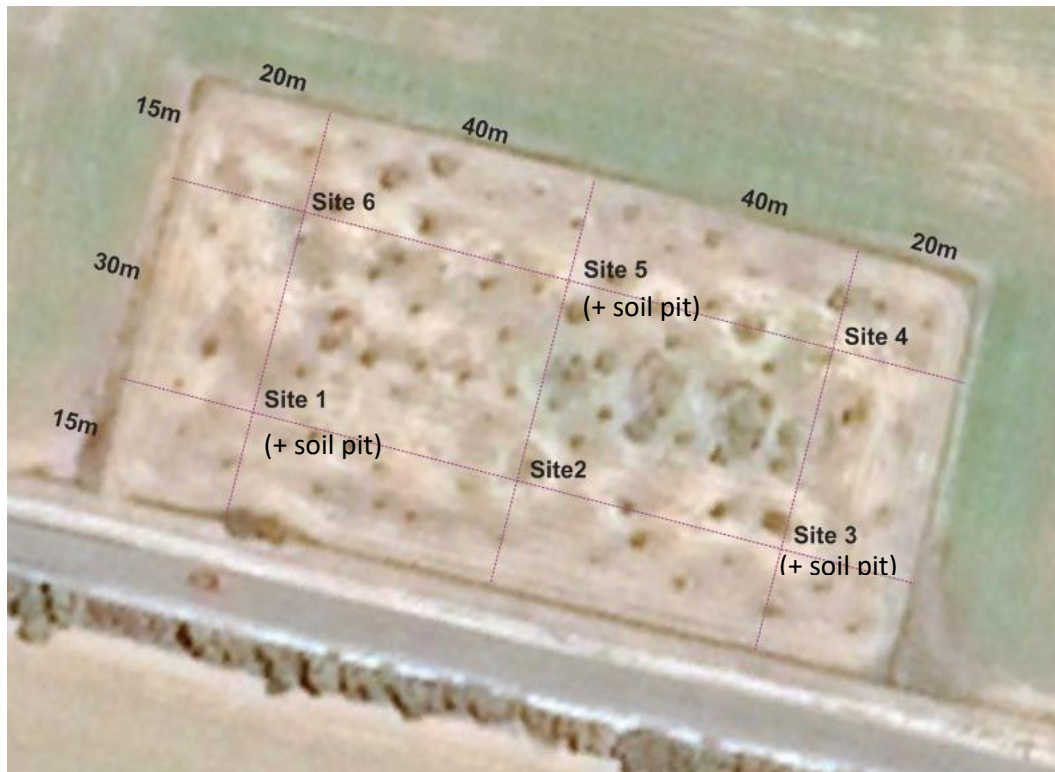


Figure 6 Layout of soil sampling sites

4 Infiltration Rate Assessment

The method used is as per the requirement of AS/NZS1547:2012 (G4) where six holes have been evaluated and in situ infiltration measurements taken using a constant head infiltrometer for calculation of infiltration rate.

Process:

- equipment used is a 60mm soil auger to create holes;
- holes to the depth of the proposed infiltration beds;
- electronic data logging permeameter;
- results are recorded every 30 seconds;
- steady state flow is established;
- regression used to calculate steady state infiltration rate;
- infiltration rates statistically analysed to calculate the LCL (at the 95% confidence level).

Equation for calculation of soil saturated hydraulic conductivity:

Equation 1:

$$K_{sat} = \frac{4.4Q \left[0.5 \sinh^{-1} \left(\frac{H}{2r} \right) - \sqrt{\left\{ \left(\frac{r}{H} \right)^2 + 0.25 \right\}} + \frac{r}{H} \right]}{2\pi H^2}$$

Where: K_{sat} = Saturated Hydraulic Conductivity of the soil in cm^3/min
 4.4 = Correction factor for a systematic underestimate of soil permeability
 Q = rate of water loss from reservoir in cm^3/min
 H = depth of water in hole in cm
 r = radius of hole in cm

Infiltration rate has been measured using a data logging permeameter. Data is plotted to establish steady state flow and linear regression is used to calculate steady state flow using Equation 1 for each hole; results are given in Table 1. Infiltration rate (Q) is calculated from the raw data displayed in Figure 7. It can also be seen the period of steady state infiltration from which Q and K_{sat} is calculated.

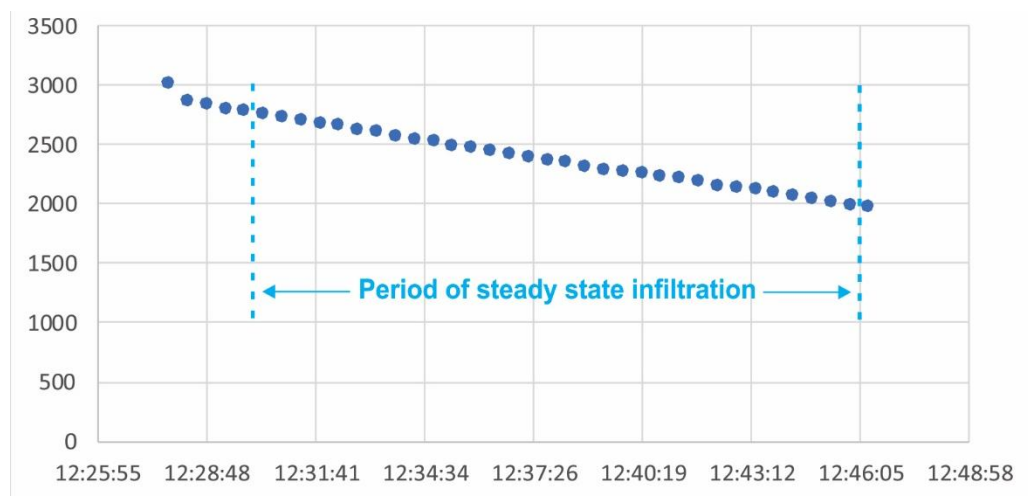


Figure 7 Shows example plot of infiltration in mL against time

Table 1 Soil infiltration rate calculation

Parameter	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Steady State Flow (cm ³ /min)	55.48	60.65	54.5	31.55	29.75	23.81
H (cm)	18	16.5	15	11	12	8
r (cm)	3.05	3.05	3.05	3.05	3.05	3.05
K _{sat} (mm/hr)	39.06	44.32	48.80	46.03	35.35	46.13
K_{sat} (mm/d)	937.54	1063.60	1171.16	1104.72	848.40	1107.21

Using the data in Table 1, the average infiltration is calculated at 1038.77mm/d or 43.28mm/hr.

It can be seen in Table 2 the relationship between infiltration rate and soil textural class. When comparing the measured infiltration rate (43.28mm/hr) with the theoretical infiltration rate for structured loam to clay loam soil (Table 3), the rate is in the range expected.

Table 2 Theoretical infiltration rates per soil textural class

Texture	Structure	Infiltration	Permeability (mm/hr)
Sand	Apedal	Very rapid	>120, >250 can be measured
Sandy Loam	Weakly pedal	Very rapid	>120
	Apedal	Rapid	60-120
Loam	Peds evident	Rapid	60-120
	Weakly pedal	Moderately rapid	20-60
	Apedal	Moderately rapid	20-60
Clay Loam	Peds evident	Moderately rapid	20-70
	Weakly pedal	Moderate	5-20
	Apedal	Slow	2.5-5
Light Clay	Highly pedal	Moderate	5-50*
	Peds evident	Slow	2.5-10
	Weakly pedal	Very slow	<2.5
Medium to heavy Clay	Highly pedal	Low to moderate	2.5-50*
	Peds evident	Very slow	<5.0
	Weakly pedal	Very slow	<2.5
Clay	Sodic and saline	Moderate	8.0
	Sodic	Very slow	<2.5
	Highly sodic	Extremely slow	<1.0

* Strongly structured polyhedral subsoils, eg Krasnozems or Red Ferrosol/Red Dermosol.
The values shown are estimates only, and should be used with caution.

Source Hazelton, Murphy 2016

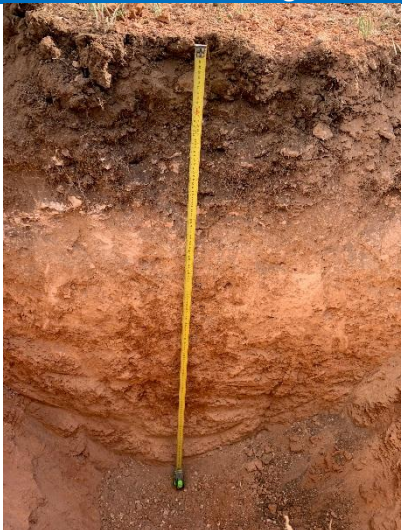
5 Soil Assessment (Physical)

Under the requirements of the SA Health Code and AS1547:2012, Design Loading Rate (DLR) can be calculated for an assessment of wastewater quality, dispersal method and condition of the receiving environment.

