Sewer Servicing Strategy

North Bellingen Urban Release Area

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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 North Bellingen Urban Release Area (NBURA) as identified in Chapter 17 of the Bellingen Shire Development Control Plan 2017. The three precincts identified for release are situated to the northeast of the town of Bellingen and includes land zoned under the Bellingen Shire Council Local Environmental Plan (LEP) 2010 as R1 (General Residential).

The lots (or part thereof) within each of the three NBURA precincts included in this assessment are tabled below. Included is also the approved residential subdivision development located on Lots 2 and 4 of DP 818626, also known as the McCristal Drive Extension. Anticipated ultimate lot yield based on the existing DA approval and development potential is also tabulated, together with the gross lot area.

The cumulative area of the NBURA is 25.6 ha.

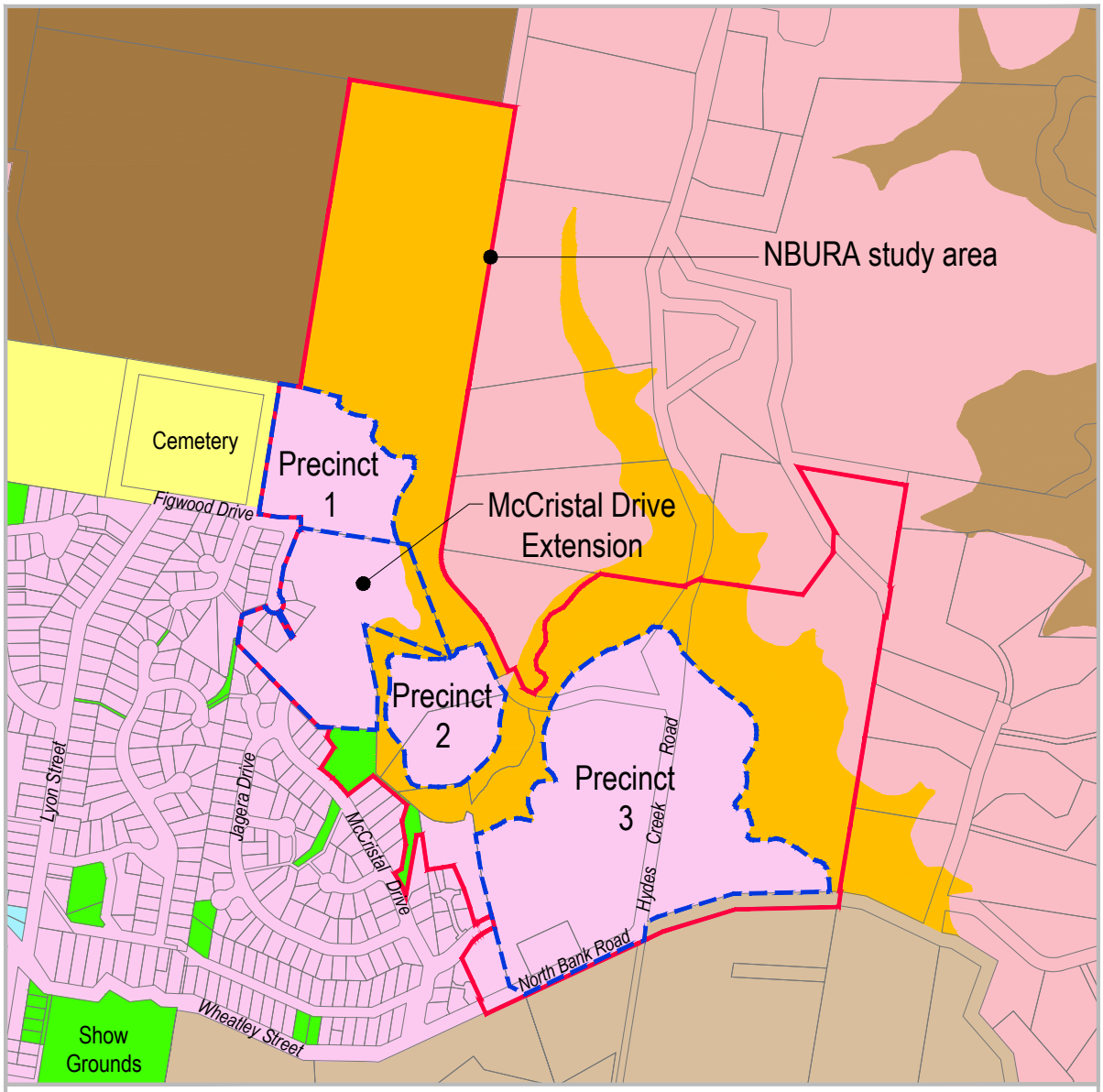
Table 1.1 Development Areas

Lot No.	*Development Title*	*Approx. Gross Developable Area (ha)*	*Existing Approved Lots*	*Approx. Ultimate Lot Yield**
Lot 8 DP 1208982	Precinct 1	3.6	0	50
Lot 2 DP 815304	Precinct 2	2.7	0	38
Lot 3 DP 815304				
Lot 1 DP 437545	Precinct 3	14.2	0	198
Lot 2 DP 1036812				
Lot 72 DP 1197946				
Lot 2 DP 818626	McCristal Drive Extension	5.1	40	40
Lot 4 DP 818626				
	TOTAL	**25.6ha**	**40 lots**	**326 lots**

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

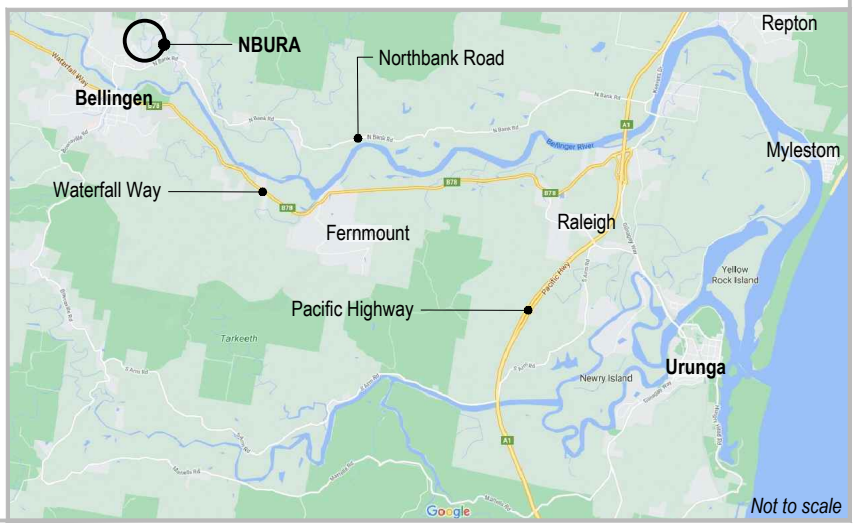
Information shown is for illustrative purposes only

Source of base data: Bellingen Shire Council and Google Maps



LEP Zones

- B1
- E3
- IN1
- R1
- R5
- RE1
- RU1
- RU2
- RU3
- SP1



North

0 200

NBURA Locality, Precinct and LEP Zoning Plan

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Sewer Servicing Strategy - North Bellingen Urban Release Area

