



GULGAN NORTH, BRUNSWICK  
HEADS



23<sup>RD</sup> DECEMBER 2021

CIVIL ENGINEERING  
REPORT



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## 1. INTRODUCTION

Ingen Consulting P/L has been engaged by Gulgan Road Property Pty Ltd to prepare a Civil Engineering Report (CER) for the proposed rezoning of Area 5 as identified in the Byron Shire Business and Industrial Lands Strategy dated October 2020.

### 1.1. Scope

The subject site, Lot 2 DP 1159910 located at 66 The Saddle Road, Brunswick Heads has several portions that are identified for rezoning. The subject site is shown in Figure 1 and the portion which is addressed in this report is shown in Figure 2 divided into Area A and Area B. The purpose of this report is to carry out a preliminary study of the rezoning potential of this site from a civil engineering perspective, particular consideration given to:

- Flooding and earthworks
- Stormwater Management
- Water supply
- Sewer reticulation
- Traffic impacts

Each of the items above will be assessed in accordance with relevant Australian Standards as well as local government policies and guidelines.

### 1.2. Site description

The subject site is located at Lot 2 DP 1159910 at 66 The Saddle Road, Brunswick Heads, see Figure 1. This 52ha site is situated between Mullumbimby and Brunswick Heads and is intersected by The Saddle Road, Gulgan Road and the Pacific Motorway. The site has been identified for potential future rezoning in Council's Business and Industrial Lands Strategy (BILS).

Figure 2 shows the areas identified in the Business and Industrial Lands Strategy, where we can see Area 'A', 3.5 hectares, which would be earmarked for a business park type zoning, typically zoned as Business Park, and Area 'B', 3.0 hectares, as a Traditional Industrial Estate. Area A is elevated, roughly between 30m and 40m AHD with ocean views. Area B is lower lying, with elevations generally between 4m AHD and 7m AHD.

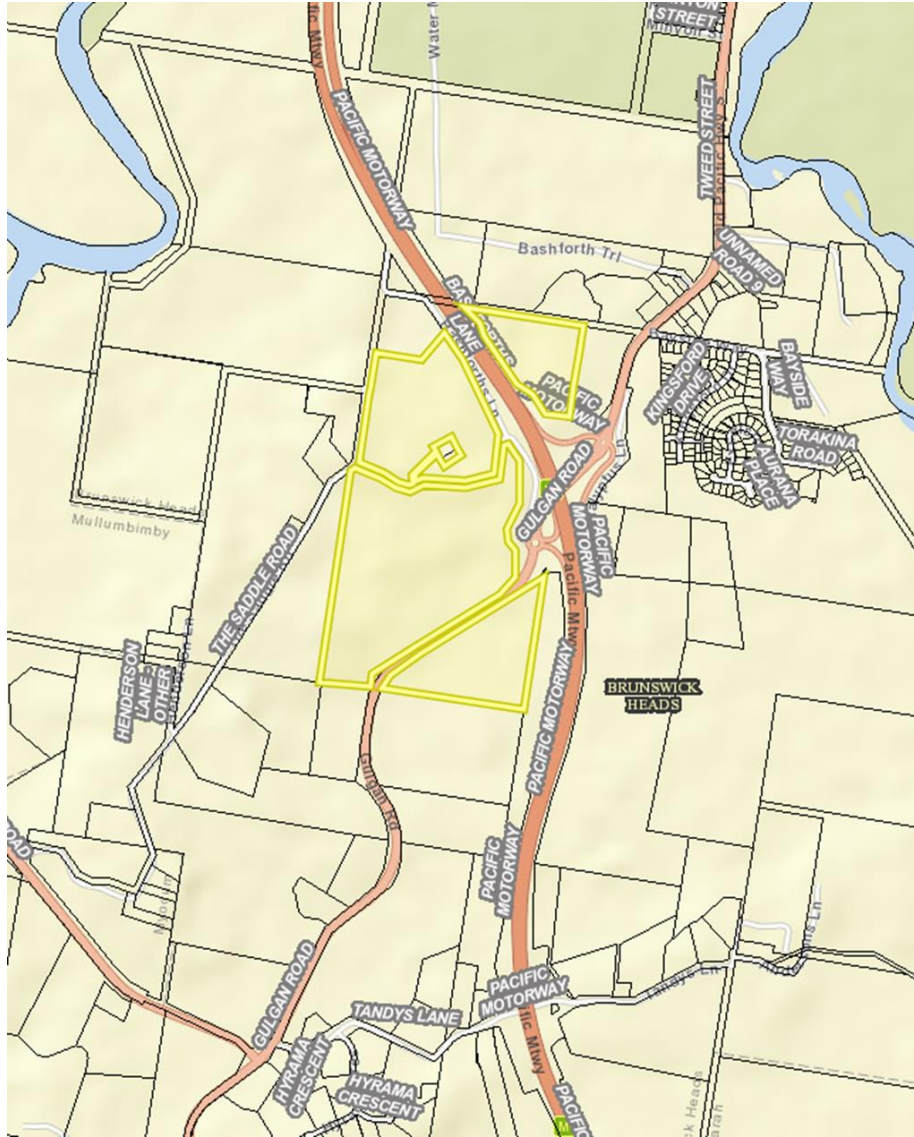


Figure 1 | Site location, Source of the map: Byron Shire Council Online Maps 2021



**Figure 2 |** Extract from BILS mapping showing the general rezoning areas, *Source: Byron Shire Council*

### 1.3. Proposed zoning

The proposed development is a Planning Proposal seeking to create a business park in Area A and a traditional industrial area in Area B shown in Figure 2, in general accordance with Byron Shire Council's Business and Industrial Lands Strategy. Due to the nature of a Planning Proposal, this Civil Engineering Report provides generic recommendations to demonstrate how compliance with relevant policies and disciplines can be achieved for each discipline.



## 2. FLOODING AND EARTHWORKS

The Business and Industrial Lands Strategy identifies the subject areas as flood free. However, a small portion of the subject site has been mapped as 'Flood 1 in 100yr – LEP / DCP controls' on Byron Council's online mapping tool. As a result, this chapter will assess flooding characteristics and any associated earthworks requirements.

### 2.1. Flood characteristics

We have carried out flood hazard mapping using flood modelling data provided by Byron Shire Council. The flood hazard map for the subject site and its surrounds is provided in Figure 3. In this figure, red is high hazard, green is intermediate hazard, blue is low hazard and pink is flood free but below the 2100 Flood Planning Level for the site.