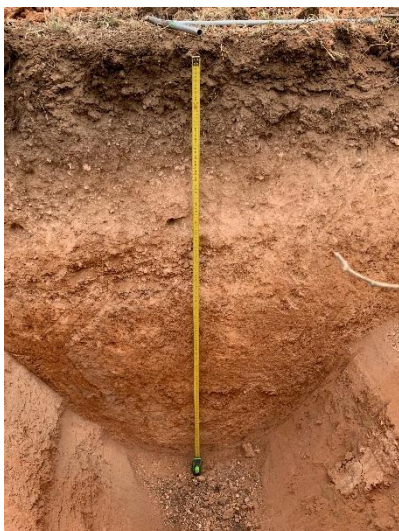
5.1 Soil Pit Assessment

Soil pits were dug to a depth of approximately 800mm for description and infiltration testing with three of the pits being dug to a depth of up to 2m (location Figure 6 and Figure 8). The A horizon was high in organic matter and loam in texture. The B horizon was friable and structured clay loam and effervesced with a fizz test indicating the presence of free lime.

The presence of lime will maintain good soil conditions for dispersal of wastewater, keeping the soil well flocculated. The major potential limitation with calcarosols is the potential for hard carbonate layers to impede drainage, no barriers were identified in the soil to 2m deep. There was no evidence of poor drainage at the site. There was no surface washing or rills evident on the gently sloping surface, and no evidence of mottling associated with waterlogging under irrigation down the profile. This soil and profile are free draining and free of major limitations, and are suitable for the intended purpose: wastewater dispersal.

Site	Image	Description
1		• 0-10cm sandy loam • 10-40cm loam with coarse fragments 3-75mm, 30% • 40-170cm clay loam with 3-10mm, <10% • Macro pores down to 50cm • Good root development in A horizon with root evident to > 1m • Fizz test shows presence of lime
2		• 0-30cm sandy loam • 30-40cm loam with coarse fragments 3-10mm, <5% • 40-85cm clay loam with 3-10mm, <10% • Good root development in A horizon with root evident to depth of pit • Fizz test shows presence of lime

3



- 0-15cm sandy loam
- 15-30cm loam with coarse fragments 3-10mm, 10%
- 30-38cm loam with coarse fragments 3-20mm, 10%
- 38-55cm loam with coarse fragments 3-5mm, <5%
- 55-80cm clay loam with coarse fragments 3-10mm, 5%
- Good root development in A horizon with root evident to > 80cm
- Fizz test shows presence of lime

4



- 0-20cm sandy loam
- 20-40cm loam with coarse fragments 3-10mm, <5%
- 40-85cm clay loam with 3-10mm, <10%
- Good root development in A horizon with root evident to depth of pit
- Fizz test shows presence of lime

5



- 0-30cm sandy loam
- 30-50cm loam with coarse fragments 3-10mm, 5%
- 40-200cm clay loam with 3-10mm, <10%
- Good root development in A horizon with root evident to > 1m
- Fizz test shows presence of lime

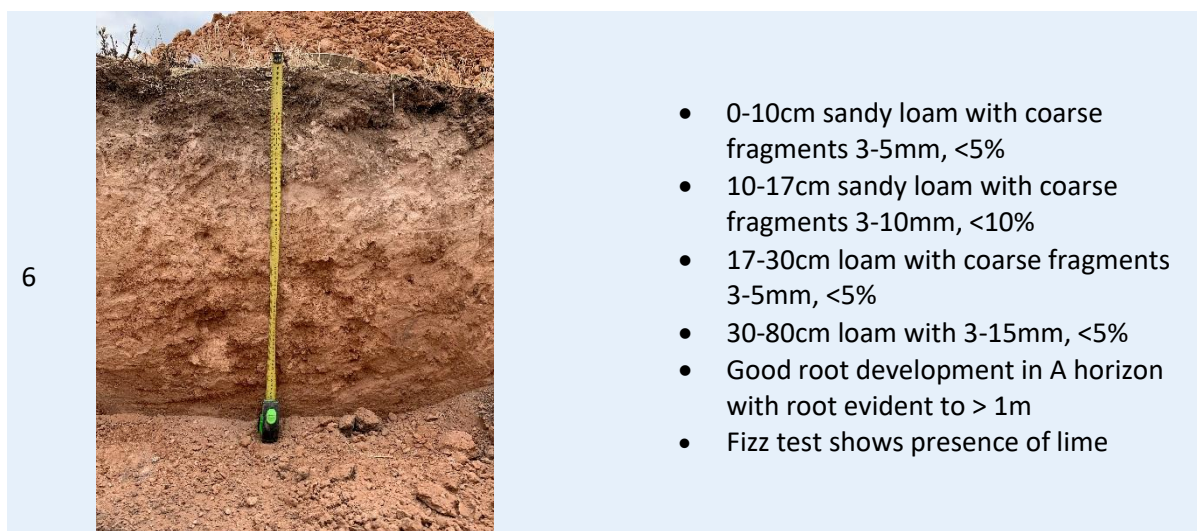


Figure 8 Soil pit images

A visual inspection of the site and soil pits dug did not identify any overt visual issues. The site had been used for the long-term spray irrigation of secondary treated wastewater.

5.2 Particle Size Analysis

Using particle size analysis, the DLR can be gained from Table 4 (SA Health, 2013).

Samples were taken from surface and deeper horizons, down to a depth of 150cm (See Table 3) and analysed for particle size.

Table 3 Sampled soil particle size analysis and textural class

Location and Horizon	Depth (cm)	Textural Class	MIR - Clay (<2 micron, %)	MIR - Sand (+20 micron, %)	MIR - Silt (2-20 micron, %)
1A	5-30	Loam	25	54	21
1B	40-100	Clay loam	29	58	13
2A	10-30	Loam	22	60	14
2B	30-80	Clay loam	27	52	21
3B	80-150	Clay loam	24	59	17
4A	20-40	Loam	20	61	19
4B	40-85	Loam	20	58	22
5B	80-120	Clay loam	30	45	25
6B	30-80	Loam	25	53	23

The surface soil is a sandy loam (field tested), the sub surface layers are friable loam to clay loam under the Australian Textural Class Classification (Figure 9). The soil has good lime (calcium) content as indicated by a field fizz test, therefore it has good structure and good hydraulic properties.

Three deeper soil pits (at sites 1, 3 and 5) were excavated to assess the soil profile and potential site limitations. There were no significant limitations for the soil profiles down to 2m (visual assessment).

