

Sewer Servicing Strategy

South Urunga Urban Release Area



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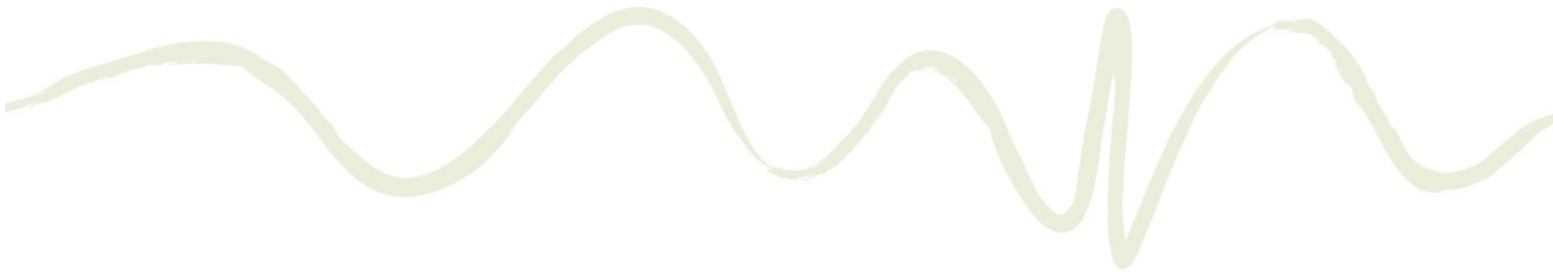
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1. Introduction

GeoLINK was engaged by Bellingen Shire Council (Council) to prepare a sewer servicing strategy for the future development of the South Urunga Urban Release Area (SUURA). The site is situated to the south of the town of Urunga and includes land zoned under the Bellingen Shire Council Local Environmental Plan (LEP) 2012 as:

- E2 (environmental conservation)
- E3 (environmental management)
- RU1 (primary production) and
- R1 (general residential).

The lots included in this assessment are tabled below. Several of these lots comprise approved residential subdivision developments, with others likely to be developed in the future. Anticipated ultimate lot yield based on existing DA approvals (where possible) and development potential is also tabulated, together with the gross lot area.

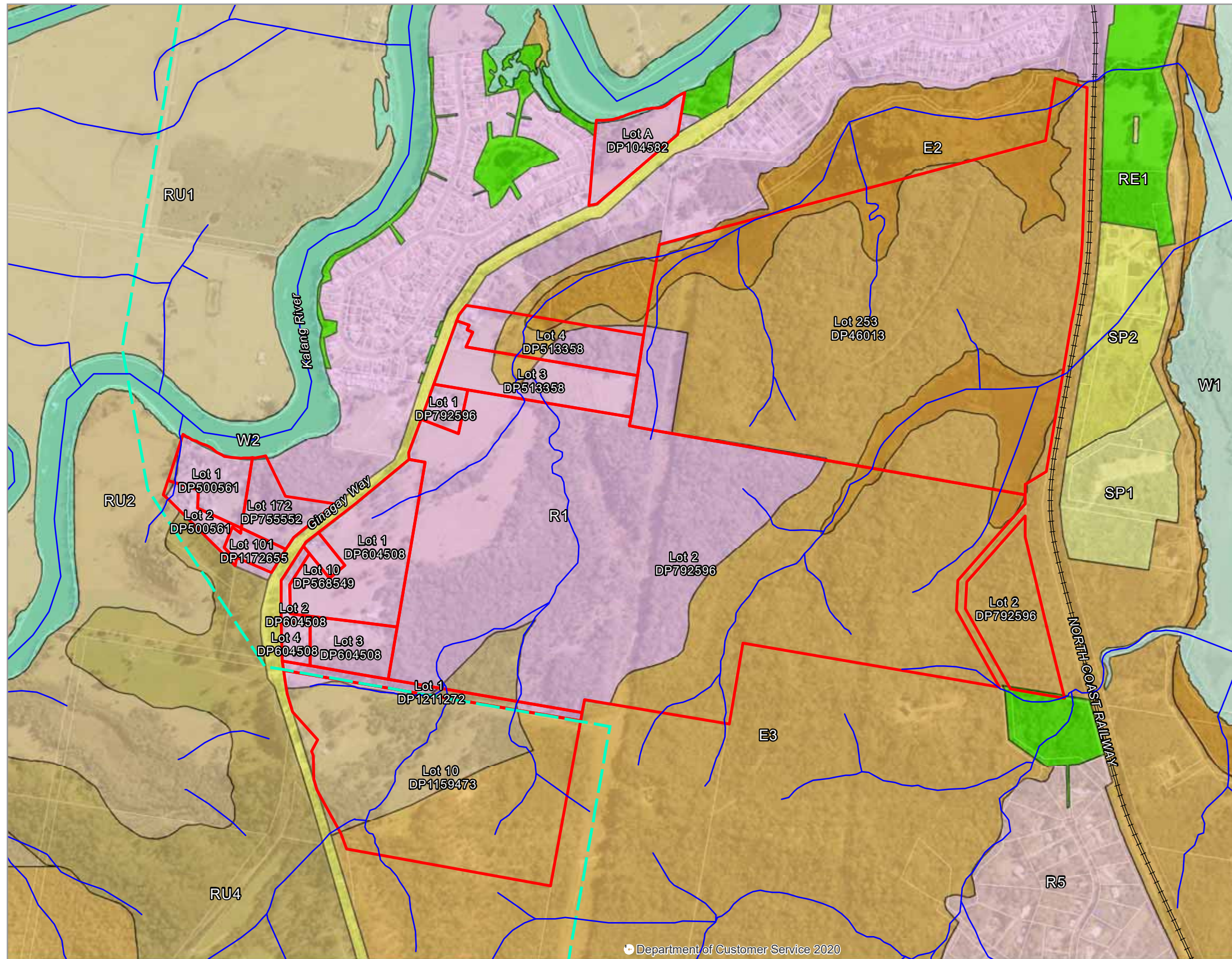
The cumulative area of all lots within the SUURA area is 204 ha.