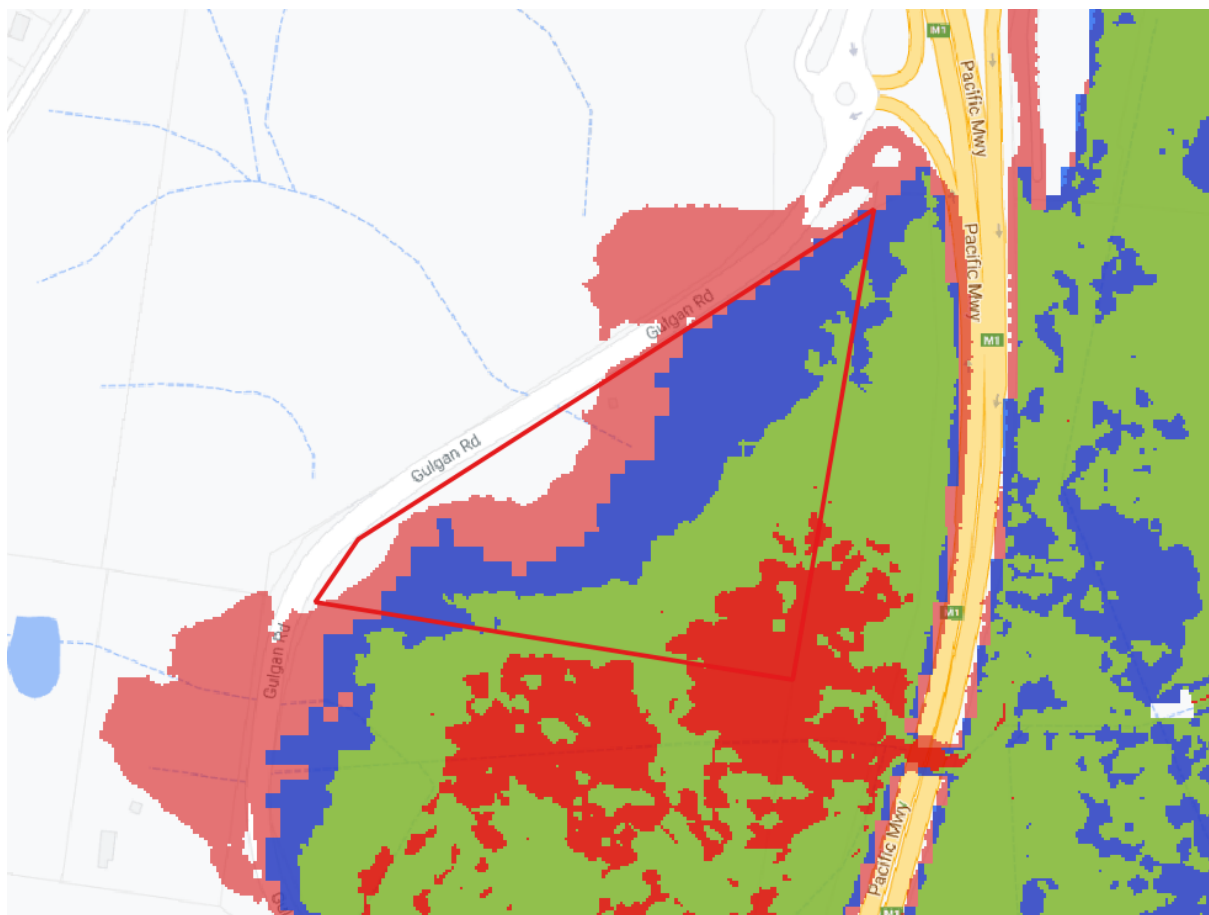


Figure 3 | Flood hazard mapping

The following can be concluded from the flood model inquiry:

- The 100-year flood level is RL 4.06m AHD
- The 2050 FPL for this site is RL 4.57m AHD
- The 2100 FPL for this site is RL 4.63m AHD
- The development areas are flood free
- Some of the eastern part of Area B is below the 2100 FPL

## 2.2. Flood Planning Matrix

Council's DCP chapter C2 includes a flood planning matrix that assist with determining flood-related requirements for future use of the site. The site is classed as 'No Hazard' and the zoning proposal is assessed against the Flood Planning Matrix as shown in Table 1. It should be noted that only 'Primary Constraints' are shown since 'Additional Constraints' do not apply to a 'No Hazard' site.

**Table 1 | Flood Planning Matrix assessment**

| Controls                          | Development / Building Type                                       | Primary Constraints (No Hazard) | Clarification   |
|-----------------------------------|---|---------------------------------|---|
| Land Use Suitability & Fill Level | Development in New Release Areas, unless separately defined below | N/A                             | N/A   |
|                                   | Development in all other areas unless separately defined below    | N/A                             | N/A   |
|                                   | Non-Habitable Building or Room                                    | N/A                             | N/A   |
|                                   | Emergency Services Critical Facilities Site                       | N/A                             | N/A   |
|                                   | Other Special Purpose Facilities                                  | N/A                             | N/A   |
| Floor Level                       | Development in New Release Areas, unless separately defined below | FL3                             | All floor levels to be greater than or equal to the Projected 2100 Flood Planning Level (FPL3). |
|                                   | Development in all other areas unless separately defined below    | FL2                             | All floor levels to be greater than or equal to the Projected 2050 Flood Planning Level (FPL2). |

|                      |   |      |   |
|----------------------|---|------|---|
|                      | Dwelling Additions, except in New Release Areas                     | N/A  | N/A   |
|                      | Non-Habitable Building or Room                                      | N/A  | N/A   |
|                      | New Critical Facilities or Special Purpose Facilities (Schools etc) | FL3a | If practical, all floor levels to be greater than or equal to the Projected 2100 Flood Planning Level (FPL3), so that these buildings will be available for accommodation / storage during and after a flood emergency. |
| Building Components  | All   | N/A  | N/A   |
| Structural Soundness | Ancillary Building  | N/A  | N/A   |
|                      | Other Building  | N/A  | N/A   |
| Flood Effect         | Development in New Release Areas, unless separately defined below   | N/A  | N/A   |
|                      | Development in all other areas unless separately defined below      | N/A  | N/A   |
|                      | Dwelling Additions, Non-Habitable Building or Room                  | N/A  | N/A   |
|                      | Other Developments  | N/A  | N/A   |
| Evacuation & Access  | Development in all other areas unless separately defined below      | N/A  | N/A   |
|                      | Development in New Release Areas, unless separately defined below   | N/A  | N/A   |
|                      | Critical Facilities   | N/A  | N/A   |
|                      | Other Special Purpose Facilities                                    | N/A  | N/A   |

Using the Flood Planning Matrix, all constraints can be summarised into this one constraint:

- All building floor levels to be equal to or greater than FPL3, being the 2100 FPL.

Based on the flood modelling provided, FPL3 for this site at the location of Area 'B' is determined to be RL4.63m AHD.

### 3. STORMWATER MANAGEMENT

Stormwater management for future use at this site will need to demonstrate compliance with Chapter B3 of the 2014 Byron Shire DCP and in particular Section B3.2.3 – Stormwater Management and the Byron Shire Council Comprehensive Guidelines for Stormwater Management (CGSM).

The purpose of this chapter is to provide a broad outline of suitable stormwater management strategies which would comply with Council's guidelines and DCP in any future development. As this Civil Engineering Report accompanies a Rezoning Application, it is anticipated that any stormwater treatment trains will be detailed further as part of a future Development Application for the site.

#### 3.1. Site characteristics

Detailed survey of the development areas of the site was carried out by Byron Bay Surveying throughout 2021 and is attached in Appendix A.

Area A is located in the higher, northern portion of the site, at elevations ranging from approximately RL26m to RL44m AHD. According to the infiltration test results in Appendix B of this report, the hydraulic conductivity of the soil in this area is in the 6mm/hr to 35mm/hr range, which is suitable for the use of infiltration trenches in accordance with section 4.7 of the Council Guide to Stormwater Management.

With Area A located on the edge of the plateau, the land drops down relatively steeply into Area B, which is at a lower level, ranging from approximately RL4m AHD to RL7m AHD (Figure 4). The infiltration tests in Appendix B show that this soil has no infiltration potential, which is confirmed during site inspections which shows this lower lying area as waterlogged, in particular in the eastern area.