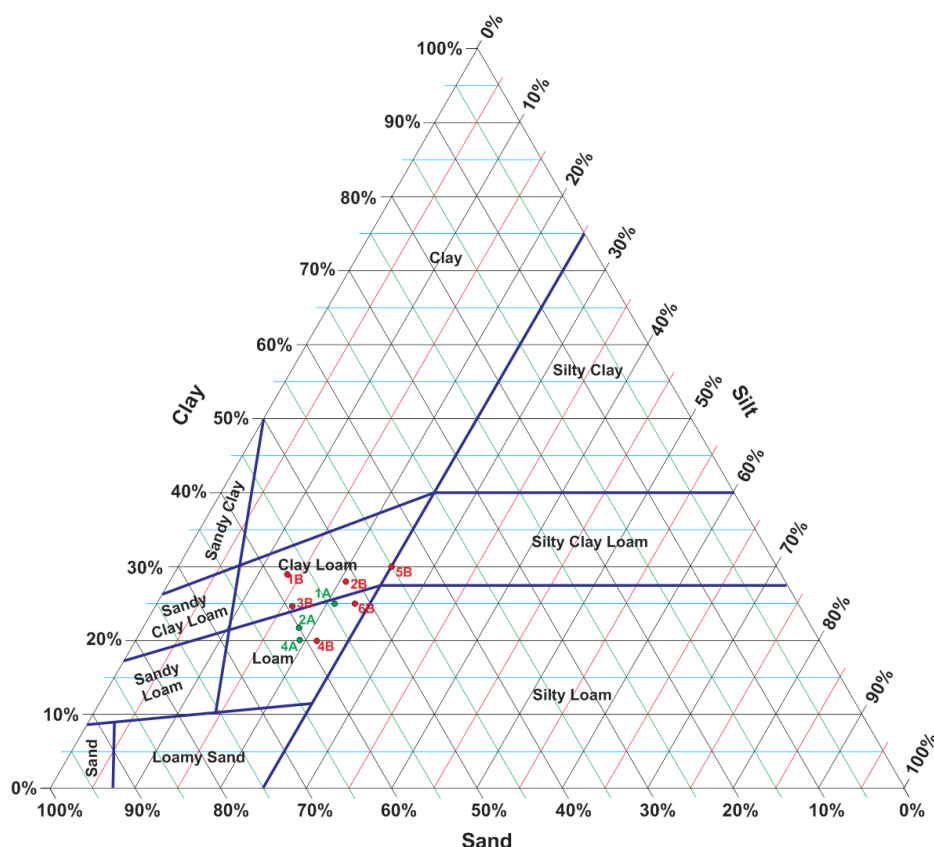


Figure 9 Australian Soil Texture Class Triangle showing texture for sampled soil

Table 4 Recommended Design Loading Rates for trenches and beds

Soil category	Soil texture	Structure	Indicative permeability (K _{sat})(m/d)	Design loading rate (DLR) (mm/d)			ETA/ETS beds and trenches
				Trenches and beds			
				Primary treated effluent		Secondary treated effluent	
				Conservative rate	Maximum rate		
1	Gravels and sands	Structureless (massive)	>3.0	20 (see Note 1)	35 (see Note 1)	50 (see Note 1)	(see Note 4)
2	Sandy loams	Weakly structured	>3.0	20 (see Note 1)	30 (see Note 1)	50 (see Note 1)	
		Massive	1.4 – 3.0	15	25	50	
3	Loams	High/moderate structured	1.5 – 3.0	15	25	50	
		Weakly structured or massive	0.5 – 1.5	10	15	30	
4	Clay loams	High/moderate structured	0.5 – 1.5	10	15	30	12
		Weakly Structured	0.12 – 0.5	6	10	20	8
		Massive	0.06 – 0.12	4	5	10	5

Soil category	Soil texture	Structure	Indicative permeability (K _{sat})(m/d)	Design loading rate (DLR) (mm/d)			ETA/ETS beds and trenches
				Trenches and beds			
				Primary treated effluent		Secondary treated effluent	
				Conservative rate	Maximum rate		
5	Light clays	Strongly structured	0.12 – 0.5	5	8	12	8
		Moderately structured	0.06 – 0.12		5	10	5 (see Notes 2, 3 & 5)
		Weakly structured or massive	<0.06			8	
6	Medium to heavy clays	Strongly structured	0.06 – 0.5	(see Notes 2 & 3)			
		Moderately structured	<0.06				
		Weakly structured or massive	<0.06				

NOTES:

1. The treatment capacity of the soil and not the hydraulic capacity of the soil or the growth of the clogging layer govern the effluent loading rate in Category 1 and weakly structured Category 2 soils. Land application systems in these soils require design by a suitably qualified and experienced person, and distribution techniques to help achieve even distribution of effluent over the full design surface (see L6.2 and Figure L4 for recommended discharge method by discharge control trench). These soils have low nutrient retention capacities, often allowing accession of nutrients to groundwater.
2. To enable use of such soils for on-site wastewater land application systems, special design requirements and distribution techniques or soil modification procedures will be necessary. For any system designed for these soils, the effluent absorption rate shall be based upon soil permeability testing. Specialist soils advice and special design techniques will be required for clay dominated soils having dispersive (sodic) or shrink/swell behaviour. Such soils shall be treated as Category 6 soils. In most situations, the design will need to rely on more processes than just absorption by the soil.
3. If $K_{sat} < 0.06\text{m/d}$, a full water balance for the land application can be used to calculate trench/bed size (see Appendix Q).
4. ETA/ETS systems are not normally used on soil Categories 1 to 3.
5. For Category 6 soils ETA/ETS systems are suitable only for use with secondary treated effluent.

Source: AS/NZS 1547:2012

6 Area Suitable for Wastewater Dispersal

The fenced wastewater disposal area (Figure 3) is suitable for wastewater dispersal and free of major limitations. The soil profile is loam Category 3b soil to clay loam Category 4a at depth with:

- Primary treated effluent DLR of 15mm/d (Table 4).
- Secondary treated effluent DLR of 30mm/d (Table 4).

7 Discussion

The purpose of this LCA is for the design of a wastewater dispersal system for the Rogues Point wastewater treatment plant.

The survey of the site indicates the soil is free draining and free of major limitations and is therefore suitable for the dispersal of primary or secondary treated wastewater with a DLR of 15 or 30mm/day respectively.

The soil assessment identified the predominant soil textural class, into which treated wastewater will be applied, to be loam Category 3b over clay loam Category 4 soil at depth. The saturated infiltration rate (K_{sat}) assessment was measured to be 43.28mm/hr.

Albeit the soil is loam at the surface to clay loam at depth and contains lime, it is recommended that the basement of receiving environment will have 1kg/m² of gypsum applied and then deep ripped. This will maintain the hydraulic performance of the soil helping to maintain good soil conditions for wastewater dispersal and good environmental outcomes. It will also 'fix' phosphorus improving the environmental outcome for the dispersal method.

There are many drivers and considerations that have been considered in the assessment of a practical solution to meet the evolving needs of Rogues Point wastewater management system. It can be seen that the proposed system will provide many benefits to the council

8 References

Standards Australia (2012) **AS/NZS 1547 On-site domestic wastewater management**

https://infostore.saiglobal.com/en-us/Standards/AS-NZS-1547-2012-117631_SAIG_AS_AS_267605/

SA Health (2013) **On-site Wastewater Systems Code.**

https://www.sahealth.sa.gov.au/wps/wcm/connect/ba6ead0048f0d8ab828287f25a3eb7d6/2013SAHealth_On-site_Wastewater_Systems_Code_April.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-ba6ead0048f0d8ab828287f25a3eb7d6-mMH7r2z

SA Health, Local Government Association (2019) **South Australian Community Wastewater Management System (CWMS): Design Criteria.**

<https://www.sahealth.sa.gov.au/wps/wcm/connect/6120cfd6-659f-4346-a04b-c37eb73fa4b7/South+Australian+Community+Wastewater+Management+System+%28CWMS%29+-+Design+Criteria.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-6120cfd6-659f-4346-a04b-c37eb73fa4b7-mOdpcmH>

