



Options Assessment Tweed Street Brunswick Heads

Byron Shire Council

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EXECUTIVE SUMMARY

Planit has been engaged by Byron Shire Council to develop and assess three options for the upgrade of a 315m section of Tweed Street, Brunswick Heads, from Booyun Street to Mullumbimbi Street. The purpose of the project is to improve amenity of this road space and the adjacent precinct. The purposes of this report are to provide insight into existing constraints, investigate opportunities for upgrade and assess three upgrade options.

Relevant Key Design Ideas listed in the Draft Master Plan are:

- Tweed Street will be returned to a slower, quieter and more narrow street.
- The road will be lined with street trees that are distinct to Brunwick Heads relating to both its natural environment and cultural heritage.
- The shared path will create a spine for art installations that interpret various parts of the environment, people and history of Brunswick Heads.
- The existing stormwater system and 'nature strip' will not be altered. Except in the new pocket park in front of the 'Breeze' housing development.

The options and recommendations presented in this report are based on field and desktop based investigations including:

- Detailed underground services locating
- A feature survey
- Geotechnical investigations
- Drainage assessment

The findings of the field and desktop investigations are summarised below:

Services Locating:

- It was found that telecommunication services are located at relatively shallow depths. It is believed that at some locations, conduits are located directly under the kerb or bitumen seal of the existing pavement. If pavement is to be removed or replaced, consideration should be given to the depth and location of these services.
- An abandoned asbestos water main not shown on Council records, has been located parallel to Tweed Street on the western side of the section between Booyun Street and Fingal Street (Figure 4). Two fire hydrants visible from the surface were found to be connected to this main. Attempts to locate this abandoned main further towards the north have not yielded any results. Accordingly, it has been assumed that the abandoned main terminates at some point between Fingal Lane and Fingal Street. It is recommended that these hydrants are decommissioned.

Feature Survey:

- Grades along the road section from Booyun Street to Mullumbimbi Lane are relatively flat which cause drainage issues. Accordingly, alternative drainage solutions should be considered.
- Inconsistencies in the general layout and arrangement of drainage infrastructure along the corridor are apparent. An opportunity exists to make these consistent in the proposed design to generate more overall cohesion.
- As is evident from the existing cross-sections along Tweed Street, both the trafficable area and the nontrafficked area of the corridor are relatively wide, providing opportunities for re-design (e.g. road alignment, parking, gardens) with minimal spatial constraints.

Geotechnical Investigations:

• The existing pavement material is in good condition and generally suitable for reuse on site. If significant changes are to be made to the existing pavement, cost savings could be made by reusing existing pavement materials in new pavement areas. Because of the quality of the existing pavement, it would be beneficial to retain as much of the existing pavement as possible.



- Two infiltration tests have been performed on the non-pavement sandy shoulder material. Relatively low saturated hydraulic conductivity has been measured. Using infiltration as a means of drainage may therefore not be a practical solution.
- The existing pavement is the old Pacific Highway.
- The existing pavement is in very good condition and is approximately 550mm thick with 40mm asphalt wearing course on top.

Drainage Assessment:

- The project extent is not subject to flooding.
- Minimal grades exist for overland flow.
- The infiltration capacity of the existing soil is very low.

A concept design has previously been developed by Planit Engineering (previously WGM Consulting). Based on the findings above, the following options have been developed:

Option 1:

This option closely resembles the existing approved draft masterplan for the site, incorporating roundabouts, road realignment, parking, gardens and signage. It is also the highest cost option.

Option 2:

This option combines elements of both Option 1 and Option 3, however the main feature is the improvement of intuitive wayfinding by laying out the legs of the roundabouts such that traffic on the Fingal Street roundabout and Mullumbimbi Street roundabout are naturally led to drive towards the eastern part of the town where the current commercial precinct is located. By activating the section between Fingal Street and Mullumbimbi Street by creating a low speed environment with on-street parking and increased pedestrian traffic, this area has improved potential for commercial and tourist development.

Option 3:

This option maximises the use of existing infrastructure. The goals of the masterplan are achieved by narrowing the traffic lanes, tidying up the road shoulders, providing some landscaping and including low cost activation options that fit in with existing infrastructure. This is a lower cost option.

When comparing these options, it was found that all options have strengths and weaknesses. Option 1 performs best at closely resembling the existing draft masterplan, however is the highest cost. Option 2 also meets the majority of community objectives and provides a platform for long term development of Brunswick Heads as a commercial and tourist destination. Option 3 meets some of the community objectives and is a lower cost option.

Recommendations:

- Undertake a full drainage study for Brunswick Heads and potentially undertake Tweed Street drainage works at the same time as any upgrade works to minimise overall cost to Council.
- Carry out a full traffic and parking study to optimise traffic flows through Brunswick Heads to improve exposure by existing and future commercial developments to through traffic.
- It may be beneficial to carry out an entire Brunswick Heads holistic master plan, incorporating the traffic and drainage studies mentioned above, of which Tweed Street could form part. Consideration should be given to the community group that has raised the need for a Tweed Street masterplan. Undertaking a full Brunswick Heads overall masterplan may cause delays to the implementation of the Tweed Street masterplan project.



1. INTRODUCTION

1.1. PROJECT BACKGROUND

Ongoing planning, community consultation and design for the upgrade of Tweed Street in Brunswick Heads NSW have been taking place since 2003. A Draft Master Plan (Appendix A) has been developed by Social Habitat in 2009, detailing a conceptual design that includes amenities, lighting, signage, and landscaping.

Relevant Key Design Ideas listed in the Draft Master Plan are:

- Tweed Street will be returned to a slower, quieter and more narrow street.
- The road will be lined with street trees that are distinct to Brunswick Heads relating to both its natural environment and cultural heritage.
- The shared path will create a spine for art installations that interpret various parts of the environment, people and history of Brunswick Heads.
- The existing stormwater system and 'nature strip' will not be altered. Except in the new pocket park in front of the 'Breeze' housing development.

The Draft Master Plan has been adopted by Council (Resolution 09-1088). Since adoption of the Draft Master Plan by Byron Shire Council, extensive consultation with community groups has been undertaken by Council to progress the project into detailed design and to source funding to deliver the project. In 2015, WGM Consulting (now known as Planit Engineering) completed a preliminary engineering design based on the concept presented in the 2009 Draft Master Plan.

Following on from these previous designs, Planit has been engaged by Byron Shire Council to deliver an options assessment for a 315m section of Tweed Street from Booyun Street to Mullumbimbi Street (Figure 1).



Figure 1 | Subject site



This section of Tweed Street includes three (3) major intersections: Booyun Street; Fingal Street and Mullumbimbi Street and two (2) minor intersections: Fingal Lane and Mullumbimbi Lane and uses the existing road corridor, which used to be the Pacific Highway before the new alignment bypassing Brunswick Heads was built.

1.2. PROJECT OBJECTIVES

Based on previous planning and community consultations, the objectives for the delivery of the Tweed Street Upgrade are:

- Lower speed environment
- Reduction of traffic noise
- Additional landscaping and green space
- Relation to commercial centre of town
- Improved access and flow for pedestrians, bicycles and mobility scooters
- Improve visual amenity using landscaping and artistic expressions to create a landmark entrance to Brunswick Heads
- Meet the design intent of the 2009 Draft Master Plan where feasible

To assist in delivering these objectives, this report aims to:

- Provide insight into opportunities and constraints associated with the study area
- Develop three (3) concept designs based on the existing design
- Assess the benefits and limitations of each design option
- Provide costing estimates for each design option

In developing the three options, consideration has been given to Council's potential budget for construction of the upgrade. A lower cost option has therefore been included in the assessment. We have also provided staging options to facilitate a gradual development of the project to spread funding requirements over a longer period of time.

1.3. SCOPE OF PROJECT

To meet the above objectives, the scope for the investigation component of this assessment includes:

- Field Investigations including:
 - Feature Survey
 - Detailed Services Location
 - Geotechnical Investigations including:
 - Determination of state of the existing pavement and shoulder material
 - Assessment of drainage and infiltration potential in the in situ subgrade
- Desktop investigations including:
 - Assessment of runoff drainage using rainfall data and existing (anecdotal) records
 - Assessment of site specific constraints in accordance with the Byron Shire DCP, LEP and existing records.

Three (3) concept design options have been developed with the outcome of these investigations:

- **Option 1**: maximum amenity and achieving the draft Tweed Street masterplan
- **Option 2**: compromise between costs and amenity and increased activation of CBD
- **Option 3:** maximises the use of existing assets to reduce cost whilst meeting as many community objectives as possible.

These options, as well as the existing concept design, have been assessed based on the following criteria:

• Design Characteristics:



- Proposed layout and road cross-sections
- Drainage:
 - Management of existing and future stormwater flows
 - Flood risk
- Services Relocation:
 - Required services relocation
 - Associated costs
- Costs & Staging:
 - Cost breakdown of staging works
 - Value for Money
 - Initial and long-term costs
- Overall Strengths and Weaknesses:
 - Maintenance requirements
 - Public risks
 - RMS requirements
 - Lighting requirements

Conclusions and recommendations are provided accordingly.



2. SITE INVESTIGATIONS

2.1. FEATURE SURVEY

2.1.1. Methodology

Prior to the survey being conducted, a 'Dial Before You Dig' search was carried out to provide a preliminary assessment of existing features and services. The results are included in Appendix B. A detailed feature survey of the study area was completed by LandSurv on 30-09-2016. Locations and depths of underground services and utilities, which were located by a separate contractor as per Section 3.2 of this report, have been included in this survey. To ensure coordination between the contractors for locating the services and the survey pickup, site meetings attended by representatives from Landsurv, NPS and Planit took place on 21-09-2016 and 30-09-2016.

2.1.2. Key Findings

The survey output is included as Appendix C. It was found that along the section of Tweed Street between Booyun Street and Mullumbimbi Lane, longitudinal grades are relatively flat. From Mullumbimbi Lane to Mullumbimbi Street, the average grade is approximately 1-2% (refer Figure 2).





The typical road cross fall on Tweed Street is approximately 3-3.5%. 1.2m wide footpaths are located on both the eastern side and the western side of the road. Typically, a 1.2m grass strip separates the kerb from the footpath. Typical existing cross sections are provided in Figure 3. Typically, the existing pavement widths along Tweed Street are as follows:

- Between Booyun Street and Fingal Street: 17-19m
- Between Fingal Street and Mullumbimbi Lane: 21m
- Between Mullumbimbi Lane and Mullumbimbi Street: 15m

Major intersecting roads (i.e. Booyun Street, Fingal Street and Mullumbimbi Street) are approximately 15-20m wide and minor intersecting roads (i.e. Fingal Lane and Mullumbimbi Lane) are approximately 4m wide.

Apart from one stormwater pit located on the corner of Tweed Street and Mullumbimbi Street, no piped drainage networks are currently situated within the project area. The existing stormwater infrastructure consists of kerb and gutter and vegetated channels along the eastern and western sides of Tweed Street. Stormwater is channelled towards Booyun Street, Fingal Street and Mullumbimbi Street.

It appears that stormwater infrastructure on the eastern side of Tweed Street is in better condition than the infrastructure on the western side, and more continuations of kerb profiles are present on the eastern end.

Stormwater flows away from Tweed Street, both to the west and to the east. An existing stormwater main runs in a northerly direction (on the western aside and parallel to Tweed Street, at approximately 30 to 40 metres from Tweed Street) and discharges into the Brunswick River. This main runs through private property, is in poor condition and is difficult to maintain. Refer to sheets 0005 -0006 for existing drainage conditions.



To the east, the nearest stormwater main runs through Park Street. However, a second trunk main starts in Mullumbimbi Lane then travels through private property in to Mullumbimbi Street, after which it heads west to Tweed Street runs along the eastern side of Tweed Street and drains towards the river.



TYPICAL CROSS SECTION BETWEEN MULLUMBIMBI LANE AND MULLUMBIMBI STREET

Figure 3 | Typical existing cross sections as surveyed

2.1.3. Implications to project

Grades along the road section from Booyun Street to Mullumbimbi Lane are relatively flat and could potentially cause drainage issues. Accordingly, alternative drainage solutions should be considered.

Inconsistencies in the general layout and arrangement of drainage infrastructure along the corridor are apparent. An opportunity exists to make these consistent in the proposed design and generate more overall cohesion.

As is evident from the existing cross-sections along Tweed Street, both the trafficable area and the non-traffic area of the corridor are relatively wide, providing opportunities for re-design (e.g. road alignment, parking, gardens) with minimal spatial constraints.

2.2. SERVICES LOCATION

2.2.1. Methodology

Prior to the survey being conducted, a 'Dial Before You Dig' search and an examination of Council GIS records has been carried out to provide a preliminary assessment of existing services and utilities. Existing services have been located by the Network Protection Specialists (NPS) using a combination of physical locating (potholing) and



electronic locating. Works on site took place between 20-09-2016 and 30-09-2016. Typically, identification took place towards the northern and the southern ends of major intersections. At minor intersections, a single location was selected, either north or south of Tweed Street. Services crossing Tweed Street have typically been located near the edge of pavement at the eastern and western sides of Tweed Street. Typically, telecommunication services crossing Tweed Street or major intersections have also been located near the centreline of the respective roads.

Upon locating, horizontal locations and depth to top of service have been marked on the surface. These results have been picked up and processed by LandSurv and have been included in the feature survey (Appendix C).

Where pavements have been breached for services location, crusher dust has been used for reinstatement.

The following limitations should be noted when interpreting the findings of services locating:

- The services that have been located using GIS are limited to those identified on 'Dial before You Dig' Plans (Appendix B) and Council records.
- Services have been located at intervals. A linear direction and constant grade has been assumed between points of location.
- Where no services have been found upon multiple attempts of locating, it has been assumed no underground services are present.
- Based on examinations of existing plans, it is considered possible that services for individual house connections (e.g. water house connections) are located under the existing road. As these services are not shown on existing records, no attempt has been made to locate these services.
- No services have been located outside the study area.
- Services should be located again by the contractor at the start of construction.

2.2.2. Key Findings

It was found that telecommunication services are located at relatively shallow depths. It is believed that at some locations, conduits are located directly under the kerb or bitumen seal of the existing pavement. If pavement is to be removed or replaced, consideration should be given to the depth and location of these services.

An abandoned asbestos water main not shown on Council records has been located parallel to Tweed Street on the western side of the section between Booyun Street and Fingal Street (Figure 4). Two fire hydrants visible from the surface were found to be connected to this main. Attempts to locate this abandoned main further towards the north have not yielded any results. Accordingly, it has been assumed that the abandoned main terminates at some point between Fingal Lane and Fingal Street. It is recommended that these hydrants are decommissioned.





Figure 4 | Abandoned asbestos water main and fire hydrants

The hydrants shown in Figure 4 are hydrants associated with the abandoned water main, and are still visible and accessible from the surface.

2.2.3. Implications to Project

If pavement is to be removed or replaced within the vicinity of the existing intersections, care should be taken when excavating within the proximity of existing services. This is especially the case for telecommunication services as it has been observed that these conduits are located relatively close to the surface.

From a design and planning point of view, when pavement is to be removed or replaced near intersections, services may need to be relocated to maintain adequate cover. As has been stated previously, no provision has been made to identify underground property connections crossing the road. During construction, care should be taken when excavating, to allow for the possibility of these type of connections to be present and provisions should be made for the possible relocation of these services.

In regards to the abandoned asbestos water main, it is recommended to remove this section of pipe if excavation near this service takes place during construction. As the abandoned fire hydrants are located within proximity to operational hydrants and are similar in appearance, it is recommended that these hydrants are removed for safety purposes.

2.3. GEOTECHNICAL INVESTIGATIONS

2.3.1. Methodology

Geotechnical investigations have been carried out by Civil Consult. Five samples were taken on September 21st 2016 to assess the consistency of the existing pavement and in-situ material. Sampling locations are presented in Figure 5.

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Figure 5 | Borehole locations

- BH1: eastern side of Tweed Street Booyun Street intersection in front of the refuge island
- **BH2**: western side of Tweed Street 20m south of Final Lane near edge of pavement
- BH3: eastern side of Tweed Street Fingal Street intersection in front of the refuge island
- BH4: centreline of Tweed Street 15m north of Mullumbimbi Lane
- BH5: western side of Tweed Street directly south of Mullumbimbi Street in cycle lane

Soil samples were taken using a mechanical excavator. Refer to Figure 6 for a typical sample pit. Upon completion of sampling, the disturbed pavement areas were reinstated using cold mix asphalt (Figure 7).



Figure 6 | In situ soil sample



Figure 7 | Reinstated asphalt after sampling



Tests performed at each sampling location include:

- DCP tests: tests performed by Civil Consult using samples from BH1 BH5
- Particle Size Distribution: tests performed by ASCT using samples from BH2 and BH4
- Atterberg Suite: tests performed by ASCT using samples from BH2 and BH4
- **CBR tests**: tests performed by ASCT using samples from BH1 BH5
- Hydraulic Conductivity (infiltration) Tests: tests performed by Trilab using samples from BH1 and BH2

2.3.2. Key Findings

The Geotechnical report is included in Appendix D. A summary of the soil profiles encountered on site is presented in Figure 8.

BH1	BH2	BH3	BH4	BH5
0.00-0.15 Gravel Existing 40mm seal on top.	0.00-0.09 Gravel Ex. 40mm seal on top.	0.00-0.10 Gravel Ex. 40mm seal on top.	0.00-0.19 Gravel Ex. 40mm seal on top.	0.00-0.11 Gravel Ex. 40mm seal on top.
0.15-0.40 Clayey	0.09-0.30 Gravel	0.10-0.54 Gravel		0.11-0.30 Gravel
Gravel			0.19-0.48 Gravel	
	0.30-1.30 Sand			0.30-1.30 Sand
0.40-1.40 Silty Sand	Test Pit Terminated at 1.3m, no Ground Water			Test Pit Terminated at 1.3m, no Ground Water
Test Pit Terminated at		0 54-1 64 Sand	0.48-1.00 Sand	
1.4m, no Ground Water		Test Pit Terminated at	Test Pit Terminated at 1.64m, no Ground Water	
		1.64m, no Ground Water		

Figure 8 | Existing soil profiles

Results from laboratory tests are summarised in Table 1.



Test Pit	Material Type	CBR	Plasticity	% Passing Sieve			Permeability
			Index	37.5mm	19mm	2.36mm	
BH1	Subgrade/ Insitu Natural	25%	-	-	-	-	8.64mm/h
	Existing Gravel	14%	4	89%	74%	35%	-
BH2	Subgrade/ Insitu Natural	10%	-	100%	100%	99%	-
BH3	Subgrade/ Insitu Natural	8%	-	-	-	-	3.20mm/h
	Existing Gravel	80%	1	87%	69%	28%	-
BH4	Subgrade/ Insitu Natural	5%	-	-	-	-	-
BH5	Subgrade/ Insitu Natural	20%	-	-	-	-	-

Table 1 | Laboratory result summary

A review of existing materials has been carried out to determine the suitability of the existing gravel for reuse on site. It was found that material sampled from BH1, BH3 and BH5 is suitable for reuse as per the Northern Rivers Development Specifications. Material sampled from BH4 generally meets the requirements of RMS R44, Site Won Materials. Based on the results from the field and laboratory tests, a pavement specification has been proposed by Civil Consult for any new pavement areas, for example if the traffic lanes are realigned, new parking was proposed, or roundabouts were constructed. This typical pavement detail is displayed in Figure 9. It is noted that the wearing course for roundabout pavements may require a separate specification.