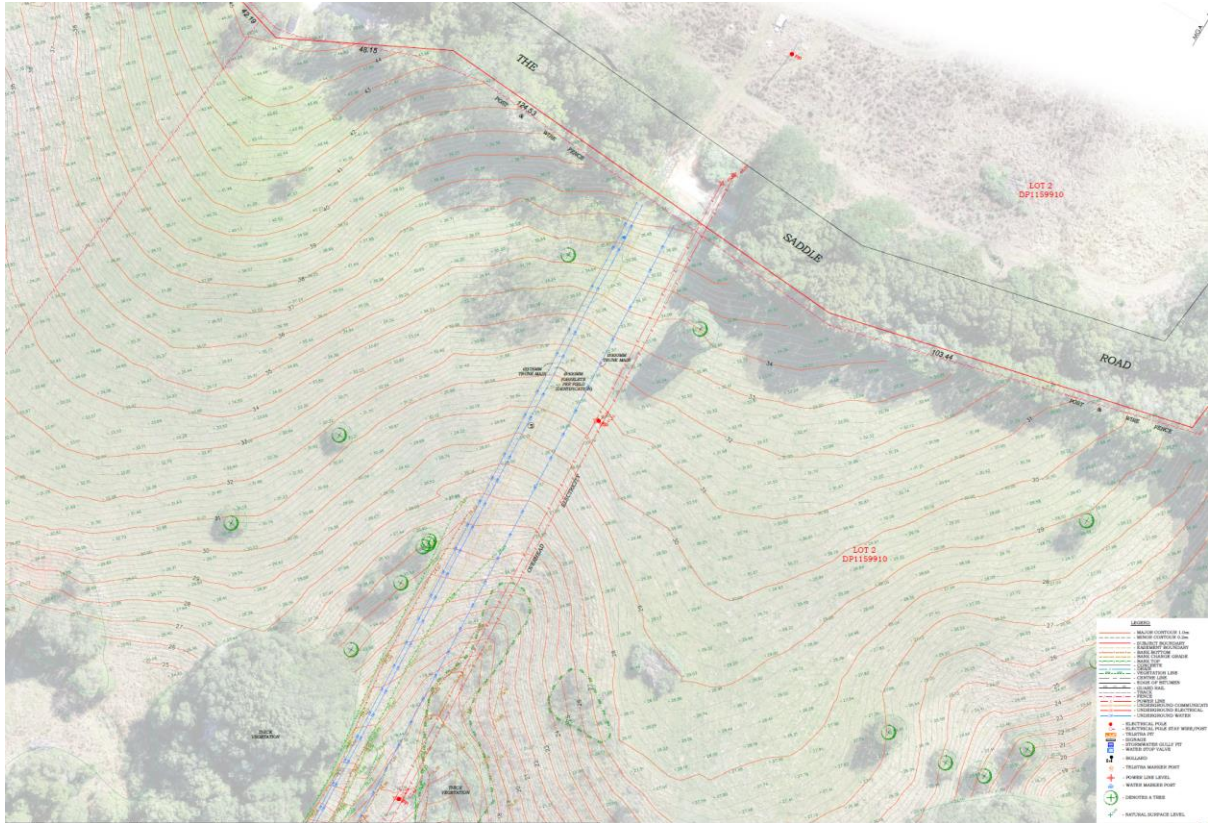


Figure 4 | Area A detail survey

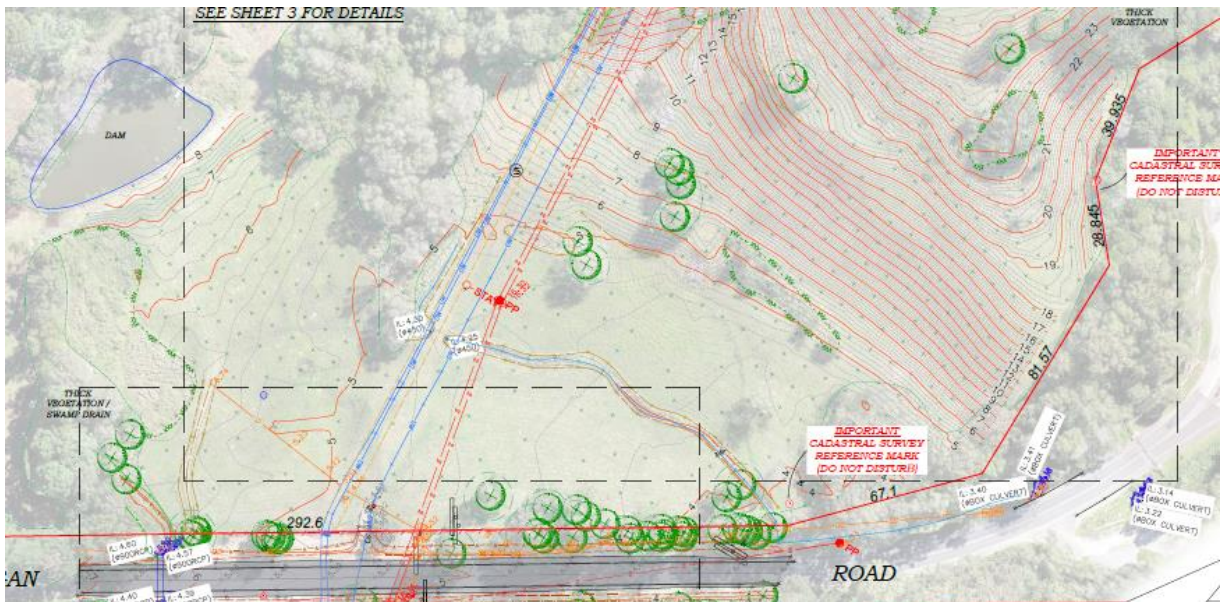


Figure 5 | Area B detail survey

Area A contains a dam to the northwest the overflow of which is directed into a watercourse that drains to the existing culvert (2 x Ø900 concrete pipes) crossing Gulgan Road in the southwestern corner of the area. The flatter portion to the east of the Rous trunk water main has an existing farm drain that drains further east, into a Gulgan Road table drain with a box culvert (3 @ 1200 x 450

RBC) crossing the approach to the western motorway overpass roundabout. The upstream end of this drain starts at the discharge point of a  $\varnothing 450$  culvert, which was likely constructed to create better farm access throughout the land. We estimate that the combined catchment of both culverts (shown in Figure 6) below is approximate 35 hectares, based on the Byron Shire online mapping tool.

At the time of the survey, the dam's water surface was approximately  $1700\text{m}^2$  in area. With an approximate average depth of 1 metre, we estimate the dam's capacity to be in the range of  $1700\text{m}^3$ , or 1.7ML.



**Figure 6 | Gulgan Road culverts catchment**

### 3.2. Gulgan Road cross drainage

Site drainage across Gulgan Road is currently through two culverts at locations indicated in Figure 6. Survey details of these culverts is provided in Figure 7 and Figure 8.

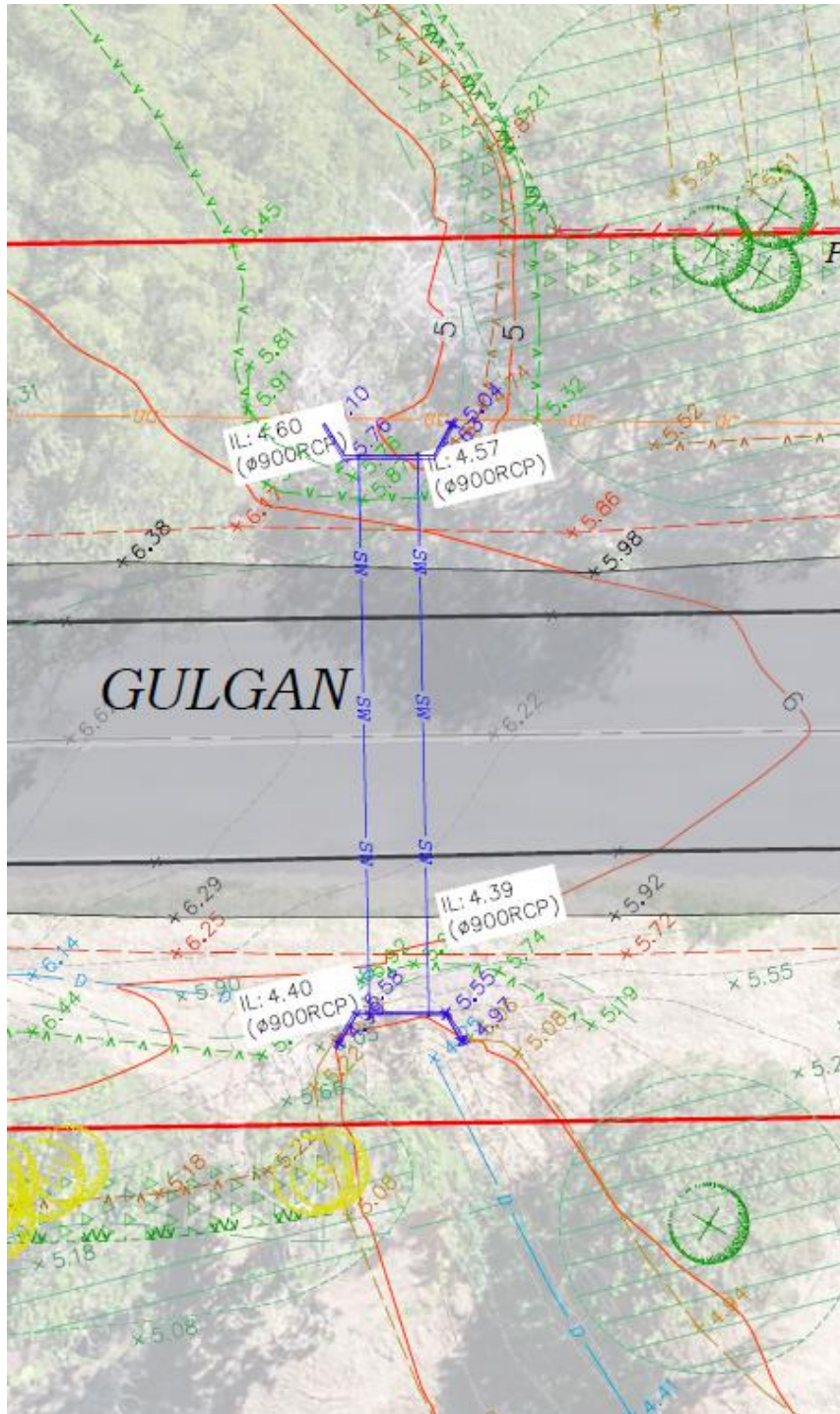
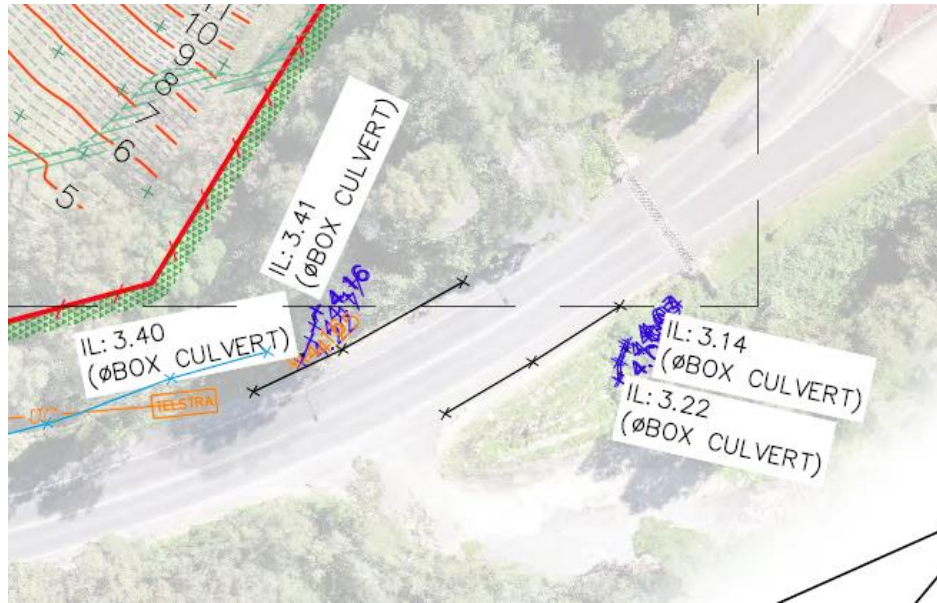


