APPENDIX C
Stormwater Technical Memorandum – DesignFlow

TECHICAL MEMORANDUM

To:	Anna Vangsness – EDQ
From:	Ralph Williams - DesignFlow
Reviewed:	Shaun Leinster (RPEQ 15637) - DesignFlow
Date:	10 April 2025
Subject:	Oonoonba Development – Stages 7C and D - Stormwater quality management

1 INTRODUCTION

This technical memorandum describes stormwater quality management relevant to Oonoonba development to support Stages 7C and D development.

2 BACKGROUND

In support of the Oonoonba development, stormwater quality management requirements under ultimate development conditions, have been assessed. A stormwater treatment strategy was derived to treat stormwater runoff from the site to meet State Planning Policy objectives. The latest assessments are reported in the following approved documents:

- *Oonoonba Development – The Village – Updated Stormwater Quality Management Plan (DesignFlow, June 2016)*

3 STAGE 7C AND D DEVELOPMENT

The extent of Stage 7C and D development is shown in Figure 1 and covers an area of 2.4ha. The stormwater treatment strategy previously reported in the Updated Stormwater Quality Management Plan have been assessed at ultimate development conditions, inclusive of Stages 7C and D. The catchment and drainage assumptions made relating to future development are still valid for Stages 7C and D development and the stormwater treatment strategy previously reported is unaltered with the inclusion of Stage 7C and D development. Figure 2 shows the current approved stormwater management strategy with the extent of Stage 7C and D shown for illustrative purposes.

Prepared by:

Ralph Williams

Reviewed/Certified by:



Shaun Leinster

RPEQ 15637

DesignFlow

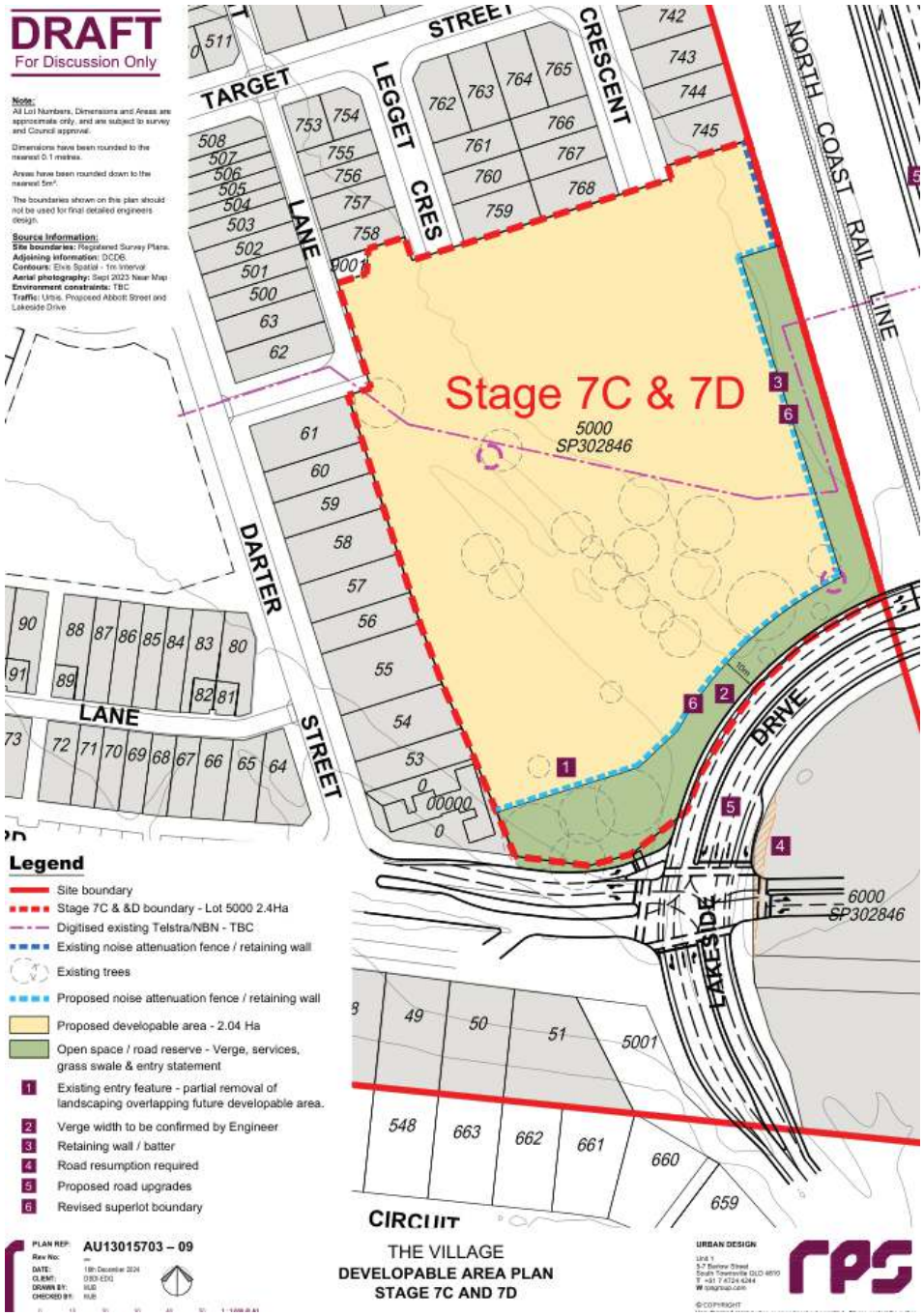


Figure 1 – Stage 7C and D development extent (source: RPS)

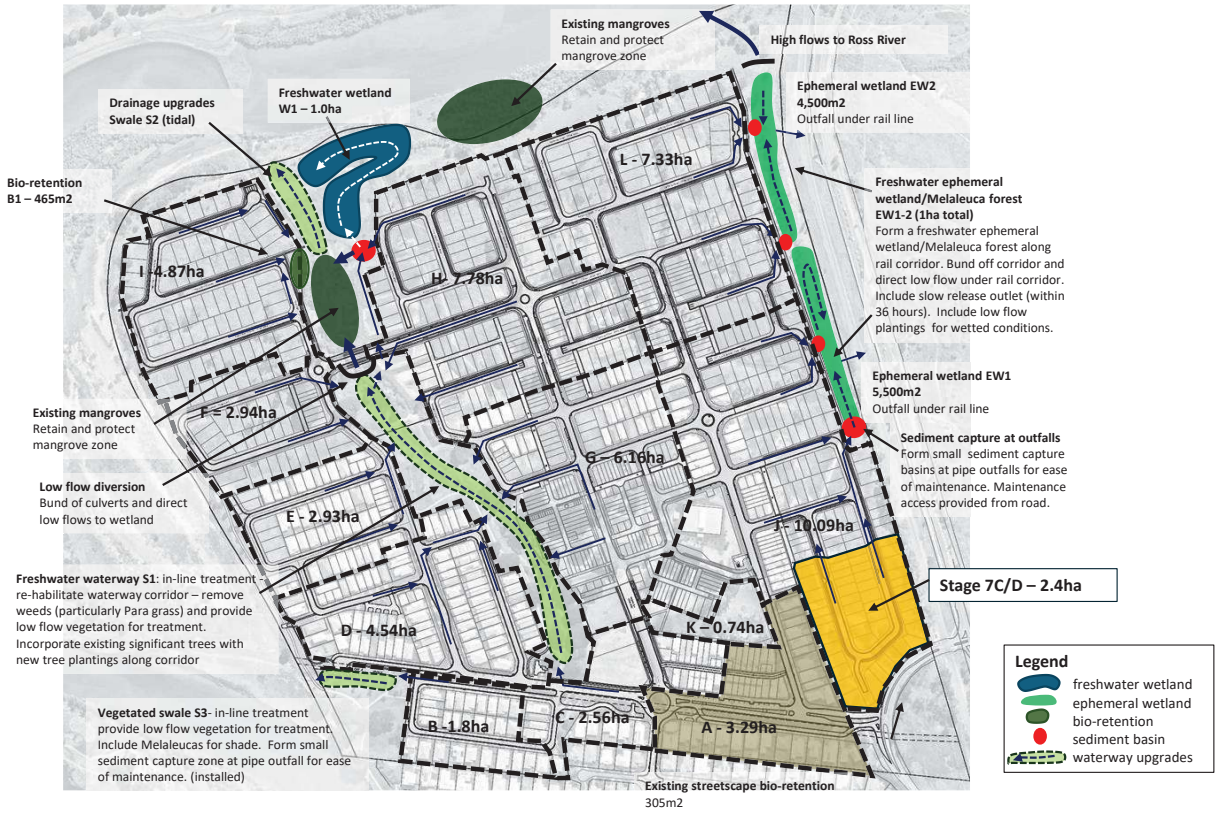


Figure 2 – Approved stormwater quality management strategy with Stages 7C and D shown

OONOONBA DEVELOPMENT – THE VILLAGE

UPDATED STORMWATER QUALITY MANAGEMENT PLAN

DesignFlow

Prepared for Economic Development Queensland

June 2016

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Table of Contents

1 EXECUTIVE SUMMARY 1
2 SITE CHARACTERISTICS 3
2.1 SITE LOCALITY 3
2.2 SITE CHARACTERISTICS 4
2.2.1 CLIMATE *4*
2.3 TOPOGRAPHY, CATCHMENTS AND DRAINAGE 5
2.4 VEGETATION 6
2.5 RECEIVING ECOSYSTEMS 6
2.6 SITE CONSTRAINTS 6
2.7 PROPOSED DEVELOPMENT 7
3 DESIGN OBJECTIVES 9
3.1 CONSTRUCTION PHASE WATER QUALITY 9
3.2 OPERATIONAL PHASE WATER QUALITY 10
4 DESIGN CONSIDERATIONS 11
4.1 MAINTAINING WATER QUALITY IMPROVEMENTS BASED ON BMP 11
4.2 DESIGN FOR FLAT DRAINAGE GRADIENTS 12
4.2.1 CONTEXT *12*
4.2.2 VEGETATED WATERWAYS *12*
4.3 CLIMATE VARIATION IN THE DRY TROPICS 15
4.4 WEEDS 15
4.5 TIDAL CONSTRAINTS 16
5 STORMWATER TREATMENT STRATEGY 17
5.1 STORMWATER TREATMENT ELEMENTS 21
5.1.1 VEGETATED WATERWAYS *21*
5.1.2 CONSTRUCTED WETLANDS *22*
5.1.3 BIO-RETENTION *26*
6 STORMWATER TREATMENT PERFORMANCE ASSESSMENT 30
6.1 MODEL STRUCTURE 30
6.1.1 CATCHMENT DATA *31*
6.1.2 WETLAND REPORTING TABLE *31*
6.1.3 SWALE REPORTING TABLE *32*
6.1.4 BIORETENTION REPORTING TABLE *33*
6.1.5 RESULTS *34*
7 PRELIMINARY EARTHWORKS 35
8 CONSTRUCTION STAGING 36
9 MAINTENANCE 37
9.1 CONSTRUCTED WETLANDS 37
9.2 VEGETATED WATERWAYS 38
9.3 BIO-RETENTION SYSTEMS 39
10 CONCLUDING REMARKS 40
11 REFERENCES 41

1 EXECUTIVE SUMMARY

The Oonoonba development is a proposed residential subdivision of approximately 53ha (approximately 900 lots) on a development site of approximately 80ha, located 4 km south of Townsville, on the southern banks of the Ross River. Stages 1 to 6 and 10 have now been built in accordance with the following:

- **Stage 1:** *Stage 1 Operational Works – Detailed Stormwater Quality Management Report – Oonoonba Urban Development, Townsville* (BMT WBM, 2011)
- **Stage 2-6 and 10:** *Oonoonba Development – The Village – Updated Stormwater Quality Management Plan* (DesignFlow, 2014).

This report presents an updated stormwater quality strategy for the Oonoonba development to meet the requirements under the State Planning Policy (DSDIP, 2013). This report supersedes the previously developed site based stormwater management plans for the site namely BMT WBM (2010, 2011) and DesignFlow (2014).

Treatment strategy

Stage 1 - implemented

The treatment strategy for Stage 1 works (completed) is detailed in BMT WBM (2011): *Stage 1 Operational Works – Detailed Stormwater Quality Management Report – Oonoonba Urban Development, Townsville.*

Stage 1 implementation used streetscape raingardens. The original intent of the stormwater management strategy for the site was for mostly streetscape approaches. Experience from Stage 1 has resulted in a re-assessment of the original strategy, with the use of wetlands now the preferred alternative.

Updated strategy

The updated treatment strategy considers an integrated approach using primarily wetlands and waterway upgrades over two main treatment zones. The major portion of development treatment will occur in the main vegetated north-south drainage corridor which discharges to a freshwater treatment wetland (1.0ha) prior to discharge to the Ross River

As part of the treatment strategy, restoration of the main drainage corridor through the site as a natural vegetated freshwater waterway is included to provide treatment, minimise wetland areas required and provide a low maintenance drainage alternative that enhances the development. Existing mangroves at the downstream end of the main drainage corridor will be retained as much as possible and integrated with the treatment strategy. Additional Melaleuca forest/ephemeral wetland zones are proposed to be developed along the eastern drainage corridor, adjacent to the railway.

A bio-retention basin (465m2) is proposed at the north western end of the development, treating development runoff that is not directed to wetlands.

The above strategy provides an integrated best environmental management approach to stormwater quality management that meets the intent of the State Planning Policy (SPP).

2 SITE CHARACTERISTICS

2.1 SITE LOCALITY

The proposed Oonoonba development is located on the southern banks of the Ross River, 4 km south of Townsville. Existing residential areas occur to the south of the site. The North Coast Rail line defines the eastern boundary of the site

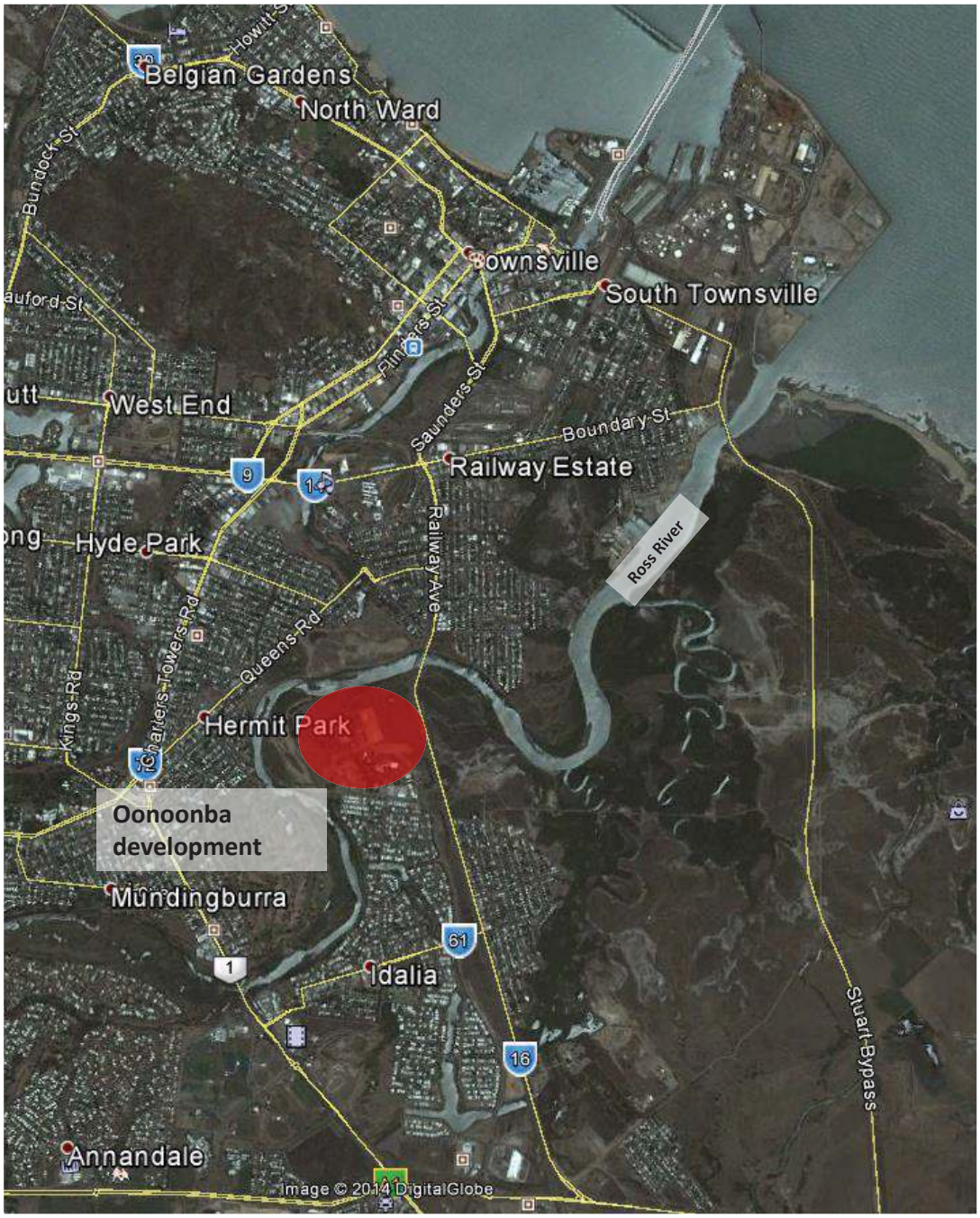


Figure 1: Oonoonba development location

2.2 SITE CHARACTERISTICS

2.2.1 Climate

Oonoonba is located in the dry tropics region of Townsville, which has distinct wet and dry seasons. The average annual rainfall is 1143 mm most of which falls in the four month "wet season" from December to March and on average, there are on average 91 rain days in a year. The variable nature of the tropical lows and thunderstorms of the region the total rainfall and number of rain days can vary significantly from year to year (Bureau of Meteorology website).

Monthly average rainfall for Townsville Airport (Bureau of Meteorology, 2007) and the estimated potential evapotranspiration (PET) for the Townsville Region are shown in Figure 2. The figure clearly indicates the seasonal nature of rainfall and that evapotranspiration is much greater than rainfall for most of the year. Temperatures in the region are moderate to high throughout the year, leading to relatively high evaporation and evapotranspiration in all months.

The seasonal nature of the climate dictates all elements of the natural and urban water cycle. During the wet season vegetation is lush, soils become waterlogged, groundwater recharge fills local aquifers, local waterways/streams flow permanently and there is no need to irrigate landscapes. During the dry season, the region becomes parched with only very hardy vegetation present, local streams cease to flow, groundwater levels drop within aquifers and extensive irrigation is required to sustain green landscapes.

The design of stormwater treatment strategy and public realm landscapes needs to account for this seasonal variability.

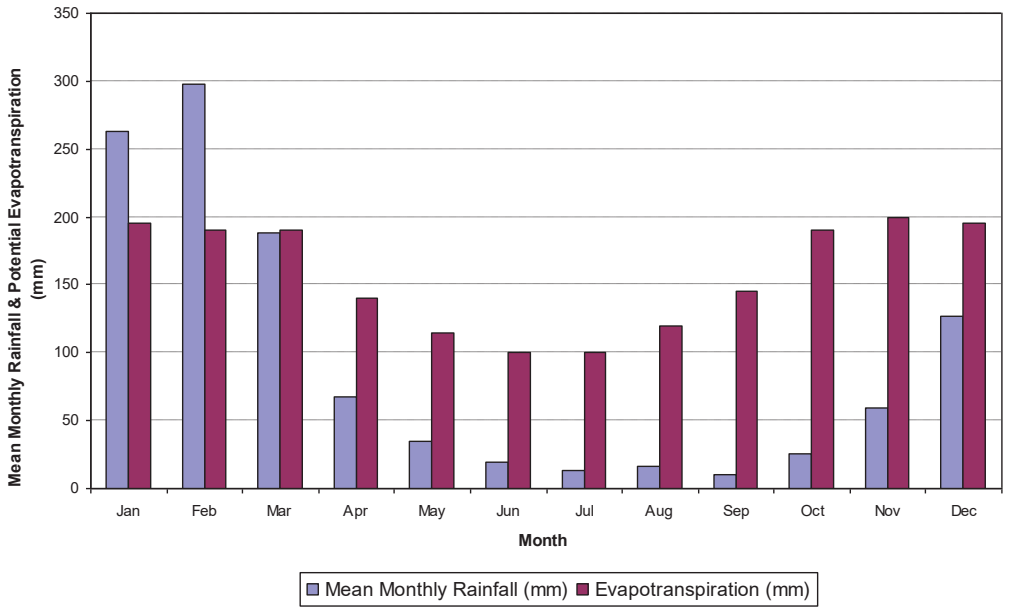


Figure 2: Average climate data for Townsville

2.3 TOPOGRAPHY, CATCHMENTS AND DRAINAGE

The general topography of the Oonoonba development site is very flat with drainage gradients of less than 0.3% typical. Existing ground levels across the site are typically below 5m AHD. A north-south catchment divide through the centre of the site directs drainage to two main drainage zones. West of the catchment divide drainage is directed to a defined drainage channel which discharges northward to the Ross river. East of the divide drainage is less formalised and occurs predominately as overland flow in a north easterly direction. Drainage channels have previously been excavated at the northern boundary of the site to facilitate drainage to the Ross River.