Table 1.1 Development Areas

Lot No.	Development Title / Address	Total Lot Area (ha)	Gross Developable Area (ha)*	Existing Approved Lots	Ultimate Lot Yield**
Lot 1 DP 500561	Brigalow Caravan Park	2.44	1.2	21	21
Lot 2 DP 500561		1.04			
Lot 101 DP 1172655	3995 Giinagay Way	0.89	2.6	22	55
Lot 172 DP 755552		2.25			
Lot 1 DP 604508	Urunga Heights (Stage GL1)	7.11	7.11	1	65
Lot 10 DP 568549	4000 Giinagay Way	0.39	0.39	1	6
Lot 2 DP 604508	3978 Giinagay Way	0.45	1.6	2	30
Lot 3 DP 604508		2.33			
Lot 4 DP 604508		0.62			
Lot 1 DP 1211272	7982 Giinagay Way	1.49	0	0	0
Lot 10 DP 1159473	3948 Giinagay Way	23.88	0.2	1	3
Lot 1 DP 792596	Urunga Heights (Stages 1A, 1B, 1C, 2, 3, SL1 and SL2)	0.85	32.0	270	270 (1A, 2 & 3) 18 (1B & 1C) 22 (SL1 & SL2)
Lot 2 DP 792596		85.20			
Lot 3 DP 513358		4.82			
Lot 4 DP 513358	4062 Giinagay Way	4.08	0.8	1	11
Lot 253 DP 46013	Railway Street	66.04	0	0	1
TOTAL		204 ha	47 ha	319 lots	502 lots