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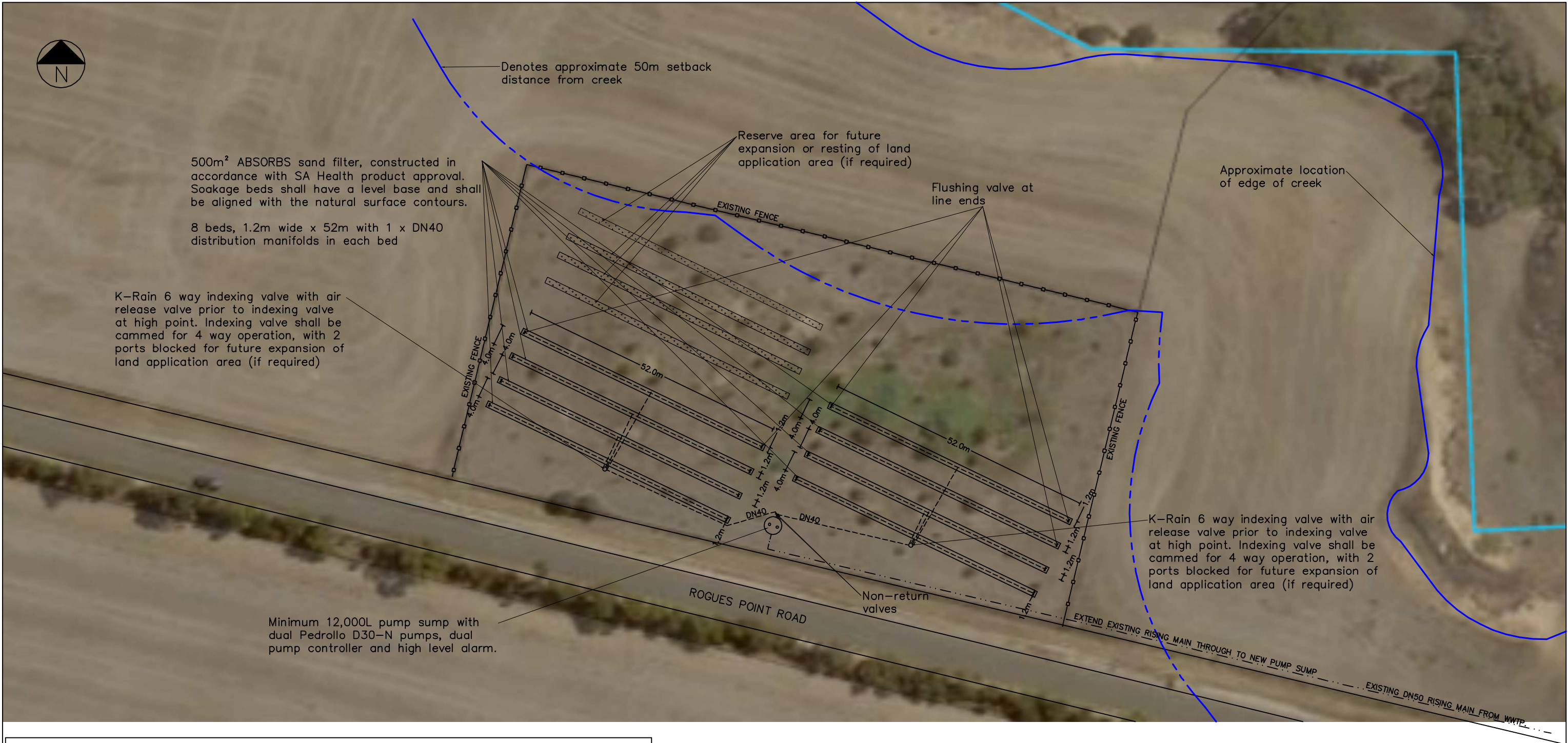
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- NOTES:
- 1. REFER TO ARCHITECTURAL PLANS AND SITE SURVEY FOR EXACT LOCATION OF BUILDINGS AND OTHER SITE FEATURES
 - 2. SEPTIC TANK SHOULD BE SET BACK 2.5m FROM ANY BUILDINGS AND PROPERTY BOUNDARY
 - 3. SAND FILTER SHOULD BE SET BACK 2.5m FROM SEPTIC TANK AND PROPERTY BOUNDARY. 3.0m FROM BUILDING OR SWIMMING POOL IF TRENCH IS LOCATED DOWNSLOPE OF BUILDING OR SWIMMING POOL, AND 6.0m IF UPSLOPE
 - 4. LAYOUT OF PLUMBING IS SCHEMATIC ONLY. PLUMBER TO CHECK ON-SITE AND MODIFY ACCORDINGLY. PLUMBING TO BE IN ACCORDANCE WITH AS3500-2018
 - 5. SITE PLAN IS TO BE READ IN CONJUNCTION WITH ON-SITE WASTEWATER MANAGEMENT REPORT
 - 6. THE INSTALLER OF THE SAND FILTER SHALL PROVIDE CERTIFICATION THAT THE WASTEWATER SYSTEM INCLUDING THE TYPE OF SAND USED FOR THE FILTER CONSTRUCTION HAS BEEN INSTALLED IN ACCORDANCE WITH THE SA HEALTH PRODUCT APPROVAL.
 - 7. PLUMBER SHALL UNDERTAKE DIAL BEFORE YOU DIG ENQUIRY AND SERVICE LOCATION PRIOR TO CONSTRUCTION
 - 8. PRE-COMMISSIONING TESTING SHALL BE UNDERTAKEN PRIOR TO BACKFILL IN ACCORDANCE WITH AS1547. A SITE INSPECTION BY THE DESIGN ENGINEER SHALL BE UNDERTAKEN DURING PRECOMMISSIONING TESTING. THIS INSPECTION WILL INCUR AN ADDITIONAL FEE AND SHALL BE ALLOWED FOR BY CONTRACTOR
 - 9. ABSORBS SAND FILTER IS A PROPRIETARY WASTEWATER MANAGEMENT SYSTEM, & SHALL BE CONSTRUCTED BY FLUID ENVIRONMENTAL PTY LTD WHO SHALL PROVIDE AN OPERATION AND MAINTENANCE MANUAL TO THE OWNER IN ACCORDANCE WITH SECTION 11.2 OF SA HEALTH ON-SITE WASTEWATER SYSTEMS CODE
 - 10. AUDIBLE / VISUAL ALARM SHALL BE INSTALLED BY LICENSED ELECTRICIAN AND SHALL BE LOCATED IN PUMP BUILDING ELECTRICAL SYSTEM AND CONTROL SYSTEM SHALL BE DESIGNED BY OTHERS
 - 11. ALL STORMWATER RUNOFF SHALL BE DIVERTED AWAY FROM WASTEWATER DISPERSAL AREA
 - 12. DN40 DISTRIBUTION LATERAL PIPES SHALL BE LILAC COLOUR PRESSURISED PVC CLASS 12 (PURPLE)
 - 13. VALVE BOXES, NON-RETURN VALVES, FLUSHING VALVES ETC SHALL BE LILAC. FLUSHING VALVES SHALL BE INSTALLED SO THAT DISCHARGE IS DIRECTED SAFELY INTO SOAKAGE BEDS DURING FLUSHING OPERATION

FLEXIBLE FITTINGS FOR PLUMBING CONNECTIONS WILL BE REQUIRED, REFER TO PLUMBING JOINT MANUFACTURER, SUCH AS STORM PLASTICS FOR APPROPRIATE FITTING

BASE OF SOAKAGE BEDS SHALL BE RIPPED TO 600mm BELOW BASE OF SOAKAGE BED AND GYPSUM APPLIED AT A RATE OF 1kg/m²

MACE ENGINEERING SERVICES	6 LENNON STREET CLARE 5453 A.B.N. 89 615 046 930 TEL. (08) 88 421242	TITLE: ON-SITE WASTEWATER MANAGEMENT SITE PLAN	DATE JULY 2025
		SITE: LOT 18 ROGUES POINT ROAD, ROGUES POINT	SCALE 1:750 @ A3
		CLIENT: YORKE PENINSULA COUNCIL	DWG No. 15067 - 01

Appendix C Interim Milestone 2 Report (issued March 26th 2025)

**LGA SA Community Wastewater Innovation Fund
Project CWMS-003—Milestone 2 interim report**

**Yorke Peninsula Council
Community Wastewater Management System review**



26th March 2025

Summary

During November 2024, Fluid Environmental undertook a field trip visiting various Community Wastewater Management System (CWMS) wastewater treatment plants with Grant Smith from the Yorke Peninsula Council. Grant provided us with significant background to the treatment plants with key design and operational information about the treatment plants and the sewer systems that feed the plants (see Appendix A).

The two-day field trip commenced with a site visit to Rogues Point treatment plant and then progressed around the Peninsula finishing at Ardrossan.

Key information and insights gained: across all treatment plant/s included:

- All treatment plants were being operated well within their design capacity apart from the Ardrossan and Maitland plants which, during periods of peak demand, exceeded plant design flows;
- Plants were generally in good asset condition and were well maintained;
- The Stansbury plant has a tank lid that required repairs (scheduled to be undertaken);
- All plants are aerobic treatment systems and have a relatively high energy requirement. The Council has updated some of the aerators at their Sequencing Batch Reactor (SBR) plants to increase aeration performance and decrease operating costs.
 - Aerator life is approximately 2 years (advice from Council)
- Plants are managed through an online SCADA system. The system has recently been upgraded to 4G prior to the decommissioning of the 3G network;
- A common problem at the treatment plants were from non-degradable gross solids (sanitary liners and wipes) that had been flushed down toilets.
 - Generally, it didn't seem to impact plant functionality but was a nuisance for inlet maintenance, desludging and disposal. It could however present an WHS issue for workers;
 - Raw sewerage plants gross pollutants are an issue this does not apply to septic tank effluent drainage schemes (STEDS).
 - Pt Turton has purchased a new gross pollutant inlet screen but it is not installed yet.
 - There are a number of plants that receive raw sewerage where gross pollutants are a significant ongoing issue;
- Plants that had highly variable flows were being managed in their operation by shutting down elements of the plants during periods of low flow. This was particularly true of coastal holiday towns that had fluctuating populations during holiday periods.
- There are a number of plants that are operating at less than 25% of design capacity
 - The cost of operations to the Council is a major consideration for these smaller plants
- The Council manages a septic tank maintenance scheme across the region to ensure appropriate maintenance of their networks;
- The Council sees changing from on-site disposal within townships to a CWMS scheme as problematic.
 - Difficult convincing the landowners to connect to the CWMS scheme which is seen as an additional 'unnecessary cost' by residents
 - Cost of installation – Council lacks a funding stream to finance better wastewater systems.
- A recurring theme in our discussions with Council was how to match more closely treatment system capacity with flow. This was particularly true in within coastal communities subject to variable but frequently low flows.