Figure 9 | Proposed pavement specification

Refer to Appendix D for the design assumptions and limitations relevant to this proposed pavement design.



2.3.3. Implications to Project

Based on the results of the field investigation it appears that the existing pavement material is in good condition and generally suitable for reuse on site. If significant changes are to be made to the existing pavement, cost savings could be made by reusing existing pavement materials for subgrade and subbase in new pavement areas.

Because of the quality of the existing pavement, it would be beneficial to retain as much of the existing pavement as possible. Traffic lanes should be contained within areas of existing high quality pavement as much as possible and any excavation or reconstruction of pavement should be carried out outside traffic lanes.

Two infiltration tests were performed on site. Relatively low saturated hydraulic conductivity was indicated. Using infiltration as a means of drainage may therefore not be the main solution as not much stormwater would infiltrate.



3. DRAINAGE ASSESSMENT

3.1. METHODOLOGY

The following inputs have been used for this drainage assessment:

- **Previous studies**: To assess flood risks within the study area, results from the North Byron Flood Study (2016) have been analysed.
- **Discussions with Council:** Anecdotal data from discussions with Council officer James Flockton have been used to map existing conditions and shortcomings of the current drainage system.
- **Geotechnical Investigations:** Hydraulic conductivity has been measured upon field investigations to determine the possibility of using infiltration structures for drainage.

3.2. KEY FINDINGS

3.2.1. Flooding

The North Byron Flood Study was prepared by BMT WBM in April 2016 and has since been adopted by Council. The study models the expected magnitude of future flooding events within the Brunswick River, Marshal Creek, and Simpsons Creek Catchments. Relevant to the Tweed Street project area, the study concludes that:

- A drainage strategy to reduce stormwater flooding in Brunswick Heads should be prepared.
- 100 year ARI peak flood levels are in accordance with Figure 10.
- 100 year ARI peak flood levels in accordance with the 2100 climate change scenario are in accordance with Figure 11.
- A Floodplain Risk Management Study should be adopted for the area.



Figure 10 | 100 Year ARI peak flood levels





Figure 11 | 100 Year ARI peak flood levels in accordance with the 2100 Climate Change Scenario

It is evident from Figure 10 and Figure 11 that the study area is not considered at significant risk of flooding. Flood risk does not increase resulting from projected climate change within the project extent as the project extent is shown flood free in the 2100 Climate Change Scenario.

It should be noted that the flood study modelled the possible maximum flood level (Probable Maximum Flood Level, PMF) which suggests that a flood depth up to 1m is theoretically possible within the study area. However, we understand that design for PMF is not warranted for this development, therefore PMF flood characteristics are not considered in this options assessment.

3.2.2. Surface drainage

As noted, minimal piped infrastructure is present within the study area. The majority of surface runoff is directed towards the east via Booyun Street, Fingal Street and Mullumbimbi Street. Drainage pits are present at the following locations:

- Intersection of Tweed Street and Mullumbimbi Street
- Intersection of Fingal Street and Park Street approximately 220m to the east from Tweed Street
- On Booyun Street, approximately 90m to the east of Tweed Street

Discussions with Council revealed that this drainage infrastructure downstream of the study area is currently undersized. It would be in the interest of the overall stormwater system to either upgrade the drainage network or to minimise runoff from the Tweed Street corridor. An existing drainage plan including overland flow paths and drainage structures has been included in sheet 0005 to 0006 of the concept design drawing set (Appendix G)

3.2.3. Infiltration

To minimise the impact of stormwater from Tweed Street onto the existing drainage infrastructure, the potential for using infiltration as a means of drainage has been explored. Potential drainage solutions using infiltration would include rain gardens, infiltration basins and underground infiltration trenches.

To explore this infiltration potential, two samples collected during the geotechnical investigations have been subjected to laboratory tests by means of constant head. For further details on sample collection and laboratory data, refer to Section 3.3 of this report and Appendix D respectively.



Based on test results, is expected that the saturated hydraulic conductivity of the natural material is within the range of 3.20mm/h to 8.64mm/h.

The Water Sensitive Urban Design (WSUD) Technical Design Guidelines for Southeast Queensland suggest that infiltration measures are suitable for soils with a saturated hydraulic conductivity above 3.6mm/h. Soils with lower conductivities may still qualify for infiltration but extensive pre-treatment is recommended to prevent clogging within the infiltration system. Therefore, infiltration should be possible in parts of the existing soil, however the measured conductivity values are low and indicate that only limited effectiveness could be achieved with the existing soils. If infiltration is required, then potentially the existing soils could be excavated and replaced with clean sand.

3.3. IMPLICATIONS TO PROJECT

As the subject site is not directly at risk of flooding, no major consideration in the design options needs to be given to flood management. Based on the topography, it is also unlikely that the subject site will be subjected to localised flooding. Stormwater runoff is the major flooding consideration. With additional paved areas as part of any upgrade, there will be additional stormwater runoff which will increase the potential for impact during major rain events.

As per the geotechnical investigations and the recommendations in the referenced WSUD design guidelines, infiltration as a means of runoff management may be possible, but low rates of infiltration should be expected and relatively large storage volumes are required. Also, due consideration should be given to pre-treatment of runoff which would further cause spatial constraints.



4. ASSESSMENT OF EXISTING FEATURES

4.1. KEY FINDINGS

4.1.1. Mapping

According to the 2014 LEP (Figure 12), the study area is zoned B4: Mixed Use. The area surrounding Tweed Street is classified as R2: Low Density Residential and B2: Local Centre. Currently, only basic signage towards the town centre is in place. The geometry of Tweed Street does not direct traffic towards the main business district of Brunswick Heads between Brunswick Terrace and Park Street. An opportunity exists when designing the road upgrade to actively guide traffic towards the town centre. No zoning constraints have been identified in regards the options for the road upgrade.



Figure 12 | Land zoning



Figure 13 | Acid Sulphate Soils

In addition to the geotechnical investigations carried out on site (refer Section 3.3.), the presence of acid sulphate soils have been considered. Acid Sulphate Soils mapping provided in the 2014 LEP (Figure 13) suggests that no adverse conditions should be encountered within the subject site in regards to soil acidity.



Other mapping included in the LEP includes heritage, building height, floor space ratio, lot size, community title, and drinking water catchments. No features relevant to the project have been identified on these maps.

4.1.2. Existing Site Features

A comprehensive log of photos taken on site has been included in Appendix E. Relevant features include:

- Pedestrian crossing between Booyun Street and Fingal Lane. This is currently the only pedestrian crossing within the subject site. During site inspections, it was observed that additional facilities for crossing Tweed Street would be beneficial.
- Road crossing for existing major intersections contain pedestrian refuge islands.
- Signage. Traffic is directed towards the town centre via Fingal Street and Mullumbimbi Street.
- Parking facilities are provided along most of Tweed Street on both the eastern side and the western side. Limited consistency exists in terms of type of parking (i.e. angled versus parallel parking) and pavement type (paved versus unpaved).
- Parking is also provided along Mullumbimbi Street, Fingal Street and Booyun Street. Similar to Tweet Street, limited consistency exists in terms of parking type and pavement.
- An existing bus stop is located directly north of Fingal Lane.
- A school is located between Fingal Street and Booyun Street. Tweed Street does not form part of the school zone. The school zone starts on Fingal Street approximately 120m east from Tweed Street and on Booyun Street approximately 170m east of Tweed Street. School traffic should be given consideration in the concept design.
- Fingal Lane and Mullumbimbi Lane are relatively narrow and are mainly used for property access.

4.2. IMPLICATIONS TO PROJECT

In the design, consideration should be given to the following:

- Maintaining existing and improving pedestrian access
- Maintaining public transport access
- Formalising parking facilities
- Optimising the flow of traffic to and from the town centre and school

The project area is zoned 'mixed use'. The design should consider improving the street as a zone for additional commercial activity.



5. REVIEW OF EXISTING DESIGN OPTION

5.1. DESIGN CHARACTERISTICS

The existing design option, based on the 2009 Draft Master Plan, comprises of the creation of roundabouts at Fingal Street and Mullumbimbi Street and the construction of landscaping through the median of the street. A shared bike and footpath is proposed, with some on-street parking on the left-hand side of the shared path. Additional landscaping is proposed in the road verges where possible. The roundabout, medians and parking require the traffic lanes to be realigned.

5.2. ASSESSMENT

5.2.1. Drainage

New mountable kerb and gutter was proposed as part of the design. This would drain to existing drainage infrastructure in the side streets and laneways. Drainage of the landscaped medians had not yet been resolved.

Improved drainage in Tweed Street would likely result in intensification of drainage issues in the adjacent laneways and side streets. Although the total impervious area may not increase, the presumed increased effectiveness of the kerb and gutter system would have the potential to increase peak runoff volumes into the adjacent side streets and laneways.

From site investigations, it is known that insufficient drainage infrastructure exists in the side streets and laneways, and thus any additional runoff from Tweed Street would result in intensification of ponding and property flooding issues.

5.2.2. Services Relocation

If pavement is to be removed or replaced within the vicinity of the existing intersections, care should be taken when excavating around within the proximity of existing services. This is especially the case for telecommunication services as it has been observed that these conduits are located relatively close to the surface.

From a design and planning point of view, when pavement is to be removed or replaced near intersections, services may need to be relocated to maintain adequate cover. As has been stated previously, no provision has been made to identify underground property connections crossing the road. During construction, care should be taken when excavating to allow for the possibility of these type of connections to be present and provisions should be made for the possible relocation of these services.

In regards to the abandoned asbestos water main, it is recommended to remove this section of pipe if excavation near this service takes place during construction. As the abandoned fire hydrants are located within proximity to operational hydrants and are similar in appearance, it is recommended that these hydrants are removed.

5.2.3. Costs & Staging

During the development of the masterplan by WGM in 2015, the cost of this project was estimated at \$5.3M including 10% GST and including 30% contingency. This however included the entire 1020 metres length of the masterplan project. The section that is the subject of the current report comprises of a length of 315 metres, therefore the comparative cost of this project should be less.

5.2.4. Strengths and Weaknesses

The main strength of the existing masterplan is that it meets the community objectives for the project. However, the removal of highway strength pavement through the centre of the carriageway to create gardens would come at a significant cost to construct new pavement for traffic lanes and also result in the destruction of the best section of pavement in Brunswick Heads. A landscaped median (cut through the existing pavement) would hold water, which would make the adjacent pavement deteriorate. Significant subsoil drainage would need to be installed, which would increase costs and require pavement repairs.



The shared bike and pedestrian pathway may pose a safety concern as reversing vehicles may not expect pedestrians between the on-street car park and the through lane, in particular near on-street parking areas and bus bays. Pedestrian traffic should be off road and not mixed with bicycle traffic on Tweed Street.

The removal of existing kerb and gutter and construction of a new kerb and gutter also comes at a cost, whilst not significantly improving the existing drainage system and potentially intensifying drainage impacts in adjacent streets and laneways.



6. PROPOSED DESIGN OPTIONS

The design options are presented in this chapter. The various design features are summarised in appropriate tables and a SWOT (Strengths Weaknesses Opportunities Threats) analysis has been carried out for each option. Plans and typical sections of each concept design option are included in Appendix G.

6.1. OPTION 1

As a refinement of the masterplan that has been prepared in consultation with Council and the community, Option 1 presents a design based on the use of landscaped medians through the centre, the introduction of roundabouts at Fingal Street and Mullumbimbi Street and improvements to pedestrian flow, bicycle movements and wayfinding.

6.1.1. Design Characteristics

The design characteristics for this option are described in Table 2 below.

Element	Description
Footpaths	Footpaths are proposed on both sides of the road, within the road verge at approximately 1.5 metres from the boundaries. The footpaths would work in with paved seating areas that would be constructed in front of local cafés and restaurants. Footpaths would be constructed at 1.2 metre widths.
Bicycle paths	Bicycle paths will be on-road and painted green as shown in the figure below. 1.6m wide bike paths are proposed on both sides of the road.
Pedestrian crossings	Pedestrian crossings will be created using zebra crossings with median refuge islands. In order to enhance pedestrian flow from the western side of town to the town centre, these pedestrian crossings are proposed on the southern side of each road intersection. This will also result in the slowing down of traffic, thus creating a lower- speed environment
Median	For the entire length of the project (Booyun Street to Mullumbimbi Street), it is proposed to create a 2.5 metre wide central landscaped median. This could be constructed by excavating the existing pavement throughout the median and backfilling with a soil mixture that has high infiltration capabilities, and additionally providing sufficient nutrient loading and support for the landscaping on top. This approach, however, is costly and potentially damages the nearby pavement when holding water. Another option would be to create a raised concrete median that is placed on top of

Table 2 | Option 1 Design Characteristics



	the existing wearing course with adhesives and/or dowels. On top of this raised		
	median, large landscaping pots can be placed that have drainage holes in the base.		
	Water would drain from the pots onto the raised median, then onto the road		
	pavement and into the roadside drainage system.		
	Booyun Street: Four-way crossing with give-way treatment, favouring traffic on		
	Tweed Street.		
	Fingal Lane: Four-way crossing with give-way treatment, favouring traffic on Tweed		
	Street. Median can be opened up to allow right turn out of Fingal Lane.		
Intersections	Fingal Street: Roundabout with four legs and one circulating lane.		
intersections	Mullumbimbi Lane: Four-way crossing with give-way treatment, favouring traffic on		
	Tweed Street.		
	Mullumbimbi Street: Roundabout with four legs and one circulating lane.		
	Kerbing to be used to narrow down approach and departure lanes from side streets.		
	Grades throughout Tweed Street are relatively flat. Existing trunk mains also have		
	inadequate capacity and require upgrade and maintenance. Thirdly, the infiltration		
	capacity of the soil is minimal. In order to provide a drainage solution that improves		
	the visual amenity whilst limiting the discharge increase into side streets. Grass swales		
	will be applied where possible. These can be constructed relatively flat, so that some		
	ponding can occur in these. Any silt build up will move through the grass due to rain,		
	thus removing the visual amenity concern with silting up of kerb and gutters that is		
Road runoff drainage	currently the case.		
•			
	where grass swales are proposed, existing kerb and guttering is to be removed. Using		
	handscaped areas at the side road intersections, the discharge from these swales can		
	be transitioned to existing kerb and gutter intrastructure in the side streets.		
	Footpath crossings of the grass swales can be constructed as low timber bridges (with		
	grades compliant with wheelchair ramp requirements). The drain section underneath		
	these bridges can be concreted to enable flushing out for maintenance purposes.		
	On-street angled parking is proposed in front of the IGA supermarket next to Booyun		
	Street. Approximately five 30° angled car spaces can be fitted. We propose reverse		
	parking to improve the safety of cyclists in Tweed Street. Provision of disabled parking		
	in this section is not proposed, as there is disabled parking on-site behind the		
On-street parking	supermarket. The existing informal parking on the western side of Tweed Street next		
	to Fingal Lane is proposed to be formalised into two parallel parking spaces to serve		
	the shop fronting it. Additional parallel parking is also provided.		
	Total proposed car spaces: 11		
Bus stops	It is proposed to formalise bus stops on Tweed Street between Fingal Lane and		
	Mullumbimbi Street, on the eastern side of Tweed Street.		
Landscaping	Landscaping is proposed on the median as well as on roundabout islands and near		
B	laneway intersections.		
Signage	Wayfinding signage is proposed at the various intersections to improve wayfinding to		
	the CBD to the east of the site.		
Speed zones	The extent of works is proposed to be signposted as a 50 km/h speed zone. This can		
	be reduced to a 40 km/h speed zone if required.		

6.1.2. Costs & Staging

The approximate costs of each item for this option are described in Table 3. All costs are inclusive of a 30% contingency, however these prices exclude 10% GST. Each item has been categorised as either 'Core' or as 'Optional' depending on the necessity of the item in achieving the core objective of the option.



Item	Priority	Approximate Construction Cost
Preliminaries	Core	\$418,000
Services	Core	\$243,000
Footpath	Core	\$139,000
Driveway reinstatements	Core	\$91,000
Roundabouts (excl. reseal)	Core	\$55,000
New pavement	Core	\$124,000
Total core items		\$1.07M
Removal existing kerb and gutter	Optional	\$26,000
Grass swales	Optional	\$110,000
New kerb and gutter	Optional	\$72,000
Median strip concrete works	Optional	\$161,000
Median strip landscaping works	Optional	\$26,000
Bicycle lanes	Optional	\$75,000
Roadside landscaping	Optional	\$39,000
Street furniture	Optional	\$81,500
Lighting	Optional	\$81,900
Bus stop	Optional	\$53,300
Total optional items		\$0.72M
Grand total		\$1.79M

The complete cost estimate is attached in Appendix F. After inclusion of overheads associated with the project planning and site establishment, the total project fee is estimated to be in the order of \$2M excl. GST.

6.1.3. SWOT analysis

Table 4 | Option 1 SWOT analysis

Strengths	Weaknesses	
 Reflects existing masterplan Consistent design throughout road section Roundabouts improve intersection safety and slow down traffic 	CostFew car spaces	
Opportunities	Threats	
 Stormwater trunk main construction Increased use of the CBD by bicycle users (if bicycle lanes are adopted) 	 Reduced project viability due to associated cost – there may not be sufficient budget for these works Vehicle safety associated with infrangible median obstructions such as trees Potentially increasing the need for additional street lighting due to screening by median trees 	



6.2. OPTION 2

The main purpose of Option 2 is to reduce vehicle speeds and to discourage through traffic on Tweed Street from Fingal Street to Mullumbimbi Street, redirect traffic into Mullumbimbi Street and Fingal Street towards the town centre and to create on-street parking between Mullumbimbi Street and Fingal Street to service future commercial development in this precinct.

It is proposed to construct a landscaped median between Booyun Street and Fingal Street as per Option 1, to not only create a roundabout at Fingal Street and Mullumbimbi Street, but to layout to the legs of the roundabouts such that the route Fingal Street – Park Street – Mullumbimbi Street becomes a main route.

This is achieved by narrowing the remaining two legs of both roundabouts and by creating raised pedestrian zebra crossings on the northern leg of the Fingal Street roundabout and on the southern leg of the Mullumbimbi Street roundabout. This would reduce through traffic vehicle speeds and direct visitors intuitively to the eastern part of town.

The section of Tweed Street between Fingal Street and Mullumbimbi Street would include removal of existing linemarking, then linemarking the existing pavement to create a 7.5m wide carriageway through the centre of the existing pavement, with angled car parking on both sides of the road between Fingal Street and Mullumbimbi Lane.

6.2.1. Design Characteristics

A design overview is provided in Table 5.