* Approximate

** Based on existing DAs or 70% of gross developable area divided by 500m², as appropriate



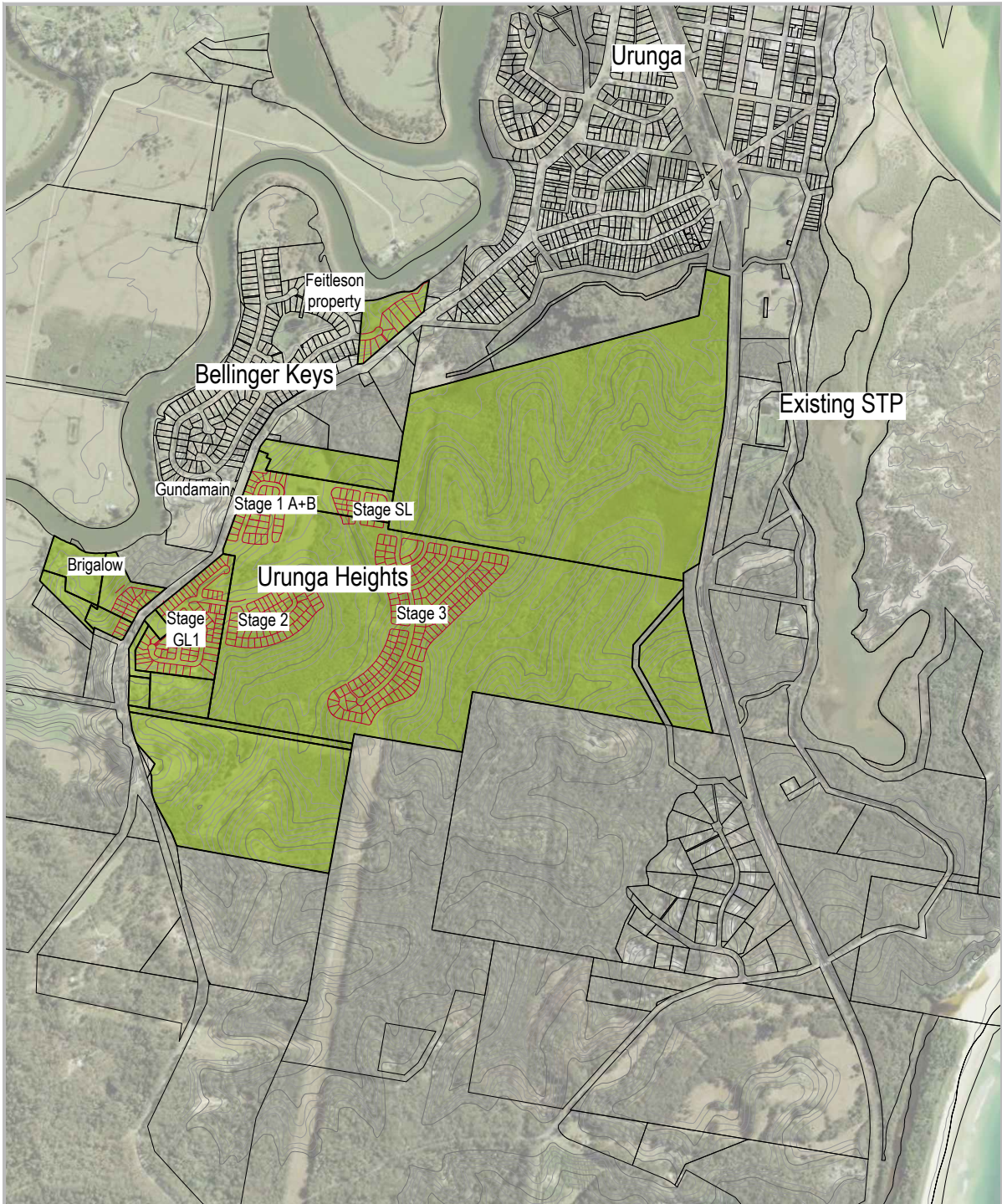
LEGEND

- Lots within study area
- Cadastre
- E2 Environmental Conservation
- E3 Environmental Management
- R1 General Residential
- R5 Large Lot Residential
- RE1 Public Recreation
- RU1 Primary Production
- RU2 Rural Landscape
- RU4 Primary Production Small Lots
- SP1 Special Activities
- SP2 Infrastructure
- W1 Natural Waterways
- W2 Recreational Waterways
- Watercourse
- Railway
- Electricity transmission line




Department of Customer Service 2020



South Urunga Structure Plan Study Area



Legend

-  South Urunga Urban Release Area (SUURA)
-  Indicative future lots subject to development approvals
-  Contours shown at 2m intervals



Study Area, Indicative Future Lots and Contours

2. Sewer Loads

Theoretical sewer design flows for SUURA have been estimated using the Water Services Association of Australia (WSAA) *Gravity Sewer Code (WS02-2014)* and Council's adopted engineering design specifications based on AusSpec.