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Illustration 1.1

2. Sewer Loads

Theoretical sewer design flows for the NBURA 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 Aus-Spec.

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 average lot size of 500m² is 50 EP/ha. The gross area takes into consideration roads, parks etc. however a portion of the NBURA might be 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 the following:

- Peak dry weather flow (PDWF), representing the peak sewage discharge from connected properties and a function of the average dry weather flow (ADWF) from connected properties
  i.e. PDWF = d * ADWF;
- Groundwater infiltration (GWI), representing the long-term non-rainfall dependent infiltration into the sewerage network from groundwater; and
- Peak inflow and infiltration (RDI) representing the peak rainfall-dependent inflow and infiltration into the sewerage network.

$$\mathbf{DF = PDWF + GWI + RDI}$$

Based on empirical evidence, WSAA deems ADWF to be 180 L/day/EP, or 0.0021 L/s/EP. Thus:

$$\mathbf{PDWF = d * 0.0021 * EP}$$

The dry weather peaking factor, d, is a function of the gross development area (A) in hectares:

$$\mathbf{D = 0.01(\log A)^4 – 0.19(\log A)^3 + 1.4(\log A)^2 - 4.66(\log A) + 7.57}$$

The GWI has been estimated for each development in accordance with WSAA, based on an assumption that good quality materials and construction have been employed and ongoing condition assessment, inspection and maintenance is performed. Due to the topography, it has also been conservatively assumed that 25% of each development area could be potentially below the groundwater table ($Portion_{WET}$):

$$\mathbf{GWI = 0.025 * A * Portion_{WET}}$$

The RDI is typically 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:

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

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 NBURA is provided below.