Figure 7 | Western culvert





**Figure 8 | Eastern culvert**

The invert levels of the dual Ø900 culvert in Figure 7 is above the 100-year flood level of RL 4.09m AHD, which means that this culvert should continue to drain freely during flood events. The box culvert (three 1200 x 450 RBC's) to the east however will be partially inundated as the tops of the head walls are at approximately RL4.2m AHD, only 0.1m above the 100-year flood level. During a site inspection following rainfall in early December 2021, it was noted that at the culvert outlet, the tail water level was at approximately at half the height of the box culverts and water levels appeared constant. There was no visible flow in the downstream drainage channel, indicating high tail water levels during and after storm events.



**Figure 9 | Culvert catchments, Source aerial image: Byron Online Mapping 2021**

The capacity of these culverts is analysed using DRAINS software, based on ARR2019 rainfall routing and the latest IFD data for the site from the website of the Bureau of Meteorology. The results of a preliminary analysis are shown in Table 2. These results show that Gulgan Road will likely be subject to flash flooding during a minor storm event, between the 1EY and the 0.2EY flow as well as larger storms.

**Table 2 | Preliminary culvert flows, m<sup>3</sup>/s**

| Storm event |        | Western culvert |          |                                 | Eastern culvert |          |                                 |
|-------------|--------|-----------------|----------|---------------------------------|-----------------|----------|---------------------------------|
| informal    | formal | pipe flow       | overflow | Catchment peak discharge timing | pipe flow       | overflow | Catchment peak discharge timing |
| 1-year      | 1EY    | 1.8             | 0        | 35-45 mins                      | 0.965           | 0        | 45 mins                         |
| 5-year      | 0.2EY  | 2.98            | 1.16     | 40-55 mins                      | 1.91            | 0        | 30-40 mins                      |
| 10-year     | 10%    | 3.05            | 1.74     | 20-30 mins                      | 2.22            | 0        | 20-30 mins                      |
| 20-year     | 5%     | 3.14            | 2.74     | 20-30 mins                      | 2.64            | 0        | 20-25 mins                      |
| 50-year     | 2%     | 3.22            | 3.76     | 30-50 mins                      | 3.06            | 0        | 20-25 mins                      |
| 100-year    | 1%     | 3.28            | 4.63     | 30-50 mins                      | 3.47            | 0        | 20 mins                         |

Following this analysis, we recommend that future development at the site should not intensify peak runoff volumes during storm events. Although Council's On-site Stormwater Detention (OSD) requirements do not technically apply as the subject site is located on both sides of Gulgan Road and the part of the subject land southeast of Gulgan Road is flood storage, it would be good practice to adhere to Council's OSD policy to avoid worsening the existing drainage issues, provided OSD does not place the development runoff peak at the same time as the overall catchment runoff peak.

### **3.3. Lawful point of discharge**

Lawful points of discharge would be the Gulgan Road cross drainage points. As stated above, the runoff intensity should not be increased to prevent worsening of any pre-existing drainage capacity issues.

### **3.4. Requirements for OSD**

A number of circumstances are provided in which OSD is not required, that may be (partially) suitable for the subject development. These are:

- Where the site drains directly to a trunk drainage system within the tidal reach of a river or stream.
- Where infiltration is used as the means of stormwater discharge from the site.
- Where a Consulting Engineer undertakes a detailed analysis of the entire catchment by a time-area model and demonstrates that the provision of detention on the subject property, including consideration of the cumulative affect of detention provisions across the catchment, will provide no benefit to any downstream drainage system for all storm frequencies up to 100 year ARI.

The reasons why these may be applicable are:

- Area 'A' has the potential to adopt infiltration as a means to discharge stormwater. It should be noted however, that infiltrated water will likely return to surface water downhill from Area 'A'. As such, it would merely function as a 'delaying' strategy rather than a complete method of discharge.
- The parcel of the subject land southeast of Gulgan Road is subject to flooding. Generally, OSD is not required when discharging directly into a flood plain subject to tidal movements, unless that section of flood plain is earmarked for development, which is currently not the case.

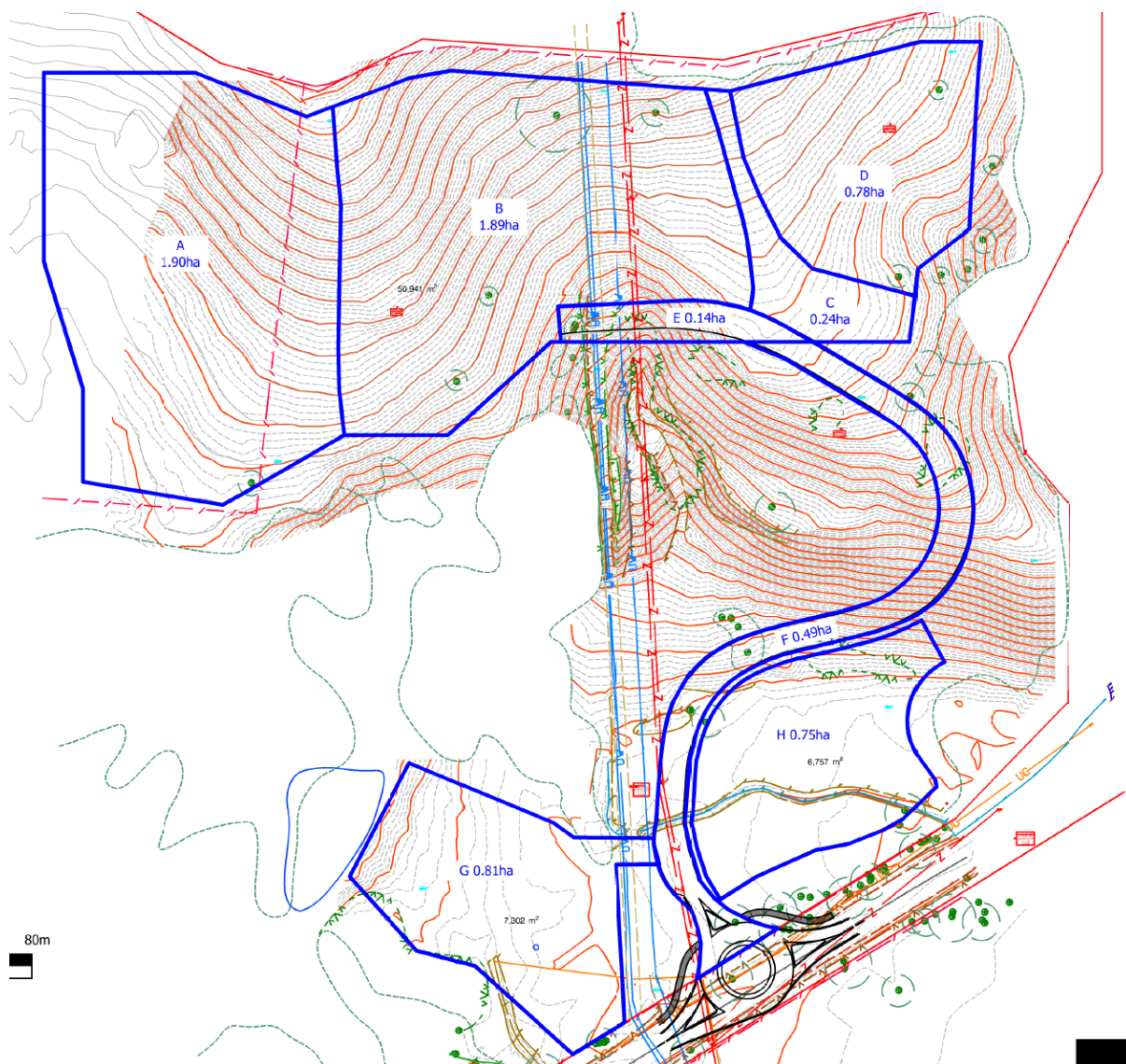
The above reasons may be negated however, if the increased peak discharge due to increased hardstand without OSD negatively affects the performance of the culverts under Gulgan Road. In that case, OSD should be employed. Gulgan Road cross drainage peak characteristics are described in section 3.2.