Theoretical sewer loadings are defined in terms of equivalent populations (EP) where a single EP is the sewage loading from an average person. In accordance with WSAA, EP per gross hectare of residential, single occupancy lots with 500m² average lot size is 50 EP/ha. The gross area takes into consideration roads, parks etc. however much of the area within the SUURA is undevelopable due to environmental constraints, and as such, estimating the gross developable area with accuracy is difficult. WSAA also specifies a rate for greenfield developments of 3.5 EP/lot, which will be used for this study.

In accordance with the WSAA code, sewer design flows (DF) comprise of three components as follows:

$$\text{Design flow} = \text{PDWF} + \text{GWI} + \text{RDI}$$

- Peak dry weather flow (PDWF), representing the peak sewage discharge from connected properties. PDWF is a function of the average dry weather flow (ADWF) and "d", which is a dry weather peaking factor, representing the gross development area in Hectares (ha). ADWF has been determined empirically by WSAA as 180 L/d/EP or 0.0021 L/s/EP. So;

$$\text{ADWF} = 0.0021 * \text{EP}$$

and

$$\text{PDWF} = d * \text{ADWF} \quad \text{or} \quad \text{PDWF} = 0.0021 * \text{EP} * d$$

The Peaking Factor "d" can be either extrapolated from Figure B1 in Appendix B of the WSAA Planning and Design Code or calculated by the following equation.

$$d = 0.01(\log A)^4 - 0.19(\log A)^3 + 1.4(\log A)^2 - 4.66(\log A) + 7.57$$

Where "A" is the gross plan area of the development's catchment.

- Groundwater infiltration (GWI), represents the long-term non-rainfall dependent infiltration into the sewerage network from groundwater; and

The GWI conservatively assumes that 30% of receiving sewer is below the groundwater table (Portion_{WET}) and therefore receives groundwater inflow. It also assumes that good quality materials and construction practices are adopted as well as ongoing maintenance is provided eliminating progressive increase of GWI over the life of the asset. GWI is calculated as follows:

$$\text{GWI} = 0.025 * A * \text{Portion}_{\text{WET}}$$

- Peak rainwater-dependent inflow and infiltration (RDI) represents the inflow and infiltration into the sewerage network.

The RDI can potentially be the highest portion of the design flows, entering the sewer network as inflow via localised flooding, illegal stormwater connections, and as rainfall infiltration through pipe and maintenance structure defects. RDI is affected by soil type, infrastructure condition, depth to pipe obvert and community awareness and attitudes. Calculation of RDI uses a model similar to the 'Rational Method' used for stormwater flow calculations, as follows:

$$\text{RDI} = 0.028 * A_{\text{EFF}} * C * I$$

Where:

- $A_{EFF} = A * (Density/150)^{0.5}$ (for residential developments with density < 150 EP/ha)
- **C** = leakage severity coefficient being a function of the soil type, likely defects and likely maintenance/monitoring/management (*to be nominated by Council, but assumed to be 1.0*)
- $I = I_{1,2} * Factor_{SIZE} * Factor_{CONTAINMENT}$
- $I_{1,2}$ = 1-hour rainfall intensity for an average recurrent interval (ARI) of 2 years = 46.8mm
- $Factor_{SIZE} = (40/A)^{0.12}$
- $Factor_{CONTAINMENT} = 1.0$ (*assumed, to be confirmed by Council*)

The flows calculated using these formulae use a wet weather sewage containment factor of 1.0, which equates to an average wet weather recurrence interval of two years.

A summary of the calculated sewer loadings for SUURA is provided below.