Tidal influences extend up the main drainage line as a result of previous drainage works. Mangroves have now established along the main drainage line, extending approximately 450m upstream from the Ross River.

The flat nature of the site is a major design constraint when integrating stormwater treatment systems into the development. Typically on such sites wetlands or at surface treatments such as streetscape raingardens are the most applicable.

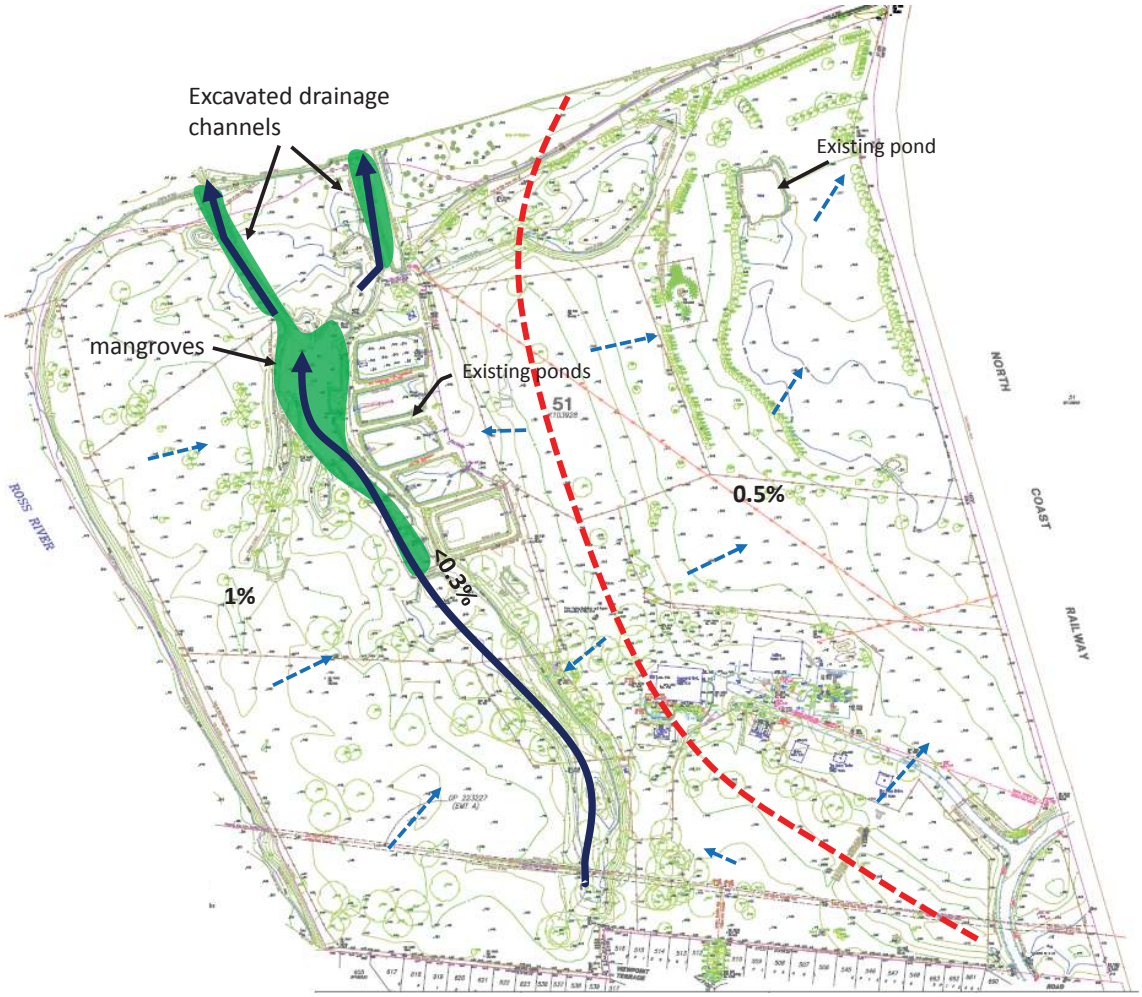


Figure 3 General drainage, catchments and topography

2.4 VEGETATION

The Oonoonba site generally is characterised by mainly open grassed paddocks. Large trees, particularly along the main drainage corridor are noted across the site. At the northern end of the site, mangroves have established as a result of previous drainage works connecting the site to the Ross River. Significant Para grass coverage is noted across the site, including the freshwater zones of the main drainage corridor.



Figure 4 Mangroves (L) and Para grass (R) across the site

2.5 RECEIVING ECOSYSTEMS

There are a number of regionally significant aquatic ecosystems that will ultimately receive stormwater runoff from the site:

- Ross River will accept runoff from the Oonoonba development. This waterway is considered to provide a key riparian corridor within the region and provide important fish and waterbird habitat. The Ross River is considered to be disturbed as a result of changes in catchment land use, however, the local Councils are committed to rectifying the system.
- Halifax Bay and Great Barrier Reef are the ultimate receiving environment for all stormwater discharge from Townsville and Thurwingowa Region. These ecosystems provide recreation resource, significant amenity and underpin economic activity. Importantly the reef represents an aquatic ecosystem that is considered to be regional, nationally and internationally significant and is the focus of numerous management initiatives of the Great Barrier Reef Marine Park Authority. Protection of ecological systems of the Great Barrier Reef from pollutants is recognised as one of the major challenges facing the Authority.

2.6 SITE CONSTRAINTS

Specific design constraints and responses that have influenced the stormwater quality management strategy are summarised in Table 1.

Table 1 Site constraints and design responses

Design constraint	Design response
Flat topography	To avoid excessively deep trunk drainage, adopt open drainage channels with end of line wetlands for treatment, where possible
Intertidal zone	Avoid/minimise impact of stormwater treatment measures on tidal zones, including mangroves, by locating out of and above these areas
Climate variability	Design for extended dry periods • Selection of suitable plant species • Include deep pools for predator refuge in wetlands • Provide saturated zones in bio-retention
Weeds	Freshwater open drainage channels with flat drainage gradients are susceptible to weed infestation. Include dense native vegetation suited to wetted conditions. Provide dense canopy of trees for shade.

2.7 PROPOSED DEVELOPMENT

The Oonoonba development will ultimately cover an area of approximately 53ha of residential development. The site is proposed to be developed into residential allotments (approximately 900 lots) typically varying in size from 100m² to +600m² lots.

Stages 1 to 6 and 10 of the development has now been built.

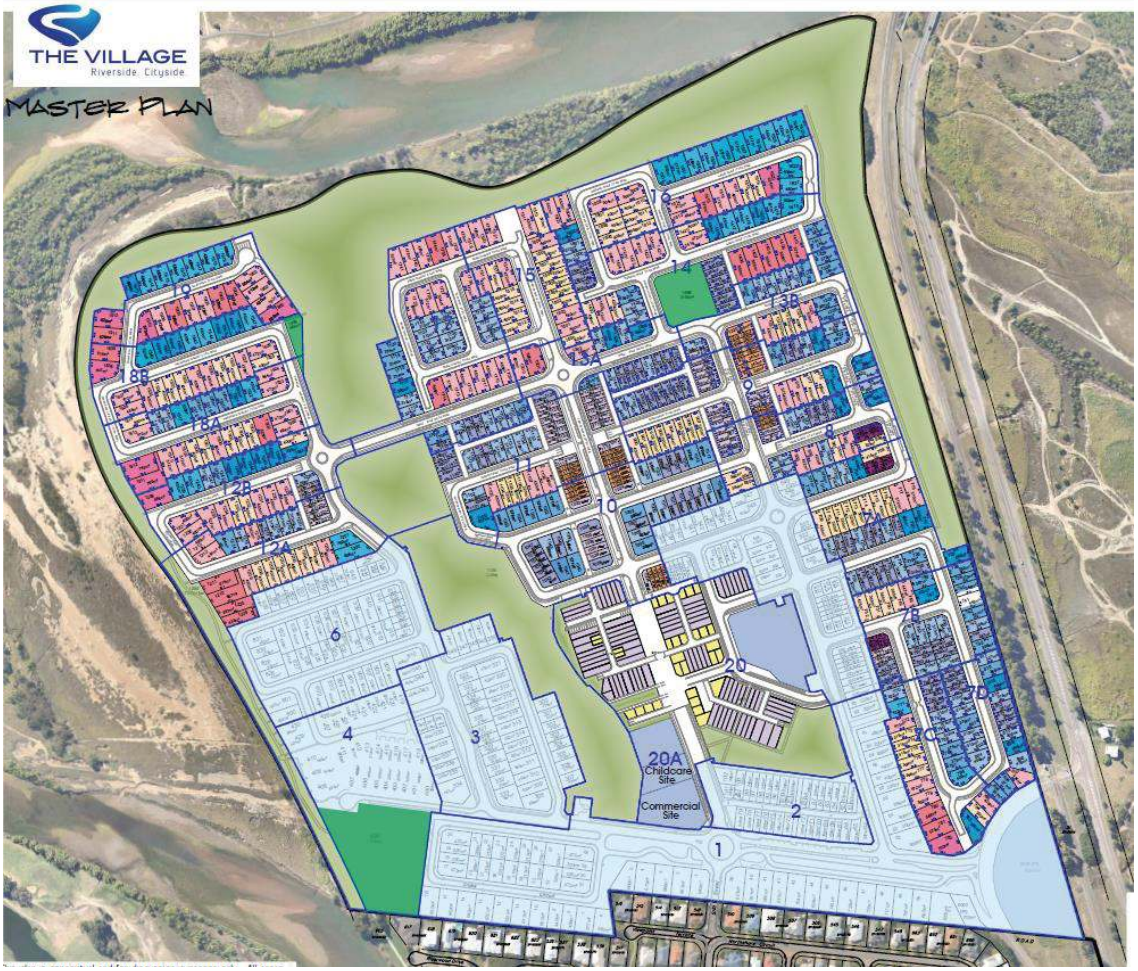


Figure 5 Oonoonba development – The Village

3 DESIGN OBJECTIVES

3.1 CONSTRUCTION PHASE WATER QUALITY

The primary focus of stormwater management during the construction phase is erosion and sediment control. The stormwater management objectives for the construction phase take the form of best-practice concentration-based discharge standards. The performance criteria are limited to those parameters that are directly linked to construction site activities. As the criteria are discharge standards, they apply to runoff events or pumped discharges (during dewatering of siltation basins) from the development site. The design objectives for stormwater discharged from the site during the construction phase are listed in Table 2, reproduced from Table A of the State Planning Policy (DSDIP, 2013)

This document does not propose erosion and sediment control measures for meeting these objectives. These will be developed as part of the operational works design.

Table 2 - Construction phase stormwater management design objectives (source: DSDIP, 2016)

Issue		Design objectives
Drainage control	Temporary drainage works	1. Design life and design storm for temporary drainage works: • Disturbed area open for <12 months—1 in 2-year ARI event • Disturbed area open for 12–24 months—1 in 5-year ARI event • Disturbed area open for > 24 months—1 in 10-year ARI event 2. Design capacity excludes minimum 150 mm freeboard 3. Temporary culvert crossing—minimum 1 in 1-year ARI hydraulic capacity
Erosion control	Erosion control measures	1. Minimise exposure of disturbed soils at any time 2. Divert water run-off from undisturbed areas around disturbed areas 3. Determine the erosion risk rating using local rainfall erosivity, rainfall depth, soil-loss rate or other acceptable methods 4. Implement erosion control methods corresponding to identified erosion risk rating
Sediment control	Sediment control measures Design storm for sediment control basins Sediment basin dewatering	1. Determine appropriate sediment control measures using: • potential soil loss rate, or • monthly erosivity, or • average monthly rainfall 2. Collect and drain stormwater from disturbed soils to sediment basin for design storm event: • design storm for sediment basin sizing is 80th% five-day event or similar 3. Site discharge during sediment basin dewatering: • TSS < 50 mg/L TSS, and • Turbidity not >10% receiving waters turbidity, and • pH 6.5–8.5
Water quality	Litter and other waste, hydrocarbons and other contaminants	1. Avoid wind-blown litter; remove gross pollutants 2. Ensure there is no visible oil or grease sheen on released waters 3. Dispose of waste containing contaminants at authorised facilities
Waterway stability and flood flow management	Changes to the natural waterway hydraulics and hydrology	1. For peak flow for the 1-year and 100-year ARI event, use constructed sediment basins to attenuate the discharge rate of stormwater from the site

3.2 OPERATIONAL PHASE WATER QUALITY

The stormwater quality management objectives that apply to the operational phase of the Oonoonba development have been established considering the State Planning Policy code – water quality.

Acceptable outcomes with respect to the SPP code is to achieve design objectives as listed in Table 3 below (derived from Table B, DSDIP, 2013 – Dry Tropics Townsville), or current best practice environmental management, reflecting land use constraints.

> *The **best practice environmental management** of an activity is the management of the activity to achieve an on-going minimisation of the activity's environmental harm through cost effective measures assessed against the measures currently used nationally and internationally for the activity (Environment Protection Act 1994 Section 21).*

Table 3 - Criteria for stormwater discharged from site

Constituent	Discharge Criteria
TSS	80% reduction in post development mean annual load
TP	65% reduction in post development mean annual load
TN	40% reduction in post development mean annual load
Gross Pollutants	90% reduction in post development mean annual load

4 DESIGN CONSIDERATIONS

Successful water sensitive urban design (WSUD) strategies respond to the specific characteristics and conditions of a site and the local and regional receiving environments. Site specific issues particular to Townsville conditions are described, that have had an influence on the proposed strategy.

4.1 MAINTAINING WATER QUALITY IMPROVEMENTS BASED ON BMP

Achieving the load based objectives (as per Table 3 previously) in Townsville requires relatively large treatment systems, particularly when wetlands are used, compared to other regions in Queensland. For example, achieving load based objectives for a development using wetlands requires wetland sizing of 7-8% of the development and above. This is dictated by the need to achieve the TSS objective of 80%. This significantly impacts on the amount of developable land available, and the cost per dwelling to achieve water quality targets.

The derivation of the objectives adhered to three underpinning principles which called for the objectives to be (Healthy Waterways, 2006):

- Locally relevant - The design objectives must, to the extent possible, be derived using locally relevant information on urban stormwater pollution generation rates and stormwater quality treatment measure performance;
- Practical - The design objectives must be achievable with more than one design solution; and
- Best Practice - The design objectives must result in the adoption of the most effective and efficient forms of contemporary 'best practice' designed stormwater quality treatment infrastructure sized to operate at their respective limit of economic performance (i.e. beyond which any further increase in treatment size will not result in any appreciable increase in treatment performance).

A best management approach aims to provide a treatment strategy suited to the site constraints, that is not an economic burden to the community. State Planning Policy stormwater objectives during the construction and operation phase (refer to Section 3) should be achieved where practical, however strict adherence should not result in excessively large assets for only small gains in treatment. This is a challenge for Townville conditions, where stormwater runoff is concentrated during a few months a year during the wet season.

When developing the stormwater treatment strategy for Oonoonba, an integrated approach using vegetated waterway and wetlands has been considered.

The operation of wetlands must allow sufficient treatment during the wet season, without resulting in excessively large wetland areas to meet State Planning Policy

load based objectives (DSDIP, 2013), which potentially impact on available developable land, cost to the community and maintenance cost to Council.

The designs developed have considered wetland notional treatment times of 36 hours to maximise volumes of wetland active storage for treatment during the high rainfall wet season, whilst still providing sufficient detention time to allow treatment processes. The wetland design has also incorporated vegetated waterways upstream of the wetlands where possible, to provide a filtering function of development runoff prior to entering wetlands.

Inclusion of upstream vegetated waterways provides an effective means of managing drainage economically in flat drainage environments as well as providing a treatment function that avoids excessively large wetland areas. This approach reduces required wetland sizes from above 7% to approximately 3-4% of the development area i.e. a 40-50% reduction in size.

4.2 DESIGN FOR FLAT DRAINAGE GRADIENTS

4.2.1 Context

The Oonoonba development site is highly constrained with regards to treatment opportunities due to the flat nature of the site. Typically on such sites wetlands or at surface treatments such as streetscape raingardens are the most applicable. Stage 1 implementation used streetscape raingardens (BMT WBM, 2011). The original intent of the stormwater management strategy for the site was for mostly streetscape approaches. Experiences from Stage 1 has resulted in a re-assessment of the original strategy, with the use of vegetated open waterways and wetlands now the preferred approach.

To avoid expensive, low gradient, large diameter pipe drainage networks, the urban drainage design considered minimising catchment areas, minimising drainage lengths and using surface drainage systems at minimum grade. The surface drainage systems are created as vegetated waterways designed to convey flows up to the major storm event.

An important design consideration for flat gradient drainage channels is the management of trickle and low flows that can result in extended wetted conditions and siltation. Typically such channels have been constructed with hard bases such as concrete. Whist conveying trickle flows and low flows efficiently, these channels provide little treatment function and require on-going maintenance for sediment removal, and maintenance of adjacent planted zones. These channels may also present a potential public slip hazard as a result of algae and slime.

4.2.2 Vegetated waterways

An approach using a densely vegetated low flow channel is proposed for the main drainage corridor for the Oonoonba development, to provide a low maintenance alternative to a hard base invert. This also allows a treatment function, minimising downstream wetland areas.

There are a number of issues that must be considered for successful outcomes using this approach. Most are related to ensuring weeds such as Typha and Para grass do not proliferate, particularly where wetted conditions persist. The main design issues include:

- Careful plant selection suited to the expected operating condition
- Design for shade over the low flow channel
- Provision of suitable access to manage weeds

These issues have been carefully considered in recent work we have completed with Mackay Regional Council, where this apprcach has now been accepted as a Council standard. The approach has identified a number of species that are best suited to not only provide a good filtering function, but also thrive and out compete weeds species in the wetted conditions.

Low flow channel planting

Two key native grass species have been identified that are common in the local area that would be suited for inclusion in vegetated waterways:

1. Leersia hexandra – suited to more permanent wetted conditions such as the base flow portion of the channel receiving constant trickle flows

2. Imperata cylindrica (blady grass) – suited to zones of the channel that are wetted frequently, but not permanently wet e.g. the low flow portion of the channel above the trickle flow invert

Both species provide dense grass coverage, typically to 0.5m in height. An interesting observation with these species is that weed infestations from species such as Typha are not occurring. The photos below show examples of Leersia hexandra in the lower wetted zone of a bulked out wetland at North Shore (Townsville), as well as an example of Leersia hexandra in an open floodplain zone.



Naturally establishing Leersia hexandra on the lower wetted batter



Leersia hexandra in an open floodplain

Design for shade

The long term success of a vegetated waterway strategy is the establishment of shade across the channel, particularly for the low flow channel section. Species such as Melaleuca are well suited to these types of channels where wetted conditions persist.

A recommended approach is to initially plant out high density (1 per 5-10 m^2) of tubestock in and around the low flow channel section. These can be thinned out if required at a later date once established. Less dense planting of trees (e.g. 1 per 25m^2)

in the floodplain zone above the low flow channel can then occur. A wider palette of species is available in this zone given the less frequent inundation.