OSD can be carried in a number of ways, such as:

- Rainwater tanks to capture and throttle back roof runoff from buildings.
- Detention in car parking areas
- Incorporate OSD in the design of bioretention basins.

### 3.5. Drainage modelling

The first step in determining the need for OSD is to calculate the runoff peaks from each individual catchment pre- and post-development and the impact OSD would have on the timing of runoff peaks. For the post-development impervious area percentages, the same numbers are adopted as described in table 3.6 of the MUSIC Modelling Guidelines. The catchment plan for this site is provided in Figure 10. Catchment areas are summarised in Table 3. The volume and timing of the unmitigated catchment discharges are provided in Table 4 and Table 5.



**Figure 10 | Catchment plan snapshot**

**Table 3 | Catchment description**

| Parameter | Pre-development |              | Post-development |              |
|-----------|-----------------|--------------|------------------|--------------|
|           | Area, ha        | % impervious | Area, ha         | % impervious |
| A         | 1.9             | 0            | 1.9              | 80           |
| B         | 1.89            | 0            | 1.89             | 80           |
| C         | 0.24            | 0            | 0.24             | 80           |
| D         | 0.78            | 0            | 0.78             | 80           |
| E         | 0.14            | 0            | 0.14             | 70           |
| F         | 0.49            | 0            | 0.49             | 70           |
| G         | 0.81            | 0            | 0.81             | 80           |
| H         | 0.75            | 0            | 0.75             | 80           |

**Table 4 | Unmitigated catchment peak discharge flow rate, m<sup>3</sup>/s**

| Catchment | stage | 1EY   | 0.2EY | 10%   | 5%    | 2%    | 1%    |
|-----------|-------|-------|-------|-------|-------|-------|-------|
| A         | pre   | 0.256 | 0.517 | 0.583 | 0.689 | 0.813 | 0.915 |
|           | post  | 0.442 | 0.697 | 0.799 | 0.914 | 1.06  | 0.116 |
| B         | pre   | 0.255 | 0.514 | 0.58  | 0.686 | 0.809 | 0.911 |
|           | post  | 0.44  | 0.694 | 0.795 | 0.909 | 1.05  | 0.115 |
| C         | pre   | 0.051 | 0.076 | 0.098 | 0.113 | 0.129 | 0.145 |
|           | post  | 0.059 | 0.096 | 0.115 | 0.132 | 0.157 | 0.177 |
| D         | pre   | 0.125 | 0.234 | 0.279 | 0.326 | 0.385 | 0.428 |
|           | post  | 0.185 | 0.303 | 0.344 | 0.391 | 0.468 | 0.514 |
| E         | pre   | 0.024 | 0.044 | 0.057 | 0.066 | 0.075 | 0.085 |
|           | post  | 0.032 | 0.053 | 0.066 | 0.075 | 0.089 | 0.1   |
| F         | pre   | 0.079 | 0.15  | 0.18  | 0.21  | 0.25  | 0.28  |
|           | post  | 0.113 | 0.187 | 0.228 | 0.259 | 0.297 | 0.336 |
| G         | pre   | 0.13  | 0.24  | 0.29  | 0.339 | 0.399 | 0.444 |
|           | post  | 0.192 | 0.314 | 0.335 | 0.404 | 0.484 | 0.532 |
| H         | pre   | 0.121 | 0.228 | 0.269 | 0.314 | 0.37  | 0.411 |
|           | post  | 0.178 | 0.292 | 0.332 | 0.378 | 0.451 | 0.495 |

**Table 5 | Unmitigated catchment peak discharge timing, minutes**

| Catchment | stage       | 1EY | 0.2EY | 10% | 5% | 2% | 1% |
|-----------|-------------|-----|-------|-----|----|----|----|
| <b>A</b>  | <b>pre</b>  | 40  | 40    | 15  | 15 | 10 | 10 |
|           | <b>post</b> | 10  | 10    | 10  | 10 | 10 | 10 |
| <b>B</b>  | <b>pre</b>  | 40  | 40    | 15  | 15 | 10 | 10 |
|           | <b>post</b> | 10  | 10    | 10  | 10 | 10 | 10 |
| <b>C</b>  | <b>pre</b>  | 10  | 5     | 15  | 5  | 5  | 5  |
|           | <b>post</b> | 5   | 5     | 15  | 5  | 5  | 5  |
| <b>D</b>  | <b>pre</b>  | 30  | 10    | 10  | 10 | 10 | 10 |
|           | <b>post</b> | 10  | 10    | 10  | 10 | 10 | 10 |
| <b>E</b>  | <b>pre</b>  | 10  | 5     | 15  | 5  | 5  | 5  |
|           | <b>post</b> | 15  | 5     | 15  | 15 | 5  | 5  |
| <b>F</b>  | <b>pre</b>  | 30  | 10    | 10  | 10 | 5  | 5  |
|           | <b>post</b> | 15  | 5     | 15  | 15 | 5  | 5  |
| <b>G</b>  | <b>pre</b>  | 30  | 10    | 10  | 10 | 10 | 10 |
|           | <b>post</b> | 10  | 10    | 10  | 10 | 5  | 10 |
| <b>H</b>  | <b>pre</b>  | 30  | 10    | 10  | 10 | 10 | 10 |
|           | <b>post</b> | 5   | 10    | 10  | 10 | 10 | 10 |

This preliminary modelling shows that the post-development runoff peaks increase in flow rate compared to the pre-development due to the increased hardstand. There is some shift in the timing of the peaks, but not sufficient to avoid coincidence with the conveyance peaks at the culverts. Therefore post-development peak-discharge when left unmitigated is likely to increase drainage issues associated with the Gulgan Road culverts. On this basis it is recommended that OSD is applied to the development to ensure post-development peak discharge the development does not exceed pre-development discharge flow rates. The details of the OSD strategy would be provided at Development Application level and would likely involve a combination of rainwater tanks and bioretention basins.

### 3.6. Stormwater quality and treatment

The 2014 Byron Shire DCP chapter B3, clause B3.2.3-7b states that subdivisions and developments involving an area of land greater than 2,500m<sup>2</sup> must address the “key” pollutants in accordance with Table B3.2 of the DCP, see Table 6.

**Table 6 | Pollutants and retention criteria, Source Byron Shire DCP 2014 Chapter B3**

| <b>Pollutant / Issue</b>                 | <b>Retention Criteria</b>                               |
|--|---|
| Litter                                   | 70% of average annual load greater than 5mm.            |
| Coarse Sediment                          | 80% of average annual load for particles 0.5mm or less. |
| Fine Particles                           | 50% of average annual load for particles 0.1mm or less. |
| Total Phosphorous                        | 45% of average annual load.                             |
| Total Nitrogen                           | 45% of average annual load.                             |
| Hydrocarbons, motor fuels, oils & grease | 90% of average annual load.                             |

There is a variety of treatment train options available for this site, including rain gardens integrated with the streetscape, bioretention basins integrated with the landscape design, proprietary treatment products, swales and stormwater pit gross pollutant traps. It is anticipated that a treatment train design will be carried out for future Development Applications for this site, to integrate with the urban and landscape design for the site.

## 4. WATER SUPPLY

### 4.1. Water supply connection point

Potable water supply is available from the reservoirs on the northern side of The Saddle Road. During preliminary discussions, Byron Shire Council have indicated they can retail the water supply to the proposed development. Due to the limited elevation difference between the more elevated areas of the BILS5 area, there may be pumps required to ensure adequate pressure.

The reservoirs are fed by Rous water mains that traverse the site from south to north.