Table 2.1 Development Areas

<i>Development</i>	<i>Lot Yield</i>	<i>EP</i>	<i>ADWF (L/s)</i>	<i>Peaking Factor d</i>	<i>PDWF (L/s)</i>	<i>GWI (L/s)</i>	<i>RDI (L/s)</i>	<i>Design flow (L/s)</i>
Brigalow Caravan Park	21	73.5	0.154	7.2	1.111	0.009	1.531	2.651
3995 Giinagay Way	55	192.5	0.404	6	2.426	0.020	3.323	5.768
Urunga Heights ('GL1')	65	227.5	0.478	4.6	2.198	0.053	5.294	7.545
4000 Giinagay Way	6	21	0.044	9.2	0.406	0.003	0.534	0.942
3978 Giinagay Way	30	105	0.221	6.8	1.499	0.012	2.041	3.552
7982 Giinagay Way*	-	-	0.000	0	0.000	0.000	0.000	0.000
3948 Giinagay Way	3	10.5	0.022	9.2	0.203	0.002	0.293	0.497
Urunga Heights (Stages 1A, 1B, 1C, 2, 3, SL1 & SL2)	310	1085	2.279	3.2	7.291	0.240	20.478	28.009
4062 Giinagay Way	11	38.5	0.081	7.75	0.627	0.006	0.950	1.582
Railway Street	1	3.5	0.007	9.2	0.068	0.000	0.100	0.168
Fietelson Property	11	38.5	0.081	6.4	0.517	0.014	1.319	1.851
TOTAL	513	1796	3.77		16.35	0.36	35.86	52.57

* Will not contribute to the sewerage loading



3. Existing Pump Station Capacity

There are a number of existing sewer pump stations (SPS) in the South Urunga area of varying size, including the Bellinger Keys SPS, owned and maintained by Council. The new developments associated with the SUURA will require additional SPS to be constructed, however it should first be determined what, if any, capacity is available within the existing SPS infrastructure.

The Bellinger Keys SPS has two Forrers pumps containing a duty of 18L/s at 30m head. Bellinger Keys currently comprises approximately 189 lots, with an ultimate expected yield of approximately 212 lots. The SPS at Bellinger Keys services these lots plus the Gundamain Caravan Park to the south, which has an existing 29 ETs and total ultimate yield of 50. Infrastructure is also in place connecting the Brigalow Caravan Park, which currently comprises 10 ETs and has an expected ultimate yield of 55. Additionally, another 11 lots (38.5 ETs) may potentially be developed on Lot A DP 104582 (the Fietelson Property) to the north. These additional lots equate to 143.5 additional ETs in total that will contribute to the Bellinger Keys SPS.

As such, the SPS at Bellinger Keys is currently servicing 228 lots, with an ultimate expected total of 371.5 ETs.

The detailed analysis undertaken by de Groot & Benson P/L (DGB) (Ref: 16179, 30/04/2019) based on actual performance data indicates that the Bellinger Keys SPS has a total capacity of 300 ETs (i.e. 300 lots), and a future Capacity of 315 ETs. DGB suggest the existing SPS has sufficient capacity to service an additional 72 lots but is ultimately under capacity by 15 ETs. GeoLINK propose only 59 additional ETs can be supported by the SPS and this is explained below.

GeoLINK have reviewed the hydraulic calculations undertaken by DGB and generally agree with how they have conducted their calculations. It is noted that actual ADWF is 1.75L/s according to the data provided by the Council. This equates to 79.5% of the original 2.2L/s design ADWF. Projecting the actual ADWF to meet the design ADWF of 2.2L/s would result in a total of 287 ET (228 existing ET/79.5*100), or 59 additional ETs. This is also confirmed in our proposed option in **Table 3.1** below, which uses DGB's proposed Peaking Factor value of 0.009L/s/ET (halfway between original design and actual) and a Stormwater value of 0.031L/s/ET (halfway between original design and actual peaking factor divided by existing ET). These are deemed to be reasonable assumptions and also match the original Public Works design flow of the SPS (18.060L/s ~ 18.054L/s).

A comparison of the calculated design flows using the Public Works Design Criteria (as per DGB report), WSAA Code, actual data and the proposed outcome is provided below in **Table 3.1** overleaf.

Adopting the WSAA Code for the current ET loading of 228 suggests the pump station is now at capacity with a design flow of 18.067L/s. However, since actual data is available and provides evidence of reduced design flows, it is evident that an additional 59 ET can be directed to the existing Bellinger Keys SPS. However, when considering the actual SPS data and adopting peaking factor of 5.79 and projecting an ultimate demand of 371.5 ETs for Bellinger Keys catchment, the design flow equates to only 16.531 L/s, suggesting that the pump station retains capacity to deal with the entire forecasted growth. Although this assumption is based on current data, it does not align with the WSAA code requirements and so adopting this strategy would not allow for system changes over time and may result servicing issues in the future. As such adopting an outcome halfway between original design and current operational data (287 ETs) would appear reasonable but somewhat conservative.