Key information summaries for each site alongside site layout overviews are provided below.

Ardrossan

Key points include:

- This plant is operating well above the design capacity.
- The influent is from two locations, Ardrossan and Tiddy Widdy beach
 - Ardrossan 72.8ML/year, 92.7% of annual flow
 - Tiddy Widdy 5.7ML/year, 7.3% of annual flow
- Currently the Council has another consultant evaluating options for the Ardrossan plant to manage flows
- This site may be influenced by the proposed Rex Minerals mine, through more permanent use and/or rental. 300 new jobs are to be created locally. Ardrossan is most likely to be influenced by the new mine due to the amenities withing the town.

Rogues Point

Key points include:

- Largely a holiday community
- James Well to the North of Rogues Point could be added to the CWMS and treatment plant.
 - If James Well were to be connected it would potentially increase flows by as much as 4-fold.
 - Total houses would be in the order of 200
 - The plant was installed by Environmental Waste Services
- Blowers are 3.5kW/hr and they operated 6-8hours per day. Energy cost \$3-4K per year
- The dispersal field is in need of an upgrade as evidenced by the uneven flow resulting in uneven growth (see below image).
- Treatment plant is within the confines of the town and nuisance noise is a potential problem for residents
- Plant has adequate capacity and does not need an upgrade to meet current demand
- Energy is the major cost of operation
- There are properties within Rogues Point that could be connected to the CWMS system



Black Point

Key points include:

- Largely a holiday community. Plant has several distinct operational periods:
 - Peak flow in January 64,000L/d, 56% of peak design flow (PDF).
 - Winter May to November 13% PDF
 - Summer November to May 13% PDF
- The plant had gone through a recent upgrade to meet flow requirements
- Two new 5 kW aerators fitted
- Had two aeration tanks where one is run throughout the year and the second one used during peak period. Run 8 months as a single and 4 months with both aeration tanks
- Treated wastewater discharged to a woodlot as beneficial reuse
- This site may be influenced by the proposed Rex Minerals mine, through more permanent use and/or rental with the creation potentially of 300 new jobs locally

The Council saw this as a site that had the capacity to meet future demands. Council did not believe that this plant would require an upgrade in the foreseeable future.

Opportunity

- Would there be an opportunity to reduce operational costs through a more passive approach?
- Potential to retrofit the SBR activated sludge plant to operate under Aerobic Granular Sludge conditions. This has potential to increase plant performance and capacity but would require some minor infrastructure changes.
- Reduce the carbon footprint of the plant by anaerobic digestion plus passive secondary treatment process
 - Reduce desludging requirement (anaerobic digestion → 90% reduction on sludge)

Port Julia

Key Points Include:

- The second smallest plant in the Council area
- Plant was installed by the community without Council involvement
- Current peak flow is about 1,700L/d
- The caravan park is about to connect to the system, approximately an additional 5,000L/d PDF
- Design capacity is 18,750L/d, with the caravan park the peak flow would be 36% of the plant PDF.
- Two tank system, primary settling tank with a secondary aeration chamber
- 1 x 1.75kW blower running 6-8hr/d
- Beneficial reuse to a planted woodlot approximately 4,000m².
- Council cannot see significant expansion in the future other than the caravan park connection, only 1-2 enquiries to join the scheme per year

Opportunity:

- Caravan park has a dump point connected to their internal system (this will not impact connection to the CWMS STEDS Scheme)
- Increase irrigation of foreshore would be more beneficial



Port Vincent

- Plant consists of two aeration tanks with 2 aerators per tank.
- Summer flow is 33% of PDF. The peak loads occur during Australia day weekend (46% of plant capacity).
- Problem at site, is from prohibited discharges, sanitary liners, wet wipes, etc.
- Plant sludge discharged to farmers paddock then the contractor walks the discharge and picks up prohibited waste
- There is a waste sludge tank

- Plant needs a primary screen (trommel like the one purchased for Point Turton). It is clear this approach would increase efficiency, reduce maintenance and have WHS benefit for staff and contractors.
- There is some expected growth with a new private caravan park
- 2 aerators per tank at 4.6kW with aeration every 20 minutes every 2 hours
- Advised that the treatment plant and CWMS has some funding for upgrade.
- The wastewater is used to irrigate lucerne field. Council sees that there is some opportunity for more beneficial reuse.

There was salt damage evident near the lucerne reuse area that will require further investigation.

- Land capability assessment required to identify the soil process causing surface salinisation.



Stansbury

The Stansbury treatment plant and beneficial reuse area is positioned well away from town.

- Average summer flow (peak season) 53% of PDF
- Peak daily flow 53,000L/d is 77% of PDF, making it one of the higher utilised plants
- Single aeration tank
- The wastewater influent is 75% raw sewage
- The reuse area is somewhat unplanned and just grows grass/weeds (currently no beneficial reuse)
- Plant working well with good water quality results
- As with other raw sewage plants the Stansbury plant has issues with wipes and liners.
- Estimated \$30M cost to sewer the whole town (Tonkin engineers)
 - Government \$10M
 - Council \$20M, approximately \$10K/household
 - Council charges approximately \$7,000 headworks fee



Sultana Point + Edithburgh

- Sultana Point is an established water treatment plant and dispersal area
- Combined summer flow 23% of PDF.
- Peak daily flow 17,350L/d or 42% of PDF
- Some connection from the southern end of Edithburgh to the Sultana Point WWTP
- Currently there are two rising mains from 1) Sultana Point and 2) Edithburgh, to separate primary tanks at the treatment plant.
- The primary streams feed to a single secondary chamber and then 3 aeration chambers
- STEDS from Sultana Point and full sewer from Edithburgh
- It appears that the dispersal area, irrigated woodlot, has a low uniformity of distribution. The potential area of the woodlot is approximately 4,900m²
- Future expansion is being planned for:
 - A new housing development in Edithburgh: Counting from Satellite imagery, there are >40 subdivided blocks to be developed from Panfry Road South to Sultana Point. Using the CWMS (>20 houses calculation) this would be an additional 20,000L/d
 - Bringing the Edithburgh Caravan Park on to the system. The caravan park (counting from Google Earth) have > 100 sites, at 3.5 people per site at 100L/p/d + accomodation cabins, there could be as much as 60,000L/d peak design flow (or 1.5-times Sultana Point WWTP capacity)
- Total theoretical wastewater generation to meet current demand (Sultana Point, Edithburgh Caravan Park, and available development to the south of Edithburgh) the total could be in the order of 100/kL/d.

Opportunity:

There is the opportunity to redevelop the Sultana Point WWTP to a passive treatment system. This approach would provide many significant benefits including:

- Reduced treatment cost as there is no requirement for aeration blowers or chemicals;
- There are a range of passive treatment systems that could be utilised as a best fit solution to treatment and dispersal. Could be retrofitted across the existing dispersal area, however in time an increased dispersal area would be required.
- Highly scalable, could be developed in as little as 10 house increments (scalability will depend on the Council) to defer upfront costs to Council. Treatment and dispersal system expansion could be funded by headworks charges.
- Would encourage the system to be STEDS to mitigate risk of Council. A STEDS scheme would make the property owner responsible for prohibitive discharges (SA Health 2013) into the wastewater system. A further advantage is that infrastructure costs would be lower for a STEDS rather than a full raw effluent system.



Foul Bay

At peak day flow the treatment plant is 14% of the treatment plant capacity. This extreme underloading makes this site ideal for:

- Decommissioning the aerobic treatment system and converting to an anaerobic treatment system plus passive secondary treatment.
- Reconfiguring the tanks to operate as an anaerobic baffled reactor
- Installing soil based passive treatment and dispersal

The advantage of this approach to Council would be:

- It mitigates the plant operation costs. The only energy requirement would be for water transfer, no energy required for treatment and no chemicals (chlorine)
- It would more than halve the operating carbon footprint of the current system
- Virtually no operator requirement, service the system (approx. 2 hrs) half yearly
- As anaerobic treatment produces less than 20% of the sludge of aerobic systems, there would be further cost savings from sludge/biosolids management.