### 4.2. Water supply demand

Demand calculations are carried out in line with Byron Shire Council's 2018 Water and Sewer Equivalent Tenements Policy. It provides water ET's for various land use categories. We have selected land use categories that best approximate the intents of the Traditional Industrial zoning concept and the Business Park zoning concept. Byron Shire Council's ET policy does not provide gross hectare rates for commercial developments. We have therefore based our estimates on the Gold Coast City Plan Schedule SC3.1-3, which gives a gross EP rate of 43.7 EP per development hectare. Gold Coast City Plan water Equivalent Person (EP) is defined as 220 litres per EP per day. One EP per annum is  $220 \times 365 = 80,300$  L/annum, which is 80.3 kL/a. The Water Directorate April 2017 defines a standard ET as an average water consumption of 230 kL/a. Thus 1 ET equates to 2.86EP. Following this method an EP rate of 43.7 becomes an ET rate of 15.28 per gross hectare.

The resulting calculations are provided in the table below. These estimates are an approximation only for preliminary planning and budgeting purposes and will be confirmed as part of future Development Applications.

**Table 7 | Water ET calculations**

| Area                   | Land use category | ET rate                | Area           | Total ET    |
|------------------------|-------------------|------------------------|----------------|-------------|
| Traditional Industrial | Light Industrial  | 15 per gross hectare   | 1.55 hectares  | 23.3        |
| Business Park          | Commercial/retail | 15.3 per gross hectare | 4.95 hectares. | 75.6        |
| <b>Total</b>           |                   |                        |                | <b>98.9</b> |



## 5. SEWER RETICULATION

### 5.1. Proposed sewer rising main alignment

The site sewage from any development in both proposed zones would be pumped to an existing pump station in Brunswick Heads, see Figure 11. The proposed route uses the existing services corridor through the centre of the subject site, then travels along the eastern boundary until it enters the Bashforth's Lane reserve in the northeaster corner, after which it crosses the Pacific Motorway by ways of underbore. The west-to-east alignment follows an existing crown road, it then crosses the Old Pacific Highway South to then follow Bayside Way, until a suitable point is found to travel north across the sportsfields to the existing pump station in Brunswick Heads. The total length of this route is approximately 2.6km.



**Figure 11 | Proposed pressure sewer route layout, Source aerial photo: Byron Online Maps 2021**

### 5.2. Sewer demand

Demand calculations are carried out in line with Byron Shire Council's 2018 Water and Sewer Equivalent Tenements Policy. It provides water ET's for various land use categories. We have selected land use categories that best approximate the intents of the Traditional Industrial zoning concept and the Business Park zoning concept. Byron Shire Council's ET policy does not provide gross hectare rates for commercial developments. We have therefore based our estimates on the Gold Coast City Plan Schedule SC3.1-3, which gives a gross EP rate of 43.7 EP per development hectare. Gold Coast City Plan sewage Equivalent Person (EP) is defined as 140 litres per EP per day. One EP per annum is

220 x 365 = 51,100 L/annum, which is 51.1 kL/a. The Water Directorate April 2017 defines a standard ET as an average water consumption of 230 kL/a. Thus 1 ET equates to 4.50 EP. Using this method an EP rate of 43.7 becomes an ET rate of 9.71 per gross hectare.

The resulting calculations are provided in the table below. These estimates are an approximation only for preliminary planning and budgeting purposes and will be confirmed as part of future Development Applications.

**Table 8 | Sewer ET calculations**

| Area                   | Land use category | ET rate                | Area           | Total ET    |
|------------------------|-------------------|------------------------|----------------|-------------|
| Traditional Industrial | Light Industrial  | 15 per gross hectare   | 1.55 hectares  | 23.3        |
| Business Park          | Commercial/retail | 9.71 per gross hectare | 4.95 hectares. | 48.1        |
| <b>Total</b>           |                   |                        |                | <b>71.4</b> |

## 6. TRAFFIC IMPACTS

A separate Traffic Impact Study has been prepared for this project. The findings are summarised in this chapter.

### 6.1. Proposed intersection

It is proposed to construct a new roundabout on Gulgan Road as is depicted in Figure 12. A single lane roundabout is selected as it minimises impacts on vegetation and existing services, whilst being the most efficient and safe intersection option for site access.

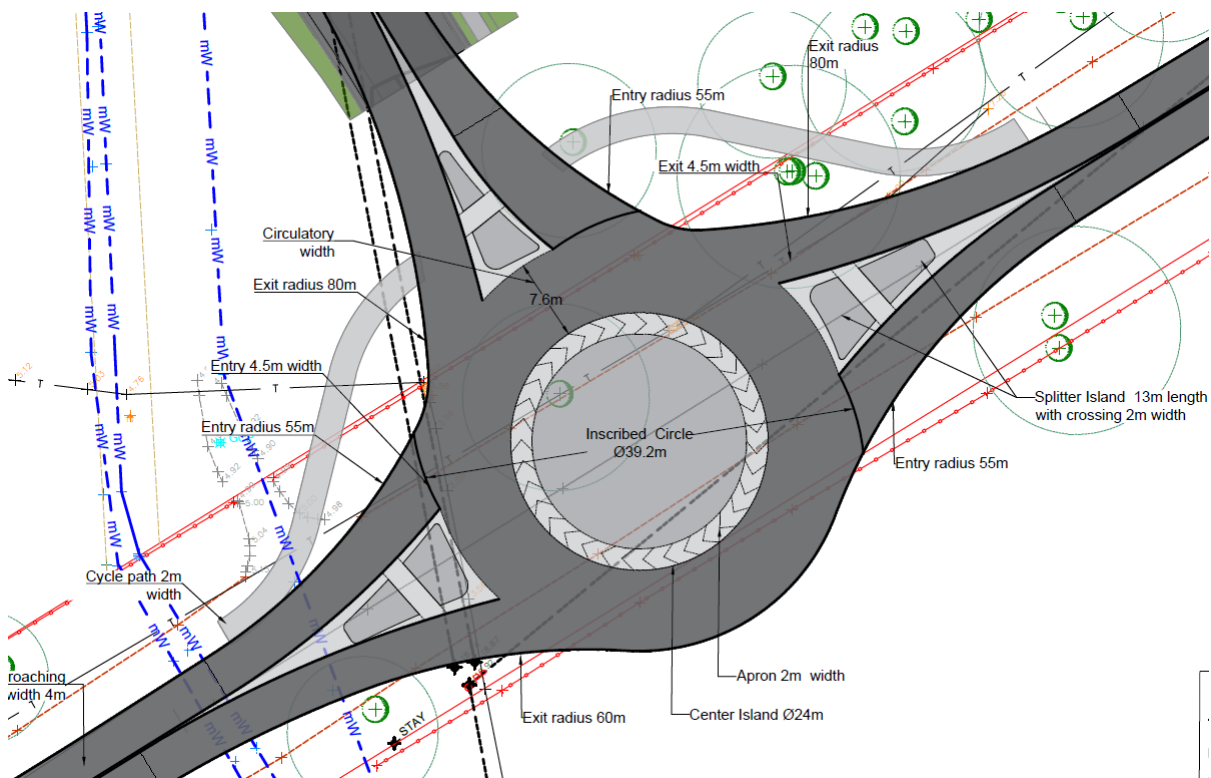


Figure 12 | Roundabout layout

### 6.2. Trip generation

Trip generation is estimated using traffic surveys of the Russellton Industrial Estate in Alstonville and the Manns Road Industrial Estate in Mullumbimby representing a typical 'traditional industrial' estate, and of Habitat in Byron, to determine a typical 'business park' trip generation rate. The development trip generation estimates are summarised in Table 9.