Table 2.1 Approved and Proposed Development Areas

Development	*Lot Yield*	*EP*	*ADWF (L/s)*	*PDWF (L/s)*	*GWI (L/s)*	*RDI (L/s)*	*Design flow (L/s)*
Precinct 1 (proposed)	50	174	0.37	1.83	0.02	3.56	5.40
Precinct 2 (proposed)	38	132	0.28	1.47	0.02	2.79	4.28
Precinct 3 (proposed)	198	694	1.46	5.54	0.09	12.01	17.64
McCristal Drive Extension (approved)	40	140	0.29	1.41	0.03	3.66	5.10
TOTAL	**326**	**1,140**	**2.40**	**10.25**	**0.16**	**22.02**	**32.43**

3. Existing Transfer and Treatment Capacity

3.1 Background

There are two existing sewer pump stations (SPS) in the North Bellingen area that are owned and maintained by Council. These are the McCristal Drive SPS and the Black Street SPS. The precincts identified and associated with the NBURA will require additional SPS(s) to be constructed, however it should first be determined what, if any, capacity is available within the existing SPS infrastructure.

3.2 McCristal Drive Sewer Pump Station

The McCristal Drive SPS has two pumps, each with a reported duty of 16L/s at 40.9m head. The catchment for this SPS currently comprises approximately 167 lots, excluding the additional approved 40 lots from the McCristal Drive Extension development. Council have confirmed that following the connection of the McCristal Drive Extension development, no further load is to be placed on this SPS.

As such, the McCristal Drive SPS is currently servicing approximately 167 lots, with an ultimate expected total of 207 lots.

The sewage from the McCristal Drive SPS is delivered through two DN100 UPVC pipelines each 403m long. At the current pump duty, the sewage is delivered at a velocity of 0.98m/s with a friction head loss of approximately 9.4m (assuming a conservative friction coefficient of 130 in the Hazen-Williams formula). There would appear to be some spare capacity within this rising main. Increasing the pump duty to 25L/s will increase the velocity in the main to 1.54m/s with a friction head loss of approximately 21.6m. Replacing the existing pumps to meet this increased capacity will ensure that the SPS is able to service the additional demands of the approved developments into the future.

Table 3.1 McCristal Drive Sewer Pump Station Flow Summary

	Lot Yield	*EP (3.5/lot)*	*ADWF (L/s)*	*PDWF (L/s)*	*GWI (L/s)*	*RDI (L/s)*	*Design Flow (PWWF)*
Current pump Capacity (WSAA)	156	546	1.15	4.13	0.12	11.80	16.04
Current Theoretical SPS Loading	167	584.5	1.23	4.42	0.12	12.20	16.74
Total Approved Loading (Theoretical)	207	724.5	1.52	5.17	0.15	14.90	20.23

The existing storage capacity of this SPS is reported to be approximately 5kL. This is equivalent to approximately 1 hour of the theoretical ADWF storage. Council reports that the actual ADWF storage experienced is in the region of 3 to 4 hours. Emergency SPS storage is required to be 8 x ADWF. The actual ADWF should be measured and emergency storage requirements calculated.

3.3 Black Street Sewer Pump Station

The Black Street SPS has two pumps, with each having a reported duty of 31L/s at 32.0m head. The catchment for this SPS currently comprises approximately 465 lots.

The sewage from the Black Street SPS is delivered initially through a single DN150 UPVC pipeline 250m in length. It then splits into two DN150 UPVC pipelines each 440m long.

At the current pump duty, the sewage is delivered at a velocity of 1.94m/s in the single pipeline and 0.97m/s in the dual pipelines, with a total friction head loss of approximately 13.7m (assuming a conservative friction coefficient of 130 in the Hazen-Williams formula). Due to the already high velocities, it would appear that the existing rising main has already reached its capacity and that the SPS appears to be overloaded. **Table 3.2** summarises the loadings for the Black Street SPS.

Table 3.2 Black Street Sewer Pump Station Flow Summary

	Lot Yield	*EP (3.5/lot)*	*ADWF (L/s)*	*PDWF (L/s)*	*GWI (L/s)*	*RDI (L/s)*	*Design Flow (PWWF)*
Current pump Capacity (WSAA)	266	931	1.96	5.08	0.44	25.54	31.06
Current Theoretical SPS Loading	465	1627.5	3.42	8.89	0.44	33.77	43.09

The existing storage capacity of this SPS is reported to be approximately 26kL. This is equivalent to approximately 2 hours of the theoretical ADWF storage. Council reports that the actual ADWF storage experienced is in the region of 6 to 8 hours. The actual ADWF should be measured and emergency storage requirements calculated.