Point Turton

- High opportunity for expansion:
 - Proposed new subdivision, full sewer
 - Potential connection of the Caravan Park to sewer, there is a broad range of accommodation:
 - Deluxe family cabins and deluxe spa cabin
 - Luxepod with 2 or 3 bedrooms
 - Powered and unpowered sites
 - Town has a RV dump point
- Peak daily flow as a percentage of design capacity
 - # 1 small treatment plant to the North of Point Turton: 35% of capacity
 - #2 larger treatment plant adjacent the town of Point Turton: 19% of capacity
- The treatment plant has had recent upgrade of aerators
- An inlet screen has been purchased for WWTP # 2 to remove sanitary liners/wipes and gross pollutants from the wastewater
- SBRWWTP is run as a single tank system in off peak periods and a two tank system during peak periods
- The treatment plant has highly variable flows, high flows during the peak holiday season
- It is a difficult site with respect to soil, shallow soil over calcrete
- Woodlot dispersal area of about 6,500m²



Hardwicke Bay

- Legacy issues in that the developer installed a gravity sewer, but the pipe didn't go anywhere. It later became Council's responsibility.
- Biggest issue is the cost of operation due to low flows
- It uses 2 x 3.5kW blowers running about 8 hours per day
- Peak Daily flow is 27% of the WWTP design capacity
- Council sees that it will be a long time before any works are required at the WWTP and dispersal area
- Adequate land available for WWTP reconfiguration with passive water treatment and dispersal



Bluff Beach

Is largely a holiday tourism location with a low percentage of permanent residents.

- It is a growing community
- Highly variable flows (holiday town)
- The peak daily flow is 19% of the WWTP design capacity (chronically underloaded)
- Whole town is a combination of pressure and gravity sewer
- Raw sewerage treatment plant (not STEDS)
- Plant is underloaded, there is a TSS issue in meeting compliance but it is improving
- Looking to increase primary treatment (note: gross pollutants liners and wipes could be a problem), increasing primary treatment capacity should improve effluent quality TSS outcomes
- Dispersal area of approximately 3,500m² with an available area of 8,500m²



Port Victoria

The town is a coastal community and tourist destination

- Town is partially sewerage, raw sewerage
- There is high potential for growth, a developer currently planning to join the system
- The WWTP has a problem with gross pollutant, liners and wipes
- No primary treatment (raw sewage goes straight to SBR inlet); this is considered a problem and plant needs primary treatment
- There are 100 caravans at Warrultee Beach that dump wastewater into the treatment plant
- Plant not at full capacity but would have problems meeting compliance

- Peak daily flow is 51% of treatment plant design.
- Beneficial reuse at the oval. Irrigation system has very low distribution uniformity and needs significant rework



Chinaman Wells

- Treatment capacity of 24,480L/day, with a peak daily flow of 4,500L/d
 - Significantly unloaded (operating at 18% of capacity)
- Excellent potential for retrofit to a passive treatment system. This approach would provide many significant benefits including:
 - Reduced treatment cost as there is no requirement for aeration blowers or chemicals;
 - There are a range of passive treatment systems that could be utilised as a best fit solution to treatment and dispersal. Could be retrofitted across the existing dispersal area, however in time an increased dispersal area would be required.
 - Highly scalable, could be developed in as little as 10 house increments (scalability will depend on the Council) to defer upfront costs to Council. Treatment and dispersal system expansion could be funded by headworks charges.



Maitland

- Full STEDS Scheme, no raw effluent, Council arranges for septic tanks to be pumped out every 4 years
 - Cost of pump out is \$300-400
 - 400 houses, approximately $\frac{2}{3}$ of the town on CWMS
 - Interestingly, for 400 houses and the peak daily flow there is 550L/house/day or 25% greater than the CWMS 2.6 people per household at 170L/p/d, 442L/household/d.
- Significant wet weather ingress into the system (only treatment plant where winter flows exceed summer flows). This would be further reflected in that there is little peak holiday season flows.
- Currently installing 100L of emergency storage (equal to approx. 50% of peak daily flow)
- Potential to retrofit the SBR activated sludge plant to operate under Aerobic Granular Sludge conditions. This has potential to increase plant performance and capacity but would require some minor infrastructure changes.
- Treated wastewater pumped to storage dam, blended with stormwater and beneficially reused for amenity irrigation.



Land Capability Assessments for sustainable wastewater dispersal

The project has committed to undertaking a number of Land Capability Assessments (LCAs) for priority CWMS sites on Yorke Peninsula to determine the suitability of site soils to receive wastewater via alternate treatment and dispersal solutions (e.g. sub-surface passive treatment and disposal).

One LCA has been undertaken to date at the Rogues Point site and is included as Appendix C. Briefly, this soil assessment confirmed that the Rogues Point dispersal area is suitable for wastewater dispersal and free of major limitations. The loam to clay loam soil was classified as Category 3-4 with a design loading rate of 30mm/d making it well suited to alternate sub-surface passive treatment and disposal solutions.

Next steps

Future work to finalise the project will include:

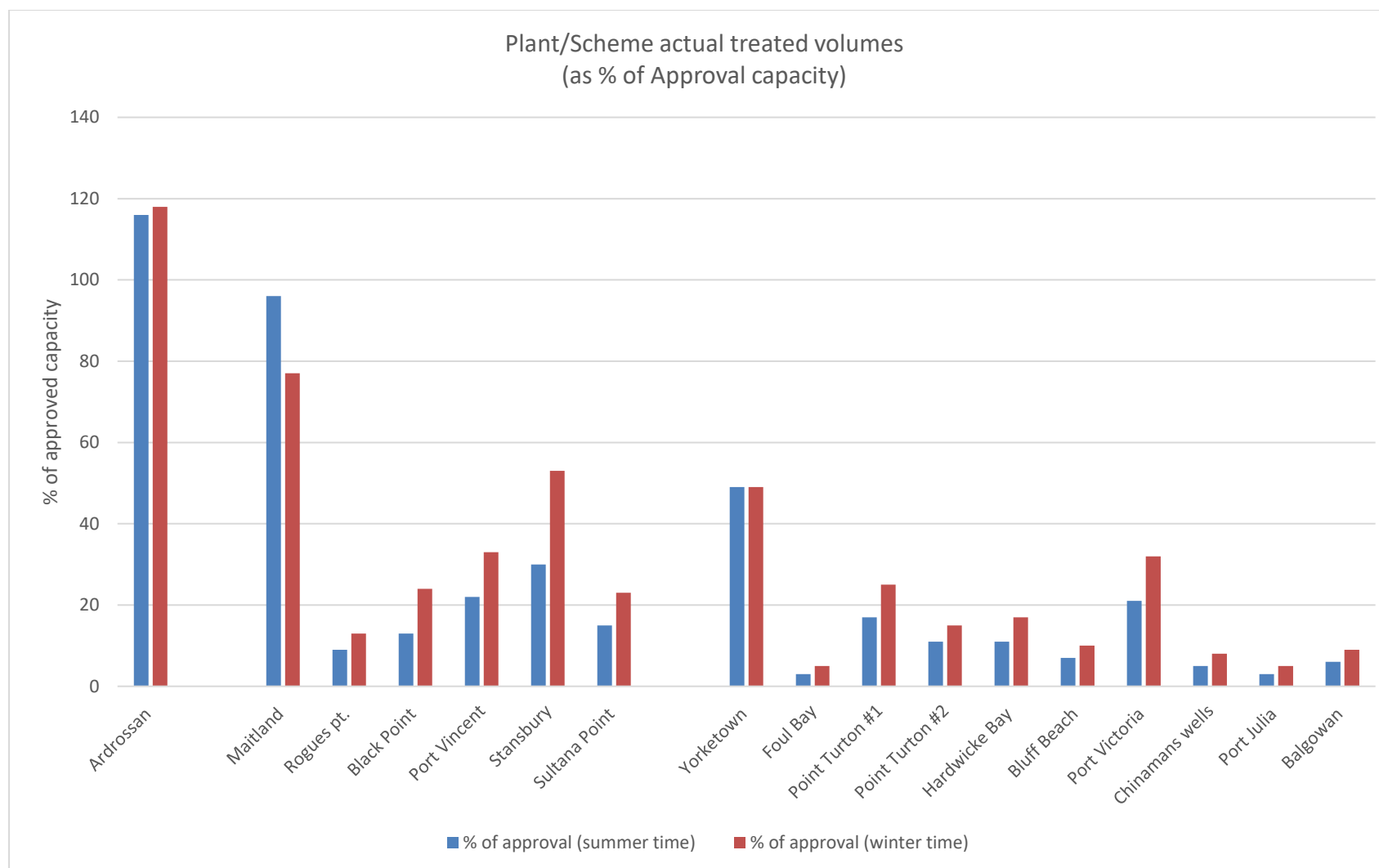
- Undertaking additional LCAs at priority sites for Council (likely Sultana Point and Chinamans Wells)
- Specifying and designing potential retrofit solutions for priority sites with Council using a suitably qualified wastewater engineer
- Seeking SA Health approval for CWMS retrofitting of at least one priority site as chosen by Council
- Assessment of future economic cost–benefits for Council from undertaking retrofitting works at priority sites of interest