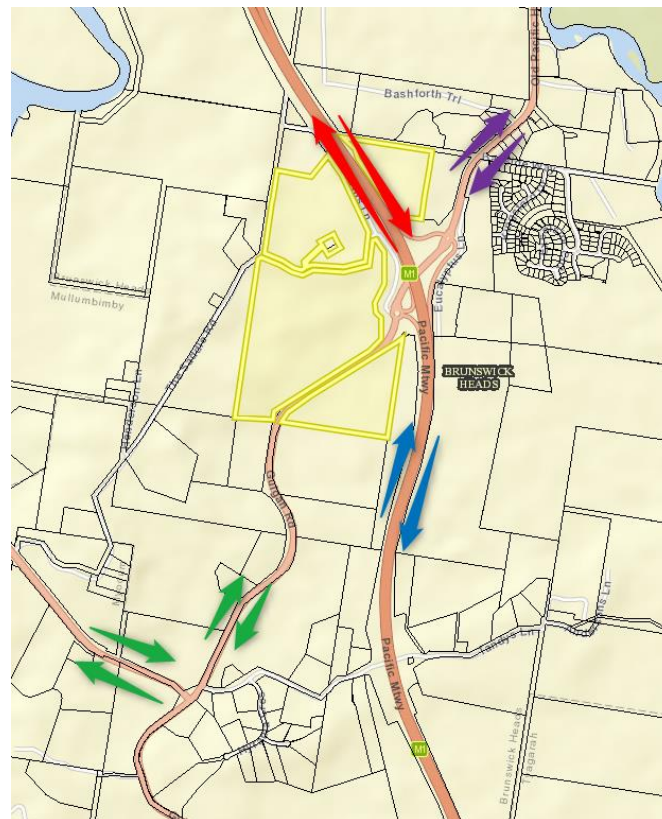
**Table 9 | Development trip generation**

| Parameter        | Traditional Industrial | Business Park | Combined     |
|------------------|------------------------|---------------|--------------|
| 7-day ADT        | 388                    | 3031          | <b>3419</b>  |
| AM peak hour     | 47.9                   | 385           | <b>433</b>   |
| PM peak hour     | 44.0                   | 331           | <b>375</b>   |
| % heavy vehicles | 25%                    | 8.7%          | <b>10.5%</b> |

### 6.3. Trip distribution

Development trip distribution is estimated using a 'gravity model'. The four main routes to and from the site are depicted in Figure 13. The resulting trip distribution per colour is:

- Red: 20.47%
- Purple: 27.84%
- Blue: 35.78%
- Green: 15.91%



**Figure 13 | Travel routes to site**

This results in the following trip distribution at the site intersection:

**Table 10 | Development trip distribution volumes**

| Parameter    | Trip generation north of the site – 84.09% | Trip generation south of the site – 15.91% | Total |
|--------------|--|--|-------|
| 7-day ADT    | 2875                                       | 544  | 3419  |
| AM peak hour | 364  | 69   | 433   |
| PM peak hour | 315  | 60   | 375   |

#### 6.4. Traffic impacts on road network

We have analysed three existing intersections near the subject site to determine the impact of the proposed development. The results of the SIDRA analysis of these intersections are summarised in the tables below.

**Table 11 | Worst case level of service**

| Intersection                | 2021 no development | 2031 no development | 2031 with development |
|-----------------------------|---------------------|---------------------|-----------------------|
| <b>Brunswick R'bout</b>     | LOS B               | LOS B               | LOS B                 |
| <b>Tandy's T-junction</b>   | LOS C               | LOS D               | LOS E                 |
| <b>Mullum Rd T-junction</b> | LOS C               | LOS F               | LOS F                 |

**Table 12 | Worst case 95%-ile queue length (m)**

| Intersection                | 2021 no development | 2031 no development | 2031 with development |
|-----------------------------|---------------------|---------------------|-----------------------|
| <b>Brunswick R'bout</b>     | 20.6                | 38.4                | 38.8                  |
| <b>Tandy's T-junction</b>   | 3.9                 | 10.8                | 12.3                  |
| <b>Mullum Rd T-junction</b> | 38.2                | 587.2               | 656.7                 |

**Table 13 | Worst case control delay (sec)**

| Intersection                | 2021 no development | 2031 no development | 2031 with development |
|-----------------------------|---------------------|---------------------|-----------------------|
| <b>Brunswick R'bout</b>     | 14.5                | 16.7                | 17.3                  |
| <b>Tandy's T-junction</b>   | 17.4                | 33.4                | 38.6                  |
| <b>Mullum Rd T-junction</b> | 24.1                | 536.5               | 646.7                 |

Byron Shire Council have scheduled concept development and design of conversion of the Mullumbimby Road T-junction to a roundabout for 2024/2025. If that were combined with an arrangement to remove the right turn out of Tandy's Lane, then the Level of Service issues at both intersections would be resolved. The development contribution of traffic to these intersections during peak hours is estimated at 2% to 5.5%.

## 7. CONCLUSIONS AND RECOMMENDATIONS

Based on the analysis carried out in this study we conclude that the proposed development is realistic and achievable for this site.

The main findings from a civil engineering perspective are:

- Flooding and earthworks – minimum floor level for all buildings to be RL4.63m AHD, which is higher than a portion of the proposed eastern industrial area.
- Stormwater management – on-site detention should be applied to avoid worsening of existing Gulgan Road cross-drainage capacity issues. Council's water quality targets can be met by designing a treatment train that is integrated with the urban design and landscape design during Development Application stage
- Water supply – Byron Shire Council can retail potable water to the site from the existing The Saddle Road reservoirs. Demand is estimated at 99 ET.
- Sewer – Sewage is proposed to be pumped to the Brunswick Heads SPS at the sports fields. The demand is estimated at 71 ET.
- Traffic – Traffic impacts are acceptable, however existing capacity issues at Mullumbimby Road and Tandy's Lane are likely to be intensified due to a predicted traffic increase of approximately 2% to 5.5% during peak hours due to the subject development. These can be resolved by the construction of a roundabout at Mullumbimby Road and removal of the right turn out of Tandy's Lane in conjunction with the roundabout construction. We understand that Council have planned an upgrade of the Mullumbimby Road intersection with Gulgan Road to address these existing capacity issues.

## REFERENCES

*North Byron Floodplain Risk Management Study and Draft Plan*, WMA Water, Sydney, October 2020

*Comprehensive Guidelines for Stormwater Management*, Byron Shire Council

*Byron Shire Development Control Plan 2014 Chapter B3 Services*

*Byron Shire Development Control Plan 2014 Chapter C2 Areas Affected by Flood*

Byron Shire Policy – Water and Sewer Equivalent Tenements 2018

*Planning for Bushfire Protection*, NSW Rural Fire Service, Granville, November 2019

*Gold Coast City Plan Schedule 3.1 Planning Assumption Tables*, City of Gold Coast, 15 December 2020

*Section 64 Determinations of Equivalent Tenements Guidelines*, Water Directorate, Sydney, April 2017

*MUSIC Modelling Guidelines*, Water by design, Version 1.0, 2010

*Gulgan North, Brunswick Heads, Traffic Impact Study*, Ingen Consulting, Alstonville, 22<sup>nd</sup> December 2021



## APPENDIX A – DETAIL SURVEY

SEE SHEET 6 FOR DETAILS

LOT 32  
DP1018929

LOT 1  
DP584730

SEE SHEET 5 FOR DETAILS

LOT 2  
DP1159910

THE  
SADDLE  
ROAD

HIGHWAY  
PACIFIC

SEE SHEET 4 FOR DETAILS

LOT 2  
DP1159910

DAM

IMPORTANT  
CADASTRAL SURVEY  
REFERENCE MARK  
(DO NOT DISTURB)

IMPORTANT  
CADASTRAL SURVEY  
REFERENCE MARK  
(DO NOT DISTURB)

IMPORTANT  
CADASTRAL PEG FOUND  
(DO NOT DISTURB)

SEE SHEET 2 FOR DETAILS

LOT 2  
DP1159910

SEE SHEET 3 FOR DETAILS

LOT 3  
DP114007

GULGAN  
ROAD

ROAD

LOT 3  
DP114007

LEGEND

- MAJOR CONTOUR 1.0m
- MINOR CONTOUR 0.2m
- SUBJECT BOUNDARY
- EASEMENT BOUNDARY
- BANK BOTTOM
- BANK CHANGE GRADE
- BANK TOP
- CONCRETE DRAIN
- VEGETATION MOW LINE
- VEGETATION DRIP LINE
- CENTRE LINE
- EDGE OF BITUMEN
- GUARD RAIL
- TRACK
- FENCE
- STORMWATER GULLY PIT
- WATER STOP VALVE
- UNDERGROUND COMMUNICATION
- UNDERGROUND ELECTRICAL
- UNDERGROUND WATER
- VEGETATION MOW LINE
- VEGETATION DRIP LINE
- ELECTRICAL POLE
- ELECTRICAL POLE STAY WIRE/POST
- TELSTRA PIT
- SIGNAGE
- STORMWATER GULLY PIT
- WATER STOP VALVE
- BOLLARD
- TELSTRA MARKER POST
- POWER LINE LEVEL
- WATER MARKER POST
- DENOTES A TREE WITH NUMBER TAG (TR 89)
- DENOTES A TREE WITHOUT TAG
- NATURAL SURFACE LEVEL

IMPORTANT  
CADASTRAL SURVEY REFERENCE MARKS HAVE BEEN FOUND IN THE VICINITY OF THIS SURVEY.  
PENALTIES APPLY FOR DAMAGE TO OR REMOVAL OF THESE MARKS  
REFER TO NSW SURVEYOR-GENERAL'S DIRECTION, NO.11 FOR MORE INFORMATION  
THE ACCURACY OF CADASTRAL BOUNDARIES DETERMINED BY THIS SURVEY ARE +/- 0.1M