Table 5 | Option 2 Design Characteristics

Element	Description			
Footpaths	Footpaths are proposed on both sides of the road within the road verge, approximately 1.5 metres from the boundaries. The footpaths would work in with paved seating areas that would be constructed in front of local cafés and restaurants. Footpaths would be constructed at 1.2 metre widths.			
Bicycle paths	1.6m wide bicycle paths will be on-road and painted green as shown in the figure below. Bike paths are proposed on both sides of the road.			
Pedestrian crossings	Pedestrian crossings will be created using zebra crossings with median refuge islands. In order to enhance pedestrian flow from the western end of town to the CBD, these pedestrian crossings are proposed on the western side of each side road intersection. This will also result in the slowing down of traffic, thus creating a lower-speed environment.			



	Pedestrian crossings on the northern leg of the Fingal Street roundabout and the southern leg of the Mullumbimbi Street roundabout will be raised, painted and zebra marked.
Median	On the section of Tweed Street from Booyun Street to Fingal Street, it is proposed to include a three metre wide landscaped median. This could be constructed by excavating the existing pavement throughout the median and backfilling with a soil mixture that has high infiltration capabilities and also sufficient nutrient loading and support for the landscaping on top. This approach, however, is costly. Another option would be to create a raised concrete median that is placed on top of the existing wearing course with adhesives and/or dowels. On top of this raised median, landscaping pots can be placed that have drainage holes in the base. Between Fingal Street and Mullumbimbi Street no median is proposed, as the carriageway is narrowed up to create on-street angled car parking and additional
	landscaping Booyun Street: Four-way crossing with give-way treatment, favouring traffic on Tweed Street
Intersections	 Fingal Lane: Four-way crossing with give-way treatment, favouring traffic on Tweed Street. Median can be opened up to allow right turn out of Fingal Lane. Fingal Street: Roundabout with four legs and one circulating lane. Traffic turning right into Fingal Street would be through traffic. The northern leg to be narrowed with raised pedestrian crossing Mullumbimbi Lane: Four-way crossing with give-way treatment, favouring traffic on Tweed Street. Mullumbimbi Street: Roundabout with four legs and one circulating lane. Traffic into Mullumbimbi Street: Roundabout with four legs and one circulating lane. Traffic into Mullumbimbi Street to be favoured, southern leg to have a raised, painted pedestrian crossing. Kerbing to be used to narrow down approach and departure lanes from side streets.
Road runoff drainage	Grades throughout Tweed Street are relatively flat. Existing trunk mains also have inadequate capacity. Thirdly, the infiltration capacity of the soil is minimal. In order to provide a drainage solution that improves the visual amenity whilst limiting the discharge increase into side streets, we will apply grass swales where possible. These can be constructed relatively flat, so that some ponding can occur in these. Any silt build up will move through the grass due to rain, thus removing the visual amenity concern with silting up of kerb and gutters that is currently the case. Where grass swales are proposed, existing kerb and guttering is to be removed. Using landscaped areas at the side road intersections, the discharge from these swales can be transitioned to existing kerb and gutter infrastructure in the side streets. Footpath crossings of the grass swales can be constructed as low timber bridges (with grades compliant with wheelchair ramp requirements). The drain section underneath
On-street parking	On-street angled parking is proposed in front of the IGA supermarket next to Booyun Street. Approximately seven 30° angled car spaces can be fitted. We propose reverse parking to improve safety for cyclists in Tweed Street. Provision of disabled parking in this section is not proposed, as there is disabled parking on-site behind the supermarket. The existing informal parking on the western side of Tweed Street next to Fingal Lane is proposed to be formalised into two parallel parking spaces to serve the shop fronting it.
	Additional on-street angled car parking is proposed on both sides of Tweed Street between Fingal Street and Mullumbimbi Lane



	Total proposed car spaces: 11
Buc stops	It is proposed to formalise bus stops on Tweed Street between Fingal Lane and
bus stops	Mullumbimbi Street, on both sides of Tweed street.
	Landscaping is proposed on the median as well as on roundabout islands and near
Landscaping	laneway intersections. Additional road side landscaping is proposed on both sides of
	Tweed Street between Mullumbimbi Lane and Mullumbimbi Street.
Signage	Wayfinding signage is proposed at the various intersections to improve wayfinding to
	the CBD to the east of the site.
Speed zones	The extent of works is proposed to be signposted as a 50 km/h speed zone. This can
	be reduced to a 40 km/h speed zone if required.

6.2.2. Costs & Staging

The approximate costs of each item for this option are described in Table 6. All costs are inclusive of a 30% contingency, however these prices exclude 10% GST. Each item has been categorised as either 'Core' or as 'Optional' depending on the necessity of the item in achieving the overall objective of the option.

ltem	Priority	Approximate	
	•	Construction Cost	
Preliminaries	Core	\$418,000	
Removal existing kerb and gutter	Core	\$30,000	
New kerb and gutter	Core	\$83,000	
Services	Core	\$243,000	
Driveway reinstatements	Core	\$91,000	
Roundabouts	Core	\$54,000	
New pavement	Core	\$196,000	
Total core items		\$1.11M	
Grass swales	Optional	\$114,000	
Footpaths	Optional	\$47,000	
Median strip concrete works	Optional	\$40,000	
Bicycle lanes	Optional	\$72,000	
Roadside landscaping	Optional	\$26,000	
Street furniture	Optional	\$70,000	
Lighting	Optional	\$62,000	
Bus stop	Optional	\$7,000	
Total optional items		\$0.44M	
Grand total		\$1.55M	

Table 6 | Option 2 Cost and staging

The complete cost estimate is attached in Appendix F. After inclusion of overheads associated with the project planning and site establishment, the total project fee is estimated to be in the order of \$1.6M excl. GST.



6.2.3. SWOT analysis

Table 7 | Option 2 SWOT analysis

Strengths	Weaknesses
 Significantly improves intuitive way finding towards the CBD to the East of Tweed Street Addresses community objectives Roundabouts improve intersection safety 	 Removal of existing high quality pavement through centreline of existing road (if median gardens are adopted) Few car spaces Cost
Opportunities	Threats
 Improvement of CBD commerce and tourism Stormwater trunk main construction Improvement of Tweed Street community and business activity 	 Limited project viability due to associated cost – there may not be sufficient budget for these works. Vehicle safety associated with infrangible median obstructions such as trees Potentially increasing the need for street lighting due to screening by median trees Partial deviation from current masterplan

6.3. OPTION 3

The purpose of Option 3 is to provide a low-cost solution that meets the main upgrade objectives of improving wayfinding, pedestrian (cross-) flows, formalising infrastructure and the creation of gardens and landscaping.

This is achieved by minimising removal of any existing infrastructure, and achieving the objectives using line marking and minimal infrastructure upgrades.

As part of this option it is proposed to remove all existing linemarking, and create a 7.5m two-way carriageway throughout, whilst creating angled on-street parking where feasible. The shoulders between existing seal and kerb and gutter could be sealed to create more parking and improving the visual amenity by removing the gravel shoulders between the existing edge of seal and kerb and gutter. In other places, the shoulders will be used to construct landscaping. The existing kerb and gutter would remain in place as is.

6.3.1. Design Characteristics

A summary of the design characteristics is provided below in Table 8.

Table 8 | Option 3 Design Characteristics

Element	Description
Footpaths	Footpaths are proposed on both sides of the road, within the road verge at approximately 1.5 metres from the boundaries. The footpaths would work in with paved seating areas that would be constructed in front of local cafés and restaurants. Footpaths would be constructed at 1.2 metre widths.
Bicycle paths	1.5m wide bicycle paths will be on-road and painted green as shown in the figure below. Bike paths are proposed on both sides of the road.



Pedestrian crossings	Pedestrian crossings will be created using zebra crossings without median refuge islands. Pedestrian crossings would be proposed at each side street intersection.
Median	No medians are proposed. The road is to be linemarked with a centreline.
Intersections	All existing turning lanes to be removed and new linemarking installed to narrow down approach and departure lanes, in particular from side streets.
Road runoff drainage	Grades throughout Tweed Street are relatively flat. Existing trunk mains also have inadequate capacity. Thirdly, the infiltration capacity of the soil is minimal. In order to provide a drainage solution that improves the visual amenity whilst limiting the discharge increase into side street, we will apply grass swales where possible. These can be constructed relatively flat, so that some ponding may occur in these. Any silt build up will move through the grass due to rain, thus removing the visual amenity concern with silting up of kerb and gutters that is currently the case. Where grass swales are proposed, existing kerb and guttering is to be removed. Using landscaped areas at the side road intersections, the discharge from these swales can be transitioned to existing kerb and gutter infrastructure in the side streets. Footpath crossings of the grass swales can be constructed as low timber bridges (with grades compliant with wheelchair ramp requirements). The drain section underneath these bridges can be concreted to enable flushing out for maintenance purposes.
On-street parking	On-street angled parking is proposed in front of the IGA supermarket next to Booyun Street. Approximately eight 45 degree car spaces can be fitted. Reverse parking is proposed to improve cyclist safety. Provision of disabled parking in this section is not proposed, as there is disabled parking on-site behind the supermarket. The existing informal parking on the western side of Tweed Street next to Fingal Lane is proposed to be formalised into two parallel parking spaces to serve the shop fronting it. Additional on-street angled car parking is proposed on both sides of Tweed Street between Fingal Street and Mullumbimbi Lane. Total proposed car spaces: 34
Bus stops	It is proposed to formalise bus stops on Tweed Street between Fingal Lane and Mullumbimbi Street, on both sides of Tweed Street.
Landscaping	Landscaping is proposed on the shoulders where suitable.
Signage	Wayfinding signage is proposed at the various intersections to improve wayfinding to the CBD to the East of the site.
Speed zones	The extent of works is proposed to be signposted as a 50 km/h speed zone. This can be reduced to a 40 km/h speed zone if required.



6.3.2. Costs & Staging

The approximate costs of each item for this option are described in Table 9. All costs are inclusive of a 30% contingency, however these prices exclude 10% GST. Each item has been categorised as either 'Core' or as 'Optional' depending on the necessity of the item in achieving the overall objective of the option.

ltem	Priority	Approximate Construction Cost	
Preliminaries	Core	\$418,000	
Services	Core	\$243,000	
Driveway reinstatements	Core	\$78,000	
New pavement	Core	\$162,000	
Removal existing concrete median	Core	\$1,000	
Bicycle lanes	Core	\$62,000	
Total core items		\$0.96M	
Footpaths	Optional	\$4,000	
Roadside landscaping	Optional	\$13,000	
Street furniture	Optional	\$60,000	
Lighting	Optional	\$62,000	
Bus stop	Optional	\$6,500	
Grass swales	Optional	\$40,000	
Total optional items		\$0.19M	
Grand total		\$1.15M	

Table 9 | Option 3 Costs

The complete cost estimate is attached in Appendix F. After inclusion of overheads associated with the project planning and site establishment, the total project fee is estimated to be in the order of \$1.15M excl. GST

6.3.3. SWOT analysis

Table 10 | Option 3 SWOT analysis

Strengths	Weaknesses	
 Maximise the use of existing assets Lower cost solution Addresses key community objectives Highest number of parking spaces Vehicle speed reduction due to raised pedestrian crossings 	 Does not address all community objectives Reduced use of street trees 	
Opportunities	Threats	
 Stormwater trunk main construction Future installation of roundabouts when additional budget is available 	 May not promote commercial viability of tweed Street 	

7. OPTIONS ASSESSMENT



7.1. COMPARISON AGAINST COMMUNITY OBJECTIVES

A discussion of each community objective is provided below. The results are summarized in Table 11.

Lower Speed Environment - Options 1 and 2 incorporate roundabouts which will slow down through traffic. In addition, Option 2 includes raised sections of road between the Fingal Street roundabout and the Mullumbimbi Street roundabout, which create a further speed reduction in that section. Option 3 includes raised pedestrian crossings and these will reduce vehicle speeds between intersections.

Reduction of traffic noise – Due to the reduction in vehicle speed, all options achieve a likely reduction in road traffic noise also. Option 2 potentially achieves a further reduction in traffic noise between Fingal Street and Mullumbimbi Street by diverting some traffic further east. The slower speed environment between Fingal Street and Mullumbimbi Street will reduce noise even further.

Care needs to be taken during the detailed design and construction of the raised sections of road in Option 2 with regards to surface treatments, that these do not create additional noise when vehicles travel over these raised sections.

Additional landscaping and green space – Both Options 1 and 2 provide ample opportunities for softening the street scape by the removal of excess pavement, the kerbs and gutter, and the introduction of grassed swales and landscaped areas. The landscaped central median which is both included in Options 1 and 2, but of which most is included in Option 1, adds to the landscaping potential. Option 3 has the least opportunity for landscaping.

Relation to the commercial centre of the town – Option 2 would score highest on this item due to the physical design to intuitively direct traffic to the east. This has been achieved by creating raised sections of road on the northern leg of the Fingal Street roundabout and the southern leg of the Mullumbimbi Street roundabout in addition to directional signage.

The second best would be Option 1, where the roundabouts help slow traffic down to enable decision making to change direction towards the east.

Option 3 would be the least successful at achieving this objective, as the through traffic lanes are not interrupted. Wayfinding is proposed to be improved by using better signage, which applies to all three options.

Improved access and flow for pedestrians, bicycles and mobility scooters – All options include painted bicycle lanes and additional pedestrian crossings, however Option 3 contains the least number of crossings. This item is best achieved in Options 1 and 2 as these designs create a lower speed environment, hence naturally improving cross flow by pedestrians. Option 2 would score highest through the use of raised pedestrian crossings between the Fingal Street and Mullumbimbi Street roundabouts.

Improve visual amenity using landscaping and artistic expressions to create a landmark entrance to Brunswick Heads – Option 2 would best meet this objective as it is most successful at directing traffic into the centre of Brunswick Heads. Option 1 partially meets the objective through the use of roundabouts and landscaped medians. Option 3 has the least affinity with this requirement.

Meet the design intent of the 2009 Draft Master Plan where feasible – Although Option 1 most closely meets the 2009 Draft Master Plan design, Option 2 meets the community objectives more effectively. Option 3 only marginally meets the design intent.

A summary of the above discussion is provided in Table 11. In this table, each option is given a \checkmark if it meets the community objective, a \bigcirc if it partially meets the objective and a \times if it does not meet the community objective.



Community objective	Option 1	Option 2	Option 3
Lower speed environment	\checkmark	\checkmark	0
Reduction of traffic noise	~	\checkmark	0
Additional landscaping and green space	~	\checkmark	0
Relation to commercial centre of town	0	\checkmark	×
Improved access and flow for bicycles and mobility scooters	\checkmark	\checkmark	\checkmark
Improve visual amenity using landscaping and artistic expressions to create a landmark entrance to Brunswick Heads	~	~	×
Meet the design intent of the 2009 Draft Master Plan where feasible	\checkmark	\checkmark	0

Table 11 | Comparison Against Project Objectives

8. RECOMMENDATIONS

8.1. STORMWATER TRUNK MAIN

During the design process, the opportunity for a stormwater conveyance strategy for Brunswick Heads was identified. It is understood that existing stormwater trunk mains are failing and are inadequate, and that replacement would be a complicated and lengthy process as these mains run through private properties without easements.

The upgrade of Tweed Street provides the opportunity to construct a stormwater trunk main deep under the Tweed Street road reserve. Although Tweed Street is higher than most of the adjacent side streets, if a trunk main were constructed of sufficient depth, then the adjacent side streets and laneways could drain back into the pipe, through a system of pits and pipes, thus significantly improving the drainage for these side streets and laneways. It is understood that inundation issues currently exist in the side streets and laneways, thus such a trunk main would be a good solution.

Although the construction of such a trunk main would be most cost effective when carried out in conjunction with the Tweed Street upgrade project, linking the two projects would likely slow down the Tweed Street upgrade or make it too costly. To overcome this issue and provide an intermediate solution, we have included a system of grassed swales in the various options presented in this report. If the alignment of a trunk main is chosen such that it is underneath these swales, then the cost and complexity of retrospective installation of a stormwater trunk main can be significantly reduced as it would only require excavation and reinstallation of these swales and side street crossings.

8.2. TRAFFIC AND TRAVEL ROUTE STUDY

Option 2 of this report is designed to encourage traffic to divert from Tweed Street into Fingal and Mullumbimbi Street towards the centre of the CBD to the east of Tweed Street. This provides the opportunity to create a townroute potentially through Park Street and Fawcett Street, which would significantly enhance commercial properties' exposure to traffic along this route and activate the town centre more as the wayfinding to the town centre becomes more intuitive. The section of Tweed Street between Fingal Street and Mullumbimbi Street will have increased parking and pedestrian traffic. This would encourage expansion of the commercial precinct towards Tweed Street, thus increasing the size of the commercial precinct and the viability of the town itself.


As such, there is an opportunity to carry out a traffic and travel route study in combination with a parking study to inform a traffic strategy for Brunswick Heads, with the aim of optimising wayfinding and facilitating long term commercial planning for Brunswick Heads. As with the congestion in Byron Bay, towns such as Brunswick Heads are becoming increasingly popular tourist destinations. Therefore, there is an opportunity at this time to plan ahead for this growth of Brunswick Heads so that the growth of tourism and commerce can be planned and guided in conjunction with the local community to create a top tourist destination for Northern NSW.

8.3. OVERALL BRUNSWICK HEADS MASTER PLAN

Following the example of the Byron Bay, Mullumbimby and Bangalow master plans, the issues raised in this report (such as traffic, parking and drainage) could be included in an overall Brunswick Heads master plan that assesse Brunswick Heads as a whole.

8.4. STAGING OF BUDGET

In order to improve project viability, it would be an option to stage the project such that essential components (all civil works and road lighting) are carried out first, whilst art works, some landscaping, pocket parks, etc. are carried out later when additional budget becomes available for these place-making components.

Staging can also be achieved first construction core elements of the selected option and addition of optional elements as funding becomes available. Table 12 summarises the cost breakdown of each option.

Cost item	Option 1	Option 2	Option 3
Core items	\$1.07M	\$1.11M	\$0.96M
Optional items	\$0.72M	\$0.44M	\$0.19M
Total	\$1.79M	\$1.55M	\$1.15M

Table 12 | Cost summary, including 30% contingency, excl GST

8.5. ASBESTOS WATER MAIN

An abandoned asbestos water main was discovered along some of the alignment in Tweed Street, as shown on the survey plans within the set of plans attached in Appendix G. In conjunction with this main, in-ground fire hydrant valves were found that were marked with yellow paint, as if still in operation. These hydrants would need to be removed as soon as possible as they pose a risk to firefighting effectiveness in Tweed Street.

We understand from former Council staff that sections of this abandoned water main were removed throughout the 1980's and 90's, however not all sections were removed. The asbestos water mains throughout the shire were subject to damage due to traffic loading, which resulted in leakages and damage to road pavements.

We recommend that this asbestos water main is removed in its entirety, however there may be significant cost involved with the removal. Alternatively, if any sections of abandoned asbestos water main are uncovered during construction works, then these sections should be removed as a minimum.

8.6. OPTION SELECTION

Assessment of the options to move forward should be based on the following criteria:

- Cost and funding
- Community benefit and need
- Outcome of drainage investigation
- Outcome of traffic study
- Outcome of a Brunswick Head wide masterplans



8.6.1. Cost and funding

Project funding is a key component that would determine the viability of the project. Funding could potentially be achieved using (a mix of) the following sources:

- Funding by Council
- A grant from the NSW state government
- A Section 94 contribution plan
- Retrospective funding by paid parking scheme

The benefits of a Section 94 contribution plan are that funding is raised from developers rather than the community. This would also find wider community support outside Brunswick Heads, as any funding by Council would be raised from rate payers throughout the shire, some of whom may not agree with the need for it. A Section 94 contribution plan would raise funds for the upgrade directly from those who benefit most from it.