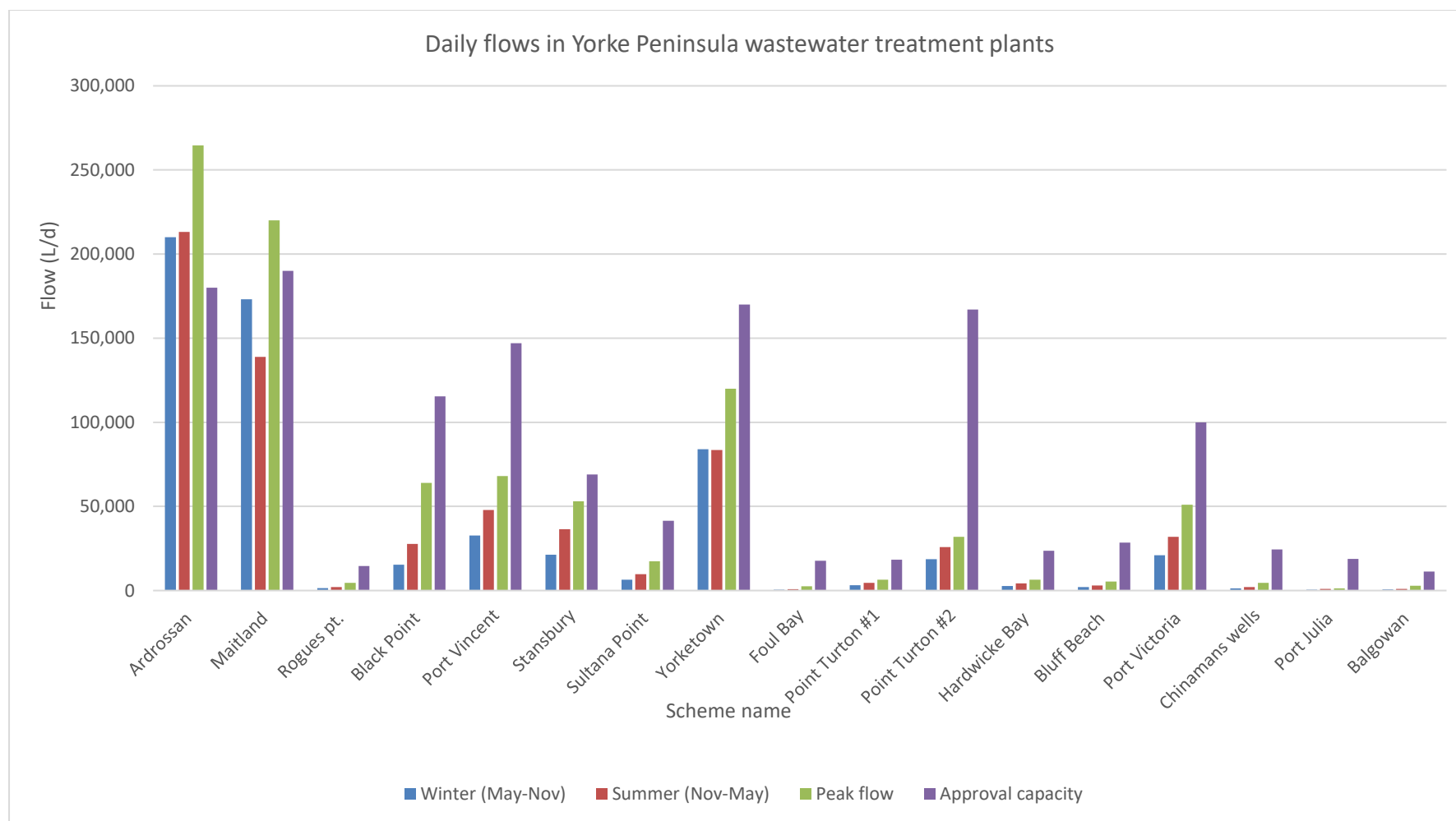


Appendix A. Treatment plant peak daily flows and approval capacity

Scheme Number	Town	Yearly (2021)		Winter (May-Nov)		Summer (Nov-May)		Peak loads		Treatment plant capacity as per DOH approval	
		ML/year	L/day	L/day	% of approval	L/day	% of approval	L/day	Time of peak	L/day	BOD ₅ (kg/day)
1	Ardrossan	78.5	211,642	210,000	116	213,110	118	264,600	Australia day weekend	180,000	48
2	Tiddy Widdy beach	See Ardrossan (Water sent to Ardrossan for processing and reuse)									
3	Maitland	57.7	155,593	173,094	96	138,921	77	220,000	End of winter, Stormwater ingress	190,000	56
4	Rogues Point	0.6	1685	1379	9	2005	13	4500	Mid-January	14,560	
5	Black Point	8	21,698	15,315	13	27,779	24	64,000	Mid-January	115,500	38.5
6	Port Vincent	13.1	40,466	32,657	22	47,905	33	68,000	Australia day weekend	147,000	62
7	Stansbury	10.7	29,027	21,237	30	36,447	53	53,000	Australia day weekend	69,000	27
8	Sultana Point	2.9	8,075	6,381	15	9,689	23	17,350	Australia day weekend	41,480	9.76
9	Edithburgh	See Sultana Point (Water sent to Sultana Point for processing and reuse)									
10	Yorke town	31	83,811	84,055	49	83,579	49	120,000	End of winter, Stormwater ingress	170,000	
11	Foul Bay	0.25	679	508	3	832	5	2500	Early January	17,680	
12	Point Turton #1	1.4	3,873	3,149	17	4,563	25	6,500	January	18,360	
13	Point Turton #2	8.2	22,315	18,685	11	25,774	15	32,000	January	167,000	59

14	Hardwicke Bay	1.3	3,525	2,740	11	4,274	17	6,400	January	23,700	
15	Bluff Beach	0.9	2,501	2,038	7	2,942	10	5,300	January	28,500	
16	Port Victoria	9.8	26,588	20,928	21	31,979	32	51,000	January	100,000	30
17	Chinamans wells	0.5	1,364	1,326	5	2,000	8	4,500	January	24,480	8.64
18	Port Julia	0.2	768	580	3	947	5	1,300	Easter	18,750	
19	Balgowan	0.3	863	674	6	1,042	9	2,800	January	11,300	3.35
Schemes on Yorke Peninsula not under council control											
1	Marion Bay									46,410	
2	The Dipper	0.3	976								





Appendix B. Treatment plant operational and maintenance costs relative to design and operating flows

Scheme Number	Town	Treatment plant capacity as per DOH approval	Treatment plant yearly average flow	Treatment plant operational & maintenance cost	Treatment plant operational & maintenance cost	Treatment plant operational & maintenance cost
		L/day	L/day	\$/yr	\$/kL design capacity/yr	\$/kL average annual flow/yr
1	Ardrossan	180,000	211,642	\$101,605 ²	\$564	\$480
2	Tiddy Widdy beach					
3	Maitland	190,000	155,593	\$107,250 ²	\$564	\$689
4	Rogues pt.	14,560	1685	\$11,781 ¹	\$809	\$6,992
5	Black Point	115,500	21,698	\$65,197 ²	\$564	\$3,005
6	Port Vincent	147,000	40,466	\$82,978 ²	\$564	\$2,051
7	Stansbury	69,000	29,027	\$38,949 ²	\$564	\$1,342
8	Sultana Point	41,480	8,075	\$23,219 ¹	\$560	\$2,875
9	Edithburgh					
10	Yorke town	170,000	83,811	\$95,961 ²	\$564	\$1,145
11	Foul Bay	17,680	679	\$4,999 ¹	\$283	\$7,362
12	Point Turton #1	18,360	3,873	\$4,999 ¹	\$272	\$1,291
13	Point Turton #2	167,000	22,315	\$94,267 ²	\$564	\$4,224
14	Hardwicke Bay	23,700	3,525	\$34,370 ¹	\$1,450	\$9,750
15	Bluff Beach	28,500	2,501	\$16,088 ²	\$564	\$6,432
16	Port Victoria	100,000	26,588	\$56,447 ²	\$564	\$2,123
17	Chinamans wells	24,480	1,364	\$13,818 ²	\$564	\$10,131
18	Port Julia	18,750	768	\$12,035 ¹	\$642	\$15,671
19	Balgowan	11,300	863	\$16,609 ¹	\$1,470	\$19,246
TOTAL		1,337,310	614,473	\$862,888	-	-