No detailed analysis has been carried out at either of the two SPSs. It appears that the Black Street SPS is undersized for the current theoretical EP loading. Actual SPS performance assessment should be undertaken to determine if any capacity issues exist. Pumping capacity within this SPS could be significantly increased by duplicating the initial 250m single portion of the rising main.

3.4 North Bellingen Sewage Treatment Plant

The North Bellingen Sewage Treatment Plant (NBSTP) has a reported reactor capacity of 5,000 EP. Upgrades to this plant are planned to commence in 2025/26 at the earliest. The current EP loading on the NBSTP is unknown. The release of Precincts 1, 2 and 3 for development will increase the loading on the NBSTP by 1,000 EP. The availability of spare treatment capacity should be confirmed prior to the approval of any further developments.

4. Future Infrastructure

The new developments identified within the NBURA yield an expected total of 326 ET. This is made up of three precincts and the approved McCristal Drive Extension. The locality of these areas is shown geographically in **Illustration 1.1** and **Figure 4.1** below.

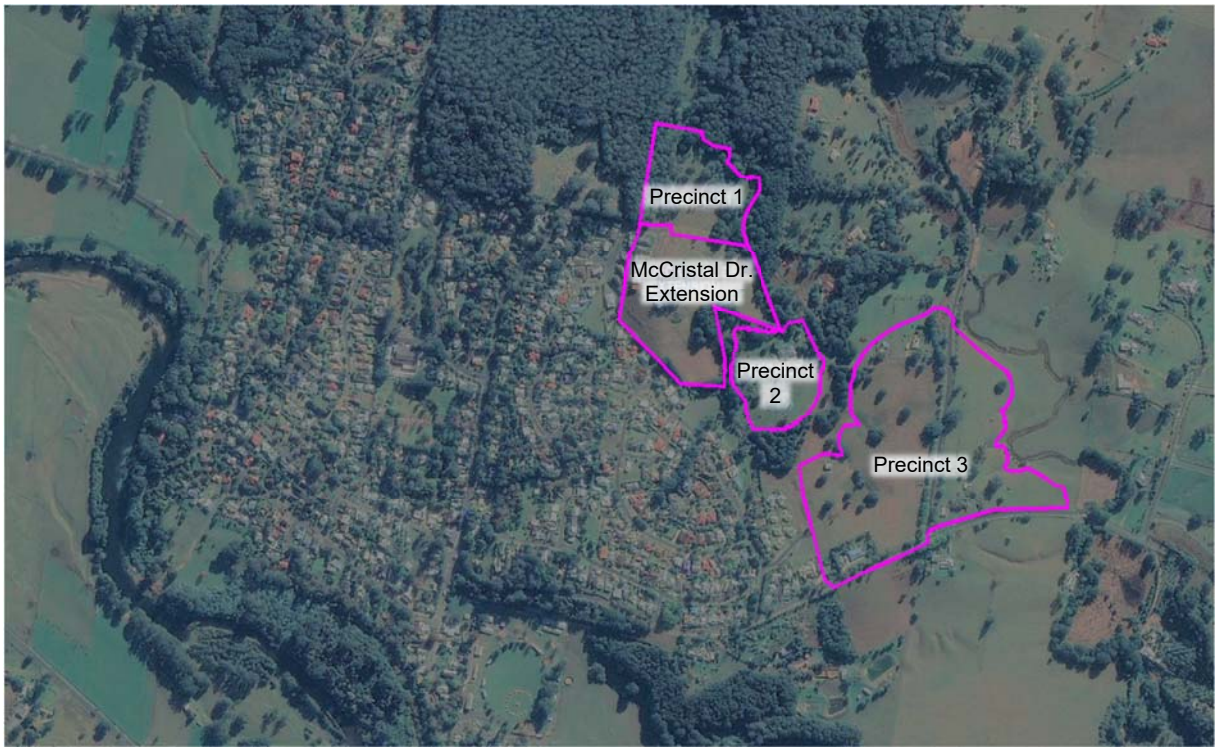

Figure 4.1 NBURA Development Area

4.1 McCristal Drive Extension

The McCristal Drive Extension is a historical residential subdivision and is proposed to create 40 allotments ranging in area from 500m^2 to 5,920m^2 and a public reserve. The original DA determination was made in 1995, with recent amendments approved in 2017. The subdivision will be carried out in two stages. This development has approval to connect the sewerage infrastructure to the McCristal Drive SPS catchment. This would increase loadings from 175 lots to 215 lots as discussed previously.