Table 3.1 Summary of Calculated Design Flows

Bellinger Keys SPS	Lot Yield	EP	ADWF (L/s)	Peaking Factor d	PDWF (L/s)	GWI (L/s)	RDI (L/s)	Design flow (L/s)
Public Works Design Criteria - Original ET	200	700	2.20	8.18	17.996	-	0.058	18.054
WSAA Code Original ET	200	700	0.42	3.4	1.428	0.182	14.796	16.224
WSAA Code Current ET	228	798	0.48	3.4	1.628	0.195	16.243	18.067
Actual SPS data Current ET	228	798	1.75	5.79	10.132	-	0.022	10.154
DGB Proposed ET	300	1050	2.70	7.98	21.546	-	0.035	21.581
GeoLINK Proposed ET	287	1004.5	2.58	6.98	18.029	-	0.031	18.060
Actual SPS Data + 143.5 ETs in New Developments	371.5	1300.3	2.85	5.79	16.509	-	0.022	16.531

Monitoring pump station data through the progressive growth stages may support additional loading outcomes, although this should not be relied upon for the servicing strategy.

Existing storage capacity of the Bellinger Keys SPS is assumed to be based on 8 x ADWF (WSAA requirements) and so loading the pump station with additional ETs (above the 59 extra) may compromise this required storage volume. Although, this would also need to be verified.

Given the existing infrastructure, topography, and comparative proximity of Gundamain and Brigalow to Bellinger Keys, it is suggested that the Brigalow area be redirected to utilise the future infrastructure required to be constructed as part of Urunga Heights. This includes Lots 1 and 2 DP 500561, Lot 101 DP 1172655 and Lot 172 DP 755552 (i.e. the four lots of the SUURA area falling on the western side of Giinagay Way). Timing for this redirection is not critical, as long as it takes place prior to any new connections associated with development beyond 59 ETs on these aforementioned lots.



4. Future Infrastructure

The new developments forecast within the SUURA yield an expected total of 513 dwellings. There is insufficient capacity within the existing nearby Council-owned SPS in Bellinger Keys to accept the future generated sewer loading. As such, a number of additional SPS will need to be constructed and sized to meet the demand.

Future development to the south of Urunga Heights, within Lots 2, 3 and 4 DP 604508, Lot 1 DP 1211272 and Lot 10 DP 1159473 would require a SPS with capacity for 33 ETs. This SPS would only require a short rising main to pump to the gravity system within Stage GL1 of the Urunga Heights development.

Similarly, the Brigalow area comprising the four lots within SUURA on the western side of Giinagay Way will also require a SPS, this time with capacity for 76 ETs. A short rising main will again connect this area into the gravity system within Stage GL1 of the Urunga Heights development.

Based on the existing topography, it is anticipated that the majority of the Urunga Heights development will be able to drain to a SPS located near the north western corner of Lot 2 DP 792596 (Urunga Heights). This SPS (UH01) will need to cater for Urunga Heights Stages 1A, 1B, 1C, 2, SL1, SL2, and part of Stage 3, comprising approximately 191 lots, as well as Stage GL1 (65 lots) and potential future development of Lot 10 DP 568549 (6 lots). Additionally, the small number of potential future lots, 11 from Lot 4 DP 513358 to the north of Urunga Heights will also be gravity fed directly to SPS UH01. The 11 Lots from Lot A DP 104582 (Fietelson property) will be directed to the Bellinger Keys SPS but ultimately end up in SPS UH01.

Due to topographical constraints, the remaining ~119 lots in Stage 3 of Urunga Heights will need to drain to two separate SPSs: UH02 and UH03. SPS UH02 will require a minimum capacity of 54 lots, and SPS UH03 will require a minimum capacity of 65 lots. Both will pump to SPS UH01 via their individual rising mains. It will be possible for these two rising mains to converge into a single rising main, as shown on **Illustration 4.1**. Since SPS UH02 and UH03 will pump to SPS UH01, UH01 will require a capacity of **513 ETs**.

SPS UH01 will be pumped via rising main to the existing South Urunga Sewage Treatment Plant (STP) on Hungry Head Road, to the north east of the SUURA. De Groot and Benson (2019) have proposed two alternative sewer rising main routes from the Urunga Heights development to the treatment plant for Council to provide comment.