Provision for suitable access for weed management

It is important that sufficient access is available for weed management. These tracks do not necessarily require to be of a standard for vehicle access, but rather sufficient to allow maintenance staff to access by foot for weed spraying. Stabilised earthen tracks above the low flow portion of the channel, along the length of the channel would be considered sufficient.

4.3 CLIMATE VARIATION IN THE DRY TROPICS

Design of vegetated treatment systems such as wetlands in Townsville must respond to the challenging climate conditions typical in the dry tropics. This is characterised by a distinct wet season (December to May), where the vast majority of rainfall occurs, followed by an extended period of little to no rain. These climatic conditions result in high water level fluctuations and long periods of wetting and drying in constructed wetlands.

Constructed wetland systems are still in their infancy in the dry tropics, and the best operating configuration is still to be tested. DesignFlow, together with Greening Australia are currently undertaking planting trials at the two wetland sites at the North Shore development (Townsville) that have been bulked out to provide sediment management for construction activities. Each wetland is designed with a different operating regime:

- Shallow ephemeral type wetland that is designed to operate in seasonal wetting and drying cycles
- A deeper wetland system that retains water throughout the whole year

Our current experience on the North Shore site suggests that the shallower type system will provide successful outcomes, allowing for a diverse range of plants. Further monitoring of seasonal variations in the coming years will confirm the preferred approach.

4.4 WEEDS

The long term success of vegetated stormwater systems in the Townsville region will often be dictated by the resilience to weed infestation. Careful design is required to avoid conditions that will be preferred by species such as Typha and Para grass. Observations at the Oonoonba site indicate that management of Para grass will be critical to the success of vegetated systems.

Careful plant design plays an important role in the management of weeds. Key aspects to consider include:

- Dense planting of native species suitable for the operating and climatic conditions

- Tree plantings to establish longer term shade canopy
- Establish batter plantings early to provide a weed barrier to aquatic plantings
- Choose species that allow easy identification of weeds for removal
- Suitable access around vegetated assets to allow weed management

Where weeds are present prior to the construction and establishment of vegetated assets, a weed management regime of spraying should occur to minimise the incidence of future weeds outbreaks. Any topsoils used should also be weed free.

4.5 TIDAL CONSTRAINTS

Design of vegetated treatment systems must consider the possible impact on tidal ingress. Tidal ranges in Townsville can be expected to approximately 2.25mAHD, corresponding to the highest astronomical tide (HAT). Freshwater treatment systems must be protected from tidal influences that could potentially have detrimental impacts of aquatic vegetation. This will typically require operating levels of the treatment systems at or above the HAT level, or appropriate measures to minimise the impact of any tidal influences (e.g. outlet configuration to restrict tidal backflow).

Existing mangroves that have established within the development site as a result of previous drainage works connecting to the Ross River will be protected as far as possible, and integrated with the treatment strategy. Development low flows are proposed to pass through freshwater treatment systems prior to any discharge to these areas.

5 STORMWATER TREATMENT STRATEGY

The stormwater treatment strategy for the Oonoonba development considers an integrated approach considering the whole development. This avoids numerous treatment elements that could occur as varying stages of the development are released. This simplifies and minimises on-going maintenance for Council.

The overall stormwater treatment strategy developed has occurred in collaboration with urban and landscape designers to ensure strategies developed do not conflict with current masterplan designs, and retain minimum flood storage volumes.

The proposed Oonoonba development will cover an area of approximately 55ha. Two main drainage discharge zones are proposed, and correspond to the location of the main treatment elements. The proposed drainage for the development will consist of a piped minor drainage system to 2 year average recurrence interval (ARI), with overland flows managed within road reserves and drainage corridors.

The flat nature of the site has required careful consideration of urban drainage and stormwater treatment solutions. From an urban design perspective a preference was for the main treatment zones to be located within and at the end of the major open drainage corridors. The main treatment elements considered in the strategy are wetlands and vegetated waterways due to the flat drainage gradients.

The treatment strategy proposed aims to create a naturalised environment, with dense planting of trees and native vegetation along drainage corridors and wetland zones. These areas will be integrated with the overall landscape enhancements (e.g. paths etc) to allow public interaction. Retaining and enhancing mangroves across the site will offer varied ecological environments. Table 4 and Figure 6 details the stormwater treatment strategy for the Oonoonba development.

Table 4 Stormwater treatment elements

Catchment		Treatment	
ID	Development Area (ha)	Treatment	Area/length
A (Stage 1)	3.29	Stage 1 Biopods	305 m²
B	1.80	Swale S3	100m
C	2.56	Swale S1 Wetland W1 Swale S2	500 m 10,000 m² 125 m
D	4.54		
E	2.93		
F	2.94		
G	6.16		
H	7.78		
I	4.87	Bioretention B1	465 m²
J	10.09	Ephemeral Wetland EW1	5,500 m²
K	0.74		
L	7.33	Ephemeral Wetland EW2	4,500 m²
Total	55.94		

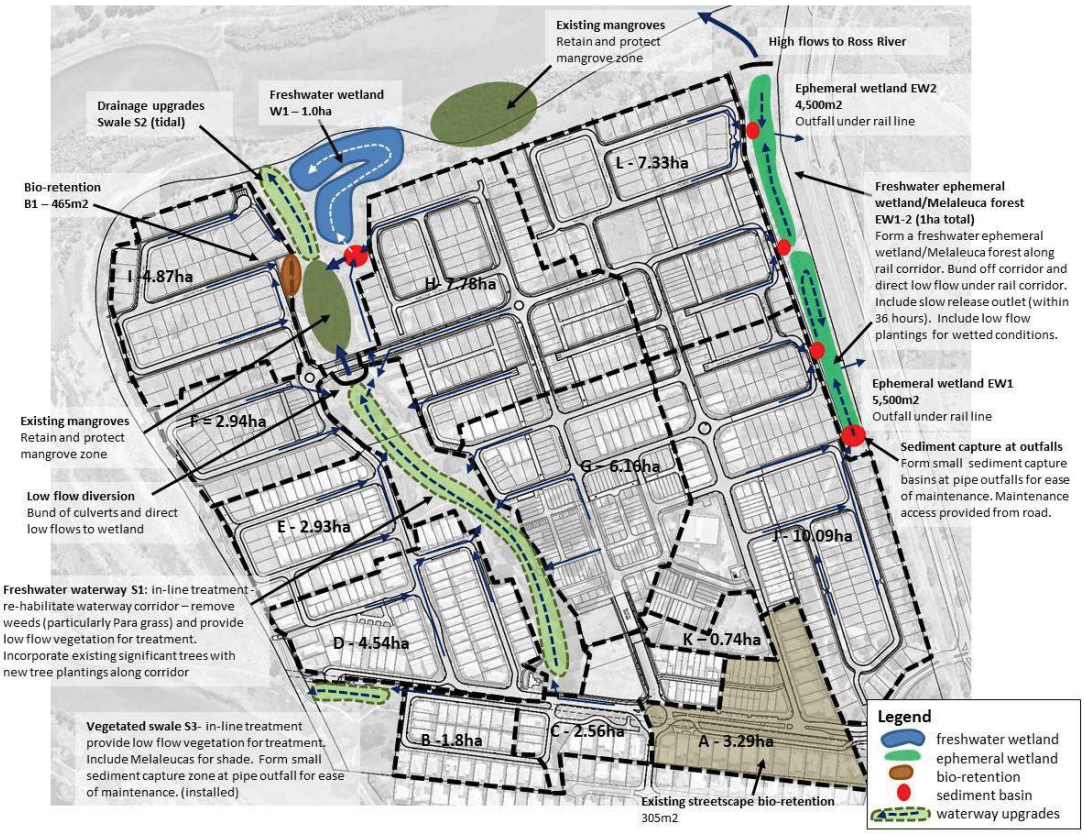


Figure 6 Oonoonba stormwater treatment strategy

Central drainage corridor

This represents the main treatment zone for the development, representing approximately 60% of the development. Restoration of the main drainage corridor (S1) upstream of the road crossing connecting Stage 12 and 13 forms an important part of the strategy, providing a treatment function and minimising the size of the downstream wetland proposed.

This drainage corridor upstream of the road crossing will be configured as a freshwater waterway, which will provide a filtering treatment function for discharged development runoff prior to diversion to the downstream wetland.

Downstream of the road crossing low flows will be diverted to a freshwater wetland (W1-1.0ha) for treatment. The operating levels of the upstream waterway and wetland must be chosen to avoid tidal influences (Highest Astronomical Tide level corresponds to 2.25mAHD, Mean High Water Spring 1.25mAHD).

Downstream of the road crossing the existing mangrove zone will be retained. This will receive high flows and overflows not treated by the wetland. Whilst this area does not form part of the formal stormwater quality management strategy presented in this report, retention of this zone is important from an ecological perspective and will provide an additional treatment buffer prior to discharge to the Ross River.

Note: development discharge from Stage 18/19 (4.75ha) is proposed to be treated by a bio-retention basin (B1 – 465 m²). Diversion to the main treatment wetland is not practical from this stage of the development. Treatment via bio-retention will be feasible in this location given an approximate 2.5 m elevation difference will be available from finished development level to the drainage invert. This basin can be easily accommodated within the masterplan layout.

Eastern drainage corridor

A 50 m wide drainage corridor is available along the eastern boundary of the site. This area is proposed to be converted to a Melaleuca forest combined with freshwater ephemeral wetlands. At the downstream end of the drainage corridor a bund will be built to retain freshwater conditions. Treated low flows are proposed to be directed under the rail line using existing culverts. High flows will continue down the channel over the downstream bund to the Ross River.

Sediment capture zones at each pipe outfall are proposed to be incorporated for maintenance purposes.

South west drainage

A small catchment at the south west corner of the development is directed to a swale (S3) prior to discharge to the Ross River. This area has recently been completed with native grass along the wetted low flow channel and extensive plantings of Melaleucas along the low flow swale to allow a shaded canopy to establish in time.

5.1 STORMWATER TREATMENT ELEMENTS

The following provides details on stormwater treatment elements proposed in the water quality strategy.

5.1.1 Vegetated waterways

Within the very flat topography of the Oonoonba development a surface drainage strategy using vegetated drainage corridors is adopted to minimise the requirements for large pipe drainage systems and provide a treatment function.

The existing main drainage corridor across the site is degraded and is infested with weeds. There exists an excellent opportunity to rehabilitate the main open drainage corridor back to a naturalised waterway with dense native plantings of grasses and trees which will significantly increase the ecological value. As well as increasing ecological value, this would increase landscape amenity, minimise maintenance weed issues by getting shade into the waterways and improve water quality treatment.

Inclusion of naturalised (vegetated) waterways into the overall strategy is critical in minimising the requirements for wetland areas. These waterways provide treatment, principally of suspended sediment, prior to discharge to wetlands for final treatment. Wetland areas to meet SPP requirements have been found to be reduced by approximately 40-50% with the inclusion of vegetated waterways that provides a water quality treatment function.

Vegetated waterways will be formed considering a trickle/low flow channel (to 3 month flows) with a flood plain zone to manage less frequent flood flows. Careful selection of plants is required to minimise the instance of weed infestations. A dense planting of trees across the low flow section (typ. Melaleuca spp.) and planting with native grass species such as Leersia hexandra and Imperata cylindrica in more frequently wetted low flow channel have been found to be effective to minimise the ingress of weeds such as Typha.

The dense canopy of trees provides a shading function that minimises the incidence of Typha growth, whilst planting such as Leersia hexandra have been found to be very resistant to weed infestation.

Adjacent floodplain zones can grassed and treed, with a mairtenance access track provided above the low flow channel section for maintenance. The floodplain zone can include park areas and specific landscape treatments.

Figure 7 provides a typical sectional detail for the proposed waterway sections. Figure 8 provides some photo examples of naturalised waterways.

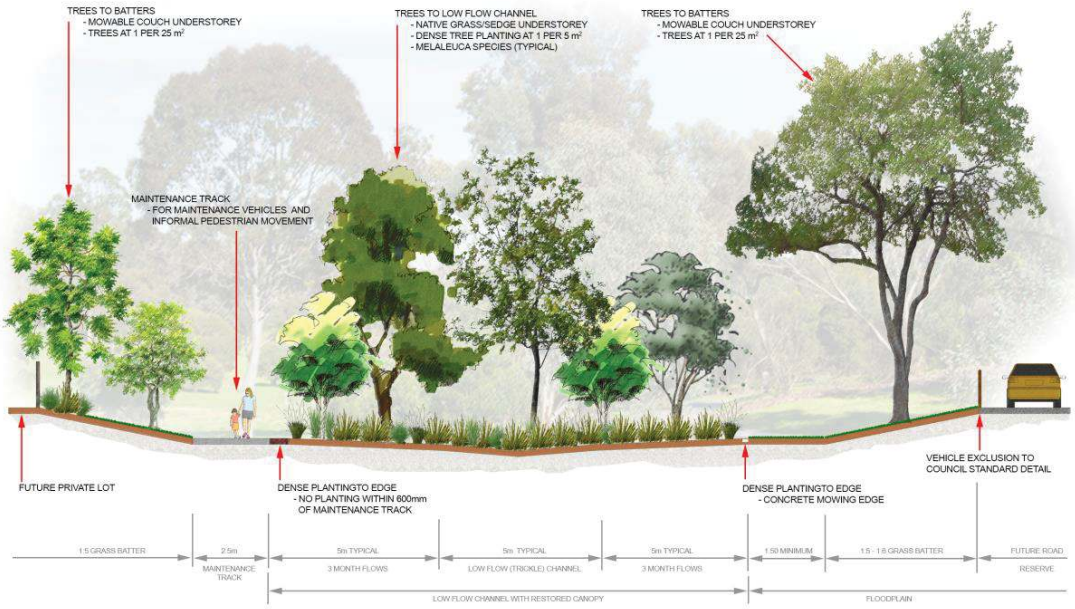


Figure 7 Typical section of a naturalised waterway



Figure 8 Example naturalised waterways

5.1.2 Constructed wetlands

Constructed wetland systems are densely vegetated water bodies that use enhanced sedimentation, fine filtration and biological uptake processes to remove pollutants from stormwater. Water levels rise during rainfall events and outlets are configured to slowly release flows, typically over two to three days, back to dry weather water levels. In addition to treating stormwater, constructed wetlands can also provide habitat, passive recreation and improved landscape amenity.

Constructed wetlands typically consist of an inlet zone (sediment management), a macrophyte zone (a shallow heavily vegetated area to remove fine particulates and uptake soluble pollutants) and a high flow by pass to protect the macrophyte from scour. Figure 9 shows the key elements of constructed wetland systems.

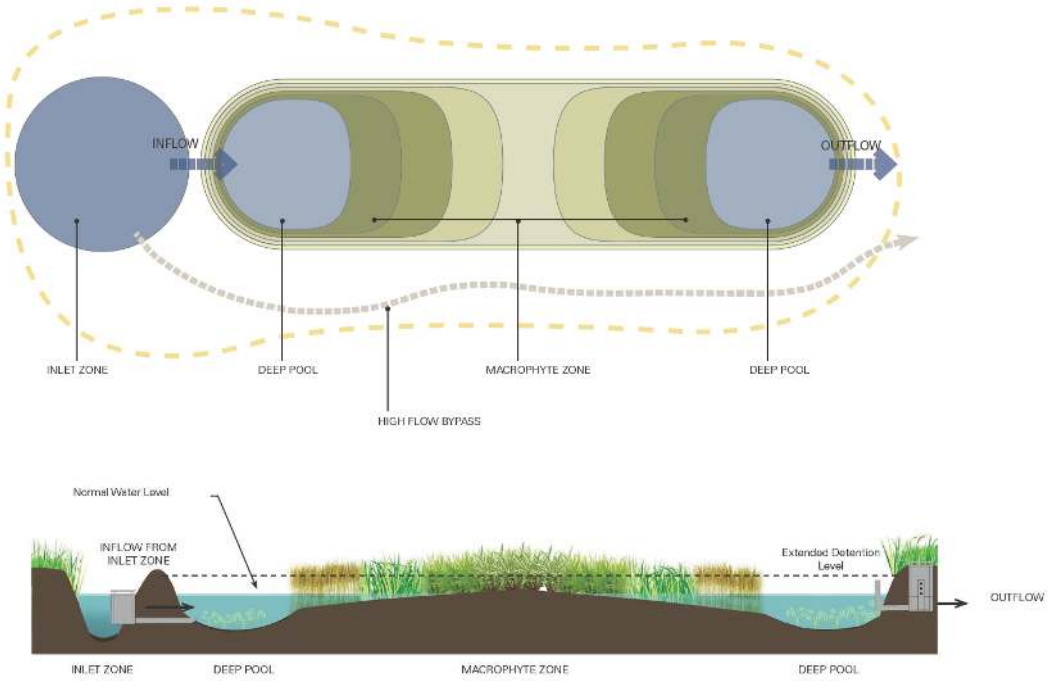


Figure 9 Typical constructed wetland details (source: Water by Design)

Design considerations in the Dry Tropics

In the context of the dry tropics, constructed wetlands will not fill and drain regularly like wetlands in temperate zones. The large and consistent rainfall during the wet months will ensure that wetlands remain charged during the wet. During the dry months the absence of rainfall will result in wetlands drying out, due to high evaporative losses and no top up from stormwater runoff.

Ephemeral vs Permanent water wetlands

Wetlands in the dry tropics may need to persist for four to seven months with very little input of water.

To account for extended dry periods wetland configurations for dry tropics can consider either an ephemeral system, designed with shallow planted zones that will dry out for up to 6 months per year, or wetlands consisting of mostly deep marsh (0.5 to 0.7 m deep) and open pool areas (to 2 m deep) that maintain a permanent pool of water over the majority of the wetland throughout the dry season. Careful plant selections are required for each type of wetland.

Wetlands for the Oonoonba development are proposed to be freshwater ephemeral wetlands. Experience from recent work around Townsville (e.g. NorthShore development where the two wetland systems are currently being trialled) indicates that this type of wetland will allow greater diversity of plant species and retain water for a reasonable duration during the dry season.

Design considerations - ephemeral wetland

An ephemeral wetland for the dry tropic regions considers shallow vegetated zones (0.1 to 0.5 m deep) over the majority of the wetland (85-90%) with open pool areas (to 2 m deep). The performance of the wetland is expected to result in the majority of the wetland drying out for 2-3 months per year. Shallower zones can be expected to be dry for up to 6 months per year. The main design issues for an ephemeral wetland are described below:

- The wetland deep pool areas are lined with a relatively impervious clay layer. This is suggested to maximise the retention of water throughout the dry season to allow permanent pools to be maintained. Clay lining of the shallow wetland floors is most likely not required as plants will be selected to survive for extended dry periods.
- Topsoil would need to be included over the wetland floor; a minimum of 200 mm is required for plant growth.
- The majority of the wetland (85-90%) shall consist of shallow vegetated zones, typically 0.1 to 0.5 m deep, with open pool areas to 2 m.
- An extended detention depth of 0.5m would be adopted for the wetland with a notional detention time of 36 hours.
- It will be beneficial to retain a deep water zone (~10-15% of wetland area), to create a habitat for mosquito larvae predators, to improve landscape aesthetics and to provide habitat and refuge zone for submerged aquatic and macrophytes during the dry. This refuge will then assist the vegetation to rapidly colonise at the beginning of the wet season.

This deep water zone should have a large section of open water, which would be designed to retain water for the whole dry season. To achieve this, the deep open pool zones are considered to 1.5-2m depths. Initial water balance modelling and observations from open water bodies around Townsville indicates water level variation due to evapotranspiration is 0.8 - 1m.

Oonoonba wetlands

Wetlands proposed for the Oonoonba development will be located at discharge points from either pipe drainage outfalls or from stormwater diverted from vegetated swales. Drainage discharges are then directed to the wetland inlet sediment capture zones to manage coarse sediment inputs. From here stormwater runoff will be directed to each wetland in a controlled manner, with high flows by-passing the wetlands.

The open waterways upstream of wetlands will be designed to convey flows at very flat grade. They will be created as a natural vegetated waterway and will provide some level of sedimentation and filtration of stormwater.