4.2 Precinct 1

Precinct 1 borders the McCristal Drive Extension to the north. There is a potential 50 lot yield from this precinct, with a calculated PWWF of 5.40L/s. Council confirmed that no further flows are permitted to be directed to the McCristal Drive SPS. The Development Control Plan 2017, Chapter 17 noted that sewer flows from this precinct must be directed into the Black Street SPS catchment via Lyon Street. Calculated loading on the Black Street SPS indicate that this SPS may already be overloaded. After the publishing of the Development Control Plan, Council confirmed that they would not support the discharge of any sewer flows from future developments into the existing network. Wastewater could be directed to the catchment of Precinct 2. If Precinct 1 is developed prior to either Precincts 2 or 3, the wastewater is to be pumped directly to the NBSTP.

4.3 Precinct 2

Precinct 2 is located to the south east of the McCristal Drive Extension and is bordered by Frenchmans Creek. There is a potential 38 lot yield from this precinct, with a calculated PWWF of 4.28L/s. Council confirmed that no flows from this precinct may be directed to the McCristal Drive SPS. A new SPS will be required to transfer the flow between catchments. Sewer flows from Precinct 2 should be directed to Precinct 3. If Precinct 2 is developed prior to Precinct 3, the wastewater is to be pumped directly to the NBSTP.

4.4 Precinct 3

Precinct 3 is located to the northern side of North Bank Road and is traversed by Hydes Creek Road. There is a potential 198 Lot yield from this precinct, with a calculated PWWF of 17.64L/s. Flows from this precinct are required to be transferred directly to the NBSTP. A new SPS will be required. If Precinct 3 is developed first, it is likely that it will be required to also transfer the flows from Precincts 1 and 2 to the NBSTP.

5. Conclusions

The existing sewerage infrastructure within North Bellingen is already under strain and is insufficient to service the expected future development associated with the NBURA. The two existing SPS, McCristal Drive and Black Street, both appear to have reached or exceeded their design capacity. Infrastructure upgrades at each SPS would increase the PWWF capacity, increasing the level of assurance to meet the required demand.

The McCristal Drive Extension has approval to discharge all sewage flows into the McCristal Drive SPS catchment, and this subdivision has been designed accordingly. This will provide a 21% increased loading on the SPS. The existing pumps are currently operating at theoretical capacity and in order to meet the increased flows to this SPS, it is likely that pump upgrades will be required. Actual PWWF loading measurements at the pump station will confirm if this is the case.

Theoretically, increased emergency storage is required at both the McCristal Drive and Black Street SPS, with neither having sufficient storage capacity in the event of an extended pumping failure. However, Council have confirmed that the actual ADWF holding capacity of the two pump stations far exceeds the theoretical data. For this reason, the actual ADWF into each pump station should be confirmed to enable the correct sizing of emergency storage requirements (if any) at each pump station.

Due to locality and topography, the three NBURA precincts identified for release will each require a SPS to transfer the wastewater to the STP. The location and capacity of the new SPS(s) will depend on existing topography, finished surface design and catchment (i.e. number of lots). Chapter 17 of Council's Development Control Plan 2017 notes that flows from Precinct 1 must be transferred to the Black Street SPS catchment in Lyon Street. Council have since confirmed that no flows from new developments are permitted to be discharged into existing pump station catchments. Wastewater flows from Precinct 1 are required to be transferred to the Precinct 2 catchment or directly to the NBSTP.

Precinct 2 flows must be directed to Precinct 3 or directly to the NBSTP. From Precinct 3, the flows must be pumped directly to the NBSTP.

6. Recommendations

The table below describes the recommended key sewer infrastructure requirements. As this Strategy is directed to the development of North Bellingen Urban Release Area precincts, no recommendations have been made with regard to infrastructure upgrade requirements at existing pump stations. The development of the precincts will not change or impact the existing or approved loading on the pump stations.

Table 6.1 Recommended Actions

Action	*Recommendation*
1	Implement the phased development of Precincts 1, 2 and 3. In order to effectively transfer the flows from these precincts to the NBSTP, various infrastructure requirements will need to be in place. The development is recommended to be phased in the following order: 1. Development of Precinct 3, with a SPS and rising main sized to meet the required demand from all three precincts. 2. Development of Precinct 2. Flows from Precinct 2 are recommended to be transferred to Precinct 3. 3. Development of Precinct 1. Flows from Precinct 1 are recommended to be transferred to Precinct 2.
2	Should the phased development of the precincts not be possible, it is recommended that sewer flows from either Precinct 1 or 2 be pumped directly to the NBSTP.
3	Confirm the current and future loading on the Bellingen sewage treatment plant. It is likely that the plant is near or at capacity. Prior to the approval of further development, it should be confirmed that the treatment capacity is available.

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