Table 4.1 Summary of Developments Contributing to SPS UH01

<i>DA Number</i>	<i>Lot and DP</i>	<i>Subdivision Name</i>	<i>No. ETs → UH01</i>	<i>% Contribution to UH01</i>
2014/AF-00156	Lot 3 DP 513358 Lots 1 & 2 DP 792596	Urunga Heights Stages 1A, 2, 3	270	53%
22017/AF-00242	Lot 3 DP 513358	Urunga Heights Stages 1B, 1C	18	4%
2017/AF-00245	Lot 3 DP 513358	Urunga Heights Stages SL1, SL2	22	4%
2019/AF-00126	Lot 1 DP 604508	Urunga Heights Stage GL1	65	13%
-	Lot 10 DP 568549	-	6	1%
-	Lots 2, 3, 4 DP 604508	-	30	6%
-	Lot 10 DP 1159473	-	3	1%
-	Lot 4 DP 513358	-	11	2%
-	Lot A DP 104582	Fietelson Property	11	2%
-	Lot 253 DP 46013	-	1	0.2%
2010/AF-00112	Lots 1, 2 DP 500561	Brigalow Caravan Park	21	4%
2011/AF-00188, 2007/AF-00265	Lot 101 DP1172655, 172 DP755552	Gundamain	55	11%
		TOTAL	513	100%



5. Conclusions

The existing sewerage infrastructure within South Urunga is insufficient to service the expected future development associated with the SUURA. In addition to gravity sewerage systems to be design and constructed servicing each development, rising mains and pump stations will be required to link the separate reticulation systems to the existing South Urunga sewer treatment plant.

The location and capacity of the new SPSs will depend on existing topography, finished surface design and catchment (i.e. number of lots). Assuming that the finished surface design levels will generally match existing topography and based on existing approved development applications and land zonings, it is possible to estimate the likely required sewerage infrastructure to service the SUURA.

The table below describes the recommended key sewer infrastructure requirements.

Table 5.1 Recommended Actions

Action	Recommendation
1	Existing SPS at Bellinger Keys remains as is to continue to service the areas of: Bellinger Keys (including the Fietelson property) and the Gundmain Caravan Park. - Capacity: 287 ETs - Current load: 228 ETs - Ultimate load: 287 ETs
2	Additional development in the Brigalow area to be serviced by new infrastructure east of Giinagay Way.
3	Development known as 'Urunga Heights', comprising subdivisions on Lot 1 and 2 DP 792596, Lot 3 DP 513358, Lot 1 DP 604508 and Lot 10DP 568549 will require a minimum of three new SPS, and a rising main connecting the system to the existing treatment plant. Two of the three SPS (UH01 and UH02) will pump to the third SPS (UH03), and this SPS will pump directly to the treatment plant. - UH01 Min. ultimate capacity required: 513 ETs - UH02 Min. ultimate capacity required: 54 ETs - UH03 Min. ultimate capacity required: 65 ETs
4	UH01 will need to be sized to accept the ultimate sewerage loading from adjacent developments, including the four lots on the western side of Giinagay Way (the 'Brigalow' area), Lot 4 DP 513358 to the north of Urunga Heights, and the five lots to the south of Urunga Heights. These lots are included in the 513 ETs noted above.
5	Development on Lot 4 DP 513358 to the north of Urunga Heights has an ultimate load of 11 ETs and will likely be able to gravity feed into the gravity sewer network in Stage 1A and 1B of Urunga Heights.
6	Development on Lot A DP 104582 (Fietelson property) has an ultimate load of 11 ETs and will continue to flow to Bellinger Keys SPS. It is likely this will feed into the existing gravity network.
7	The Brigalow area has an ultimate load of 76 ETs. This development will require a SPS to pump to the gravity reticulation network in Urunga Heights Stage GL1 (Lot 1 DP 604508).
8	The five lots to the south of Urunga Heights (Lots 2, 3 and 4 DP 604508, Lot 1 1211272 and Lot 10 DP 1159473) have a combined ultimate load of 33 ETs. Development on these lots will also require a SPS to pump into the gravity reticulation network in Urunga Heights Stage GL1 (Lot 1 DP 604508).



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