DISCLAIMER

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REGISTERED LAND SURVEYING  
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Alstonville NSW 2477 Tel: 0431 348 590  
info@ByronBaySurveying.com.au  
www.ByronBaySurveying.com.au

| REV | DATE       | DESCRIPTION    |
|-----|------------|----------------|
| 01  | 29/04/2021 | ORIGINAL ISSUE |
| 02  | 24/05/2021 | DETAILS ADDED  |
| 03  | 18/10/2021 | DETAILS ADDED  |
| 04  | 26/11/2021 | DETAILS ADDED  |

| PROJECT       | BRU007     |
|---------------|------------|
| SURVEYOR      | LF & DH    |
| SURVEY DATE   | 16/11/2021 |
| FIELD BOOK ID | TSC3#2     |
| PLAN BY       | DH         |
| APPROVED BY   | LF         |

| MGA        | HZ DATUM |
|------------|----------|
| GNSS CORS  | ORIGIN   |
| AHD        | VT DATUM |
| SSM84987   | ORIGIN   |
| 5.026      | LEVEL    |
| 22/04/2021 | SCMS     |

IMPORTANT NOTICE:  
THIS PLAN MAY HAVE BEEN CHANGED DURING PRINTING OR REFORMATTING. THE SCALE SHOULD THEREFORE BE VERIFIED PRIOR TO USE. ANY DIMENSIONS SHOWN ON THIS PLAN OVERRULE SCALING.

PLAN OF DETAIL SURVEY  
PART OF GULGAN ROAD  
LOT 2 IN DP1159910  
66 THE SADDLE RD  
BRUNSWICK HDS 2483  
CLIENT: INGEN CONSULTING  
DWG No: BRU007 4.DWG  
SHE. 1 OF 7

⑤ - H395977 EASEMENT FOR WATER PIPELINE  
5.03 WIDE (DP445893)  
⑥ - Y943604 EASEMENT FOR WATER PIPELINE  
5.03 WIDE (DP42319)

IMPORTANT  
UNDERGROUND SERVICES SHOWN HAVE ONLY BEEN LOCATED TO QUALITY LEVEL C DUE TO INFRASTRUCTURE COMPOSITION (GROUND PENETRATING RADAR HAS BEEN UTILISED). POTHOLES IS ESSENTIAL FOR ACCURATE LOCATING AND DEPTHING OF ALL SERVICES SHOWN. ONLY SERVICES IDENTIFIED FROM DBYD RECORDS HAVE BEEN INVESTIGATED, OTHERS MAY EXIST THAT HAVE NOT BEEN LOCATED.

BOUNDARIES HAVE BEEN INVESTIGATED (NOT MARKED) IN ACCORDANCE WITH THE PROVISIONS OF THE SURVEYING & SPATIAL INFORMATION ACT, 2017 AND ARE BASED ON THE LATEST SURVEY RECORDS AVAILABLE FROM LAND REGISTRY AT THE TIME OF SURVEY. NO RESPONSIBILITY CAN BE TAKEN FOR SURVEYS AT A LATER DATE WHICH MAY VARY BOUNDARY DIMENSIONS. ANY EASEMENTS WHETHER REGISTERED OR IMPLIED HAVE NOT BEEN INVESTIGATED. THE POSITIONAL ACCURACY OF ANY CRITICAL FEATURE REQUIRES CONFIRMATION PRIOR TO ITS USE IN DESIGN OR CONSTRUCTION. UNDERGROUND SERVICES HAVE NOT BEEN INVESTIGATED. CONSULT WITH 'DIAL BEFORE YOU DIG' PRIOR TO ANY EXCAVATION WORKS.

## APPENDIX B – INFILTRATION TEST REPORTS

**Document title:** RING INFILTRATION TEST  
**Document number:** J1143\_IR  
**Author:** Jordy Nasario da Silva, *BEng, AdvDipMgt.*  
**Client Name:** Gulgan North Property Pty Ltd  
**Client's representative:** Steve Connelly  
**Project Number:** J1143  
**Data Issued:** 27/04/2021  
**Number of Locations:** 4 (refer to map below)

**Hydraulic Conductivity (K) =**

1. Location 1 = 0 mm/h
2. Location 2 = 0 mm/h
3. Location 3 = 35 mm/h
4. Location 4 = 6 mm/h

| Location 3                   |              |             |                               |              |             | Location 4                   |              |             |                               |              |             |
|------------------------------|--------------|-------------|-------------------------------|--------------|-------------|------------------------------|--------------|-------------|-------------------------------|--------------|-------------|
| Constant water level = 50 mm |              |             | Constant water level = 150 mm |              |             | Constant water level = 50 mm |              |             | Constant water level = 150 mm |              |             |
| time (min)                   | Volum e (mL) | Q (mL /s)   | time (min)                    | Volum e (mL) | Q (mL /s)   | time (min)                   | Volum e (mL) | Q (mL /s)   | time (min)                    | Volum e (mL) | Q (mL /s)   |
| 5                            | 100          | 0.33        | 5                             | 130          | 0.43        | 5                            | 0            | 0.00        | 5                             | 25           | 0.08        |
| 10                           | 110          | 0.37        | 10                            | 125          | 0.42        | 10                           | 25           | 0.08        | 10                            | 25           | 0.08        |
| 15                           | 75           | 0.25        | 15                            | 125          | 0.42        | 15                           | 25           | 0.08        | 15                            | 25           | 0.08        |
| 20                           | 75           | 0.25        | 20                            | 100          | 0.33        | 20                           | 25           | 0.08        | 20                            | 25           | 0.08        |
| 25                           | 110          | 0.37        | 25                            | 100          | 0.33        | 25                           | 25           | 0.08        | 25                            | 25           | 0.08        |
| 30                           | 75           | 0.25        | 30                            | 125          | 0.42        | <b>AVERAG E LAST 5</b>       |              | <b>0.07</b> | <b>AVERAG E LAST 5</b>        |              | <b>0.08</b> |
| 35                           | 85           | 0.28        | <b>AVERAG E LAST 6</b>        |              | <b>0.39</b> |                              |              |             |                               |              |             |
| 40                           | 75           | 0.25        |                               |              |             |                              |              |             |                               |              |             |
| <b>AVERAG E LAST 8</b>       |              | <b>0.29</b> |                               |              |             |                              |              |             |                               |              |             |

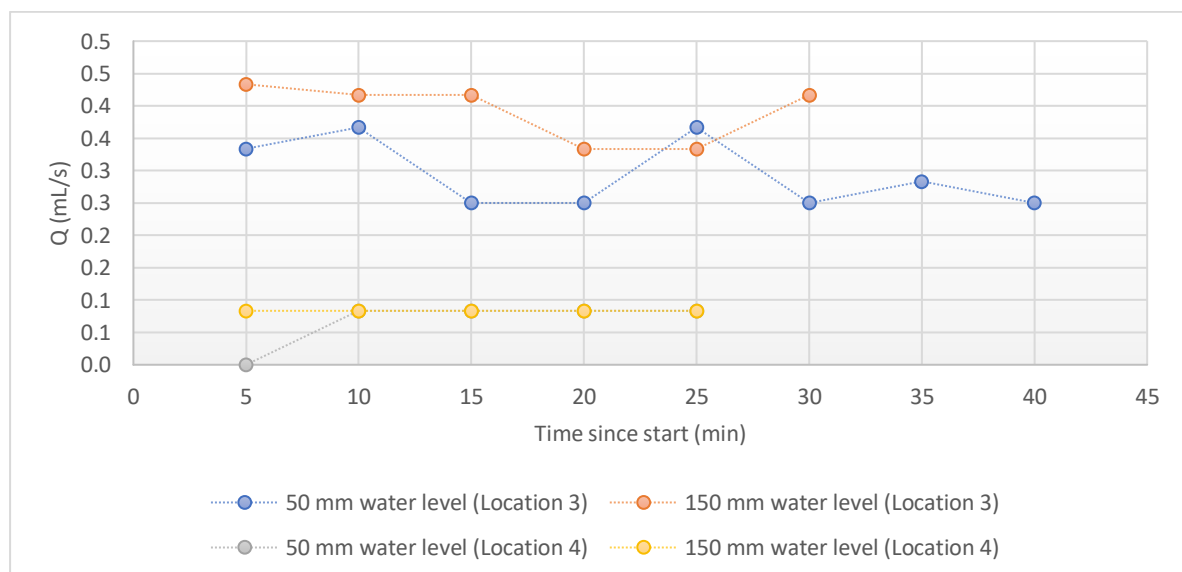




Figure 1 | Sampling locations