The disadvantages of a Section 94 contribution plan are that it may take a long time until sufficient funds are raised to commence the construction of the project. It may also deter some developers due to increased development cost.

8.6.2. Community benefit and need

Option 2 would likely have the greatest community benefit. In addition to signage, it employs physical restraints at the roundabouts to intuitively direct drivers to the town centre in the east. As signage only has limited effectiveness, the use of physical design to direct traffic intuitively greatly enhances wayfinding.

Option 2 is a slight deviation from the original community plan which is best reflected by Option 1. Option 1 has been designed to closely match the community masterplan, whilst ensuring that the physical components such as car parking dimensions and roundabout design comply with relevant standards.

8.6.3. Outcome of drainage investigation

A stormwater trunk main through Tweed Street, if constructed at the same alignment as the grassed swales shown in Options 1 and 2, can be retrofitted if it is determined that this trunk main should be constructed at a later date. Options 1 and 2 will allow retrofitting at minimal cost.

If Option 3 is adopted the trunk main should be constructed prior to construction of the Tweed Street upgrade. Option 3 involves sealed pavement from kerb to kerb, therefore the retrofitting of a stormwater trunk main would require excavation and reinstatement of pavement along the entire length of the project, which would drive up project cost.

8.6.4. Outcome of the traffic, travel and parking study

Option 1 and Option 3 do not include a physical change to the major travel route other than signage, and therefore may not have a significant effect on the main travel route through Brunswick Heads. Option 2 provides a physical means of intuitively encouraging more traffic to divert towards the town centre to the east of Tweed Street. Therefore, adopting this option would assist with any need to divert traffic to the town centre. The impact and effectiveness of this should be modelled as part of a traffic study.

It is recommended that traffic, travel and parking studies are carried out prior to detailed design of this project. Such studies may identify a need to increase or decrease on-street parking along Tweed Street. Such a need should be incorporated into the final detailed design.

Following the paid parking scheme success in Byron Bay, there is an opportunity to introduce a paid parking scheme to certain precincts within Brunswick Heads. As paid parking would significantly alter parking behaviour and traffic movements, the need and details of such a scheme should be identified and resolved prior to carrying out detailed design as it would impact on the number and layout of on-street car spaces along Tweed Street.



APPENDICES

- Appendix A 2009 Tweed Street Master Plan
- Appendix B Dial Before You Dig Results
- Appendix C Detail Survey
- Appendix D Geotechnical Report
- Appendix E Site Photos
- Appendix F Cost Estimates
- Appendix G Concept Plans



APPENDIX A | 2009 TWEED STREET MASTER PLAN









APPENDIX B | DIAL BEFORE YOU DIG RESULTS



Job No 10659045

Caller Details

Contact:	Mr Niek van Oers	Caller Id:	1508213	Phone:	0415507523
Company:	WGM Consulting	Mobile:	0415507523	Fax:	Not Supplied
Address:	Suite 9A 80-84 Ballina Street Lennox Head NSW 2478	Email:	niek@wgmconsultin	g.com.au	

Dig Site and Enquiry Details

WARNING: The map below only displays the location of the proposed dig site and does not display any asset owners' pipe or cables. The area highlighted has been used only to identify the participating asset owners, who will send information to you directly.



set owners, who will send info	ormation to you o	lirectly.			
User Reference:	2237				
Working on Behalf of:					
Byron Shire Council					
Enquiry Date:	Start Date:	End Date:			
09/05/2016	11/05/2016	26/05/2016			
Address:					
Mullumbimbi Street					
Brunswick Heads NSW 24	483				
Job Purpose:	Excavation				
Onsite Activity:	Mechanical Ex	cavation			
Location of Workplace:	Both				
Location in Road:	CarriageWay,	Footpath,Nature Strip			
 Check that the location submit a new enquiry. Should the scope of wor you must submit a new Do NOT dig without plan 	of the dig site is ks change, or pla enquiry. ns. Safe excavati	correct. If not you mus an validity dates expire on is your responsibility			
I you do not understand the plans of now to proceed salely,					

please contact the relevant asset owners.

Notes/Description of Works:

Not Supplied

Your Responsibilities and Duty of Care

- If plans are not received within 2 working days, contact the asset owners directly & quote their Sequence No.
- ALWAYS perform an onsite inspection for the presence of assets. Should you require an onsite location, contact the asset owners directly. Please remember, plans do not detail the exact location of assets.
- Pothole to establish the exact location of all underground assets using a hand shovel, before using heavy machinery.
- Ensure you adhere to any State legislative requirements regarding Duty of Care and safe digging requirements.
- If you damage an underground asset you MUST advise the asset owner immediately.
- By using this service, you agree to Privacy Policy and the terms and disclaimers set out at www.1100.com.au
- For more information on safe excavation practices, visit www.1100.com.au

Asset Owner Details

The assets owners listed below have been requested to contact you with information about their asset locations within 2 working days. Additional time should be allowed for information issued by post. It is **your responsibility** to identify the presence of any underground assets in and around your proposed dig site. Please be aware, that not all asset owners are registered with the Dial Before You Dig service, as it is asset owners are registered with the Dial Before You Dig service,

so it is **your responsibility** to identify and contact any asset owners not listed here directly. ** Asset owners highlighted by asterisks ** require that you visit their offices to collect plans.

Asset owners highlighted with a hash require that you call them to discuss your enquiry or to obtain plans.

Seq. No.	Authority Name	Phone	Status
52705728	Essential Energy	132391	NOTIFIED
52705730	Optus and/or Uecomm, Nsw	1800505777	NOTIFIED
52705729	Telstra NSW, North	1800653935	NOTIFIED

END OF UTILITIES LIST





WARNING: This document is confidential and may also be privileged. Confidentiality nor privilege is not waived or destroyed by virtue of it being transmitted to an incorrect addressee. Unauthorised use of the contents is therefore strictly prohibited. Any information contained in this document that has been extracted from our records is believed to be accurate, but no responsibility is assumed for any error or omission. Optus Plans and information supplied are valid for 30 days from the date of issue. If this timeline has elapsed please raise a new enquiry.

Sequence Number: 52705730



For all Optus DBYD plan enquiries – Email: <u>Fibre.Locations@optus.net.au</u> For urgent onsite assistance contact 1800 505 777 Optus Limited ACN 052 833 208



LEGEND

For more info contact a Telstra Accredited Locater or Telstra Plan Services 1800 653 935







One 50mm PVC conduit (P50) containing a 50-pair and a 10-pair cable between two 6-pits, 20.0m apart, with a direct buried 30-pair cable along the same route.

Two separate conduit runs between two footway access chambers (manholes) 245m apart. A nest of four 100mm PVC conduits (P100) containing assorted cables in three ducts (one being empty) and one empty 100mm concrete duct (C100) along the same route.

WARNING: Telstra plans and location information conform to Quality Level 'D' of the Australian Standard AS 5488 - Classification of Subsurface Utility Information. As such, Telstra supplied location information is indicative only. Spatial accuracy is not applicable to Quality Level D. Refer to AS 5488 for further details. Telstra does not warrant or hold out that its plans are accurate and accepts no responsibility for any inaccuracy shown on the plans. FURTHER ON SITE INVESTIGATION IS REQUIRED TO VALIDATE THE EXACT LOCATION OF TELSTRA PLANT PRIOR TO COMMENCING CONSTRUCTION WORK. A plant location service is an essential part of the process to validate the exact location of Telstra assets and to ensure the asset is protected during construction works. The exact position of Telstra assets can only be validated by physically exposing it. Telstra will seek compensation for damages caused to its property and losses caused to Telstra and its customers.



Telstra	For all Telstra DBYD plan enquiries -	Sequence Number: 52705729
	For urgent onsite contact only - ph 1800 653 935 (bus hrs)	CAUTION: Critical Network Route in plot area.
TELSTRA C	ORPORATION LIMITED A.C.N. 051 775 556	DO NOT PROCEED with any excavation phot to
Generated On 09/05/2016 08:49:14		1800 653 935

The above plan must be viewed in conjunction with the Mains Cable Plan on the following page

WARNING - Due to the nature of Telstra underground plant and the age of some cables and records, it is impossible to ascertain the precise location of all Telstra plant from Telstra's plans. The accuracy and/or completeness of the information supplied can not be guaranteed as property boundaries, depths and other natural landscape features may change over time, and accordingly the plans are indicative only. Telstra does not warrant or hold out that its plans are accurate and accepts no responsibility for any inaccuracy shown on the plans.

It is your responsibility to locate Telstra's underground plant by careful hand pot-holing prior to any excavation in the vicinity and to exercise due care during that excavation.

Please read and understand the information supplied in the duty of care statement attached with the Telstra plans. TELSTRA WILL SEEK COMPENSATION FOR LOSS CAUSED BY DAMAGE TO ITS PLANT.

Telstra plans and information supplied are valid for 60 days from the date of issue. If this timeframe has elapsed, please reapply for plans.



		0m 20m 40m 60m 80m 100m		
Telstra	For all Telstra DBYD plan enquiries -	Sequence Number: 52705729		
For urgent onsite contact only - ph 1800 653 935 (bus hrs		CAUTION: Critical Network Route in plot area. DO NOT PROCEED with any excavation prior to		
TELSTRA CORPORATION LIMITED A.C.N. 051 775 556 Generated On 09/05/2016 08:49:25				
		1800 653 935		

WARNING - Due to the nature of Telstra underground plant and the age of some cables and records, it is impossible to ascertain the precise location of all Telstra plant from Telstra's plans. The accuracy and/or completeness of the information supplied can not be guaranteed as property boundaries, depths and other natural landscape features may change over time, and accordingly the plans are indicative only. Telstra does not warrant or hold out that its plans are accurate and accepts no responsibility for any inaccuracy shown on the plans.

It is your responsibility to locate Telstra's underground plant by careful hand pot-holing prior to any excavation in the vicinity and to exercise due care during that excavation.

Please read and understand the information supplied in the duty of care statement attached with the Telstra plans. TELSTRA WILL SEEK COMPENSATION FOR LOSS CAUSED BY DAMAGE TO ITS PLANT.

Telstra plans and information supplied are valid for 60 days from the date of issue. If this timeframe has elapsed, please reapply for plans.

Tweed Street Options Assessment Byron Shire Council



APPENDIX C | DETAIL SURVEY







APPENDIX D | GEOTECHNICAL REPORT

21 Clark Street, Ballina, NSW, 2478 ABN: 12591694943 P: (02) 66874450 E: info@civilconsult.com.au

19t^h October 2016

PLANIT Shop 9a 80-84 Ballina Street LENNOX HEAD, NSW 2478 Attention: Simon Millichamp

ENGINEERING REPORT

Geotechnie	cal Investig	ation and Pav	ement l	Design, Tweed S	itreet Upgrade
Job No.	16041	Rev No.	1	Date	19/10/2016

1 Introduction

This report presents the results of a factual geotechnical investigation carried out at the site of a proposed street upgrade in Brunswick Heads as part of the Tweed Street upgrade proposal. The focus of the geotechnical investigation was on areas of existing sealed pavement. Test pits were undertaken to examine the condition within gravel and subgrade/natural materials.

The scope of the services provided by Civil Consult included the following;

- o Production of geotechnical test pit logs
- Factual geotechnical report of the findings
- o Presentation of the subsurface profile
- Presentation of laboratory testing undertaken
- o Pavement design

2 Site Conditions

2.1 Site Description

The site is located in the centre of Brunswick Heads on a predominantly flat section of Tweed Street between Booyun Street and Mullumbimbi Street. The site consists of an existing pavement of approximately 300m long by 15.5m wide with commercial and residential buildings along both eastern and western boundaries of the street. Tweed Street is currently live to motor vehicle, cycle and pedestrian traffic, incorporating concrete kerb and guttering, foot paths, traffic islands, road and pedestrian signage, power poles and mature vegetation within the footprint of the

proposed upgrade. Unsealed sections were observed on both the eastern and western shoulders of Tweed Street between the existing seal and the kerb and guttering.

2.2 Site Geological Setting

The site is identified as part of the Tyagarah Landscape (ty) as defined by Morand (1994)¹. The Tyagarah landscape is defined as sediment basins of mixed estuarine and aeolian origin forming level to gently undulating plains. Reference to The Lismore-Ballina 1:100 000 geological map indicates that the site is underlain by Quaternary estuarine alluvium overlain by and/or mixed with Quaternary (Pleistocene) sands. The sands are generally aeolain, originating from the adjacent beach ridge systems.

3 Field Investigation

The location of the test pits were agreed upon with the client prior to the works being undertaken and incorporated a services location provider. On completion of each pit, the holes were backfilled and compacted using machine compaction equipment followed by the reinstatement of existing gravel and cold mix seal.

A Site Plan identifying approximate location of each test pit can be found in Appendix A.

Engineering logs are presented in Appendix B.

3.1 Field Work Undertaken

Five test pits were undertaken on the 21st of September 2016; TP1 to TP5 were excavated using a 5 tonne CAT 305D CR excavator. Test pits 1 and 3 were undertaken adjacent traffic islands on the eastern side of Tweed Street in the centre of Booyun and Fingal streets respectively. TP3 was excavated adjacent an existing pedestrian traffic island and crossing to the south of Fingal Lane on the western side of Tweed Street. TP4 was excavated in the centre of Tweed Street adjacent the northern side of Mullumbimi Lane and TP5 was undertaken in the centre of Mullumbimi Street on the western side of Tweed Street.

3.2 Field Sampling and Testing

A field sampling and testing program was undertaken during the investigation to determine the condition of the existing gravel and subgrade/insitu natural materials. Samples were taken from each test pit and delivered to Australian Soil and Concrete Testing for laboratory testing. A DCP (Dynamic Cone Penetrometer) was performed insitu at subgrade level for each test pit. The following table summarises the testing and sampling that was undertaken during the investigation.

Test Pit	Location	Gravel	Subgrade/ Insitu Natural Material
TP1	Intersection of Tweed Street and Booyun Street, Eastern side	-	DCP, CBR, Permeability
TP2	Adjacent southern side of Fingal Lane, Western side	CBR, PSD, PI	DCP, CBR, PSD, Permeability
TP3	Intersection of Tweed Street and Fingal Street, Eastern side	-	DCP, CBR
TP4	Centre of Tweed Street, adjacent northern side of Mullumbimbi Lane	CBR, PSD, PI	DCP, CBR
TP5	Intersection of Tweed Street and Mullumbimbi Street, Western side	-	DCP, CBR

Table 1 – Summary of testing and sampling undertaken

NOTE: CBR – California Bearing Ration, PSD – Particle Size Distribution, PI – Atterberg Limits, DCP – Dynamic Cone Penetrometer.

3.3 Subsurface Profile and Description

A summary of the subsurface profile is described as follows for Tweed Street Brunswick Heads;

Table 2 – Tweed Street Existing and Subgrade Profile

UNIT	Depth to top of layer (m)	Approximate layer thickness (m)
WEARING COURSE; 40mm AC seal.	n/a	n/a
EXISTING; GRAVEL, medium to coarse grained, slightly moist.	0	0.05-0.15
PRECEDING WEARING COURSE; 40mm AC seal.	0.15	n/a
PRECEDING EXISTING; GRAVEL, medium to coarse grained, dry.	0.55	0.15-0.40
NATURAL INSITU; SAND, fine to medium, dry.	1.6	Not determined

NOTE: AC – Asphalt Concrete.

Test pit 5 varied slightly from the summary presented above; Uncontrolled fill, (SAND) was observed beneath the preceding gravel fill.

Groundwater seepage was not observed at the time of the investigation. Ground water levels are transient and variations differing from those observed at the time of the investigation can be expected due to climatic effects, heavy rainfall and permeability of the soil strata.

4 Field Work Results

4.1 Laboratory Results

A summary of selected results is presented in the Table 4 for reference. Please note the full results of the laboratory testing is presented in Appendix C at the end of this report, and includes; Particle Size Distribution, Atterberg limits, CBR's and Permeability.

			% Passing Sieve				
Test Pit	Material Type	CBR (%)	Plasticity Index	37.5mm	19mm	2.36mm	Permeability
TD1	Subgrade/Insitu						
IPI	Natural	25	-	-	-	-	2.4e-6 (m/s)
TP2	Existing Gravel	14	4	89	74	35	-
тор	Subgrade/Insitu						/
IPZ	Natural	10	-	100	100	99	8.9e-7 (m/s)
трр	Subgrade/Insitu						
1P3	Natural	8	-	-	-	-	-
TP4	Existing Gravel	80	1	87	69	28	-
	Subgrade/Insitu						
TP4	Natural	5	-	-	-	-	-
TOF	Subgrade/Insitu						
185	Natural	20	-	-	-	-	-

Table 4 – Summary of selected laboratory results

4.2 Review of Existing Materials

From the investigation, varying levels of existing gravel subbase were noted across the site.

In order to retain this material and re-use in the new pavement arrangement, a review of the material has been undertaken and compared to a number of relevant specifications as follows;

- RMS 3051 DGS20 Subbase Requirements
- RMS 3071 SMZ lower layer Requirements
- RMS R44 SMZ lower layer Requirements
- Northern Rivers Local Government Construction NGS20 Subbase Requirements

From the review that was undertaken, the gravel material that was found in TP2 and TP4 does not meet the requirements of the Northern Rivers Local Government Construction Manual for base or subbase, however material observed in TP4 generally meets the requirements for RMS R44 Site Won Selected Material. This material is considered suitable for use in the SMZ layer of the proposed pavement, which is discussed in Section 5 of the report. Full details of the review are presented in Appendix F at the end of this memo.

Please note that there may be variability in quality and thickness of this material across the site in areas other than the specific test locations where test pits were undertaken. It is recommended that the depths and quality of this material is verified during construction stage, by further test pit testing and a minimum of 2 further CBR laboratory tests prior to installation of final pavement arrangement.

5 Pavement Design Methodology

Pavement design has been completed by Civil Consult in accordance with the following documents;

- Northern Rivers Council Development Design Specification Pavement Design.
- Austroads (2010) Guide to Pavement Structural Design. Part 2: Pavement Structural Design.

A flexible pavement solution consisting of a gravel subbase, base and asphalt-wearing course has been adopted for the purposes of design, in accordance with the references above.

5.1 Assumptions

Assumptions made during the design process have been outlined in Table 5 below.

Design Assumption	Value
AADT	5313 Based on WIMM data provided by Byron Shire Council for this road
Pavement Design Life	20 Years
Design ESA (DESA) – Proposed Road	3.24 x 10 ⁵
Subgrade CBR (%)	6.5

Table 5 – Design Assumptions

Full details of the DESA calculation have been provided at the end of this memo.

6 Pavement Design

Pavement design has been undertaken using Section D2.10 from the Northern Rivers Local Government Development Design Specification (Pavement Design), and a check has been carried out using Figure 8.4 of Austroads Pavement Structural Design (2012). The results of the analysis are attached at the end of this memo in Appendix D.