Wetland W1 (1.0ha), which manages approximately 60% of the development, will be built and planted when approximately 80-90% of the contributing development catchment has been built out. This sequencing protects the wetland from high

sediment laden runoff from construction activities, which can potentially smother establishing wetland vegetation. In this case, use of construction sediment measures such as temporary sediment basins will be required to protect downstream waterways.

At the eastern boundary of the site ephemeral wetlands EW1 and EW2 are proposed within the main drainage corridor. This area will be combined with a Melaleuca forest, providing a dense canopy of shade to minimise weed ingress. The drainage corridor will be planted with a range of grasses, sedges and rushes suited to the expected wetted conditions. During storm event the drainage corridor will pond with water and be slowly released over 36 hours. High flows will still continue down the channel to the outfall to Ross River.

Vegetation

Wetland plants that occur naturally in the freshwater lagoons, floodplains and wetlands of the Townsville Region are likely to be appropriate for stormwater treatment wetlands. These local plants are able to tolerate the high water level fluctuations and long periods of wetting and drying. DesignFlow, in consultation with local industry, have developed an extensive palette of plants suited to Townsville conditions over the last few years whilst working on the North Shore development.

A wetland planting trial is currently underway with Greening Australia at the North Shore wetland sites on a range of wetland plants. A number of species are being trialled from shallow to deep marsh species to review the overall performance during the wet and dry season. The outcomes of this trial will help inform future plant selections for constructed wetlands in Townsville.

Plant communities such as Eleocharis sedgelands, Oryza, Pseudoraphis, Leersia hexandra and Hymenachne grasslands, Melaleuca forests are likely to be key components of the design.

Mosquitoes

Mosquitoes are responsible for the transmission of a number of arboviral diseases the most common in northern Australia are Ross River fever, and malaria (DHCS, 2001). The government actively controls mosquitoes, especially when outbreaks of arboviral diseases occur. Wetlands create standing water bodies which are potential breeding grounds for mosquitoes. In particular, wetland drying presents the risk of mosquito breeding, as it can lead to isolated stagnant pools as a wetland dries out.

Mosquito control is an important consideration in the design of any wetland type in the dry tropics region. The design needs to carefully consider issues such as the likelihood of the design to create disconnected shallow pools, promotion of mosquito larvae predators, vegetation type and edge type. Key management measures include:

- Permanent pools to support mosquito predators – e.g. small native freshwater fish

- Waterbodies edged with "sloped" banks to prevent the formation of isolated stagnant pools
- Diversity of aquatic species to support macroinvertabrates. Macroinvertabrates serve an important function in the management of mosquito numbers.

5.1.3 Bio-retention

Although the vast majority of stormwater treatment proposed for the Oonoonba development is associated with wetlands and vegetated waterways, bio-retention is proposed to treat Stage 18 and 19 at the north western end of the development.

Function

Bio-retention systems are vegetated areas where runoff is filtered through a filter media layer (e.g. sandy loam) as it percolates downwards. Vegetation plays a key role in bio-retention systems. The surface is densely planted with ground level grasses and rushes and may also contain selected tree and shrub species. The agitation of the surface of the bio-retention basin caused by movement of the vegetation and the growth and die off of root systems prevents accreted sediments clogging the filtration media. Beneath the surface, vegetation provides a substrate for biofilm growth within the upper layer of the filter media. Vegetation facilitates the transport of oxygen to the soil and enhances soil microbial communities which enhance biological transformation of pollutants.

In a bio-retention system, treatment of the stormwater occurs both on the surface amongst the vegetation and within the filter media. When larger storm inflows cause temporary ponding on the surface of the basin, pollutants are removed from the stormwater through sedimentation and particulate adhesion onto the stems and leaves of the vegetation. As stormwater percolates through the filter media, fine particulates and some soluble pollutants are removed through processes such as adhesion on to the surface of the filter media particles, biological transformation of pollutants by biofilms growing on the surface of the filter media particles, and biomass uptake of nutrients and metals through the root systems of the vegetation growing in the system.

Bio-retention basins typically use temporary ponding of 0.2–0.4 m depth above the filter media surface to increase the volume of runoff treated through the filter media. Flows above the design flow are conveyed through overflow pits or bypass paths so the filter media surface is protected from high velocities that can dislodge collected pollutants or scour vegetation.

There is a reasonable amount of flexibility regarding the size, shape and location of the systems. As such, there are opportunities to integrate bio-retention systems as landscape features throughout the urban environment as described in the following sections.

The photos below provide examples of bio-retention basins integrated into public realm, parkland spaces and streetscapes.



Figure 10 Examples of bio-retention basins in urban areas

Design considerations in the Dry Tropics

The nature of the climate in Townsville means bio-retention basin must include a saturated zone in the base. Experimental trials conducted by the Facility for Advancing Water Biofiltration (FAWB) show benefits for plants and for removing nitrogen. By using a saturated zone soil moisture can be maintained during the long dry season to sustain vegetation for a number of months without rainfall or stormwater inflow. Figure 11 shows that saturated zones are a relatively simple modification to standard bio-retention designs by:

- incorporating an impervious liner to ensure the basin holds water
- amending the hydraulic structures at the outlet to allow 400–500 mm ponding in the base
- using coarse gravel the base of the saturated zone to support the removal of nitrogen
- ensuring the base of the basin is flat.

Top-up of the saturated zone of the bio-retention basin during the dry season may be required to ensure there is enough water in the zone to sustain plants.

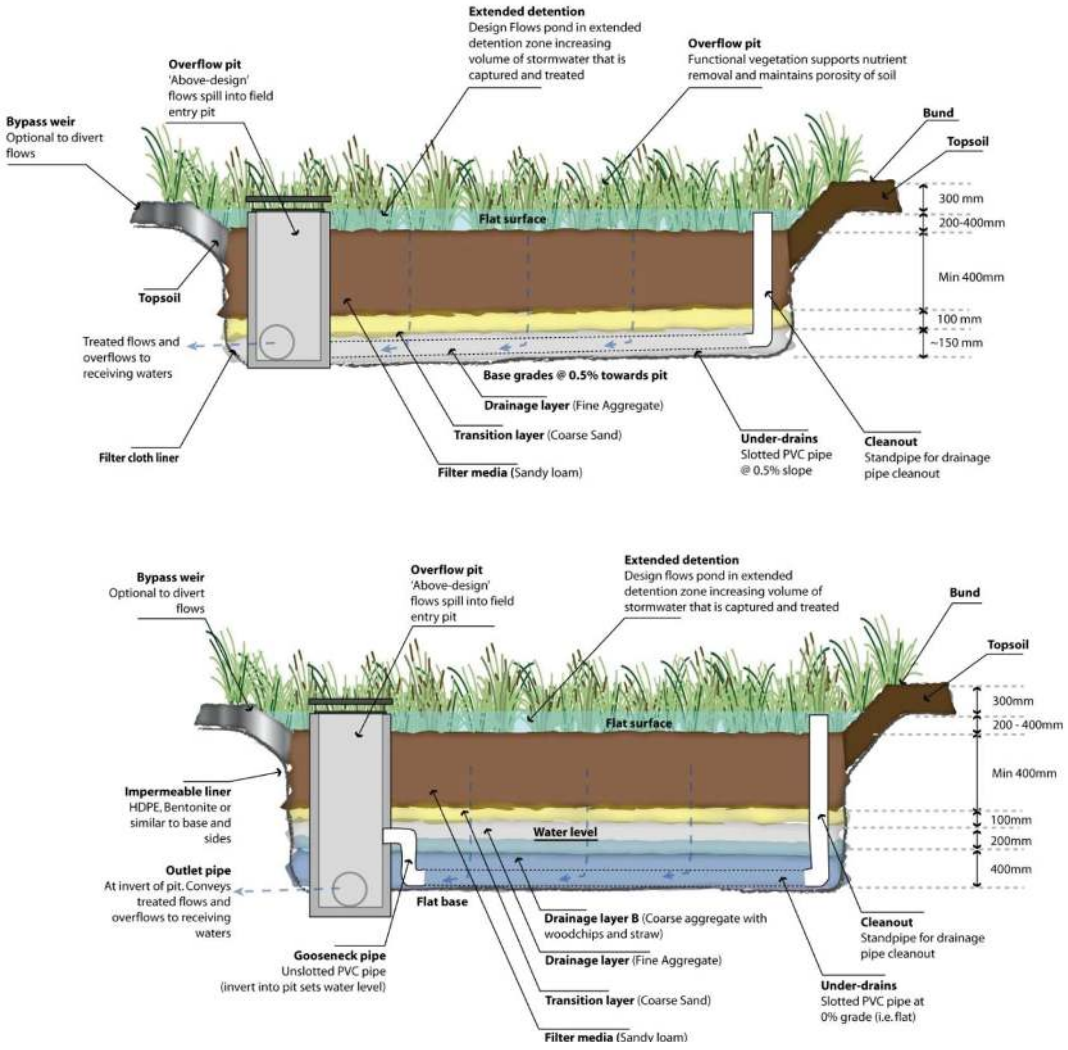


Figure 11: Typical section through bio-retention basin with a saturated zone

Vegetation selection

Due to the wet and dry seasons in the Townsville region, bio-retention systems will operate substantially differently to those in temperate regions. During the wet season, the bio-retention systems will receive large volumes of consistent rainfall while during the dry season the bio-retention are likely to remain dry if no irrigation is used.

Bio-retention systems are typically constructed using free draining soils and so, unlike wetlands, they drain completely after the cessation of rainfall. A typical hydraulic conductivity of bio-retention systems is 100 to 200 mm/hr; therefore bio-retention systems can drain within hours after a storm event.

During the dry season, bio-retention systems will dry out relatively quickly due to the nature of the free draining soils. Therefore, vegetation selection must be carefully considered to ensure the bio-retention vegetation can be sustained during long periods of little or no rainfall. It is expected that without irrigation, the majority of the bio-retention vegetation will die back during the dry season, but should be capable of re-establishment at the start of the next wet season.

Establishment of trees within and around the bio-retention basins have also been found to be an effective way to manage weeds and thus reducing general maintenance. They also provide additional amenity function. Filter depths of 0.7 m minimum are preferred (where drainage permits) in such cases to provide sufficient media for potential tree plantings within the basins.

Typical plant species considered appropriate for bio-retention in Townsville include:

Acacia holosericea	*Silver leaf wattle*
Alloteropsis semialata	*Cockatoo grass*
Carex appressa	
Lomandra hystrix	
Ghania aspera	
Isachne globosa	
Imperata cylindrical	*Blady grass*
Chrysopogon fallax	*Golden beard grass*
Leptochloa neesii	*Umbrella canegrass*
Melaleuca leucadendra	
Melaleuca nervosa	*Fibrebark*
Melaleuca viridiflora	*Broad leaved tea tree*
Oryza australiensis	*Australian wild rice*
Pandanus cookii	*Screw pine*

6 STORMWATER TREATMENT PERFORMANCE ASSESSMENT

MUSIC modelling was conducted to quantitatively assess the stormwater treatment performance of the proposed stormwater strategy. MUSIC version 6.0 was used for the assessment and model the parameters have been adapted from the Mackay MUSIC Guidelines (MRC, 2008). These are considered the most applicable modelling guidelines applicable to Townsville.

Details of the modelling assumptions, parameters and results are presented in the following sections.

6.1 MODEL STRUCTURE

The structure of the MUSIC model is shown in Figure 12 with the general data upon which the model is based provided in Table 5.

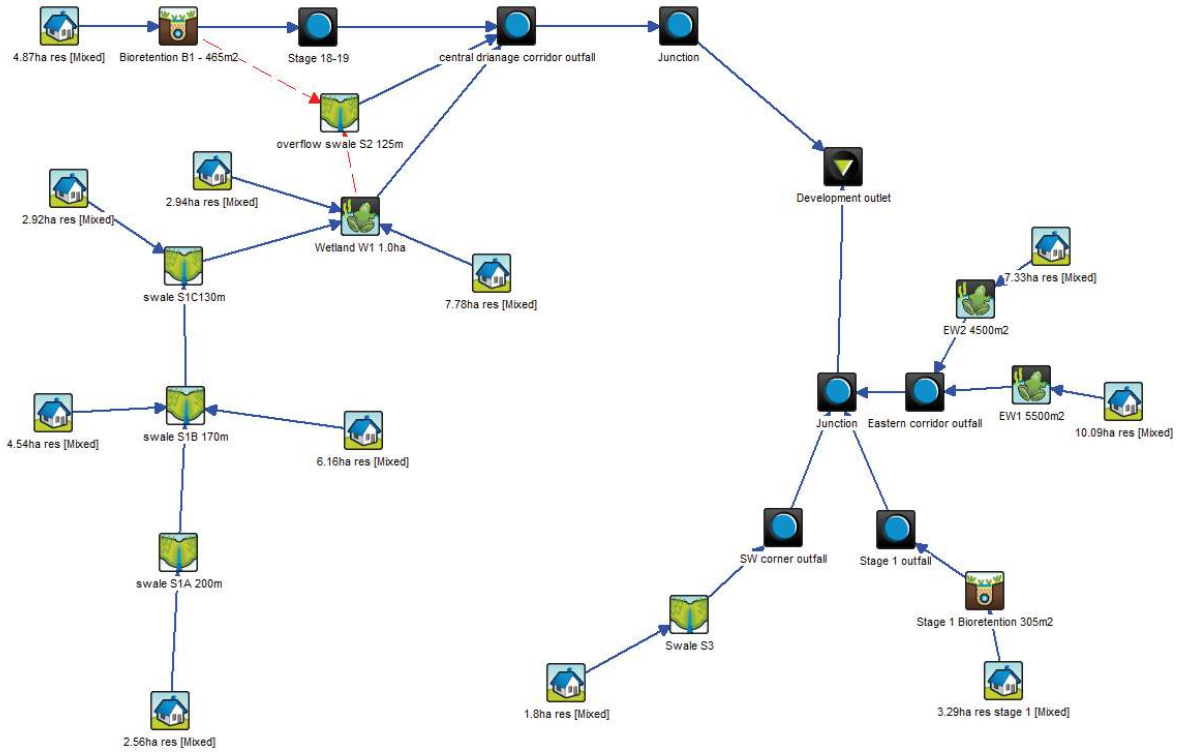


Figure 12: MUSIC catchment and model layout

Table 5: MUSIC model data summary

Input	Data used in modelling
Rainfall station	32040 Townsville
Time step	6 minute
Modelling period	1970-1984
Mean annual rainfall	1165 mm (for the period used)
Mean annual evapotranspiration	1856 mm
Rainfall runoff parameters	Upland soils (Table 7 Mackay MUSIC modelling guidelines)
Pollutant export parameters	Urban Residential (Table 9 Mackay MUSIC modelling guidelines)

6.1.1 Catchment data

Catchment areas draining to each treatment system have been derived from proposed master plan layout for the development, considering the pipe drainage system that would apply. The model adopts the lumped catchment approach with an overall percent impervious value assigned depending on the landuse.

Table 6 Land use assumptions

Land use	Percent impervious
Urban residential	60%
Community facility and park	30%

The main catchment areas draining to each treatment zone are shown previously in Figure 6. For the purposes of sizing treatment systems, open space and drainage reserves have been excluded from the catchment areas as these areas will provide a treatment function.

6.1.2 Wetland reporting table

The model parameters adopted for each wetland are shown in Table 7. The main treatment wetland (W1) is proposed to be configured with an inlet pond. Smaller eastern corridor wetlands (EW1-2) will be provided with small sediment basins at pipe outfalls prior to diversion to each wetland.

Table 7 Wetland node reporting table

Parameter	W1	EW1	EW2
Catchment area (ha)	26.9	10.83	7.33
Inlet pond volume (m3)	1,000	500	300
Macrophyte surface area (m2)	10,000	5,500	4,500
Proportion contributory catchment area %	3.7%	5.1%	6.1%
Has surface area been calculated correctly	Y	Y	Y
Extended detention depth (m)	0.5	0.5	0.5
Permanent pool volume (m3)	3,000	0	0
Exfiltration rate (mm/hr)	0	0	0
Evaporation loss as % PET	125	125	125
Equivalent pipe dia (mm)	153	113	103
Overflow weir length (m)	20	20	20
Notional detention time (hrs)	48	36	36
Number CSTR cells	5	5	5

6.1.3 Swale reporting table

The model parameters adopted for each swale are indicated in Table 8. Freshwater swales (S1 and s3) will be planted with native grass species such as Leersia hexandra and Imperata cylindrical across the low flow portion of the channel. These species typically grow to over 0.5 m in height. Swale S2 will provide treatment to wetland overflows. This drainage corridor will be tidal and salt water species such as Sporobolous (salt couch) are more appropriate. A maximum vegetation height of 100mm is considered in this case.

The swale width and height consider only the low flow portion of the channel, where the majority of treatment will occur. Swale gradients are taken at 0.1% reflecting the generally flat gradients available. Swale lengths represent the minimum length of treatment each sub-catchment can expect to have, based on the current masterplan.

Modelled parameters are considered a conservative representation of actual conditions.

Table 8 Swale reporting table

Parameter	S1A-C	S2	S3
Length (m)	500	125	100
Bed slope (%)	0.1	0.1	1.0
Base width (m)	5	5	1
Top width (m)	15	15	5.6
Depth (m)	0.5	1.0	0.4
Vegetation height (mm)	0.5	0.1	0.25
Exfiltration (mm/hr)	0	0	0

6.1.4 Bioretention reporting table

The model parameters used for each bio-retention cell are shown in Table 9. The bioretention systems were modelled using minimum 30 mg/kg Orthophosphate (OP) minimum 400 mg/kg Total Nitrogen (TN) in accordance with the recent advice issued by Healthy Waterways Partnership.

(http://healthywaterways.org/initiatives/waterbydesign/stormwater)

Table 9 Bio-retention reporting table

Parameter	Bio-retention basin ID	
	B1	Stage 1 (existing)
Catchment Area (ha)	4.87	3.29
Surface Area (m2)	465	305
Has the surface area been calculated appropriately?	Y	Y
Extended detention depth (m)	0.3	0.2
Filter area (m2)	465	305
Proportion contributing catchment area (%)	1.0	0.9
Hydraulic conductivity (mm/hr)	150	150
Filter depth (m)	0.6	0.3
Overflow weir width (m)	5	5
Seepage loss (mm/hr)	0	0

6.1.5 Results

The results of the MUSIC modelling for the proposed development are shown in Table 10. Results are provided for the whole site.

Whilst individual treatment elements may not necessarily meet load based objectives, the combined effect of all treatments when considered at the catchment outlet applies when considering the water quality objectives to meet SPP requirements.

Table 10: MUSIC model results – stormwater quality

ID	Pollutant	Inflows (kg/yr)	Outflows (kg/yr)	Reduction achieved (%)	Water Quality Objective (%)
TOTAL	TSS	95,000	18,900	80.1%	80%
	TP	189	61	67.6%	65%
	TN	931	590	36.6%	40%

The above results indicate that water quality objectives are met for both TSS and TP, but fall below the TN objective. As explained in Sections 3.2 and 4.1 previously, given the constrained nature of the site due to flat drainage gradients, practically achieving the TN objective will require considerably larger treatments for only a minor reduction in nitrogen load.

Given the water quality strategy considers an integrated approach using vegetated waterways and wetlands and retains and enhances existing mangrove zones across the development, the approach is considered best practice environmental management with significant ecological benefits, complying with the intent of the SPP (refer to Section 3.2 previously).

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7 PRELIMINARY EARTHWORKS

The main wetland zone (W1 – 1.0ha) has been fully designed and in readiness for construction. The earthworks of the shown in Figure 13.

The wetland layout was selected to avoid impact on the existing mangroves and fit within the constraints of the current masterplan layout. Operating levels have been selected based on requirements to allow low flow diversions to the wetland and avoid tidal influences into the wetland. For the purposes of preliminary design a 3 m wide access track is included around the perimeter of the wetland and wetland batters are taken at 4H:1V.

The preliminary earthworks indicate that it is possible to develop a total wetland area of 1.0 ha in the downstream open drainage zone within the site constraints. The final form of the wetland layout will likely alter as detail design progresses, however the overall intent indicated in this preliminary earthworks model will be maintained.