¹ Based on data provided by Yorke Peninsula Council; ² Based on data interpolated from [Yorke Peninsula Council Strategic Asset Management Plan 2025–2034](#)

Operational and maintenance cost data provided by council and sourced from published asset management reports are summarised in the Appendix B Table above. The table shows the plant breakdown of O&M costs for each site as a whole, and also normalised to plant design flow and actual observed average flows. Analysis of cost data showed a strong general negative relationship between plant size (average daily flow rate) and flow-specific O&M costs (\$ per kL average daily flow) which meant that generally the larger plants have lower operating costs per kL than do smaller plants. This is shown by comparing the data in Figures B1 and B2 below.

This trend was not unexpected and is reported in the literature. For example, previous research into energy efficiency and energy performance benchmarking of wastewater treatment plants in South Australia showed that the larger metropolitan plants are generally more efficient and have lower energy use per unit of treatment throughput than smaller regional plants ([Krampe, 2010](#)). This is due to economies of scale effects for larger plants and efficiency gains in mechanical and electrical equipment.

This information will be useful for Council to inform decision making around prioritising sites for future retrofitting and conversion to passive treatment designs with lower O&M cost requirements.

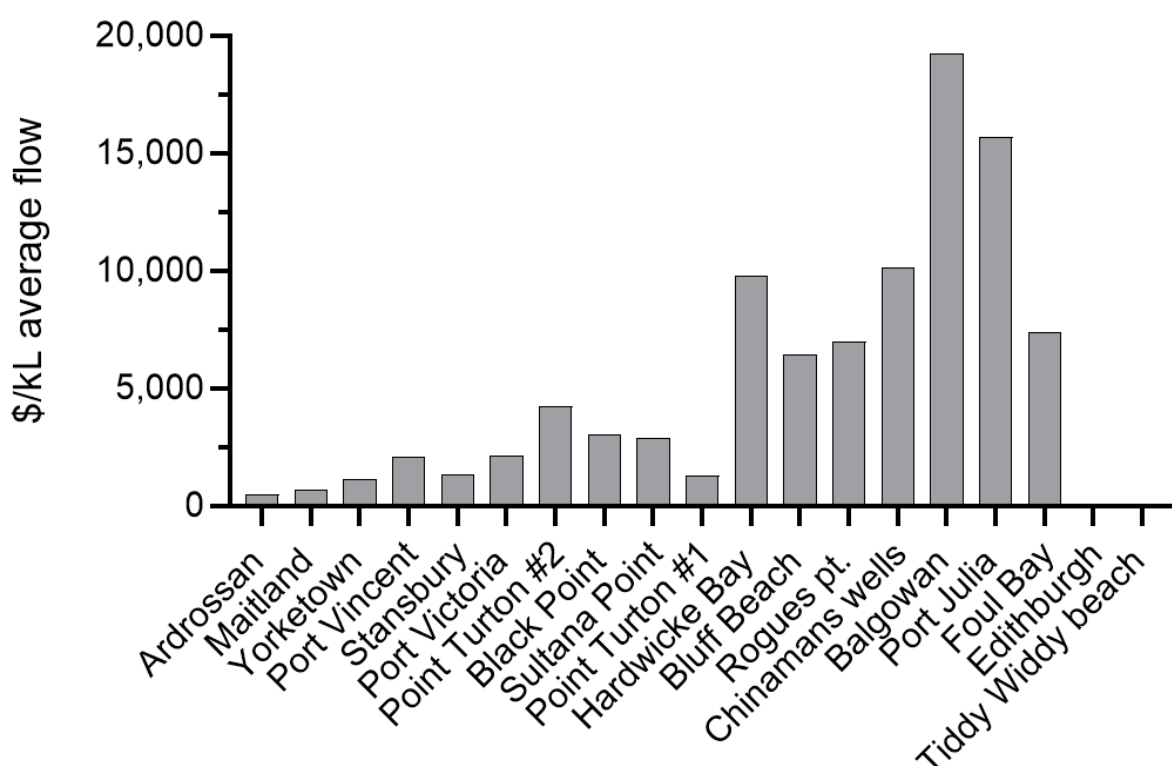


Figure B1. Normalised annual operation and maintenance costs for each CWMS plant normalised to yearly average daily flow rate (\$ per kL average daily flow). Data sorted by descending order of wastewater treatment plant average daily flow.

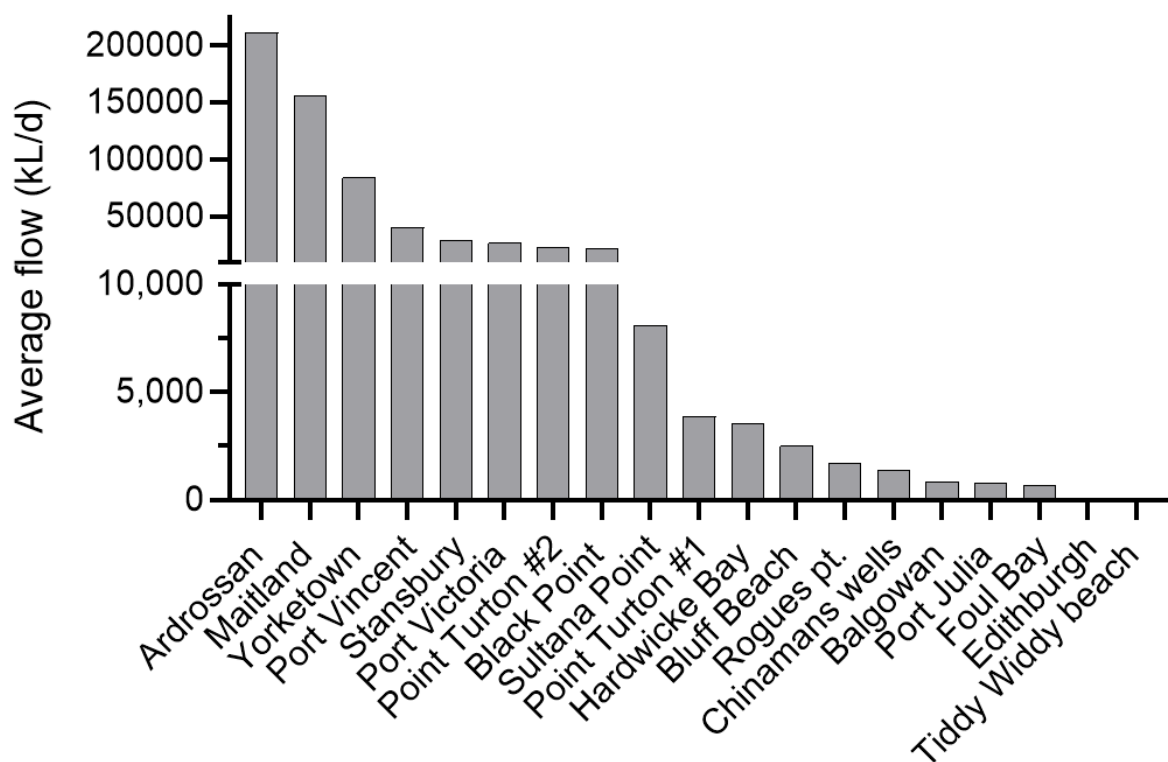


Figure B1. Annual average plant flow rate (kL/d) across the 19 treatment plants, with data sorted from largest daily flows (Ardrossan) to smallest (Foul Bay). NB. No plant-specific flow data available for Edithburgh or Tiddy Widdy beach.

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