The subgrade CBR value adopted has been based on laboratory test results taken during the geotechnical investigation. A total of five (5) CBR tests were undertaken within the subgrade material and the design CBR has been calculated using the guidelines provided in Section D2.06 (4) of Northern Rivers Local Government Development Design Specification (Pavement Design) and reproduced below.

Design CBR = Least of estimated CBRs, for less than five results
Design CBR = 10th percentile of all estimated CBRS, for five or more results
= C - 1.3S
Where C is the mean of all estimated CBRs, and
S is the standard deviation of all values.

6.1 Subgrade design CBR

Due to the large variation in the subgrade CBR results, the statistical methods outlined above were not used, as this produced for too conservative design value for subgrade CBR. Based on an average value of 13.5, and a minimum value of 5, a design CBR value of 6.5 was adopted which is considered a moderately conservative value for the purposes of flexible pavement design.

7 Pavement Arrangement

The proposed pavement is a granular pavement with an Asphalt Concrete (AC) wearing course and the details of the configuration is provided in Table 6.

Table 6 – Proposed Pavement

Pavement Configuration	Course
40mm AC40	Wearing course
7mm Primerseal (7mm Aggregate with C170)	Seal
150mm DGB 20 (CBR>60%)	Base Course
200mm Crushed Chert, DGB or equivalent (CBR > 30%)	Subbase
Subgrade CBR>6.5%	Foundation (Insitu)

A sketch of the pavement arrangement is provided at the end of this memo, in Appendix D.

All works and materials for "Base Course & Subbase Course", and "SMZ" shall be controlled and in accordance with RMS Specifications; R44, R3071 & R3051, and relevant Northern Rivers Local Council Specifications.

7.1 Verification of CBR on site

The following must be undertaken during construction work to confirm the material CBR requirements listed in Table 5 of this report, and to meet the requirements the Northern Rivers Council Pavement design specification (Table D2.5);

• Undertake a minimum of 2 CBR tests within the existing gravel proposed for re-use.

7.2 Subsurface drainage

Subsurface drainage is used to maintain road formation and moisture conditions in pavement. Consistent moisture content provides structural adequacy and uniformity. Various drainage systems including edge drains, trench drains and drainage layers can be used to sufficiently drain the pavement and selected material zones. It is recommended that subsurface drainage is installed in accordance with the subsoil drainage detail prepared by Civil Consult and attached in Appendix E at the end of this report. All subsurface drainage should be installed as per Northern Rivers Local Government Development Design Specification (Subsurface Drainage).

8 Limitations of Pavement Design, Geotechnical Investigation & Design

This pavement has been designed using the assumptions presented within Table 1 and undertaken in accordance with generally accepted engineering practices including use of Austroads Pavement Structural Design Part 2 (2010), and Northern Rivers Council Development Design Specification Pavement Design. Civil Consult should be notified of any changes to these design assumptions as this will affect pavement configuration, and subsequently design life and performance of the pavement.

The results, analysis and design presented in this report are indicative of the specific investigation test location and sample points agreed upon between Civil Consult and the client.

The data provided in this report relates only to the structures and roads described within this report and should not be used or modified for any other purpose. Civil Consult accepts no liability for any use of the data by others.

The results and design work (where presented) in this report are based specifically on test and sample locations, and are only valid at these precise locations. At all other locations across the site differences will occur to varying degrees. The subsurface profile will vary between test locations and also between individual samples taken within a test location. Conditions in the subsurface profile including groundwater can change over short periods of time and this should be considered when reviewing data presented in this report.

The data presented in the report should be reviewed by a suitable qualified engineer when footings, excavations, and subsurface structures are installed to confirm assumed conditions presented in this report. If they do not agree, further advice should be sought immediately.

Due to inherent uncertainties when interpreting subsurface conditions, there are often cost variations during projects or during the execution of projects as a result of unanticipated subsurface conditions. Civil Consult accepts no responsibility for variation of the subsurface profile and the consequences of these variations on the project or execution of the project.

Civil Consult accepts no responsibility for the use or modification of the data presented within this report by others.

9 Reference

1. Morand D.T., 2001, *Soil Landscapes of the Lismore-Ballina*, *1:100,000 Sheet* report, NSW Department of Land and Water Conservation, Sydney.

If you should require any further information or clarification, please do not hesitate to contact this office.

Civil Consult Pty Ltd

Greg Saenger – Senior Geotechnical Engineer

civil consult

Consulting Engineers CPEng, MIEAust, NPER, RPEQ 0490 419 541

Appendix A – Site Plan Appendix B – Geotechnical Logs Appendix C – Laboratory Results Appendix D – Pavement Arrangement & Calculation Appendix E – Subsurface Drainage Detail Appendix F – Gravel Material Review



Appendix A – Site Plan



0.27	0.06	0.07	0.29	
4.60	4.20	3.80	3.40	
4.33	4.14	3.73	3.11	
	R	11.650.00 R 11,65	93.56 -2.0%	
960	<u> </u>	1000	1020	
GEC	SITE PLAN	0NS	ult 016	
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Appendix B – Geotechnical Logs

G	eo	te	ch	nica	al E	Ξng	gineerir	ng Log										Site Id	lenti	fier:	<u>TP1</u>		
Pro Cli Jo	oje en b N	ct: t: Iun	nbe	r:		Twe	eed Street L	Jpgrade PLANIT 16041	Type: Equipment: Contractor:	5 To Rugendy	Test onne excava vke & Bashfo	Pit ator orth	Dep Wic Len	oth: dth: igth:		1.40 0.50 1.00	m m m	D D L)ate ()ate (.ogge	Commenced Completed: ed by:	Page: 1 d: 21/09/2 21/09/2 Mitche	of 1 2016 2016 I Hill	
Sit Ea No Ele	e: stii rth eva	ng: ing tio): n:		Tw SE SE SE	eed E Pl E Pl E Pl	& Booyun, I _AN _AN _AN	Eastern side	North: Inclination: Azimuth:		- 90 -		Hor Ver Sur	izon tical vey:	tal D Datu	atum: ım:			- (- 1 -	Comments: Test pit terminate 1.4m, GW not ob	ed at target de served.	pth	
DI	RILI	LIN	G &	LEVEL	.s		N		ESCRIPTION	ESCRIPTION					ST	RENG	тн 8	& DEF	ECT	SAMI TEST	SAMPLES/ TESTING		
Method	Loddne	Moisture	RL (m)	Lithology Graphic	•	USCS Symbol	Lithology	DESCRIPTION Soil: colour, g Rock: colour,	l rain size/plasticity grain size, structu	re	Origin	Strength	Weathering	(Recovery%) RQD%	Defec (mm)	t Spacin	■ 1000 B	L/ TE	ABOR/ EST RI	ATORY ESULTS	DCP Blows/ 100mm	Depth	
			-		0.0 0.1	⁰ GW ⁵ GC	GRAVEL Clayey GRAVEL	Brown, yellow slightly moist, top. Brown, yellow grained, slight seal on top.	r, medium to coarse with existing 40mm r, red mottle, mediun tly moist, with existir	grained, AC seal on n to coarse ng 40mm AC	Fill - Uncontrolled Fill - Uncontrolled						-						
Machine Excavated Trench				2		SM	Silty SAND	Test pit tern 1.4m, GW	ne to medium grain DCP)	pth	Alluvium	MD						CBR=25 [°]	***		4 7 11 12 7 8 7 6 7 6 7	0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4	
	1			ci		/i	С	on	SU	lt													

Classifications compliant with AS1726-1993: Geotechnical Site Investigations.

Geotechnical Engineeri	ng Log				s	Site Identifier: <u>T</u>	<u>P2</u>						
Project: Tweed Street Client: Job Number:	Upgrade Type: PLANIT Equipment: 5 16041 Contractor: Ruge	Test Pit Tonne excavator ndyke & Bashforth	Depth Width Lengt	h: h: th:	1.30 0.50 1.00	m m m	Date Commenced: Date Completed: Logged by:	Page: 1 c 21/09/20 21/09/20 Mitchel	of 1 016 016 Hill				
Site:Fingal Lane, SouthernEasting:SEE PLANNorthing:SEE PLANElevation:SEE PLAN	Western side North: Inclination: Azimuth:	- 90 -	Horizo Vertic Surve	ontal cal Da ey:	Datum: atum:		- Comments: Test pit terminated 1.3m, GW not obse	at target dep rved.	oth				
DRILLING & LEVELS	MATERIAL DESCRIPTION			S	STRENG	Ή&	DEFECTS	SAMP TESTI	LES/ NG				
Method Support Moisture Depth (m) Depth (m) Graphic Graphic	DESCRIPTION Soil: colour, grain size/plasticity Rock: colour, grain size, structure	St rength Origin	Weathering (Recovery%)	Monoral (mi	fect Spacing m) 00		LABORATORY TEST RESULTS	DCP Blows/ 100mm	Depth				
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Brown, yellow, medium to coarse grained, slightly moist, with existing 40mm AC seal of top. Brown, yellow, medium to coarse grained, with existing 40mm AC seal on top.	Fill - VD ON Uncontrolled Fill - Uncontrolled				0.00 -C 0.30 0.30	CBR=14%, PI=4		0.3				
	from DCP)					-0	CBR=10%	4 12 17 16	0.4				
Machine Exc						0.90		15 12 11	0.8				
								10 10 9	1.1 1.2 1.3				
	Test pit terminated at target depth 1.3m, GW not observed.												
Classifications compliant with A\$1726-1903: Cent	civil consult												

Log Status: FINAL

Page: 1 of 1

Ge	ot	ecl	hn	ica	IE	'nç	gineerin	g Log								Site Ide	entifier: <u>T</u>	<u>P3</u>	
Pro Clie Job	oject ent: o Nu	: mbe	er:			Twe	ed Street U F	pgrade PLANIT 16041	Type: Equipment: Contractor:	5 To Rugendy	Test Inne excava Vke & Bashfo	Pit itor orth	Dep Wic Ler	oth: dth: ngth	1.64 m 0.50 m 1.00 m	Da Da Lo	ate Commenced: ate Completed: ogged by:	Page: 1 c 21/09/20 21/09/20 Mitchel	of 1 016 016 Hill
Site Eas Nor Ele	e: sting rthin vatio	g: ig: on:		Twee	d & SEE SEE SEE	Fin E PL E PL E PL	gal Street, E .AN .AN .AN	astern side	North: Inclination: Azimuth:		- 90 -		Hor Ver Sur	izor tical vey	ital Datum: Datum: :	-	Comments: Test pit terminated 1.64m. GW not obs	at target der erved.	oth
DR	RILLI	NG 8	LE	EVELS			M	ATERIAL DI	ESCRIPTION						STRENGTH	& DEFE	CTS	SAMP TESTI	LES/ NG
Method	Moisture	RL (m)	Depth (m)	Lithology Graphic		USCS Symbol	Lithology	DESCRIPTION Soil: colour, g Rock: colour,	rain size/plasticity grain size, structur	re	Origin	Strength	Weathering	(Recovery%) RQD%	Defect Spacing (mm) 00 00 00 00 00 00 00 00	LAI TE:	BORATORY ST RESULTS	DCP Blows/ 100mm	Depth
Machine Excavated Trench					0.10	GW GW	SAND	Grey, fine to n slightly moist, top. Brown, yellow with existing 4 Grey, fine to n from DCP)	medium to coarse medium to coarse 0mm AC seal on top nedium grained, dry.	grained, dry, grained, dry, p.	Alluvium	MD				-CBR=8%		3 3 6 7 7 6 5 5 5 5 5 5 5	0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6
Class	ssifica	tions of	-4 5 com	Di	rith A	S 172	I C 26-1993: Geotec	ON chnical Site Inves	tigations.	lt		Lo	og S	tatus	5: FINAL			Page	1 of 1

Classifications compliant with AS1726-1993: Geotechnical Site Investigations.

Geotechnical Engineering Log Site Identifier:												Site Identifier: <u>T</u>	<u>P4</u>							
Pro Cli Jol	ojec ent: b Ni	:t: : uml	ber:			Twe	eed Street l	Jpgrade PLANIT 16041	Type: Equipment: Contractor:	5 To Rugendy	Test nne excava /ke & Bashfo	Pit itor orth	Dej Wie Ler	oth: dth: ngth	:	1.00 0.50 1.00	m m m	Date Commenced: Date Completed: Logged by:	Page: 1 c 21/09/20 21/09/20 Mitchel	of 1 016 016 Hill
Site Eas No Ele	e: stin rthi vat	g: ng: ion	:	Cer	ntre, SE SE SE	Noi E Pl E Pl E Pl	rth of Mullur LAN LAN LAN	nbimbi Lane	North: Inclination: Azimuth:		- 90 -		Hor Ver Su	izor tical rvey	ntal D Datu :	atum: ım:		 Comments: Test pit terminated 1.0m. GW not observed 	at target der rved.	oth
DF	RILL	ING	& L	EVEL	S		N	IATERIAL D	ESCRIPTION						ST	RENG	тн а	& DEFECTS	SAMP TESTI	LES/ NG
Method	Support Moisture	RL (m)	Depth (m)	Lithology Graphic		USCS Symbol	Lithology	DESCRIPTION Soil: colour, g Rock: colour,	l rain size/plasticity grain size, structur	re	Origin	Strength	Weathering	(Recovery%) RQD%	Defec (mm)	t Spacir	- 1000 6	LABORATORY TEST RESULTS	DCP Blows/ 100mm	Depth
Î			0	•	0.00	GW	GRAVEL	Brown, yellow slightly moist, top.	, medium to coarse with existing 40mm	grained, AC seal on	Fill - Uncontrolled	VD					0.00			
ed Trench			-		0.19	GW	GRAVEL	Brown, yellow with existing 4	, medium to coarse 0mm AC seal on top	grained, dry, o.	Fill - Uncontrolled							-CBR=80%, PI=1		
e Excavate			-	> • ····	0.48	sw	SAND	Grey, fine to r	nedium grained, dry.		Alluvium	L					0.48		3	0.5
Machine			-									VD	-					-CBR=5%	28	0.7
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Clas	ssific	ation	s cor	npliant	with	AS17	26-1993: Geote	chnical Site Inves	stigations.			Lo	og S	tatus	s: F	INAL			Page	:1 of 1

Page: 1 of 1

Geotechnical Engineering	I Log				Site Identifier: <u>T</u>	<u>P5</u>
Project: Tweed Street Up Client: PL Job Number:	grade Type: ANIT Equipment: 5 To 16041 Contractor: Rugendy	Test Pi nne excavato ke & Bashfort	it Depth: or Width: th Length:	1.30 m 0.50 m 1.00 m	Date Commenced: Date Completed: Logged by:	Page: 1 of 1 21/09/2016 21/09/2016 Mitchel Hill
Site:Tweed & Mullumbimbi Street, WeEasting:SEE PLANNorthing:SEE PLANElevation:SEE PLAN	stern side North: Inclination: Azimuth:	- 90 -	Horizon Vertical Survey:	tal Datum: Datum:	 Comments: Test pit terminated 1.3m. GW not obse 	at target depth rved.
DRILLING & LEVELS MA	TERIAL DESCRIPTION			STRENGTH	& DEFECTS	SAMPLES/ TESTING
Method Support Moisture Rt. (m) Fithology ficanhic ficanhic ficanhic	DESCRIPTION Soil: colour, grain size/plasticity Rock: colour, grain size, structure	Origin 8) Strengtn Weathering (Recovery%) RQD%	Defect Spacing (mm) 0 0 0 0 0 0 0 0 0 0 0	LABORATORY TEST RESULTS	Depth
	signing from, with existing 40mm AC seal of top. Brown, yellow, medium to coarse grained, dry, with existing 40mm AC seal on top. Brown, yellow, fine to medium grained, trace gravel, dry. (Inferred from DCP)	Fill - Uncontrolled Fill - Uncontrolled	/L /D	0.30		0.3 1 0.4 1 0.5 5
Macchine E Macchine E - - - - - - - - - - - - -				1.00	-CBR=20%	0.6 5 0.7 5 0.8 5 0.9 5 1.0 4 1.1
						4 <u>1.2</u> 4 1.3
	Test pit terminated at target depth 1.3m. GW not observed.					
Classifications compliant with AS1726-1993: Geotechn			I og Status	· FINAI		Page: 1 of 1

Page: 1 of 1



Appendix C – Laboratory Results

AUSTRALIAN SOIL AND S.C.T. CONCRETE

TESTING

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(02) 6686 8567 office@asct.com.au 0405 233 188 92 602 346 127



Workbook: WB11 Rev 5 - 02/11/15

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Sample Date:	21/0	9/2016	G	ading	Te	st D	ate					2	26/0	09/2	201	6				
Chainage/RI :	/ 0	NA		Mat	teria	al T	vne					-	F>	kisti [.]	ng	•				
Offset/RI ·		NA		Soil D)esc	rint	tion					Siltv	/ Sa	indv	 / Gr:	ave	I			
Control Line:		NA	S	mnlir	ng M	//etł	hod					Sire,	50	NA		are				
Laver/Denth:	PAV	FMFNT	PI Ci	iring (°on	diti	on						Aiı	r Dr ⁱ	ied					
PI Sieve State:	Drv	Sieved	110		2011	arci	011.						7.11	DII	icu					
		Test	Data					-												
	Grading																			
		Envelope	100																	-
Sieve Size (mm)	% Passing	Min Max					\mathbf{N}													_
150	100		90																	_
130	100																			_
100	100		80																	-
75	100		70																	-
75	100		70																	
27 5	94		60																	_
37.5	8/		3																	_
26.5	/8																			_
19.0	69		8																	-
13.2	60		40																	_
9.5	52		-10																	_
6.7	45		30																	_
4.75	38													\mathbf{N}						-
2.36	28		20												\mathbf{V}					_
1.18	21																			_
0.600	17		10																-	
0.425	15																			_
0.300	14		0																	-
0.150	12			150 125	100	75	53	7.5	6.5	LU C C C	9.5	6.7	.75	.36	.18	0.6	125 2	0.3	CT.	
0.075	11							ŝ	7	Sieve	⊣ ?s (mi	m)	4	2	Η		0.7	C	0.0	j –
	Notes on Test									Re	sult	ts								
				Lio	quic	d Lir	nit	(%)							-	17				
				Pla	asti	c Liı	mit	(%)							-	16				
				Pl	asti	city	/ Inc	lex								1				
				Linea	ar S	hrir	nkag	ge (%	6)											
		Test Met	hods U	sed																
AS 1289	.3.6.1 - Determination	of the particle size distri	bution	of a so	- lic	Sta	nda	rd n	neth	nod	of a	naly	/sis	by s	siev	ing				
AS 1289	.3.1.2 - Determination	of the liquid limit of a so	oil - One	point	t Ca	ssa	grar	nde	Met	hoc	l (su	ıbsic	liar	y m	eth	od)				
	AS 1289.3.2.1	- Determination of the p	plastic l	mit o	fas	soil	- Sta	anda	ard	met	hod									
	AS 1	289.3.3.1 - Calculation c	of the p	astici	ty ir	nde	x of	a sc	oil											
														—				-		
	credited for compliance	e with ISO/IEC 17025. Th	ne												1			Р	uge 1	<i>uj 1</i>
res	ults of the tests include	ed in this document are	-							Ľ	2	K	e.	~	A	1				
trac	ceable to Australian/na	tional standards.													V					
			Annro	oved P	۶v.						П	Ken	ner							
	NATA Accreditatio	on number: 19644								An	prov	ved	Sig	, natr	orv					
COMPETENCE		10077								Ϋ́	,		-'6'		- · y					
													ν	Vorki	book	WR	10 Re	- R v	25/0	7/16
P													,	2.116			2.10		, 01	, 10