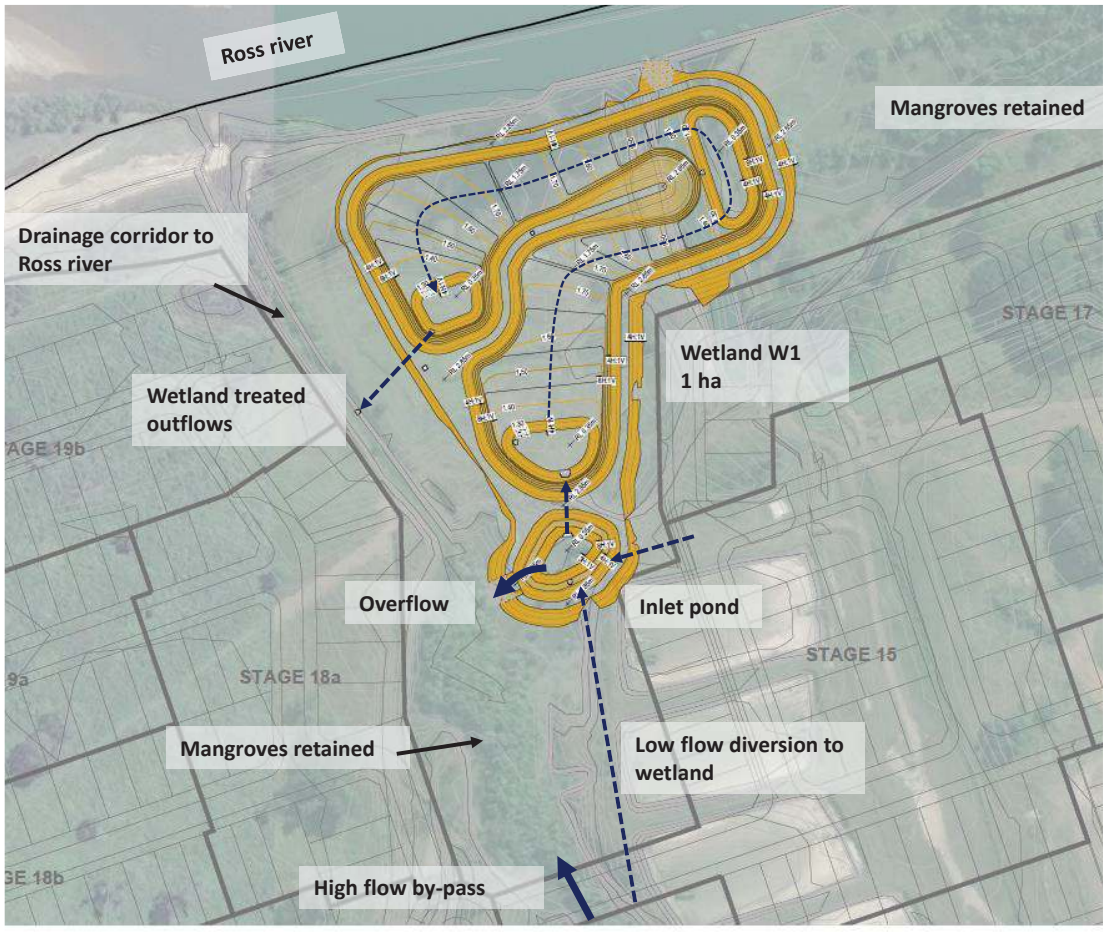


Figure 13 Preliminary earthworks model - wetland W1

8 CONSTRUCTION STAGING

It is important that WSUD systems are protected from large sediment loads during the building phase and certain measures are available to protect both wetlands and bio-retention systems. These include:

- Isolate WSUD systems from inflows during the allotment building phase to protect vegetated zones from sediment smothering. This can allow systems to become well established before coming on line. Irrigation will most likely be required to maintain plant health. Construction sediment management via temporary sediment basins etc will be required to protect downstream waterways.

- In the case of bio-retention systems provide a temporary protective layer over the filter media, such as turf. This then removed and planted as designed toward the end of the allotment building phase.

- Bulk out the wetlands and bio-retention basins as use them as temporary sediment basins. This can provide an effective means of protecting downstream receiving water from construction sediment loads. This option does not allow planting to commence and will not provide any aesthetic value during the allotment development phase. At near completion of the building phase (say 90%) the wetlands and bio-retention basins can be de-silted and completed as per the design intent.

The recommended approach for the Oonoonba development is to isolate treatment systems from construction sediment loads and sequence construction of each once the build out phase of the development reaches approximately 80%. As an example, wetland 1 (1.0ha) would be required to be built at the completion of Stage 12. The contributory catchment at this stage will be nearing 80%. Construction of the road connecting Stage 12 to 15 will then occur, together with necessary diversion structures to direct drainage to the wetland.

Further detailed advice in relation to construction and establishment of the stormwater treatment system will be provided during Operational Works as each treatment site detailed further.

9 MAINTENANCE

WSUD infrastructure such as constructed wetlands, vegetated waterways and bio-retention basins require ongoing inspection and maintenance to ensure they establish and operate in accordance with the design intent. Potential problems associated with WSUD systems as a result of poor maintenance include:

- Decreased aesthetic amenity;
- Reduced functional performance;
- Public health and safety risks; and
- Decreased habitat diversity (dominance of exotic weeds).

The following sections summarise the maintenance requirements of the constructed wetlands, bio-retention basins and vegetated swales. Detailed operation and maintenance schedules will be provided prior to handover of assets.

It is recommended that the personnel who are to undertake the operation and maintenance of the vegetated assets be briefed and trained on procedures and protocols prior to commencement. Keeping and maintaining records on the condition of the systems and all maintenance works required will be important to inform and schedule future maintenance works.

9.1 CONSTRUCTED WETLANDS

Maintaining healthy vegetation and adequate flow conditions in a wetland are the key maintenance considerations. Weeding, planting, mowing and debris removal are the dominant tasks (but should not include the use of herbicides as this affects water quality). In addition, wetlands need to be protected from high loads of sediment and debris and the inlet zone needs to be maintained in the same way as sedimentation basins. Routine maintenance of wetlands should be carried out once a month.

The most intensive period of maintenance is during the plant establishment period (first two years) when weed removal and replanting may be required. It is also the time when large loads of sediments could impact on plant growth, particularly in developing catchments with poor building controls. Debris removal is an ongoing maintenance function. If not removed, debris can block inlets or outlets, and can be unsightly if in a visible location. Inspection and removal of debris should be done regularly. Additional inspections are recommended following large storm events to check for scour and damage.

Typical maintenance of constructed wetlands will involve:

- De-silting the inlet zone following the construction/ building period

- routine inspection of the wetland to identify any damage to vegetation, scouring, formation of isolated pools, litter and debris build up or excessive mosquitoes
- routine inspection of inlet and outlet points to identify any areas of scour, litter build up and blockages
- removal of litter and debris
- removal and management of invasive weeds
- repair to wetland profile to prevent the formation of isolated pools
- periodic (usually every 5 years) draining and de-silting of the inlet pond
- regular watering of littoral vegetation during plant establishment
- water level control during wetland plant establishment
- replacement of plants that have died (from any cause) with plants of equivalent size and species as detailed in the planting schedule
- vegetation pest monitoring and control.

9.2 VEGETATED WATERWAYS

The establishment of vegetated waterways (as per the suggested design approach) is expected to reduce on-going maintenance in the long term. This includes:

- Reduced weed management
- Reduced removal of accumulated silts
- Lower risk of mosquito breeding

Densely vegetated waterways will filter out sediments, with the trapped sediment supporting vegetation growth. The visual amenity of the waterways will be significantly improved and provide a habitat for macro invertebrates for mosquito control.

The main maintenance activities that will be required include:

- Removal of weeds – spot spraying as required
- Repair of any erosion to batters and culvert locations (minimal)
- Removal of litter/debris (as required)

- Removal of excessive accumulated sediment (where smothering of vegetation occurs)

- Repair to access tracks – e.g. rutting - as required

9.3 BIO-RETENTION SYSTEMS

Typical maintenance of bio-retention systems during operation will involve:

- Routine inspection of the bio-retention system profile to identify any areas of obvious increased sediment deposition, scouring from storm flows, rill erosion of the batters from lateral inflows, damage to the profile from vehicles and clogging of the bio-retention system (evident by a 'boggy' filter media surface).

- Routine inspection of inflows systems, overflow pits and under-drains to identify and clean any areas of scour, litter build up and blockages.

- Removal of sediment where it is smothering the bio-retention system vegetation.

- Where a sediment forebay is adopted, removal of accumulated sediment.

- Repairing any damage to the profile resulting from scour, rill erosion or vehicle damage by replacement of appropriate fill (to match onsite soils) and revegetating.

- Tilling of the bio-retention system surface, or removal of the surface layer, if there is evidence of clogging.

- Regular watering/ irrigation of vegetation until plants are established and actively growing.

- Removal and management of invasive weeds (herbicides should not be used).

- Removal of plants that have died and replacement with plants of equivalent size and species as detailed in the plant schedule.

- Pruning to remove dead or diseased vegetation material and to stimulate growth.

- Vegetation pest monitoring and control.

Maintenance should only occur after a reasonably rain free period when the soil in the bio-retention system is dry. Inspections are also recommended following large storm events to check for scour and other damage.

10 CONCLUDING REMARKS

An updated stormwater quality management strategy has been developed for the Oonoonba development to meet the requirements of the State Planning Policy (DSDIP, 2013). The overall treatment strategy considers an integrated approach using primarily vegetated waterways and wetlands.

The major portion of development treatment will occur in the main north-south vegetated drainage corridor which discharges to freshwater treatment wetland (1.0ha) prior to discharge to the Ross River. At the eastern boundary of the site a Melaleuca forest/ephemeral wetland system will be included along the drainage corridor adjacent to the rail line.

As part of the treatment strategy, restoration of the main drainage corridor through the site as a naturalised freshwater waterway is included to minimise wetland areas required and provide a low maintenance drainage alternative that enhances the development.

Existing mangroves at the downstream end of the main drainage corridor will be retained as much as possible and integrated with the treatment strategy.

The above strategy provides an integrated best environmental management approach to stormwater quality management that meets the intent of the State Planning Policy (SPP), thereby affording appropriate protection to the Ross River, Halifax Bay and the Great Barrier Reef.

11 REFERENCES

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APPENDIX D
Flood Information – Water Engineering Partners

Water Engineering Partners Pty Ltd
Level 1, 21 Quay Street Brisbane Qld 4000
PO Box 5106, West End QLD 4101

Phone: 07 3473 1360
Email: info@wep.com.au
Website: wep.com.au

ABN 47 664 596 105

14 May 2025

Ref: L.30257.002

Thea Platz
Economic Development Queensland
GPO Box 2202
Brisbane Qld 4001

Dear Thea

The Village Oonoonba- Stage 7C & 7D (Lot 5000 on SP302846) Flood Information

1. Purpose and Background

This letter report provides flood information relevant to the development of Stage 7C & 7D of The Village at Oonoonba. Stage 7C & 7D occupy Lot 5000 on SP302846 (the **Site**).

Figure 1 presents a locality plan for the Site.



Figure 1 Locality Plan

Figure 2 presents the Developable Area Plan for the Site (an excerpt from RPS Plan AU13015703-09).

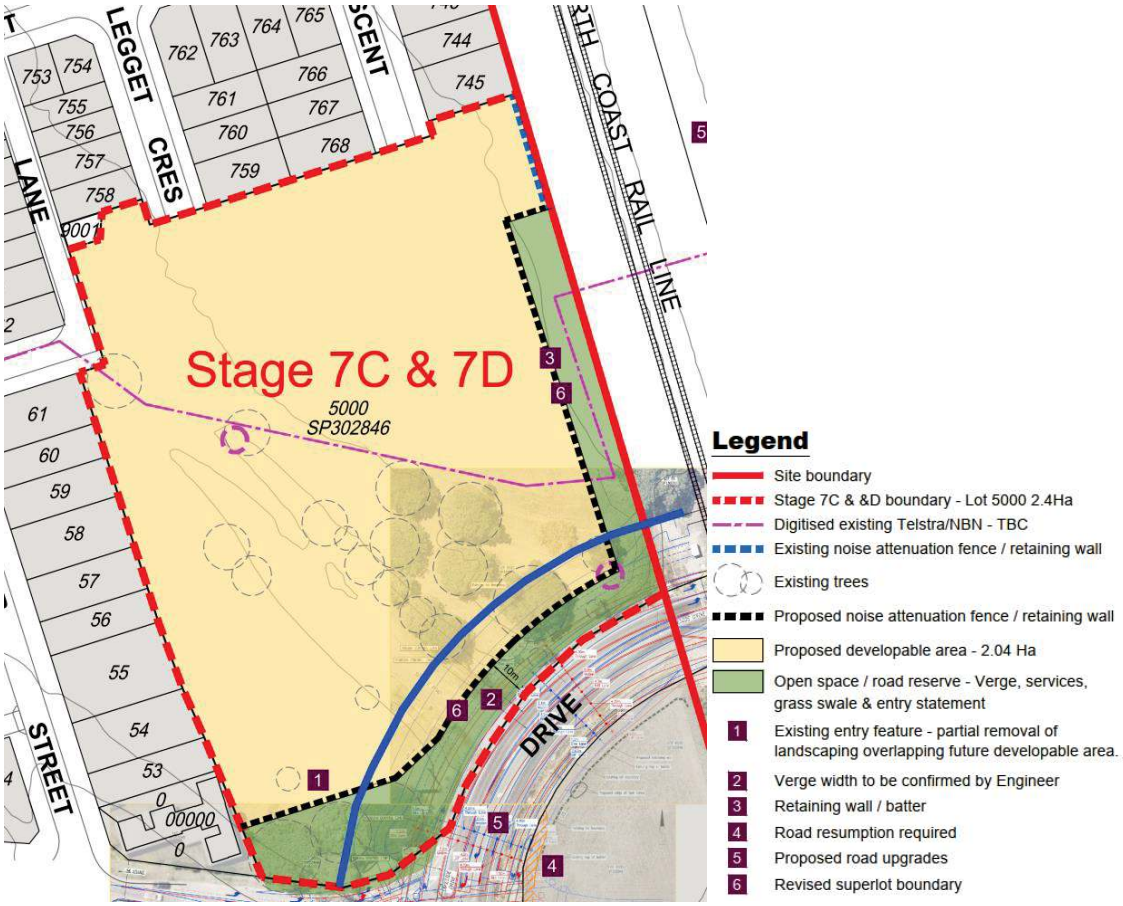


Figure 2 Developable Area Plan

2. Current Planning Scheme and Mapping

2.1 Definitions and Immunity Requirements

According to Table SC1.2.2 of Schedule 1 of *Townsville City Plan* (Version 2024/01 current at the time of this letter, hereafter referred to as the **Planning Scheme**):

- The defined flood event is the *'1% annual exceedance probability (AEP) flood and is mapped as the combined extent of the high and medium flood hazard areas identified on overlay map OM-06.1 and OM-06.2'*; and
- The defined flood level is the *'flood level relative to the Australian Height Datum (AHD) of the 1% AEP flood.'*

Performance Outcome PO1 of the *Flood hazard overlay code* of the Planning Scheme requires that *'Development in medium and high hazard areas is designed and located to minimise susceptibility to and potential impacts of flooding.'*

Acceptable Outcome AO1.1 to PO1 requires that:

> *'Where the development is located within an area shown on overlay map OM-06.1 or 06.2 as medium hazard — further investigation area, new buildings containing habitable rooms:*
>
> *a) are sited on a part of the site which is outside the medium hazard — further investigation area; or*
>
> *b) are sited on the highest part of the site.'*

Acceptable Outcome AO1.2 to PO1 includes the requires that:

'Where development is located within another hazard area shown on overlay map OM-06.1 or 06.2:

a) floor levels of all habitable rooms are a minimum of 300mm above the defined flood level;

b) floor levels of all non-habitable rooms (other than class 10 buildings) are above the defined flood event'.

Consequently, to satisfy AO1.2 it would be necessary to set the floor levels of all habitable rooms 300 mm above the 1% AEP flood level.

Further, Section SC6.7.4.4.7 of the Flood hazard planning scheme policy states that a sensitivity assessment should be completed with respect to climate change to 2100 to determine areas where the 1% AEP event including climate change would produce a flood level in excess of the 1% AEP event without climate change plus 300 mm freeboard.

2.2 Mapping

Figure 3 presents an excerpt from overlay map OM-06.1 which presents the hazard mapping relevant to the Site.

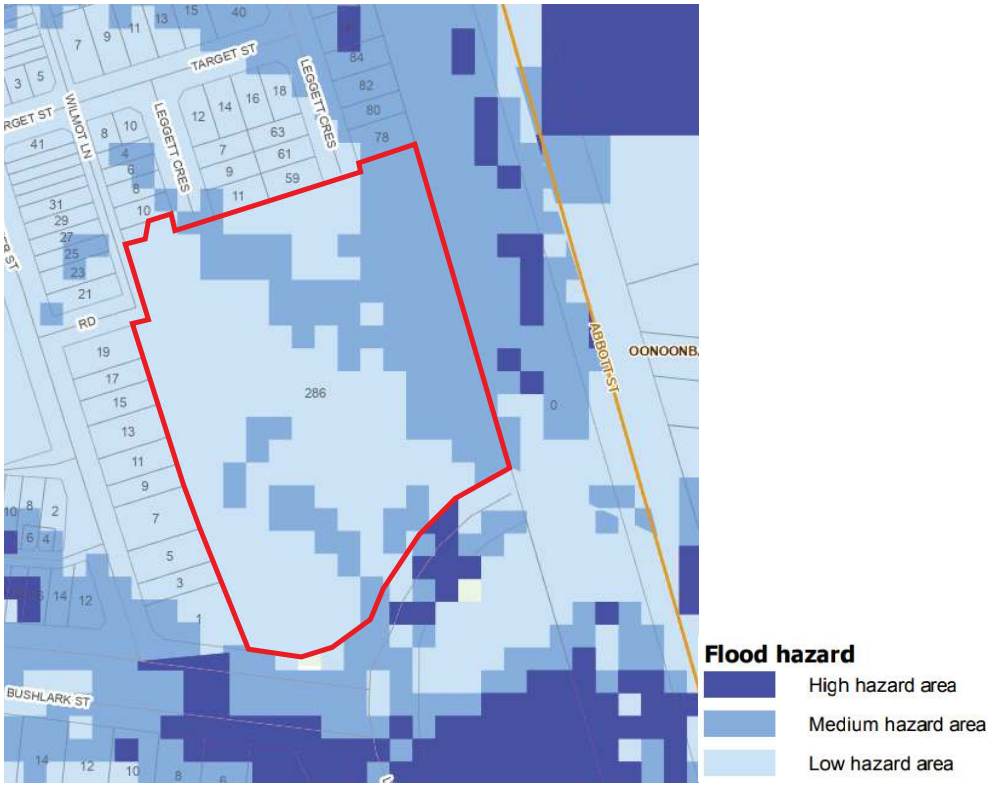


Figure 3 Flood Hazard Mapping, Planning Scheme Overlay Map OM-06.1

With reference to Figure 3, the majority of the Site is defined as a low hazard area, with the eastern part of the Site defined as being medium hazard.

The hazard mapping correlates with the depth mapping currently adopted by Council. The depth mapping for the 1% AEP event is presented in Figure 4. Figure 4 has also been annotated to show the 1% AEP flood level at key locations.

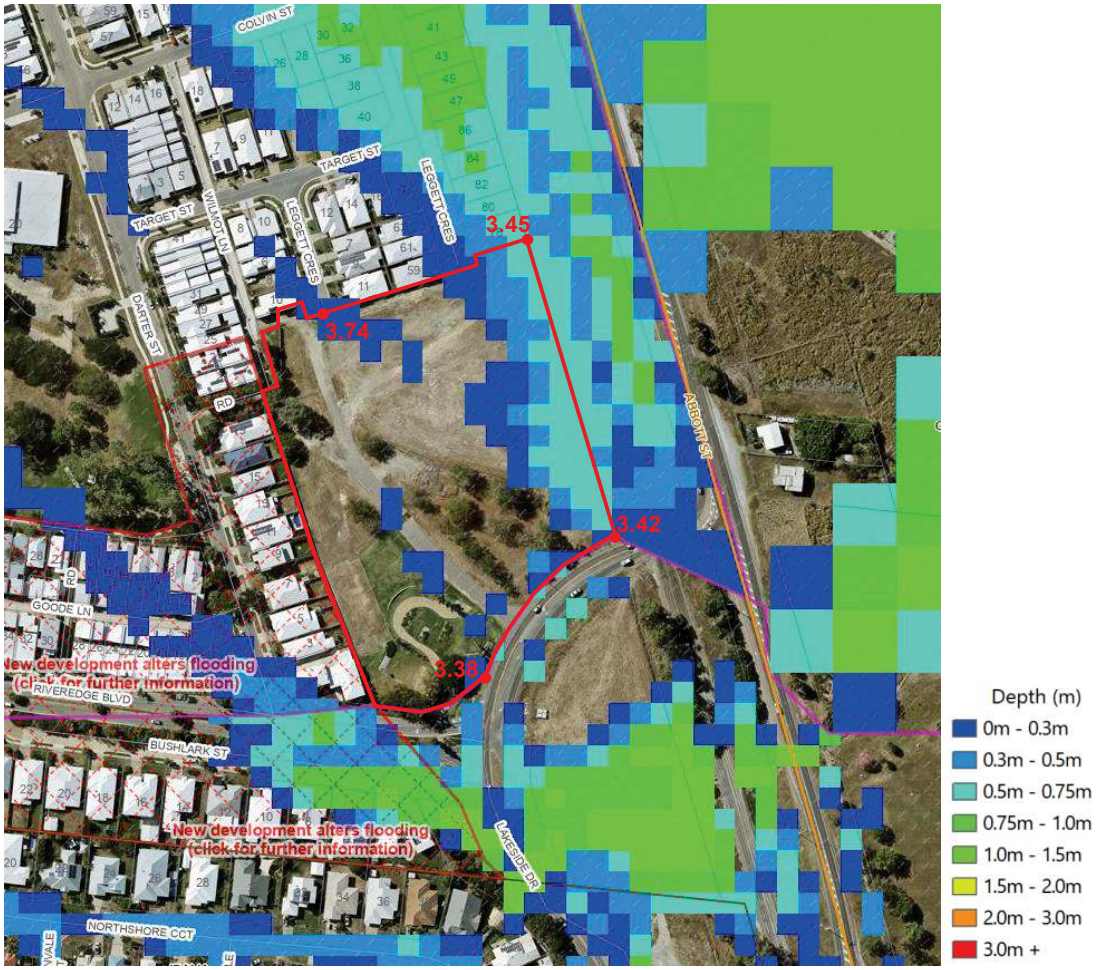


Figure 4 Flood Levels and Depths, 1% AEP Event, Current Planning Scheme

It is considered that the flood level information presented in Figure 3 and Figure 4 includes both regional flooding in the Ross River and local runoff from the catchment surrounding the Site derived as part of Council's City-Wide Flood Constraints Project.

With reference to Figure 4, the majority of the inundation relates to regional flooding in the Ross River. Flooding in the Ross River results in backwater flooding within the North Coast Railway corridor to the east of the Site. This flooding produces a 1% AEP event flood level of the order of 3.45 mAHD at the Site.

It is understood that this mapping is based on the 2013 flood modelling of the Ross River as reported in the *Ross River Flood Study, Base-line Flooding Assessment* (Aecom, January 2013).

In addition to the mapping reflecting regional flooding, the mapping also includes local catchment runoff. This is evident in the level of 3.74 mAHD nominated at the Site boundary at Leggett Crescent. It is considered that the mapping of this local flooding is approximate in nature and that the relatively low flows associated with local runoff can be readily managed as part of Site design.

3. February 2019 Event

The largest flood event in recent times occurred in February 2019. It is relevant to note that the February 2019 event was an extreme event well in excess of the design standard for flood immunity in the planning scheme. Based on available information, it is estimated that the 2019 event was in excess of a 0.05% AEP (2,000 year) event at Rooney's Bridge.

According to the Aecom report *Ross River Flood Study, Base-line Flooding Assessment* (Revision A, October 2021, the **Ross River Flood Study**), relevant flood levels for the 2019 event in relation to the Site are:

- Ross River at Rooneys Bridge: 4.35 mAHD (Figure 23); and
- Debris level at Darter Street: 4.73 mAHD (Table 15).

Figure 5 presents the results of modelling of the 2019 event documented in Figure 4-1 of the BMT report *The Village Oonoonba – Review of Constructed Development Levels* (Revision 4, February 20200).

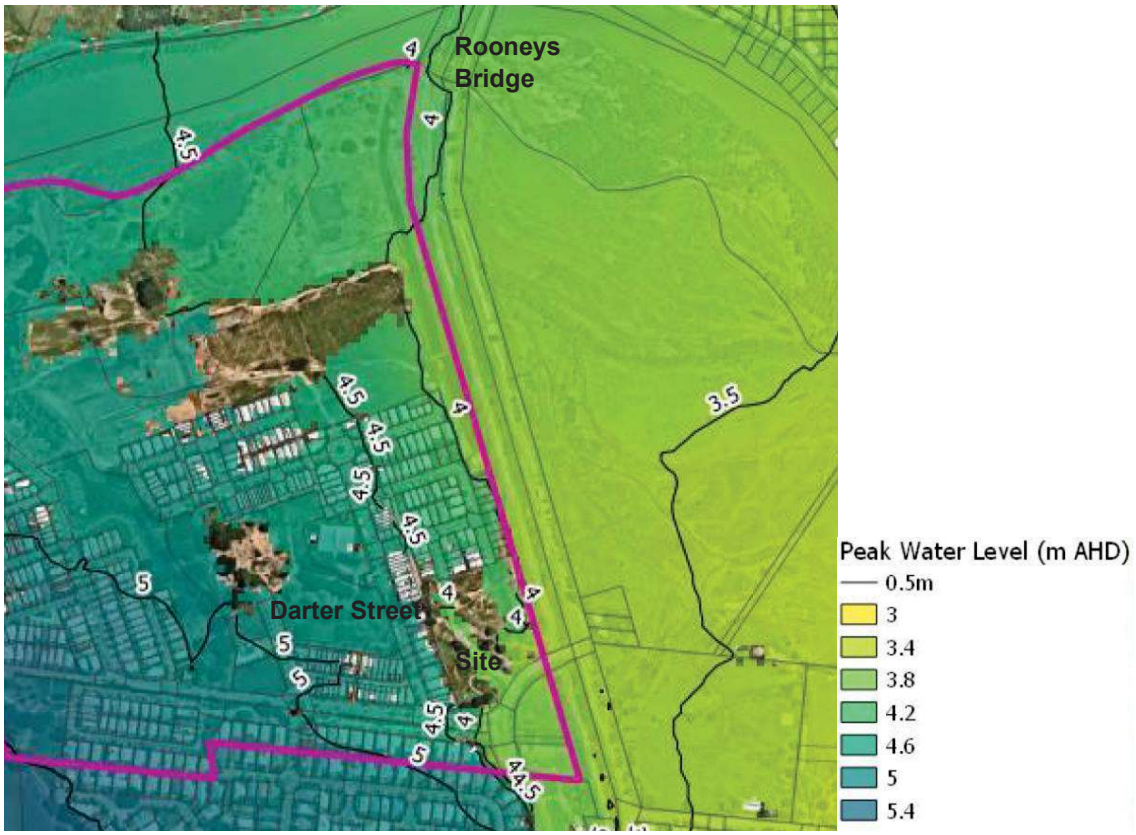


Figure 5 Modelled Flood Levels, 2019 Event

With reference to Figure 5, the flood level for the 2019 event at the eastern boundary of the Site is of the order of 4 mAHD.

4. Latest Flood Modelling

Subsequent to the February 2019 Event, Council commissioned new flood modelling of the Ross River. The results of the modelling are presented in the Ross River Flood Study.

As the flood mapping derived from the Ross River Flood Study is yet to be formally adopted by Council, the flood mapping currently associated with the Planning Scheme (refer Section 2) is based on the previous 2013 modelling of the Ross River.

Given that the mapping derived from the Ross River Flood Study reflects the most advanced modelling of the river system available and is expected to be adopted by Council in the short-medium term, it is recommended that the flood level information contained in the Ross River Flood Study be used in preference to the mapping under the current Planning Scheme.

The flood levels at the Site nominated in the Ross River Flood Study are slightly higher than those nominated under the current Planning Scheme mapping.

The ground level data considered for the Ross River Flood Study was generally based on 2016 LiDAR data, with 2019 LiDAR data used in areas (including The Village in Oonoonba) where development has taken place since the capture of the 2016 LiDAR data (Section 3.1.2 of the Ross River Flood Study).

It is important to note that the Ross River Flood Study includes 'rainfall on grid' modelling. Under this system, rainfall is applied to each two-dimensional cell representing the ground in the model. For short duration storms, this approach allows local catchment runoff to be modelled. However, care needs to be taken with the consideration of runoff associated with local catchment flooding as it can be very shallow and not representative of true flooding. Consequently, it is typical to filter flood depths less than a certain threshold. For this report, a threshold of 100 mm was adopted.

As a consequence of the rainfall on grid approach, flood mapping from the Ross River Flood Study that is relevant to the Site includes local catchment runoff and regional flooding in the Ross River.

Figure 6 presents the peak flood depths in the vicinity of the Site for both local runoff and regional flooding for the 1% AEP event as calculated by the Ross River Flood Study. The figure has been annotated to indicate the flood level for the 1% AEP event and the 1% AEP event including climate change at key locations.

With reference to Figure 6, while there is inundation indicated in the centre of the Site, this is shallow and associated with local runoff rather than regional flooding in the Ross River. To illustrate this, Figure 7 presents the flooding associated with Ross River without local catchment runoff. The figure shows that the majority of the developable area is outside the regional flood extent for the 1% AEP event.



Data Sources:
Photography: Google Earth
Topography: 2019 Lidar
Cadastre: Queensland Globe
Coordinate System: GDA94 / MGA zone 55

Water Engineering Partners endeavours to ensure that the information provided in this map is correct at the time of publication. Water Engineering Partners does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

Legend:
- Peak 1% AEP Ross River Level (mAHD)
- Stage7

* Note: Depths below 100mm are not reported

N

PROJECT: The Village - Oonoonba

TITLE: Stage 7 Peak 1% AEP Flood Depths

CLIENT: Economic Development Queensland

WEP | Water Engineering Partners
WWW.WEPCOM.AU

SCALE: 0 18 36 m

FIGURE NUMBER: 6

REVISION:

DATE: 14-May-2025

Filepath: Y:\Jobs\30200-30299\30257_Oonoonba\06_GIS\Figures\1pAEP_MHWS_depths_stage7.qgz



Data Sources:
Photography: Google Earth
Topography: 2019 Lidar.
Cadastre: Queensland Globe
Coordinate System: GDA94 / MGA zone 55

Water Engineering Partners endeavours to ensure that the information provided in this map is correct at the time of publication. Water Engineering Partners does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

Legend:

- Peak 1% AEP Ross River Level (mAHD)
- Stage7

N

PROJECT: The Village - Oonoonba

CLIENT: Economic Development Queensland

TITLE: Stage 7 Peak Flood Levels

WEP | Water Engineering Partners
WWW.WEPC.COM.AU

SCALE: 0 18 36 m

FIGURE NUMBER: 7

REVISION:

DATE: 14-May-2025

Filepath: Y:\Jobs\30200-30299\30257_Oonoonba\06_GIS\Figures\1pAEP_MHWS_levels_stage7.qgz

5. Site Development

Based on the flood mapping for the 1% AEP event (Figure 6 and Figure 7), the majority of the Site is not affected by regional flooding in the Ross River.

Although it will be necessary to model the impact of works that extend into areas affected by the 1% AEP regional flood event, it is considered that filling of the developable area shown on Figure 2 should be readily achievable.

Similarly, it is considered that the flood inundation indicated with respect to local catchment runoff is associated with relatively low flows that can be managed as part of normal subdivisional design.

Finally, it is noted that design work is currently progressing with respect to the remainder of The Village Oonoonba. The design work could result in slight changes in flood level at the Site.

If you have any queries in relation to this information, please do not hesitate to contact me.

Yours faithfully



Water Engineering Partners Pty Ltd

APPENDIX E
Traffic Technical Memorandum – Urbis

Technical Memorandum

The Village Oonoonba

Date	11 June 2025	**Project Number**	P0051836
Client	EDQ	**Prepared By**	Alice Shi / Denise Wang
Project	The Village Oonoonba Traffic Assessment	**Reviewed By**	Andy Johnston / Jadyn Benzie

1. Introduction

1.1 Background

Urbis has been engaged by Economic Development Queensland – Urban Developments team (EDQ UD) to provide traffic engineering advice for The Village development at Oonoonba, within the Oonoonba Priority Development Area (PDA).

This technical memorandum has been prepared to assist with pre-lodgement discussions for the delivery of infrastructure works to allow for further development at the site to occur. Intersection upgrades at the following sites are proposed as part of these works:

1. Abbott Street / Lakeside Drive
2. Lakeside Drive / Riveredge Boulevard

The locations of these intersections in context of the PDA are indicated on Figure 1. It is noted that the masterplan shown on Figure 1 is indicative only, indicating a denser outcome than what is being sought for approval.

The Lakeside Drive / Riveredge Boulevard intersection is within the PDA boundary, however the Abbott Street / Lakeside Drive intersection is outside of the PDA. The assessment of both intersections has been requested by the Department of Transport and Main Roads (TMR) through advice received from an associated Material Change of Use (MCU) application.

This assessment has determined the proposed upgrade layouts for both intersections. The proposal plan is enclosed at **Appendix A** and the concept sketches for the intersection layouts are enclosed at **Appendix B**.

Document Set ID: 27254459
Version: 1, Version Date: 25/06/2025

Figure 1 Study Intersection Locations



Source: Nearmap, EDQ

1.2 References

In preparation of this assessment, previous traffic studies have been provided for review, including:

- South Townsville Road Strategic Assessment of Service Requirements (SASR) Future Situation and Causal Factors, prepared by Bitzios Consulting, dated 29 August 2024
- The Village, Oonoonba, Townsville Traffic Impact Assessment, prepared by Calibre Consulting, dated 4 May 2018.
- 286 Lakeside Drive, Oonoonba Proposed Mixed Use Development Traffic Engineering report, prepared by TTM, dated 25 June 2021.

The first report has been provided by TMR for input to this assessment.

This third report refers to the traffic impacts of the proposed development at Lot 6,000.

Document Set ID: 27254459
Version: 1, Version Date: 25/06/2025

2. Transport Assessment

2.1 Background Traffic Volumes

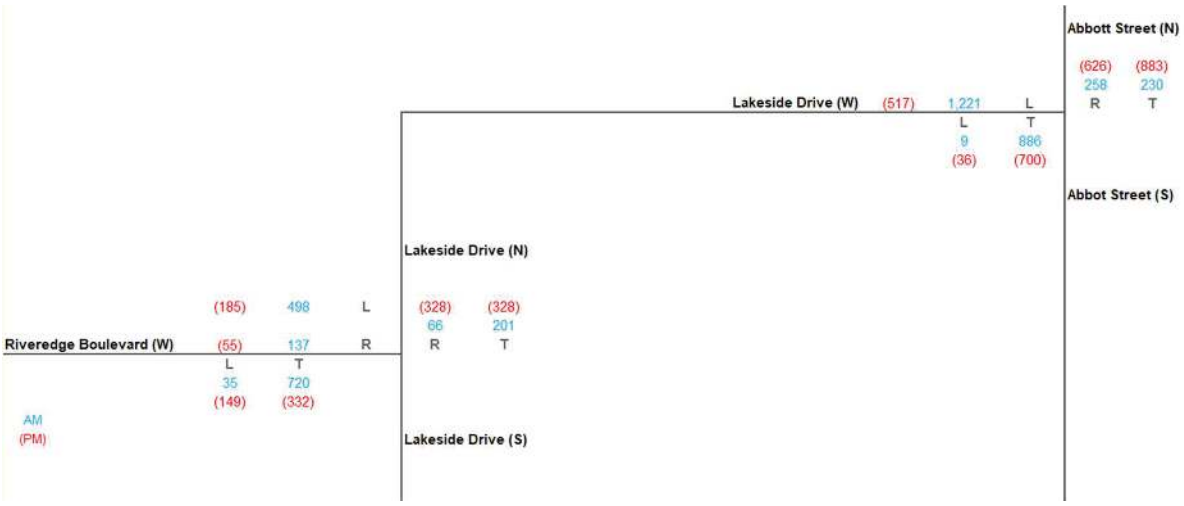
Previous traffic assessments adopted 2024 background traffic surveys as the base for the analysis. However, with the provision of TMR's future network planning and modelling (the South Townsville Road SASR report prepared by Bitzios Consulting), the traffic volumes for the external network have been informed from TMR's assessed model. This model was based on a subnetwork of the Townsville Aimsun Mesoscopic Model (TAMM), which was developed in 2022 and incorporates traffic demand from the Townsville Strategic Transport Model (TSTM).

Urbis was provided with the Stage 2 Future Year Base Modelling Report, which included Appendix A containing TAMM traffic volumes for the 2036 and 2046 forecast years. These datasets were reviewed to identify volumes for key road links within the study area.

The review found that on several road sections, projected 2046 volumes were lower than 2036 volumes due to capacity constraints in the base network, which limited the release of full demand. A significant number of vehicles remained unreleased at the end of the modelled period, affecting the ability of the model to reflect future conditions within the study corridor.

Given this limitation, Urbis adopted the 2036 volumes as the base and applied background traffic growth to derive volumes for the 2039 assessment year. The 2036 model volumes are shown on Figure 2.

Figure 2 2036 Traffic Volumes (Future Scenario Modelling)



Source: TMR adapted by Urbis

A copy of the extracted traffic modelling outputs is enclosed at **Appendix C**.

2.2 Background Traffic Growth

Annual growth rates were calculated by comparing the cordon matrices from the 2036 and 2046 TAMM scenarios for the AM peak (0700 to 0900) and PM peak (1500 to 1800). As shown in Table 1, growth rates of 1.35% for the AM peak and 1.24% for the PM peak were derived.

Table 1 Future year demand and annual growth rate

Peak Period	2036 Demand	2046 Demand	Annual Growth Rate
AM (0700–0900)	6,075	6,895	1.35%
PM (1500–1800)	9,021	10,141	1.24%

Document Set ID: 27254459
Version: 1, Version Date: 25/06/2025

2.3 Assessment Scenarios

It has been assumed that the full development can be completed at 2029. Therefore the 10 year design horizon has been adopted as 2039.

The assessed scenarios include the AM and PM weekday peaks for the design horizon year (2039).

2.4 Development Traffic Volumes

The Village Masterplan Traffic

The Calibre Consulting traffic report (2018) was prepared to assess the masterplan traffic impacts for The Village. As this encompasses all the proposed uses over the site, the traffic volumes outlined in the report have informed this assessment. Figure 3 outlines the proposed use and yields associated with the assessment.