TESTING

Australian Soil and Concrete Testing - BallinaPO Box 5120, Ballina Mail Centre, Ballina NSW 247817 De-Havilland Crescent, Ballina NSW 2478Telephone:(02) 668E-Mail:Office@aseMobile:0405 23

(02) 6686 8567 office@asct.com.au 0405 233 188 92 602 346 127



Workbook: WB11 Rev 5 - 02/11/15



Brisbane 346A Bilsen Road, Geebung QLD 4034 Ph: +61 7 3265 5656 Perth 2 Kimmer Place, Queens Park WA 6107 Ph: +61 8 9258 8323

		Te	PERME	ABIL 289 6.7.1	TY E	ЗҮ С кн2 (ва	ONS ased or	STAN NKHHea	T HEAC ad (1988) Mar	D TEST	REPO atory Test	RT ing,10.7)		
CI	ient	Australi	ian Soil & Co	ncrete	Testin	g			. ,	Repoi	rt No.	1609115	7-CHP	1
Ac	ddress	PO Boy	(1232 Park	Ridge	QLD	4125				Test I Repoi	Date rt Date	17/10/16 21/10/20	-21/10/ 16	/16
Pr	oject	883 - T	weed Street,	Bruns	wick H	eads								
CI	ient ID	883-00	1 - TP1							Depth	(m)	Not Supp	olied	
Des	scription	Silty SA	ND- grey wit	th some	e orga	nics				Samp	Іе Туре	Remould Specime	led Soi n	I
						RE	SULTS	OF TES	TING					
Comp	paction Me	ethod			AS1	289.5.1	.1 - St	andard (Compaction	1				
Maxin	mum Dry E	Density (t/m	³)			1.61		Hydraul	ic Gradient					0.8
Optim	num Moist	ure Conten	t (%)			17.1		Surchai	ge (kPa)				Co	onfined
Place	ment Mois	sture Conte	ent (%)			16.9		Head P	ressure App	lied (kPa)				2.65
Moist	ure Ratio	(%)				98.8		Water 1	уре				De-	ionized
Place	ement Wet	Density (t/	m ³)			1.89		Percent	age Materia	I Retained/S	ieve Size	(mm)	0 %	/ 9.5 mm
Densi	ity Ratio (%	%)				100.2								
	F	PERN	IEABIL	ΤY		k (2	₀₎ =		2.4	x 10	-06	(m/se	ec)	
	4.000E-06 3.500E-06						Perm							
	3.000E-06													
k20 (m/sec)	2.500E-06 2.000E-06													
	1.500E-06													
	1.000E-06 0		500		1000		1500 Elar	osed Time of	2000 Test (mins)		2500	3000		3500
Rema	arks:	The abov	ve specimen wa	as remou	Ided to	a targe	t of 100	0% of Sta	andard Dry D	Density and a	at Optimun	n Moisture C	ontent.	
Samp	ole/s suppl	ied by clier	nt		The co	mpactio	on data	was sup	plied by the	client		Page:	1 of 1	REP06401
The	Act results of the docume	credited for co e tests, calibra nt are traceat Tested at T	ompliance with ISC ations, and/or mea ole to Australian/Na irilab Brisbane Lab	D/IEC 1702 surements ational Sta oratory.	25. included ndards.	l in this			Authorised S	Signatory	>	Labo	ACCEPTED A TECHNICA COMPETENCE TRATOTY NO	o. 9926

The results of calibrations and tests performed apply only to the specific instrument or sample at the time of test unless otherwise clearly stated. Reference should be made to Trilab's "Standard Terms and Conditions of Business" for further details. Trilab Pty Ltd ABN 25 065 630 506

ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING



Brisbane 346A Bilsen Road, Geebung QLD 4034 Ph: +61 7 3265 5656 Perth 2 Kimmer Place, Queens Park WA 6107 Ph: +61 8 9258 8323

			P Test M	ERM	IEA AS 128	BILI 9 6.7.1,	TY 5.1.1	ВҮ , кн	CC 2 (Bas	DNS sed o	STANT n K H Head	HEAD (1988) Manu	TEST REP	ORT		
Cli	ient	Austr	alian	Soil &	Cond	crete -	Festi	ng					Report No.	16091 <i>°</i>	158-CHP	,
Ad	ldress	PO B	lox 12	32 P	ark R	lidge	QL	D 41	25				Test Date Report Dat	20/10/ [/] e 24/10/2	16-24/10, 2016	/16
Pr	oject	883 -	Twee	d Stre	et, B	runsw	/ick H	lea	ds							
Cli	ient ID	883-0)02 - 1	FP2									Depth (m)	Not Su	pplied	
Des	cription	n Silty	SAND	- grey	y with	some	e org	anio	S				Sample Ty	be Remou Specin	ılded Soi nen	I
									RES	ULTS	6 OF TEST	ING				
Comp	action M	ethod					AS	1289	9.5.1.1	1 - Si	andard Co	ompaction				
Maxin	num Dry	Density (t/m ³)					1.	62		Hydraulic	Gradient				0.9
Optim	um Mois	ture Con	tent (%)				15	5.8		Surcharge	e (kPa)			Co	onfined
Place	ment Moi	sture Co	ntent (%)				15	5.8		Head Pres	ssure Applie	ed (kPa)			4.02
Moistu	ure Ratio	(%)						10	0.0		Water Typ	be			De-	ionized
Place	ment We			1.	87		Percentag	ge Material I	Retained/Sieve S	ize (mm)	0 %	/ 9.5 mm				
Densi	ity Ratio (%)					99	9.6								
	I	PER	ME	ABI	LIT	Υ		k	⁽²⁰⁾) =		8.9 2	x 10 ⁻⁰⁷	(m/s	sec)	
										Perr	neability					
k20 (misec)	1.500E-06 1.400E-06 1.300E-06 1.200E-06 1.000E-06 9.000E-07 8.000E-07 6.000E-07 5.000E-07	The al	500		1000	remou	1500	oat	200	00 Ela	2500 psed Time of Te	3000 st (mins)	3500	4000	4500	5000
Samp	le/s supn	lied by c	lient				The c	omp	action	n data	a was supp	lied by the o	lient	Pa	ge: 1 of 1	REP06401
The r	Ac results of th docume	credited fc e tests, ca ent are trac Tested a	or complia librations eable to at Trilab I	ance with , and/or Australia Brisbane	n ISO/IE measur an/Natio Labora	C 1702 rements nal Stan	5. include dards.	ed in t	his			Authoris C.	ed Signatory Park	La	NAT TECHNIC boratory N	A. 0. 9926

the sp c instrume the time therwise clearly stated. The results of c sample Reference should be made to Trilab's "Standard Terms and Conditions of Business" for further details. Trilab Pty Ltd ABN 25 065 630 506 ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING



Appendix D – Pavement Arrangement & Calculation

Job Number: 16041



NOTES

1 - CBR TESTING TO BE CARRIED OUT AT SUBGRADE, AT MINIMUM TWO (2) LOCATION ALONG THE PROPOSED NEW ROAD

2 - RESULT OF CBR MUST BE GREATER THAN 5, OTHERWISE NOTIFY THE PAVEMENT DESIGNER, WHO WILL REVIEW AND PROVIDE NEW THICKNESS OF PAVEMENT.

3 - EARTHWORKS UNDERTAKEN FOR THE CONSTRUCTION OF THE PROPOSED ROAD SHALL BE UNDERTAKEN IN ACCORDANCE WITH RMS R44

4 - SUBSOIL DRAINAGE TO BE INSTALLED AS PER NORTHERN RIVERS LOCAL GOVERNMENT DRAINAGE SPECIFICATION.

5 - UNDERTAKE A PROOF ROLL AT BOTH THE EXPOSED SUBGRADE AND TOP OF CBR 15 MATERIAL USING A 12T ROLLER, LOADED WATER CART OR PNEUMATIC TYRED TIP TRUCK. ANY AREAS WHICH DISPLAY DEFLECTION SHOULD BE REMOVED AND REPLACED WITH COMPACTED SELECT FILL. MATERIAL. THIS MATERIAL SHALL BE PLACED IN 150MM LAYERS AND RECEIVE REASONABLE COMPACTIVE EFFORT TO ACHIEVE TARGET DENSITY OF 95% MD

PAVEMENT ARRANGEMENT PROPOSED ROAD

CLIENT: PLANIT CONSULTING PROJECT: TWEED STREET PAVEMENT TITLE: PAVEMENT ARRANGEMENT DRAWING: 16041_DWG_GEO01 DATE: 26.10.16 REV: FOR INFO



8 MORTON WAY P: (02) 6687445 SKENNARS HEAD M: 0490 419 541 NSW 2478 INFO@CIVILCONSULT.COM.AU

PAVEMENT DESIGN CHECK IN ACCORDACNE WITH AUSTROADS 2012

Project: Tweed Street Upgrtade - Byron Shire Council Job Number: 16041

civil consult

Heavily Trafficked

Design Equation

219-211log(DCBR)+58(Log(DCBR))^2)*(Log(DESA/1200

Pavement	DTL (DESA)	Design Subgrade	Required cover over	Design CBR	Required Cover Over	Design CBR	Required Cover		Proposed	Pavement Design (mm)	
Туре		CBR	Subgrade Material (mm)	Select Material	Select Material		(mm)	AC	Base	Sub-Base (CBR>30)	Select Material (CBR>14)
GP With Spray Seal	3,240,000	6.5	380	14	236	30	150	40	150	200	0

Existing gravel mateiral is considered acceptable for re-use as this material. Where minimium thickness (100mm) are not met, increase subbase thickness to 200.

Tweed Street Pavement - Planit Consulting

Description	AADT ⁽¹⁾	% HV ⁽²⁾	AADHV ⁽³⁾	LDF ⁽⁴⁾	DF ⁽⁵⁾	Annual Growth Rate	CGF ⁽⁶⁾	NHVAG	NDT	ESA/HVAG ⁽⁷⁾	DESA ⁽⁸⁾	DSAR5	DSAR7	DSAR12
Tweed Street	5313	4	191	1.00	0.50	3.00	36.8	2.80	3.60.E+06	0.90	3.24.E+06	4.66.E+06	7.35.E+06	3.40.E+07

Assumptions:

⁽¹⁾ Annual Average Daily Traffic

(2) % Heavy Vehicles

⁽³⁾ Annual Average Daily Heavy Traffic

⁽⁴⁾ Lane distribution factor **[Two-lane configuration, assumed=1]**

⁽⁵⁾ Direction factor [Half in each direction, assumed=0.5]

⁽⁶⁾ Cumulative growth factor as per Equation 7.2 Austroads Guide

⁽⁷⁾ ESA/HVAG=0.9 [From Table 7.5 Austroads Guide-Presumptive numbers of heavy vehicle axle groups per heavy vehicle]

⁽⁸⁾ Design Traffic in Equivalent Standard Axles (ESAs)

TWEED STREET

* Tuesday, 6 November 2007

Time	Total	Total	Total	C1%	C1%	C1%	C1%	C1%	C1%	C1%	CL%	C1%	C1%	C1%	C1%	Mean	Vpp
0000	10	8	2	80 0	0.0	10 0	0.0	10.0	6	7	8	9	10	11	12	11470	85
0100	3	2	1	100.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.6	-
0200	3	2	1	66.7	0.0	22.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.6	1
0300	2	0	2	100 0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.9	-
0400	10	6	4	80.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	56.7	-
0500	41	21	20	80.5	0.0	10.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.6	-
0600	83	46	27	88 0	1.0	0 1	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.6	60.5
0700	182	99	23	90.7	֥*	0.4	1.2	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0	49.4	57.2
0800	294	182	112	92.0	1 1	2.2	0.2	0.5	0.0	0.0	0.0	1.1	0.5	0.0	0.0	45.0	54.4
0900	400	226	174	93 5	1 5	4.4	0.2	0.3	0.0	0.0	0.0	0.7	0.0	0.0	0.0	46.2	53.3
1000	376	209	1.67	03.4	1.0	4.0	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	45.3	52.6
1100	348	181	167	93.4	1 . 1	3.7	0.5	0.5	0.0	0.0	0.3	0.3	0.0	0.0	0.0	46.5	53.3
1200	401	212	189	95 0	0.6	4.3	0.5	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	45.0	52.6
1300	383	184	199	94 0	0.0	3.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.6	53.3
1400	335	166	169	93 7	2 1	2.2	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.8	53.3
1500	353	176	177	94 3	0.0	3.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.1	52.9
1600	420	182	238	97 4	0.7	1 4	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	45.8	53.3
1700	344	158	186	96.5	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	47.1	54.0
1800	254	129	125	96.9	0.0	2 0	1 2	0.5	0.0	0.3	0.0	1.5	0.0	0.0	0.0	46.2	54.0
1900	193	99	94	95 3	1 0	2.6	4.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.3	54.0
2000	119	59	60	100 0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	45.7	52.2
2100	92	38	5.4	95.7	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.2	55.8
2200	32	17	15	96 9	0.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.0	54.4
2300	25	13	12	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.6	53.3
07-19	4090	2104	1986	94 5	0.9	3 5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.8	55.1
06-22	4577	2346	2231	94 6	0.0	2.5	0.5	0.2	0.0	0.1	0.1	0.3	0.0	0.0	0.0	46.0	53.3
06-00	4634	2376	2258	94 6	0.9	3.3	0.5	0.2	0.0	0.1	0.1	0.3	0.0	0.0	0.0	46.1	53.6
00-00	4703	2415	2288	94.4	0.9	3.4	0.5	0.2	0.0	0.1	0.1	0.3	0.0	0.0	0.0	46.1	53.6
			~~00	24.4	0.9	5.6	0.4	0.2	0.0	0.1	0.1	0.3	0.0	0.0	0.0	46.2	53.6

Peak step 16:00 (420) AM Peak step 9:00 (400) PM Peak step 16:00 (420)

Vehicles = 4703

Posted speed limit = 50 km/h, Exceeding = 1458 (31.00%), Mean Exceeding = 54.79 km/h Maximum = 89.7 km/h, Minimum = 11.3 km/h, Mean = 46.2 km/h

85% Speed = 53.6 km/h, 95% Speed = 58.3 km/h, Median = 46.4 km/h 20 km/h Pace = 36 - 55, Number in Pace = 3860 (82.08%) Variance = 63.08, Standard Deviation = 7.94 km/h

* Virtual Day (7)

Time	Total	Total	Total BA	C1%	C1% 2	C1%	Cl&	C1%	Mean	Vpp							
0000	16	8	8	97.3	0.0	1.8	0.0	0.9	0.0	0.0	8	9	10	11	12		85
0100	10	5	5	94.4	1.4	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.9	57.6
0200	10	4	6	89.9	0.0	8.7	0.0	0 0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	47.6	55.8
0300	10	4	6	87.5	0.0	9.7	0.0	0 0	0.0	0.0	0.0	4.4	0.0	0.0	0.0	51.0	
0400	12	7	5	80.5	2.4	7.3	6.1	0.0	0.0	0.0	1.4	4.4	0.0	0.0	0.0	50.3	60.8
0500	37	14	22	88.3	1.2	7.4	1.9	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	50.0	59.8
0600	112	57	56	89.7	1.9	6.1	1.5	0.0	0.1	0.0	0.0	0.8	0.4	0.0	0.0	49.3	57.6
0.700	188	99	89	91.2	1.8	5.2	0.6	0.4	0.1	0.1	0.1	0.5	0.1	0.0	0.0	47.4	55.4
0800	313	177	136	93.3	1.9	3.5	0.5	0 1	0.0	0.0	0.2	0.5	0.1	0.0	0.0	46.0	54.7
0900	400	206	194	94.0	2.4	2.8	0.3	0.2	0.1	0.0	0.2	0.4	0.0	0.0	0.0	45.7	52.9
1000	413	204	209	95.0	2.1	1.9	0.4	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0	45.3	52.6
1100	427	212	214	95.6	1.6	2.2	0.2	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	45.1	52.2
1200	435	212	223	94.9	1.6	2.8	0.3	0.1	0.0	0.0	0.2	0.0	0.0	0.0	0.0	45.2	52.2
1300	424	208	216	94.8	1.3	3.2	0.1	0.0	0.1	0.0	0.1	0.2	0.0	0.0	0.0	45.4	52.6
1400	411	206	205	93.9	2.1	3.2	0.5	0 1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	45.8	52.9
1500	407	197	210	94.9	1.7	2.8	0.1	0 2	0.0	0.1	0.1	0.1	0.0	0.0	G.O	45.5	52.6
1600	420	198	222	95.6	1.5	2.3	0.2	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	45.8	52.9
1700	383	184	199	96.5	1.1	1.6	0.3	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	46.5	53.3
1800	310	147	163	96.3	1.1	1.8	0.7	0.0	0.0	0.1	0.0	0.3	0.0	0.0	0.0	46.4	53.3
1900	242	120	122	95.0	1.2	2.3	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	45.9	52.9
2000	150	72	78	97.3	0.8	1.7	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	44.9	52.2
2100	99	48	51	97.1	0.6	1.9	0.1	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	45.6	54.0
2200	54	26	28	95.8	0.0	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.6	54.7
2300	31	16	15	96.3	0.5	1.8	0.5	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	46.9	55.1
07-19	4530	2251	2280	94.8	1.7	2 7	0 3	0.1	0.0	0.0	0.5	0.5	0.0	0.0	0.0	47.2	55.8
06-22	5134	2548	2586	94.9	1 6	27	0.3	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	45.7	52.9
06-00	5219	2589	2629	94.9	1 6	2 7	0.2	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	45.7	52.9
00-00	5313	2631	2682	94.8	1.6	27	0.4	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	45.7	52.9
		-		-			0.4	0.1	0.0	0.1	0.1	0.2	0.0	0.0	0.07	45.8	52.9
Vehicle	S = 1271	941								18.							