Figure 3 The Village Development Yield

Table 2-1: Proposed Development Yield

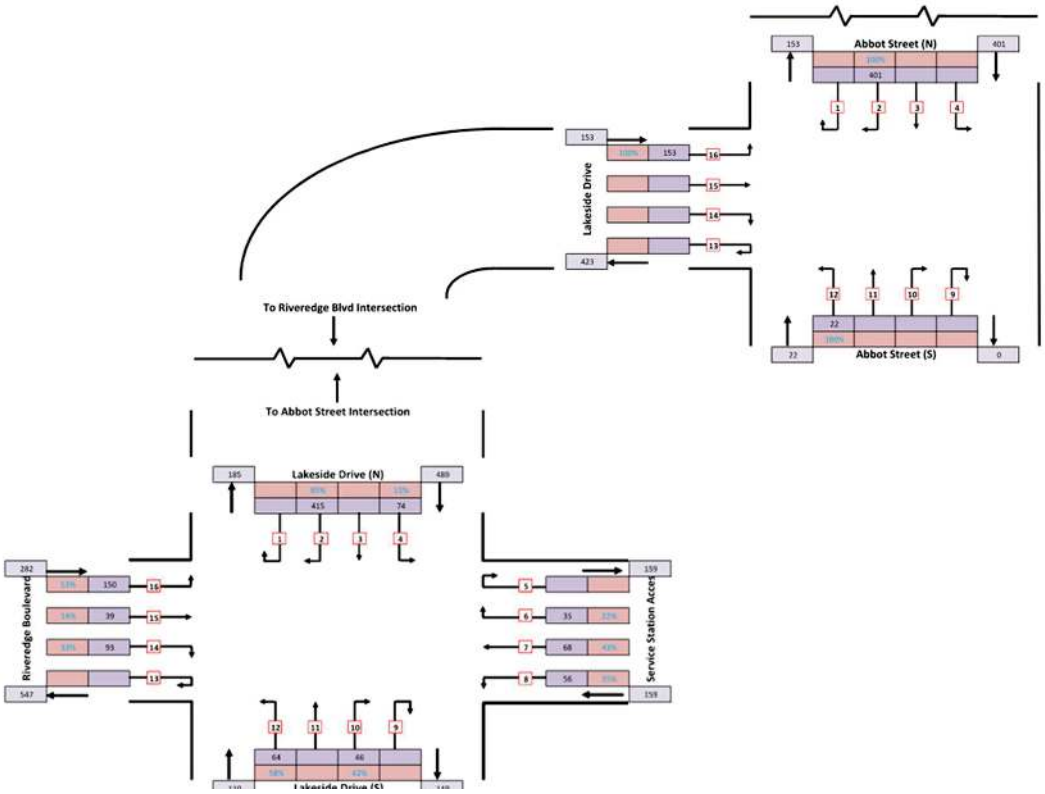
Land Use	Quantum and Unit
Low Density Residential (Stages 1 to 20 inclusive)	626 Dwellings
Medium Density Residential (Lots that are less than 250 m^2)	330 Dwellings
Single Occupant Home Office (100 m^2)	31 Dwellings
Community Site (Church)	1,600 m^2 Total GFA
Child Care	75 children
Commercial (Retail)	1,500 m^2 Total GFA
Service Station	8 bowsers 180 m^2 service centre shop 2 drive-thru food outlets totaling 226 m^2 GFA 400 m^2 of service workshop with 6 service bays 790 m^2 of supermarket shop 308 m^2 of retail shop 180 m^2 of café with 42 m^2 of outdoor dining space

Source: Calibre Consulting

The corresponding traffic volumes for the full development are outlined in Figure 4 and Figure 5 for the AM and PM peaks, respectively.

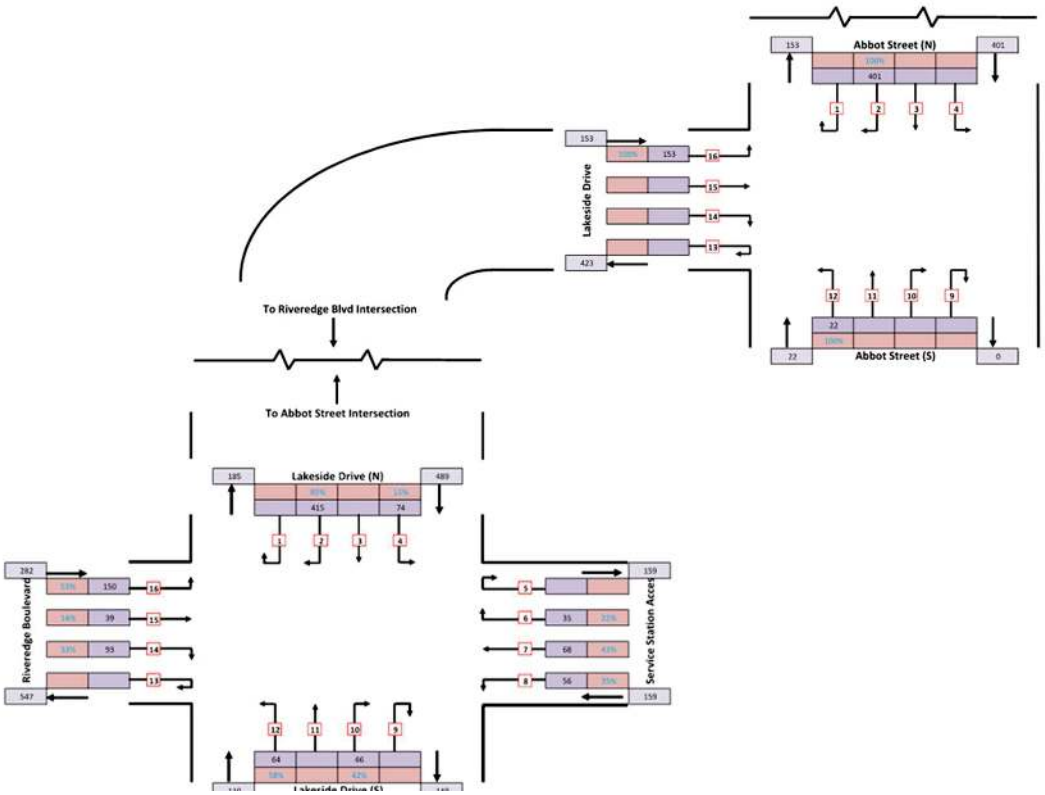
Document Set ID: 27254459
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Figure 4 The Village Traffic Generation – AM Peak



Source: Calibre Consulting

Figure 5 The Village Traffic Generation – PM Peak



Source: Calibre Consulting

Document Set ID: 27254459
Version: 1, Version Date: 25/06/2025

Adjustments for Updated Trip Rates

The trip assumptions adopted for the Calibre assessment referred to 2002 guidelines from the NSW Roads and Traffic Authority (RTA), and Institute of Transportation Engineers (ITE) traffic engineering handbook for trip rates. More recent data is now available for many of the uses proposed which indicate many of the older trip rates overestimate the traffic generation.

This assessment has made adjustments for the following uses:

- **Low density residential** – instead of a standard rate from NSW data, this assessment adopts the AM and PM trip rates informed from the 2024 survey data for the Riveredge Boulevard catchment.
- **Medium density residential** – the Transport for NSW (TfNSW) 2024 publication Guide to Transport Impact Assessments has more recent survey data. This assessment adopts the regional average rates for AM and PM peaks.
- **Single occupant home office** – as per the Calibre assessment, this use adopts the same rate as the Medium density residential use and has been updated accordingly.
- **Retail** – typically, the AM peak rate for retail uses is much lower than the peak which occurs during the PM. This assessment adopts a 30% factor of the PM trip rate for the AM trip rate.

The Calibre assumptions and proposed amended trip rates are outlined in Table 2.

Table 2 Comparison of Trip Rates

Land Use	Calibre Assumption – AM Peak Rate	Calibre Assumption – PM Peak Rate	Amended Assumption – AM Peak Rate	Amended Assumption – PM Peak Rate
Low density residential	0.85 vph/house	0.85 vph/house	0.55 vph/house	0.68 vph/house
Medium density residential	0.55 vph/unit	0.55 vph/unit	0.41 vph/unit	0.60 vph/unit
Single occupant home office	0.55 vph/unit	0.55 vph/unit	0.41 vph/unit	0.60 vph/unit
Retail	12.5 vph/100sq.m GFA	12.5 vph/100sq.m GFA	3.75 vph/100sq.m GFA	12.5 vph/100sq.m GFA

The adoption of these amended trip rates has been applied as a reduction from the Calibre assessed trips based on the difference in trip generation. The difference in trips is outlined in Table 3.

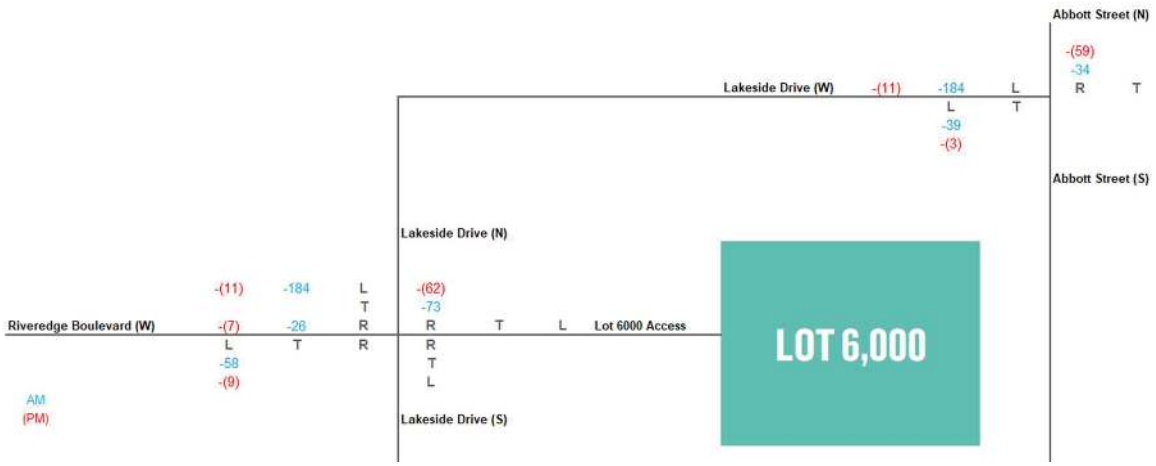
Table 3 Difference in Assessed Trip Generation

Land Use	Calibre Assumption – AM Peak Trips	Calibre Assumption – PM Peak Trips	Amended Assumption – AM Peak Trips	Amended Assumption – PM Peak Trips	Difference – AM Peak Trips	Difference – PM Peak Trips
Low density residential	532	532	347	425	*-185*	*-107*
Medium density residential	182	182	135	198	*-46*	*17*
Single occupant home office	17	17	13	19	*-4*	*2*
Retail	150	150	45	150	*-105*	*0*
Total Difference					**-341**	**-89**

The change in trips has been distributed across the network following the Calibre traffic distribution assumptions.

Document Set ID: 27254459
Version: 1, Version Date: 25/06/2025

Figure 6 Adjusted Trip Generation



Lot 6000 Traffic

The proposed development uses and traffic generation for Lot 6000 has been outlined in the TTM traffic report dated 25 June 2021, prepared for the development application over the lot. The report outlines the following land uses and yields as shown in Figure 7. It is noted the future stages are indicative at this stage as the actual uses and yields are not known.

Figure 7 Lot 6000 Development Yield

Table 2.1: Proposed Land Uses

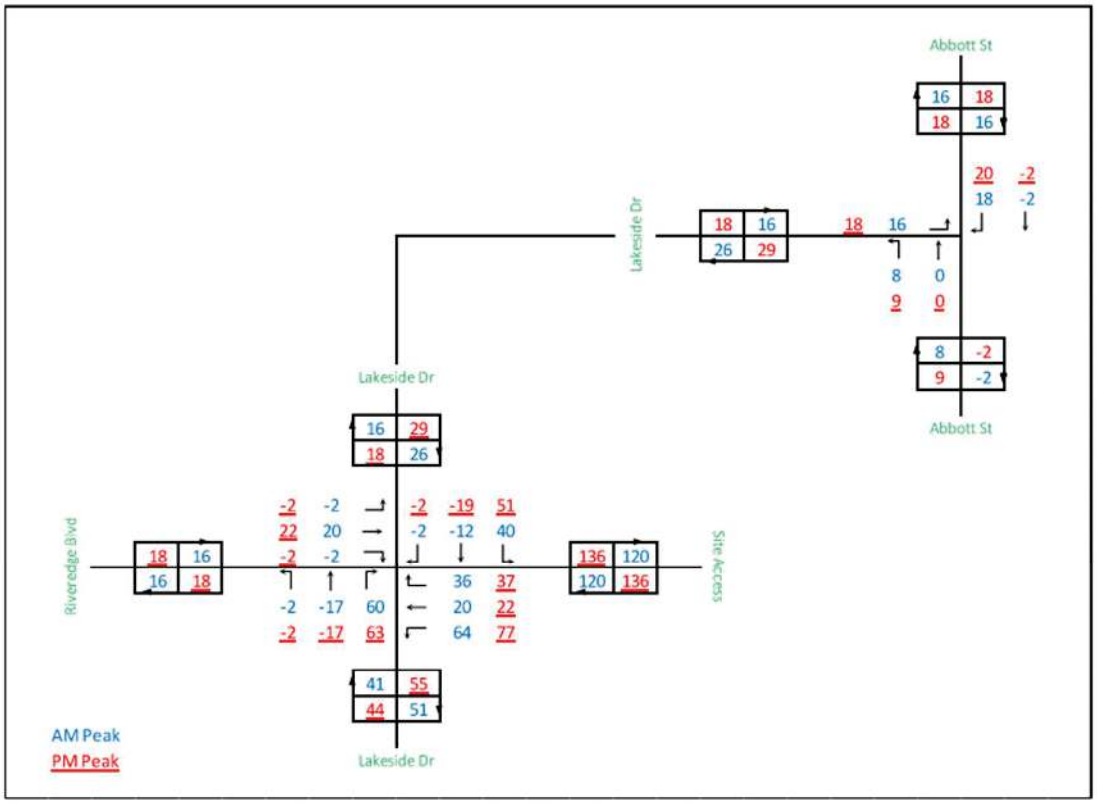
Use	Use	Area/Qty
Stage 1	Service Station	240m² GFA 8 Fuel Bowsers
	Fast Food Outlet	223m² GFA
Future Stages	Indoor Sport & Rec (Gym)	700m² GFA
	Health Care	680m² GFA

Source: TTM

Figure 8 illustrates the assessed traffic generation associated with Lot 6000 as estimated by TTM. The negative values relate to the drop in trips associated with the convenience uses on the lot.

Document Set ID: 27254459
Version: 1, Version Date: 25/06/2025

Figure 8 Lot 6000 Assessed Traffic Generation



Traffic Network Diagram 8: Development Traffic Volumes (vph) – Ultimate

Source: TTM

These values have been adopted in place of the Lot 6000 turning movements outlined in the Calibre report.

Assessed Volumes

Lakeside Drive and Abbott Street through volumes have been informed from the TMR model volumes (2036 scenario) and growthed at 1.35% p.a. (AM) and 1.24% p.a. (PM).

$$= 2036\ Model\ Volumes\ \times\ growth\ factor\text{^}(2039 - 2036)$$

Riveredge Boulevard volumes represent the development traffic. This has been informed from the masterplan traffic assessment, with adjustments to account for updated trip generation data.

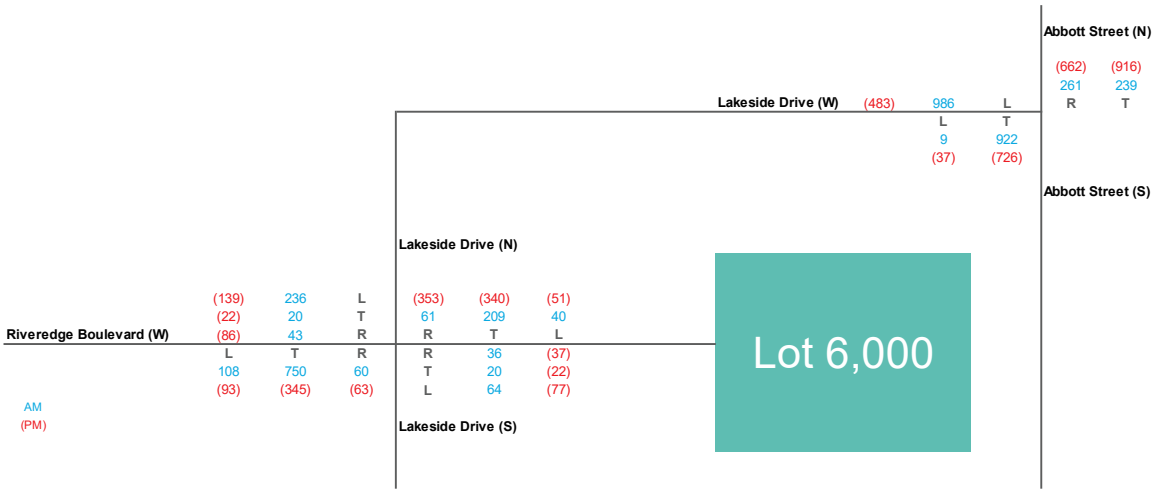
$$= Full\ Development\ Volumes\ (Calibre\ Traffic\ Report)\ adjusted\ for\ updated\ residential\ trip\ rates$$

Lot 6000 turning movements have been adopted from the TTM report which was prepared for the application over the site.

The assessed traffic volumes are shown on Figure 9.

Document Set ID: 27254459
Version: 1, Version Date: 25/06/2025

Figure 9 Assessed Traffic Volumes (2039 AM and PM)



Source: Urbis

2.5 Assessment Results

The SIDRA assessment outcomes from the analysis is outlined in the following sections for each of the study intersections. The ultimate intersection layout has been reported.

In line with discussions with TMR, the two intersections have been networked in SIDRA. The results reported are the network results. A copy of the SIDRA outputs is included at **Appendix D**.

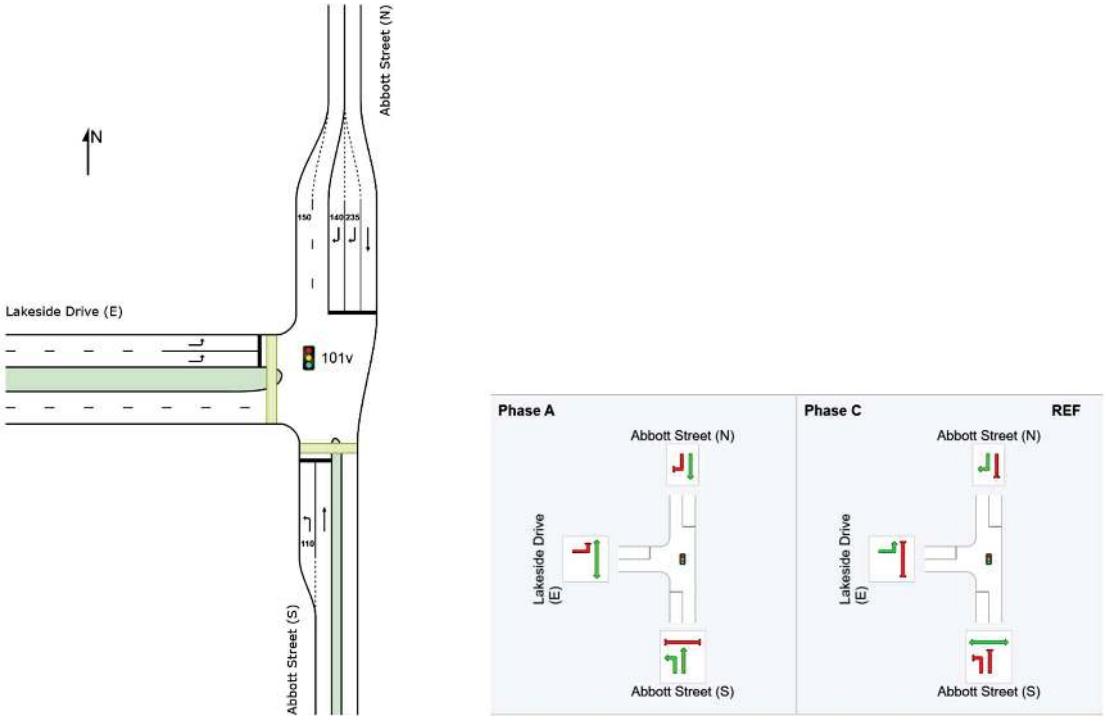
Abbott Street / Lakeside Drive

The proposed layout of the Abbott Street / Lakeside Drive intersection is shown on Figure 10. The associated phasing is also included. As illustrated, the intersection will include the following changes:

- Signalised with pedestrian crossings on the western and southern approaches to match the existing connections.
- Two right turn lanes and one through lane on the north from Abbott Street into Lakeside Drive.
- Two left turn lanes on the west from Lakeside Drive into Abbott Street.
- One through lane on the south (Abbott Street) with a dedicated left lane turning into Lakeside Drive.

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Version: 1, Version Date: 25/06/2025

Figure 10 Abbott Street / Lakeside Drive - SIDRA Layout and Phasing Summary



Source: SIDRA

Table 4 reports the network intersection results from the SIDRA analysis.