Vehicles = 37194/

Posted speed limit = 50 km/h, Exceeding = 10794 (29.02%), Mean Exceeding = 54.49 km/h Maximum = 96.9 km/h, Minimum = 11.3 km/h, Mean = 45.8 km/h 85% Speed = 52.9 km/h, 95% Speed = 57.6 km/h, Median = 46.1 km/h 20 km/h Pace = 36 - 56, Number in Pace = 30685 (82.50%) Variance = 61.12, Standard Deviation = 7.82 km/h

In profile: Vehicles = 37194 / 39926 (93.16%) DESOF= 324×106



Appendix E – Subsurface Drainage Plan

Job Number: 16041

14





SCALE 1:10

CLIENT: PLANIT CONSULTING PROJECT: TWEED STREET UPGRADE DRAWING NAME: SUB SOIL DETAIL DRAWING: 16041_DWG_00 DATE: 06.10.16 REV: FOR INFO



8 MORTON WAY SKENNARS HEAD M: 0490 419 541 NSW 2478

P: (02) 6687445 INFO@CIVILCONSULT.COM.AU



Appendix F – Gravel Material Review

Job Number: 16041

Material & Location	Te	est	LAB Results	RMS 3051 DGS20 Subbase Requirements	RMS 3071 SMZ lower layer Requirements	RMS R44 SMZ lower layer Requirements	NR-LG NGS20 Subbase Requirements	RMS 3051	Requireme	nts Satified	NR-LG
	C	BR	14	-	19 min	19 min	30 min	-	×	*	×
	Liquid L	.imit (%)	19	23 max	-	-	23 max	✓	-	-	\checkmark
	Plastic I	Limit (%)	15	20 max	-	-	23 max	✓	-	-	\checkmark
	Plasticity	Index (PI)	4	12 max	15 max	15 max	12 max	\checkmark	✓	\checkmark	\checkmark
		100mm	100	-	-	100	-	-	-	\checkmark	-
		53mm	95	-	100	-	-	-	×	-	-
GRAVEL		37.5mm	89	-	95 - 100	-	-	-	×	-	-
(EXISTING)		26.5mm	81	100	-	-	100	×	-	-	×
TWEED ST	PSD Passing	19.0mm	74	95 - 100	50 - 85	>50%	96 - 100	×	✓	\checkmark	×
TP2		13.2mm	65	70 - 90	-	-	-	×	-	-	-
	(% by mass)	9.5mm	57	58 - 80	-	-	65 - 89	×	-	-	×
	(70 by 111833)	6.7mm	49	-	40 - 80	-	-	-	✓	-	-
		4.75mm	44	43 - 65	-	-	47 - 80	✓	-	-	×
		2.36mm	35	30 - 55	35 - 70	-	32 - 67	✓	✓	-	\checkmark
		0.425mm	23	10 - 30	-	-	14 - 42	✓	-	-	\checkmark
		0.075mm	14	7 - 14	-	-	6 - 26	✓	-	-	\checkmark

Material & Location	Τe	est	LAB Results	RMS 3051 DGS20 Subbase Requirements	RMS 3071 SMZ lower layer Requirements	RMS R44 SMZ lower layer Requirements	NR-LG NGS20 Subbase Requirements	RMS 3051	Requireme	nts Satified	NR-LG
	C	BR	80	_	19 min	19 min	30 min	-	√	√	√ ×
	Liquid L	.imit (%)	17	23 max	-	-	23 max	✓	-	-	\checkmark
	Plastic I	Limit (%)	16	20 max	-	-	23 max	✓	-	-	\checkmark
	Plasticity	Index (PI)	1	12 max	15 max	15 max	12 max	✓	✓	\checkmark	\checkmark
		100mm	100	-	-	100	-	-	-	\checkmark	-
		53mm	94	-	100	-	-	-	×	-	-
GRAVEL		37.5mm	87	-	95 - 100	-	-	-	×	-	-
(EXISTING)		26.5mm	78	100	-	-	100	×	-	-	×
TWEED ST	PSD Passing	19.0mm	69	95 - 100	50 - 85	>50%	96 - 100	×	✓	\checkmark	×
TP4		13.2mm	60	70 - 90	-	-	-	×	-	-	-
	(% by mass)	9.5mm	52	58 - 80	-	-	65 - 89	×	-	-	×
	(70 by mass)	6.7mm	45	-	40 - 80	-	-	-	✓	-	-
		4.75mm	38	43 - 65	-	-	47 - 80	×	-	-	×
		2.36mm	28	30 - 55	35 - 70	-	32 - 67	×	×	-	×
		0.425mm	15	10 - 30	-	-	14 - 42	✓	-	-	\checkmark
		0.075mm	11	7 - 14	-	-	6 - 26	✓	-	-	\checkmark

Tweed Street Options Assessment Byron Shire Council



APPENDIX E | SITE PHOTOS







Booyun Street intersection southeast: existing drainage



Booyun street intersection towards east: existing refuge island







Northeast of Booyun Street intersection: existing edge of road



Northeast of Booyun Street intersection: existing footpath and nature strip



North of Booyun Street intersection from east: existing pedestrian crossing



Fingal Lane intersection towards east: existing lane



Fingal Lane intersection northeast: existing road







Fingal Street intersection southeast: existing drainage



Fingal Street intersection towards east: existing road



Fingal Street intersection from east: existing intersection



Fingal Street intersection southeast: existing drainage



Northeast of Fingal Street: existing drainage



Northeast of Fingal Street: existing road



Southeast of Mullumbimbi Lane: existing drainage



Northeast of Mullumbimbi Lane: existing drainage



Mullumbimbi Street intersection from east: existing intersection



Southeast of Mullumbimbi Street intersection: existing drainage



Mullumbimbi Street intersection towards east: existing road



Northeast of Mullumbimbi Street Intersection: existing nature strip and drainage



Southwest of Booyun Street intersection: existing drainage (towards south)



Southwest of Booyun Street intersection: existing drainage (towards west)



Booyun Street intersection from west: existing intersection



Booyun Street intersection towards west: existing refuge island



Northwest of Booyun Street intersection: existing intersection



Northwest of Booyun Street intersection: existing Northwest of Booyun Street intersection: existing drainage



road



Northwest of Booyun Street intersection: existing pedestrian crossing



Fingal Lane intersection towards east: existing lane



Northwest of Fingal Lane intersection: existing bus stop



Northwest of Fingal Lane intersection: existing bus stop



Northwest of Fingal Lane intersection: existing drainage



Fingal Street intersection towards west: existing refuge island



Fingal Street intersection towards west: existing road







Northwest of Fingal Street intersection: existing drainage

Northwest of Fingal Street intersection: existing road







Northwest of Mullumbimbi Lane intersection: existing intersection



Mullumbimbi Lane intersection towards west: existing road







Southwest of Mullumbimbi Street intersection: existing intersection and nature strip



Southwest of Mullumbimbi Street: existing intersection and footpath





Mullumbimbil Street intersection towards west: existing refuge island

Northwestwest of Mullumbimbi Street intersection: existing drainage and footpath
Tweed Street Options Assessment Byron Shire Council



APPENDIX F | COST ESTIMATES





The items	quantities and rates shown in this schedule are intended for the nurnose of preparing a hudget est	timate for the l	ingrade of Tw	OPTION 3	rick Heads. This hill of quant	tities has been prepared in consultation with Ryron Shire Council abased on the Ontions Assessment (Res
			2) issued by I	Planit on 17 January	2017.	
ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	RATE (EXCL GST)	AMOUNT (EXCL GST)	COMMENTS/ASSUMPTIONS
1.0 1.4	PRE-CONSTRUCTION PHASE Detailed Design	1	Item	\$50,000.00	\$50,000.00	Estimates based on various projects rates.
1.5 1.6	Traffic Modelling Stormwater assessment and modelling	1	ltem Item	\$5,000.00 \$10,000.00	\$5,000.00 \$10,000.00	Estimates based on various projects rates. Estimates based on various projects rates.
1.7 1.8	Environmental assessment and approvals Project management	1	ltem Item	\$30,000.00 \$30,000.00	\$30,000.00 \$30,000.00	Estimates based on various projects rates. Estimates based on various projects rates.
				Subtotal	\$125,000.00	
2.0 2.1	GENERAL Site establishment	1	Item	\$20,000.00	\$20,000.00	Estimates based on various projects rates.
2.2 2.3	Traffic control Survey setout and control	1	ltem Item	\$100,000.00 \$15,000.00	\$100,000.00 \$15,000.00	Estimates based on various projects rates. Estimates based on various projects rates.
2.4 2.5	Management Plans (CEMP, SMP, TCP) Site disestablishment & clean up	1	ltem Item	\$10,000.00 \$10,000.00	\$10,000.00 \$10,000.00	Estimates based on various projects rates. Estimates based on various projects rates.
2.6 2.7	Provision & Management of Program Pavement & Trench Testing	1	ltem ltem	\$10,000.00 \$5,000.00	\$10,000.00 \$5,000.00	Estimates based on various projects rates. Estimates based on various projects rates.
2.8	Supply of as-built information	1	Item	\$5,000.00	\$5,000.00	Estimates based on various projects rates.
				Subtotal	\$175,000.00	
2.0	TOPSOIL STRIPPING					
2.1	Strip topsoil to stockpile (150mm thick, location to be determined on site by superintendent)	330	m³	\$15.00	\$4,950.00	Assuming topsoil to be stripped at all proposed landscaped and new pavement areas.
				Subtotal	\$4,950.00	
3.0	EARTHWORKS					
3.1 3.2	Cut and removal of soil for boxing out new pavement Cut and removal of soil for swales and raingardens	400 175	m ³ m ³	\$45.00 \$45.00	\$18,000.00 \$7,875.00	Asume proposed pavement depth as per Geotechnical Report Assume 0.15m deep
				Subtotal	\$25,875.00	
4.0	ROAD WORKS					Length based on edges of existing seal to be cut in order to install kerbing and cutting of the extent of
4.1	Saw cut	50	m	\$11.00	\$550.00	works lines on each road and lane that joins onto Tweed Street.
4.2	Remove existing pavement	100	m²	\$25.00	\$2,500.00	Asume proposed payement as per Gentechnical Report
4.3.1	40mm AC	1,000	m ²	\$32.00	\$32,000.00	
4.3.2 4.3.3	7mm primeseal 150mm Basecourse (DGB20)	1,000	m ²	\$7.50 \$25.00	\$7,500.00 \$25,000.00	
4.3.4 4.3.5	200mm Subbase (Crushed Rock) Prepare subgrade	1,000	m ² m2	\$22.00 \$2.00	\$22,000.00 \$2,000.00	
4.4	Remove kerb and gutter	0	m	\$44.00	\$0.00	
4.5	New Kerb and Gutter	0	m	\$73.00	\$0.00	
4.7 4.8	Remove existing median Raised median	20	m ²	\$35.00 \$240.00	\$700.00 \$0.00	Including landscaping
4.9	Pedestrian island	0	m ²	\$70.00	\$0.00	Including Landscaping
4.10		0	EdCII 2	\$15,000.00	\$0.00	
4.11 4.12	Raised Road Section Painting of bike path wearing course	0 960	m ²	\$100.00 \$50.00	\$0.00 \$48,000.00	Including painted textured surface
4.13 4.14	Linemarking Linemarking (miscellaneous)	2500	m item	\$1.90 \$5,000.00	\$5,000.00	Pedestrian crossing, symbols, chevrons etc
				Subtotal	\$150,000.00	
5.0 5.1	PEDESTRIAN FOOTPATH Removal of existing concrete footpath	0	m²	\$35.00	\$0.00	
5.1 5.3	Construction of new concrete footpath New Pram crossing (kerb cut down and footpath shaping)	40 0	m ² each	\$70.00 \$1,250.00	\$2,800.00 \$0.00	Assumed
5.4	New timber decking	0	m²	\$200.00	\$0.00	Based on hardwood. Potential cost saving using composite/recycled timber decking.
				Subtotal	\$2,800.00	
6.0	GRASS SWALES AND LANDSCAPING					
6.2 6.3	Topsoil Turf	1150	m ²	\$11.00	\$12,650.00	
6.4	Landscaping	1	Item	\$10,000.00	\$10,000.00	Nominal amount based on assumed number of trees
				Subtotal	\$33,000.00	
7.0	Sapiron					
7.0	Adjust lid heights (valve, hydrant boxes etc.)	1	Item	\$20,000.00	\$20,000.00	Nominal amount
7.3	Allowance to relocate telecom services near intersections	1	Item	\$160,000.00	\$160,000.00	Indicative amount subject do detailed design and assessment by asset owners.
				Subtotal	\$187,000.00	
12.0	STREET FURNITURE & URUTING - Deferse Tweed Street Master Plan for Local Street		1			
13.1	Bike Stands Bubbich big	4	each	\$450.00	\$1,800.00	Assumed number
13.3	Bench Seats	4	each	\$1,100.00	\$4,400.00	Assumed number
13.4 13.6	Street lighting (Fingal St roundabout's Norfolk Pine)	0	each	\$12,000.00	\$48,000.00	Assumed number To be confirmed by lighting engineer. Assumed time as designed to be a set of the se
13.7 13.9	Installations (2 installations)	1	ltem	\$10,000.00	\$1,800.00	To be refined based on clarification on each installation. Price based on \$5,000 per installation.
				Subtotal	\$81,600.00	
14.0	Traffic Signs	30	each	\$420.00	\$12,600.00	Assumed number
14.3 14.4	Bus Stop Shelters (revamped) Evicting drivenum engletatoment	0 1	item	\$10,000.00	\$0.00	Naminal amount
14.5	Existing university reinstatement	6	each	\$10,000.00	\$00,000.00	
15.0				Suptotal	¢//,ouu.u0	
15.0 15.1	SEDIMENT AND ENDING CONTROL Sediment fence	2000	m	\$7.50	\$15,000.00	
15.2	Gravel filled filter bags	40	each	\$38.00	\$1,520.00	required to mitigate the migration of sediment into property's and roadways during construction. To prevent sediment from flowing down kerb and gutter during construction
15.3	Crearing and Maintenance	1	Prov. Item	\$5,000.00	\$5,000.00	nequirea to ensure the sediment and erosion control is working sufficiently.
				Subtotal	\$21,520.0 0	

				Contingency (30%)	\$884,345 \$265,304	
		TOTA		(INCLOCE COM	\$1,149,649	
1				(i)		



			BILL	OF QUANTITIES					
				OPTION 3					
The items,	e items, quantities and rates shown in this schedule are intended for the purpose of preparing a budget estimate for the upgrade of Tweed Street, Brunswick Heads. This bill of quantities has been prepared in consultation with Byron Shire Council abased on the Options Assessment (Rev								
			2) issued by I	Planit on 17 January	2017.				
ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	RATE (EXCL GST)	AMOUNT (EXCL GST)	COMMENTS/ASSUMPTIONS			





			BILL	OF QUANTITIES		
The items	, quantities and rates shown in this schedule are intended for the purpose of preparing a budget esti	mate for the	ate for the upgrade of Tweed Street, Brunswick Heads. This bill of quantitie		ick Heads. This bill of quant	ities has been prepared in consultation with Byron Shire Council abased on the Options Assessment (Re
ITEM NO	ITEM DESCRIPTION	OUANTITY	UNIT	RATE (EXCL GST)	AMOUNT (EXCL GST)	COMMENTS/ASSUMPTIONS
1.0						
1.4	Detailed Design	1	Item	\$50,000.00 \$5,000.00	\$50,000.00	Estimates based on various projects rates.
1.6	Stormwater assessment and modelling	1	Item	\$10,000.00 \$30,000.00	\$10,000.00	Estimates based on various projects rates.
1.8	Project management	1	Item	\$30,000.00	\$30,000.00	Estimates based on various projects rates.
				Subtotal	\$125,000.00	
2.0	CENEDAL					
2.1	Site establishment	1	Item	\$20,000.00	\$20,000.00	Estimates based on various projects rates.
2.2	Survey setout and control	1	Item	\$15,000.00	\$100,000.00	Estimates based on various projects rates. Estimates based on various projects rates.
2.4	Site disestablishment & clean up	1	Item	\$10,000.00	\$10,000.00	Estimates based on various projects rates. Estimates based on various projects rates.
2.6	Provision & Management of Program Pavement & Trench Testing	1	Item	\$10,000.00	\$10,000.00	Estimates based on various projects rates. Estimates based on various projects rates.
2.8	Supply of as-built information	1	Item	\$5,000.00	\$5,000.00	Estimates based on various projects rates.
				Subtotal	\$175,000.00	
2.0	TOPSOIL STRIPPING	540		645.00	60.212.50	
2.1	Strip topsoil to stockpile (150mm thick, location to be determined on site by superintendent)	548	m³	\$15.00	\$8,212.50	Assuming topsoil to be stripped at all proposed landscaped and new pavement areas.
				Subtotal	\$8,212.50	
3.0	EARTHWORKS	1				
3.1 3.2	Cut and removal of soil for boxing out new pavement Cut and removal of soil for swales and raingardens	150 475	m³ m³	\$45.00 \$45.00	\$6,750.00 \$21,375.00	Asume proposed pavement depth as per Geotechnical Report Assume 0.15m deep
				Subtotal	\$28,125.00	
4.0	ROAD WORKS	500	m	\$11.00	\$5.500.00	Length based on edges of existing seal to be cut in order to install kerbing and cutting of the extent of
4.1		500	m	\$11.00	\$3,300.00	works lines on each road and lane that joins onto Tweed Street.
4.2 4.3	Remove existing pavement Construct new pavement	1,550	m²	\$25.00	\$38,750.00	Asume proposed pavement as per Geotechnical Report
4.3.1	40mm AC	350	m ²	\$32.00	\$11,200.00	
4.3.2	150mm Basecourse (DGB20)	350	m ²	\$7.50 \$25.00	\$2,625.00 \$8,750.00	
4.3.4 4.3.5	200mm Subbase (Crushed Rock) Prepare subgrade	350 350	m² m2	\$22.00 \$2.00	\$7,700.00 \$700.00	
4.4	Remove kerb and gutter	525	m	\$44.00	\$23,100.00	
4.5	New Kerb and Gutter	870	m	\$73.00	\$63,510.00	
4.7 4.8	Remove existing median Raised median	30 125	m ² m	\$35.00 \$240.00	\$1,050.00 \$30,000.00	Including landscaping
4.9	Pedestrian island	0	m ²	\$70.00	\$0.00	
4.10.1	Clean and prep AC	101	m2	\$50.00	\$5,026.55	Including painted textured surface
4.10.2	Concrete kerb around perimeter	50	m2	\$90.00 \$90.00	\$2,513.27	For traffic lanes
4.10.4	Fill island	101	m2	\$40.95	\$2,010.02	Pedestrian crossing, symbols, chevrons etc
4.10.0	Norfolk pine on one island	4	ea	\$1,400.00	\$2,000.00	
4.10.8		4	2	\$3,000.00	\$20,000.00	
4.11 4.12	Raised Road Section Painting of bike path wearing course	350 1100	m ²	\$150.00 \$50.00	\$52,500.00 \$55,000.00	
4.13 4.14	Linemarking Linemarking (miscellaneous)	1450 1	m item	\$1.90 \$5,000.00	\$2,755.00 \$5,000.00	Assumed
				Subtotal	\$349,731.08	Based on hardwood. Potential cost saving using composite/recycled timber decking.
5.0 5.1	PEDESTRIAN FOOTPATH Removal of existing concrete footpath	200	m²	\$35.00	\$7,000.00	
5.1 5.3	Construction of new concrete footpath New Pram crossing (kerb cut down and footpath shaping)	120 10	m ² each	\$70.00 \$1.250.00	\$8,400.00 \$12,500.00	
5.4	New timber decking	40	m²	\$200.00	\$8,000.00	Nominal amount based on assumed number of trees
				Subtotal	\$35,900.00	
6.0						
6.2	Topsoil	3300	m ²	\$11.00	\$36,300.00	Nominal amount
6.3 6.4	Turf Landscaping	3300 1	m² Item	\$9.00 \$20,000.00	\$29,700.00 \$20,000.00	Assuming two operatiors for three days Indicative amount subject do detailed design and assessment by asset owners.
				Subtotal	\$86,000.00	
7.0 7.1	Services Adjust lid heights (valve, hydrant boxes etc.)	1	ltem	\$20,000.00	\$20,000.00	Assumed number
7.2 7.3	Removal of redundant AC water main Including two fire hydrants Allowance to relocate telecom services near intersections	1	ltem ltem	\$7,000.00 \$160,000.00	\$7,000.00 \$160,000.00	Assumed number Assumed number
				Subtotal	\$187,000.00	Assumed number To be confirmed by lighting engineer.
						Assuming near angled parking and around timber decks To be refined based on clarification on each installation. Price based on \$5,000 per installation.
13.0 13.1	STREET FURNITURE & LIGHTING - Refer to Tweed Street Master Plan for Locations Bike Stands	4	each	\$450.00	\$1,800.00	
13.2 13.3	Rubbish bins Bench Seats	6	each each	\$2,600.00 \$1,100.00	\$15,600.00 \$4 400 00	
13.4	Street lighting Tree lighting (Fingal St roundahout's Norfolk Pine)	4	each	\$12,000.00 \$15,000.00	\$48,000.00	Assumed number
13.7	Hardwood Bollards	80	each	\$60.00 \$15.000.00	\$4,800.00	
		-		Subtotal	\$89,600.00	Nominal amount
				Subtotal	\$65,666.66	
14.0	MISCELLANEOUS	1				1
14.1	Traffic Signs	30	each	\$420.00	\$12,600.00	required to mitigate the migration of sediment into property's and roadways during construction.
14.3 14.4	Invew siletters (bus stop and pocket park) Bus Stop Shelters (revamped) Example 1 Bus Stop Shelters (revamped) Bus Stop Shelters (re	0	item	\$18,000.00 \$5,000.00	\$0.00 \$5,000.00	It o prevent seament from nowing down kerb and gutter during construction Required to ensure the sediment and erosion control is working sufficiently.
14.5	Existing driveways reinstatement	7	each	\$10,000.00	\$70,000.00	INOMINAI AMOUNT
				Subtotal	\$87,600.00	
15.0 15.1	Sediment fence	2000	m	\$7.50	\$15,000.00	
15.2 15.3	Gravel tilled filter bags Clearing and Maintenance	40	each Prov. Item	\$38.00 \$5,000.00	\$1,520.00 \$5,000.00	
			+	Subtotal	\$21,520.00	



			BILL	OF QUANTITIES		
				OPTION 2		
The items	, quantities and rates shown in this schedule are intended for the purpose of preparing a budget estin	mate for the u	upgrade of Tv	veed Street, Brunsv	vick Heads. This bill of quanti	ities has been prepared in consultation with Byron Shire Council abased on the Options Assessment (Re
			2) issued by	Planit on 17 Januar	2017.	
ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	RATE (EXCL GST)	AMOUNT (EXCL GST)	COMMENTS/ASSUMPTIONS
				TOTAL (EXCL GST)	\$1,193,689	
				Contingency (30%)	\$358,107	
		TOTA	(INCL CONT	IGENCY, EXCL GST)	\$1,551,795	
			TOTAL	(INCL GST @ 10%)	\$1,706,975	

PLANIT	

The items	, quantities and rates shown in this schedule are intended for the purpose of preparing a budget esti	mate for the u	pgrade of Tw 2) issued by I	OPTION 1 eed Street, Brunswick Planit on 17 January 2	Heads. This bill of quar 2017.	ntities has been prepared in consultation with Byron Shire Council abased on the Options Assessment (Rev
1.0	PRE-CONSTRUCTION PHASE	QUANTITY	UNIT	RATE (EXCL GST)	AMOUNT (EXCE GST)	
1.4 1.5	Detailed Design Traffic Modelling	1	Item Item	\$50,000.00 \$5,000.00	\$50,000.00 \$5,000.00	Estimates based on various projects rates. Estimates based on various projects rates. Catinates based on various projects rates.
1.6 1.7	Stormwater assessment and modeling Environmental assessment and approvals Project magazagement	1	Item Item	\$10,000.00 \$30,000.00 \$30,000.00	\$10,000.00 \$30,000.00	Estimates based on various projects rates. Estimates based on various projects rates. Estimates based on various projects rates.
1.8		1	item	\$30,000.00	\$30,000.00	Estimates based on various projects rates.
				Subtotal	\$125,000.00	
2.0	GENERAL Site establishment	1	ltem	\$20,000,00	\$20,000,00	Estimates based on various projects rates
2.2	Traffic control Survey setout and control	1	Item	\$100,000.00 \$15.000.00	\$100,000.00 \$15.000.00	Estimates based on various projects rates. Estimates based on various projects rates.
2.4	Management Plans (CEMP, SMP, TCP) Site disestablishment & clean up	1	Item	\$10,000.00 \$10,000.00	\$10,000.00 \$10.000.00	Estimates based on various projects rates. Estimates based on various projects rates.
2.6 2.7	Provision & Management of Program Pavement & Trench Testing	1	ltem Item	\$10,000.00 \$5,000.00	\$10,000.00 \$5,000.00	Estimates based on various projects rates. Estimates based on various projects rates.
2.8	Supply of as-built information	1	Item	\$5,000.00	\$5,000.00	Estimates based on various projects rates.
				Subtotal	\$175,000.00	
2.0	TOPSOIL STRIPPING					
2.1	Strip topsoil to stockpile (150mm thick, location to be determined on site by superintendent)	525	m³	\$15.00	\$7,875.00	Assuming topsoil to be stripped at all proposed landscaped and new pavement areas.
				Subtotal	\$7,875.00	
3.0	EARTHWORKS				40	
3.1 3.2	Cut and removal of soil for boxing out new pavement Cut and removal of soil for swales and raingardens	475	m ³	\$45.00	\$6,750.00 \$21,375.00	Asume proposed pavement depth as per Geotechnical Report Assume 0.15m deep
				Subtotal	\$28,125.00	
4.0	POVD MODRY					
4.1	Saw cut	500	m	\$11.00	\$5,500.00	Length based on edges of existing seal to be cut in order to install kerbing and cutting of the extent of works lines on each road and lane that joins onto Tweed Street
4.2	Remove existing pavement	1 450	m ²	\$25.00	<u> </u>	
4.2	Construct new pavement	250		\$23.00	\$30,230.00	Asume proposed pavement as per Geotechnical Report
4.3.2	7mm primeseal	350	m ²	\$7.50	\$2,625.00	
4.3.3 4.3.4	150mm Basecourse (DGB20) 200mm Subbase (Crushed Rock)	350 350	m²	\$25.00 \$22.00	\$8,750.00 \$7,700.00	
4.3.5	Prepare subgrade	350	m2	\$2.00	\$700.00	
4.4 4.5	Remove kerb and gutter New Kerb and Gutter	450 760	m	\$44.00 \$73.00	\$19,800.00 \$55,480.00	
4.7	Remove existing median	30	m²	\$35.00	\$1,050.00	
4.8	Raised median 32mm dowels at 600 centres	250 833	ea	\$30.00	\$25,000.00	Including landscaping
4.8.2	Somm AC surrounds around concrete kerb	1000	m m	\$90.00	\$45,000.00	
4.8.4	Landscaping (trees in pots with drainage holes, stuck to concrete	20	ea	\$45.00	\$20,000.00	
4.9	Pedestrian island	0	m²	\$70.00	\$0.00	
4.10	Roundabout (median)	2	Each	\$E0.00	ŚE 026 EE	Including Landscaping
4.10.1	32mm dowels at 600 centres around perimeter	84	ea	\$30.00	\$2,513.27	
4.10.5	Somm AC around kerb	50	m m2	\$40.00	\$2,010.62	
4.10.6	Trees in island (landscaping trees) Norfolk pine on one island	4	ea	\$500.00 \$1.400.00	\$2,000.00 \$1,400.00	
4.10.8	Side road splitter islands	4	ea	\$5,000.00	\$20,000.00	
4.11 4 12	Raised Road Section	0	m ²	\$150.00 \$50.00	\$0.00 \$57 500 00	Including painted textured surface
4.13	Linemarking (inicellaneous)	1650	m	\$1.90	\$3,135.00	For traffic lanes Pedestrian crossing, symbols, chevrons etc.
				Subtotal	\$399,388.23	
5.0 5.1	PEDESTRIAN FOOTPATH Removal of existing concrete footpath	300	m ²	\$35.00	\$10,500.00	
5.1 5.3	Construction of new concrete footpath New Pram crossing (kerb cut down and footpath shaping)	200 10	m ² each	\$70.00 \$1.250.00	\$14,000.00 \$12,500.00	Assumed
5.4	New timber decking	350	m²	\$200.00	\$70,000.00	Based on hardwood. Potential cost saving using composite/recycled timber decking.
				Subtotal	\$107,000.00	
6.0	GRASS SWALES AND LANDSCAPING					
6.2 6.3	Topsoil Turf	3150 3150	m ²	\$11.00 \$9.00	\$34,650.00 \$28,350.00	
6.4	Landscaping	1	Item	\$30,000.00	\$30,000.00	Nominal amount based on assumed number of trees
				Subtotal	\$93,000.00	
7.0	Services					
7.1 7.2	Adjust lid heights (valve, hydrant boxes etc.) Removal of redundant AC water main Including two fire hydrants	1	Item Item	\$20,000.00 \$7,000.00	\$20,000.00 \$7,000.00	Nominal amount Assuming two operatiors for three days
7.3	Allowance to relocate telecom services near intersections	1	Item	\$160,000.00	\$160,000.00	Indicative amount subject do detailed design and assessment by asset owners.
				Subtotal	\$187,000.00	
13.0	STREET FURNITURE & LIGHTING - Refer to Tweed Street Master Plan for Locations					
13.1 13.2	Bike Stands Rubbish bins Rubbis	6	each each	\$450.00 \$2,600.00	\$2,700.00 \$20,800.00	Assumed number Assumed number Assumed number
13.3 13.4	sence seats Street lighting Teac lighting (figeal (figeal dependence))	4	each each	\$1,100.00 \$12,000.00	\$4,400.00 \$48,000.00	Assumed number Assumed number To be confirmed by lighting and the second
13.6 13.7	Irree lighting (Fingal St roundabout's Norfolk Pine) Hardwood Bollards Installisting (2) installations)	1 120	each each	\$15,000.00 \$60.00	\$15,000.00 \$7,200.00	10 be confirmed by lighting engineer. Assuming near angled parking and around timber decks To be refined based on deal of the second based on the
13.9	inistanauons (2 instanauons)	1	item	\$15,000.00	\$15,000.00	To be retined based on clarification on each installation. Price based on \$5,000 per installation.
				Subtotal	\$113,100.00	
14.0 14 1	MISCELLANEOUS Traffic Signs	30	each	\$420.00	\$12 600 00	Assumed number
14.3 14.4	New shelters (Bus stop and pocket park) Bus Stop Shelters (revamped)	2	item	\$18,000.00	\$36,000.00	
14.5	Existing driveways reinstatement	7	each	\$10,000.00	\$70,000.00	Nominal amount
				Subtotal	\$123,600.00	



	BILL OF QUANTITIES										
				OPTION 1							
The items	, quantities and rates shown in this schedule are intended for the purpose of preparin	g a budget estimate for the u	pgrade of Twee	ed Street, Brunswic	k Heads. This bill of quantit	ties has been prepared in consultation with Byron Shire Council abased on the Options Assessment (Rev					
			2) issued by Pl	anit on 17 January	2017.						
ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	RATE (EXCL GST)	AMOUNT (EXCL GST)	COMMENTS/ASSUMPTIONS					
15.0	SEDIMENT AND EROSION CONTROL										
15.1	Sediment fence	2000	m	\$7.50	\$15,000.00	required to mitigate the migration of sediment into property's and roadways during construction.					
15.2	Gravel filled filter bags	40	each	\$38.00	\$1,520.00	To prevent sediment from flowing down kerb and gutter during construction.					
15.3	Clearing and Maintenance	1	Prov. Item	Prov. Item \$5,000.00 \$5,000.00		Required to ensure the sediment and erosion control is working sufficiently.					
				Subtotal	\$21,520.00						
			Т	OTAL (EXCL GST)	\$1,380,608						
			C	ontingency (30%)	\$414,182						
		ΤΟΤΑΙ	(INCL CONTIG	ENCY, EXCL GST)	\$1,794,791						
			TOTAL (INCL GST @ 10%)	\$1,974,270						

Tweed Street Options Assessment Byron Shire Council



APPENDIX G | CONCEPT PLANS



BYRON SHIRE COUNCIL TWEED STREET UPGRADE OPTIONS ASSESSMENT

TWEED STREET (BOOYUN STREET - MULLUMBIMBI STREET) **BRUNSWICK HEADS NSW 2483**

FINAL ISSUE FOR COMMUNITY CONSULTATION

DRAWING NUMBER	TITLE	REVISON
J137 - 0001	INDEX AND LOCALITY PLAN	В
J137 - 0002	EXISTING SURVEY PLAN	В
J137 - 0003	EXISTING CONDITIONS PLAN SHEET 1 OF 2	В
J137 - 0004	EXISTING CONDITIONS PLAN SHEET 2 OF 2	В
J137 - 0005	EXISTING DRAINAGE PLAN SHEET 1 OF 2	В
J137 - 0006	EXISTING DRAINAGE PLAN SHEET 2 OF 2	В
	DESIGN OPTION 1	
J137 - 0007	DESIGN OPTION 1 OVERALL LAYOUT PLAN	A
J137 - 0008	DESIGN OPTION 1 LAYOUT PLAN SHEET 1 OF 2	В
J137 - 0009	DESIGN OPTION 1 LAYOUT PLAN SHEET 2 OF 2	В
J137 - 0010	DESIGN OPTION 1 TYPICAL SECTIONS	В
	DESIGN OPTION 2	
J137 - 0011	DESIGN OPTION 2 OVERALL LAYOUT PLAN	А
J137 - 0012	DESIGN OPTION 2 LAYOUT PLAN SHEET 1 OF 2	В
J137 - 0013	DESIGN OPTION 2 LAYOUT PLAN SHEET 2 OF 2	В
J137 - 0014	DESIGN OPTION 2 TYPICAL SECTIONS	В
	DESIGN OPTION 3	
J137 - 0015	DESIGN OPTION 3 OVERALL LAYOUT PLAN	А
J137 - 0016	DESIGN OPTION 3 LAYOUT PLAN SHEET 1 OF 2	В
J137 - 0017	DESIGN OPTION 3 LAYOUT PLAN SHEET 2 OF 2	В
J137 - 0018	DESIGN OPTION 3 TYPICAL SECTIONS	В



LOCALITY PLAN SCALE: N.T.S



TWEED STREET UPGRADE OPTIONS ASSESSMENT

CLIENT:

BYRON SHIRE COUNCIL 70-90 STATION STREET MULLUMBIMBY NSW 2482



DRAWING J137 - 0001

INDEX AND LOCALITY PLAN

REV	R

REV ISSUE A DRAFT ISSUE FOR COMMUNITY CONSULTATION SCALE NORTH POIN

NOT TO SCALE

PLANIT ENGINEERING SUITE 9A, 80-84 BALLINA STREET PO BOX 161 LENNOX HEAD NSW 2478



P: 02 6687 4666 E: admin@planitengineering.com.a ABN: 99 613 049 568

1N





TWEED STREET UPGRADE

CLIENT:

BYRON SHIRE COUNCIL 70-90 STATION STREET MULLUMBIMBY NSW 2482



DRAWING: J137 - 0002

EXISTING SURVEY PLAN

REV B

REV	ISSUE	DATE	DRAWN	DESIGN	CHECK	APPROVED		
A	DRAFT ISSUE	30-11-16	NVO	NVO	мк	мк		
в	FOR COMMUNITY CONSULTATION	18-01-17	NVO	NVO	MK	SM		
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	Full Size 1 1000 , Half Reduction	1:2000			L	$\Lambda \Delta$		
	SCALE (m)							
PLANIT ENGINEERING								
PLA		SUITE 9A, 80-84 BALLINA STREET						
PL/ SUIT	E 9A, 80-84 BALLINA STREET							
PL/ SUIT PO E	TE 9A, 80-84 BALLINA STREET 30X 161 LENNOX HEAD NSW 2	2478						
PLA SUIT PO E P: 02	E 9A, 80-84 BALLINA STREET 30X 161 LENNOX HEAD NSW 2 2 6687 4666 E: admin@	2478 Dplaniteng	Ineering.c	com.au				



















TYPICAL SECTION A / 0008 SCALE: NTS



TYPICAL SECTION B / 0009 SCALE: NTS





	STRIP	12
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150		
CLEAN COL		

1.3m



TWEED STREET UPGRADE OPTIONS ASSESSMENT

CLIENT:

BYRON SHIRE COUNCIL 70-90 STATION STREET MULLUMBIMBY NSW 2482

drawing: J137 - 0010

DESIGN OPTION 1 TYPICAL SECTIONS

REV B

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REV	ISSUE	DATE	DRAWN	DESIGN	CHECK	APPROVED
A	DRAFT ISSUE	30-11-16	NVO	NVO	мк	МК
в	FOR COMMUNITY CONSULTATION	18-01-17	NVO	NVO	МК	SM
SCAL	E.		NO	RTH POI	NT.	

NOT TO SCALE

PLANIT ENGINEERING SUITE 9A, 80-84 BALLINA STREET PO BOX 161 LENNOX HEAD NSW 2478



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E: admin@planitengineering.com.au









TYPICAL SECTION C / 0012 SCALE: NTS



SECTION D / 0013 SCALE: NTS



NOTES: 1) DIMENSIONS ARE INDICATIVE ONLY AND VARY ALONG THE ALIGNMENT 2) SERVICES ARE NOT SHOWN IN SECTIONS





1.2m 1.3m





DESIGN OPTION 2

REV B

PLANIT

TYPICAL SECTIONS								
REV	ISSUE	DATE	DRAWN	DESIGN	CHECK	APPROVED		
A	DRAFT ISSUE	30-11-16	NVO	NVO	мк	МК		
в	FOR COMMUNITY CONSULTATION	18-01-17	NVO	NVO	МК	SM		
SCALE		NORTH POINT						

NOT TO SCALE

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TYPICAL SECTION E / 0016

SCALE: NTS

9 9	SRASSED STRIP	FOOTPATH 	GRASSED STRIP	ANGLED PARKING BAYS	CYCLE LANE		TRAFFIC LANE	CYCLE LANE	PARALLEL PARKING BAYS	RAISED G	RASSED FO(STRIP 	DTPATH GRASSED STRIP 	PROPERTY BOUNDARY
	1.3m	, 1.3m ,	1.2m , 4.1m	3m	1.5m	3,5m	3,5m	1.5m	3.2m	1.5m	1.6m	1.2m , 1.8m] ,

TYPICAL SECTION F / 0017 SCALE: NTS



NOTES: 1) DIMENSIONS ARE INDICATIVE ONLY AND VARY ALONG THE ALIGNMENT 2) SERVICES ARE NOT SHOWN IN SECTIONS





NOT TO SCALE

PLANIT ENGINEERING SUITE 9A, 80-84 BALLINA STREET PO BOX 161 LENNOX HEAD NSW 2478



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