Table 4 Abbott Street / Lakeside Drive – SIDRA Results

Scenario	DOS	Average Delay (sec)	95th Percentile Queue (m)	Critical Movement
2039BG+Dev AM Peak	0.89	120.6	454.5	S-T
2039BG+Dev PM Peak	0.88	40.5	392.5	N-R

As shown, the degree of saturation (DOS) is expected to remain within the capacity threshold (0.90). Being a signalised intersection, delays are not a critical factor as the controlled nature of the intersection reduces the risk of unsafe driver behaviour that would be exhibited at priority controlled intersections.

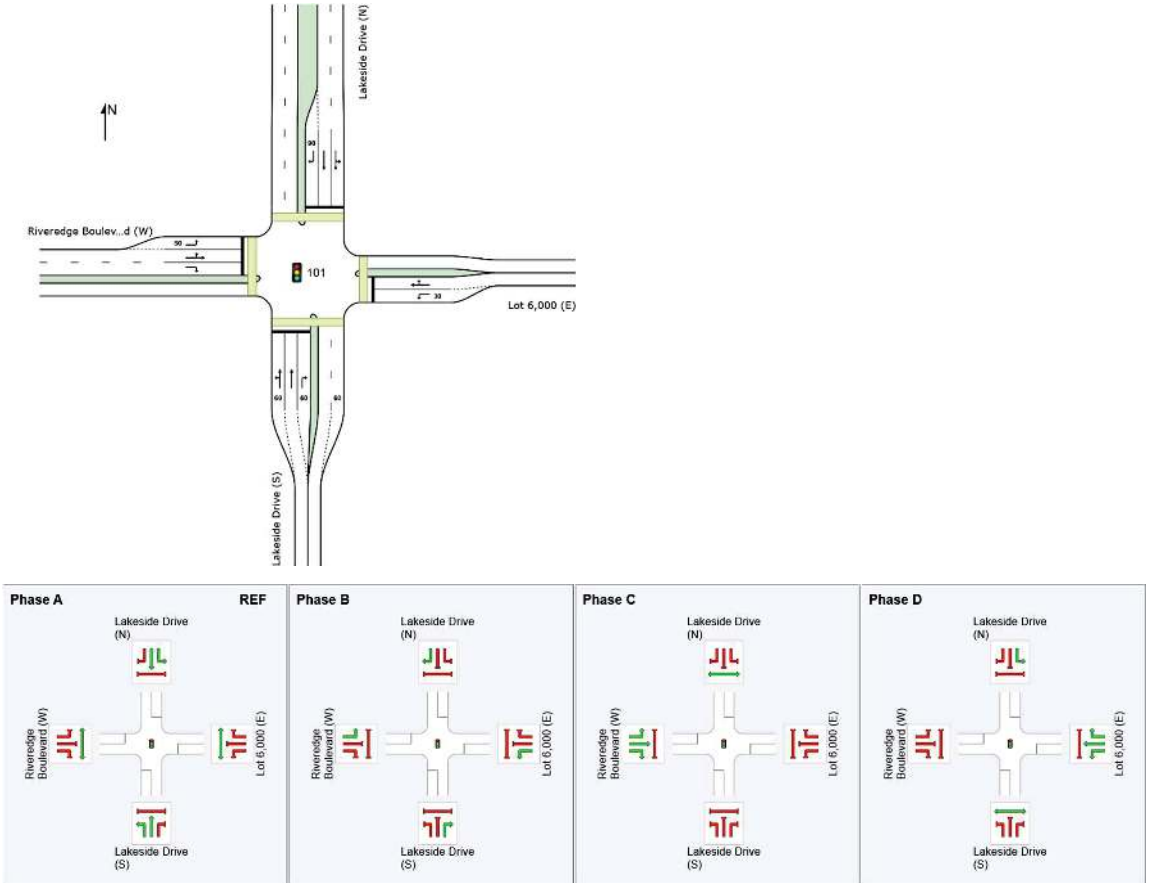
Lakeside Drive / Riveredge Boulevard

The proposed layout of the Lakeside Drive / Riveredge Boulevard intersection is shown on Figure 11 (note that the civil drawing has not yet been updated to include the separate left turn lane on the southern Lakeside Drive approach). The associated phasing is also included. As illustrated, the intersection will include the following changes:

- Short right turn lane on the northern Lakeside Drive approach.
- Two full length through lanes on Lakeside Drive north approach with a shared left movement on the kerbside lane entering Lot 6000.
- Turning lanes for the Lot 6000 access.
- Dual left turns on the western Riveredge Boulevard approach, with the middle lane shared as a through movement, and a single right turn lane.
- Double through lanes on Lakeside Drive south with a shared left turn.
- Signalised pedestrian crossings on all four approaches.

Document Set ID: 27254459
Version: 1, Version Date: 25/06/2025

Figure 11 Lakeside Drive / Riveredge Boulevard - SIDRA Layout and Phasing Summary



Source: SIDRA

Table 5 reports the network intersection results from the SIDRA analysis.

Table 5 Lakeside Drive / Riveredge Boulevard – SIDRA Results

Scenario	DOS	Average Delay (sec)	95th Percentile Queue (m)	Critical Movement
2039BG+Dev AM Peak	0.74	46.0	217.9	N-R
2039BG+Dev PM Peak	0.57	60.4	177.5	N-R

As shown, the degree of saturation (DOS) is expected to remain within the capacity threshold (0.90). Being a signalised intersection, delays are not a critical factor as the controlled nature of the intersection reduces the risk of unsafe driver behaviour that would be exhibited at priority controlled intersections.

The results indicate that theoretically, queues on Lakeside Drive north approach would extend back to Abbott Street during the PM peak. However, due to the fact that both intersections will be signal controlled and there are boom gates at the level crossing, the risk of vehicles queuing through the rail corridor will be minimal. Through discussions with QR, it is understood that the interaction with the rail corridor will require their input. Through consultation with the rail engineers, the signal controls between all three points (Abbott Street / Lakeside Drive, Lakeside Drive / Rail crossing, and Lakeside Drive / Riveredge Boulevard) will be designed such that queues will be safely managed. This will likely involve queue detectors which will trigger a flushing of downstream queues and stop upstream traffic to minimise the queuing across the rail corridor.

Furthermore, as road rules stipulate that vehicles cannot queue through a signalised intersection, drivers will be aware of queueing through a level crossing as a high risk decision. In congested urban environments, queues through signalised corridors with level crossings is a regular occurrence with drivers familiar with the traffic control measures. Therefore, the safety risks associated with the queues would be managed by the intersection controls.

Document Set ID: 27254459
Version: 1, Version Date: 25/06/2025

3. Safety Assessment

A safety assessment has been prepared for the proposed intersection designs. This follows the risk assessment framework outlined in the Guide to Traffic Impact Assessments (GTIA) Section 9.

3.1 Existing Issues

Currently, the road corridor encompassing the two intersections involve the following safety related issues:

1. Uncontrolled pedestrian crossing on Lakeside Drive, next to rail corridor – crosses free left turn lane with vehicle priority, vehicle speeds higher with continuous lane and large corner radius
2. No designated pedestrian crossing over the rail line – no safe or formal connection for pedestrians or cyclists to travel between Lakeside Drive and Abbott Street
3. No pedestrian paths provided on Lakeside Drive
4. Local access on Lakeside Drive is line marked for left in / left out but not physically restricting right turns
5. Left slip lane on Lakeside Drive turning into Riveredge Boulevard – not preferred treatment for pedestrian and cyclist safety

Figure 12 Existing Safety Issues



Source: Nearmap

Document Set ID: 27254459
Version: 1, Version Date: 25/06/2025

3.2 Crash History

Crash data has been sourced from the QLD Department of Transport and Main Roads for the study area for the most recent 5-year period (2019-2023) of available crash data. The locations of recorded crashes are shown in Figure 13.

Figure 13 Crash Locations (2019-2023)



Source: Google Earth

As shown, three crashes were recorded at the Lakeside Drive / Riveredge Boulevard intersection, of which two were hospitalisations. One crash occurred near the Abbott Street / Lakeside Drive intersection, approximately 160m north of the intersection. This also resulted in a hospitalisation. With no crashes recorded at the Abbott Street / Lakeside Drive intersection, there is no indicated crash trend at this location.

Table 6 details the crash descriptions. The crashes were all of different natures, indicating that there is no trend related to a deficiency of the road design. For the crashes located at the Lakeside Drive / Riveredge Boulevard intersection, the two hospitalisations involved two vehicles colliding. Crash ID 373885 is recorded as a DCA code 101 through-through collision, however this intersection is a T-junction therefore this crash type is not possible. It is reasoned that this crash may instead be a DCA code 102, which relates to through-right crash from adjacent approaches.

Table 6 Crash History (2019-2023)

Crash Reference	Crash Severity	Crash Year	Location	DCA Code	DCA Description
334068	Hospitalisation	2021	Lakeside Dr / Riveredge Blvd	202	Vehs Opposite Approach: Thru-Right
334103	Minor injury	2022	Lakeside Dr / Riveredge Blvd	808	Off Path-Curve: Mounts Traffic Island
373885	Hospitalisation	2020	Lakeside Dr / Riveredge Blvd	101	Vehs Adjacent Approach: Thru-Thru
334145	Hospitalisation	2022	Abbott St (~160m north of Lakeside Dr)	704	Off Path-Straight: Right Off Cway Hit Obj

Document Set ID: 27254459
Version: 1, Version Date: 25/06/2025

The crash history does not indicate that the study area has a crash trend, however the incidences of three hospitalisations should be sought to be reduced.

3.3 Proposed Design

The proposed design will signalise both intersections and provide formal pedestrian facilities throughout the study area. Table 7 summarises how the proposed design will address the key issues identified. As shown, the proposed design will address all existing issues, by providing safe infrastructure for pedestrians, cyclists and drivers.

Table 7 Addressing Key Existing Issues

Issue ID	Existing Issue	Proposed Design Change	How Design Addresses Issue
1	Uncontrolled pedestrian crossing on Lakeside Drive, next to rail corridor	Signalised crossing as part of Abbott Street / Lakeside Drive intersection upgrade	Providing a controlled (signalised) crossing facility will ensure that pedestrians and vehicle conflicts are separated
2	No designated pedestrian crossing over the rail line	Crossing facility proposed as part of the rail crossing	Providing a formal crossing facility integrated with the rail corridor will ensure pedestrian, vehicle and train conflicts are separated
3	No pedestrian paths provided on Lakeside Drive	Pedestrian path included on the northern side of Lakeside Drive with signalised crossing to access Lot 6000	Providing pedestrians with a formal off-road facility will enable safe and accessible movement
4	Local access on Lakeside Drive is line marked for left in / left out but not physically restricting right turns	The access will be closed via a kerb extension across the access and extension of the median to ban turning movements	Eliminating vehicle movements at the removed access will reduce the potential conflicts between vehicles and pedestrians
5	Left slip lane on Lakeside Drive turning into Riveredge Boulevard	Stand up left turn / through lane instead of slip lane	Removing the slip lane will eliminate the risks associated with pedestrians and cyclists crossing slip lanes

Existing Property Access

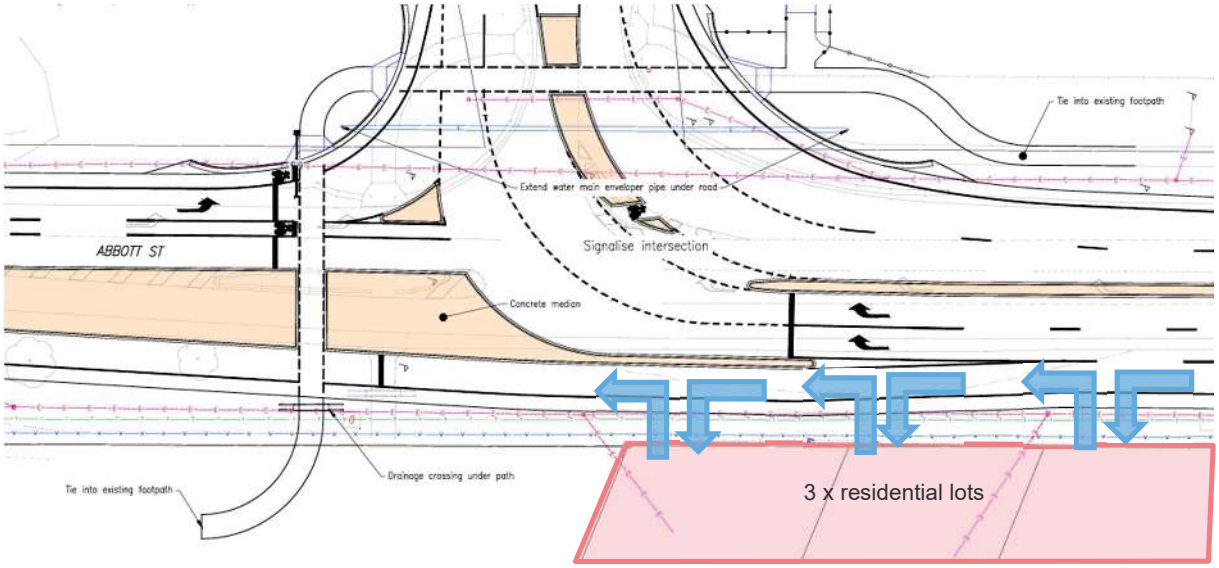
It is noted that the three low density residential lots accessed from Abbott Street will have access maintained with the design. By implementing a median that restricts access to left-in, left-out movements, the design effectively reduces the risk associated with right-turn movements in a multi-lane environment. The arrangement is indicated on Figure 14.

The extension of the central median across the frontage of the southernmost lot, located in the middle of the intersection, has been introduced to manage access safely. Although only the middle lot is currently occupied, the design accommodates the potential for future development of the other lots, ensuring they are safely accessible when needed. Opportunities to u-turn are located approximately 1km north and south of the lots, to enable travel northbound and southbound with the right turn restrictions. While the design may create some inconvenience for the three lots on Abbott Street, the operational and safety benefits of the intersection upgrade offer significant advantages for the broader community.

Further refinement of the interface with the Abbott Street pavement will be addressed as the design develops.

Document Set ID: 27254459
Version: 1, Version Date: 25/06/2025

Figure 14 Residential Lot Access Design



Source: Stantec

3.4 Risk Assessment

As outlined in the GTIA Section 9, a safety risk assessment has been prepared. The rating descriptors are defined in Table 8 and Table 9.

Table 8 Potential Consequence

Rating	Descriptor
1	Property Only
2	Minor Injury
3	Medical Treatment
4	Hospitalisation
5	Fatality

Table 9 Potential Likelihood Descriptor

Rating	Descriptor	Occurrence
5	Very likely. The event is expected to occur in most circumstances	Once per quarter
4	There is a strong possibility the event will occur	Once per quarter to once per year
3	The event might occur at some time	Once per year to once every three years
2	Not expected, but there's a slight possibility it may occur at some time.	Once every three years to once every seven years
1	Highly unlikely, but it may occur in exceptional circumstances. It could happen, but probably never will.	Less than once every seven years

Document Set ID: 27254459
Version: 1, Version Date: 25/06/2025

The issues identified have been assigned a risk rating using the risk score matrix shown on Figure 15.

Figure 15 Risk Score Matrix

Figure 9.3.2(a) – Safety risk score matrix

Potential likelihood	Potential consequence: Property only (1)	Minor injury (2)	Medical treatment (3)	Hospitalisation (4)	Fatality (5)
Almost certain (5)	M	M	H	H	H
Likely (4)	M	M	M	H	H
Moderate (3)	L	M	M	M	H
Unlikely (2)	L	L	M	M	M
Rare (1)	L	L	L	M	M

L: Low risk
M: Medium risk
H: High risk

Risk scores are calculated as likelihood multiplied by consequence level. Table 10 outlines the potential risks, and risk scores associated with the current design and the proposed design.

Table 10 Risk Safety Assessment

Risk Item	Existing Situation			Proposed Design			Comment
	Likelihood	Consequence	Risk Score	Likelihood	Consequence	Risk Score	
Abbott Street / Lakeside Drive							
Through-right crash on Abbott Street	2	4	8 **Med**	1	4	4 **Med**	No crashes recorded in the 5 year period, signalising the intersection will control the movements reducing the likelihood
Through-left crash on Abbott Street	1	3	3 **Low**	1	3	3 **Low**	Existing design has continuous left lane with merge, proposed design will control the movements
Pedestrians crossing Lakeside Drive being hit by a car	2	4	8 **Med**	1	4	4 **Med**	Existing design has an uncontrolled crossing facility, proposed design will provide signalised crossings reducing the likelihood
Pedestrians crossing Abbott Street being hit by a car	2	4	8 **Med**	1	4	4 **Med**	Existing design has an uncontrolled crossing facility, proposed design will provide signalised crossings reducing the likelihood
Pedestrians crossing the level crossing being hit by train	1	5	5 **Med**	1	5	5 **Med**	While the likelihood is very low in both scenarios, the proposed design will provide a controlled pedestrian crossing facility which will control pedestrian movements and essentially reduce the likelihood to nil resulting in a lower risk. However, if the crossing is circumvented, a fatality could still occur

Document Set ID: 27254459
Version: 1, Version Date: 25/06/2025

Risk Item	Existing Situation			Proposed Design			Comment
	Likelihood	Consequence	Risk Score	Likelihood	Consequence	Risk Score	
Queueing spills back to the level crossing being hit by train	2	5	10 **Med**	1	5	5 **Med**	Existing design has boom gates to control vehicles crossing the rail corridor, proposed design will have networked signal controls with queue detection to actively manage potential queues over the rail corridor (through consultation with QR)
Lakeside Drive / Riveredge Boulevard							
Through-right crash on Lakeside Drive	3	4	12 **Med**	1	4	4 **Med**	One crash occurred during the 5 year period, signalising the intersection will control the movements reducing the likelihood
Through-right crash on Riveredge Blvd	3	4	12 **Med**	1	4	4 **Med**	One crash occurred during the 5 year period, signalising the intersection will control the movements reducing the likelihood
Through-left crash on Riveredge Blvd	2	3	6 **Med**	1	3	3 **Low**	No crashes recorded in the 5 year period, signalising the intersection will control the movements reducing the likelihood
Pedestrians crossing Lakeside Drive being hit by a car	2	4	8 **Med**	1	4	4 **Med**	Existing design has no formal crossing facility, proposed design will provide signalised crossings reducing the likelihood
Pedestrians crossing Riveredge Blvd being hit by a car	2	4	8 **Med**	1	4	4 **Med**	Existing design has no formal crossing facility and uncontrolled left slip lane crossing, proposed design will provide signalised crossings and remove slip lanes reducing the likelihood
Lakeside Drive midblock							
Vehicles turning into / out of access point hitting another car	2	3	6 **Med**	1	3	3 **Low**	The access will be closed therefore the risk will be eliminated

The risk assessment indicates that the proposed design will reduce the risk score for all identified risks through the controlled nature of signalising the intersections and removal of slip lanes. While many of the risk levels (Low, Medium) do not change between the scenarios, it is noted that no High risks were identified.

Therefore, the proposed design is considered to provide a safer overall outcome for the study intersections.

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Version: 1, Version Date: 25/06/2025

4. Summary

Urbis has undertaken the traffic engineering assessment for The Village development at Oonoonba, within the Oonoonba PDA, to identify the intersection upgrade layouts for the two study intersections:

1. Abbott Street / Lakeside Drive
2. Lakeside Drive / Riveredge Boulevard

The traffic analysis has identified that both intersections will be signalised with additional traffic lanes to accommodate the anticipated traffic growth and development traffic associated with The Village and Lot 6000.

The assessment results indicate that both proposed intersection layouts will operate within acceptable capacity limits at the 2039 design horizon.

A safety assessment identifies that the proposed design will provide a safer outcome overall for the study intersections, through the nature of signal controlling the vehicle and pedestrian movements, providing formal pedestrian crossing facilities and removing slip lanes.

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Version: 1, Version Date: 25/06/2025

APPENDIX A PROPOSAL PLAN (RPS)

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DRAFT
For Discussion Only

Legend

- The Village Site Boundary
- Existing Development
- Existing Lots to be dedicated as new road - 3670m²

Note:
All Lot Numbers, Dimensions and Areas are approximate only, and are subject to survey and Council approval.

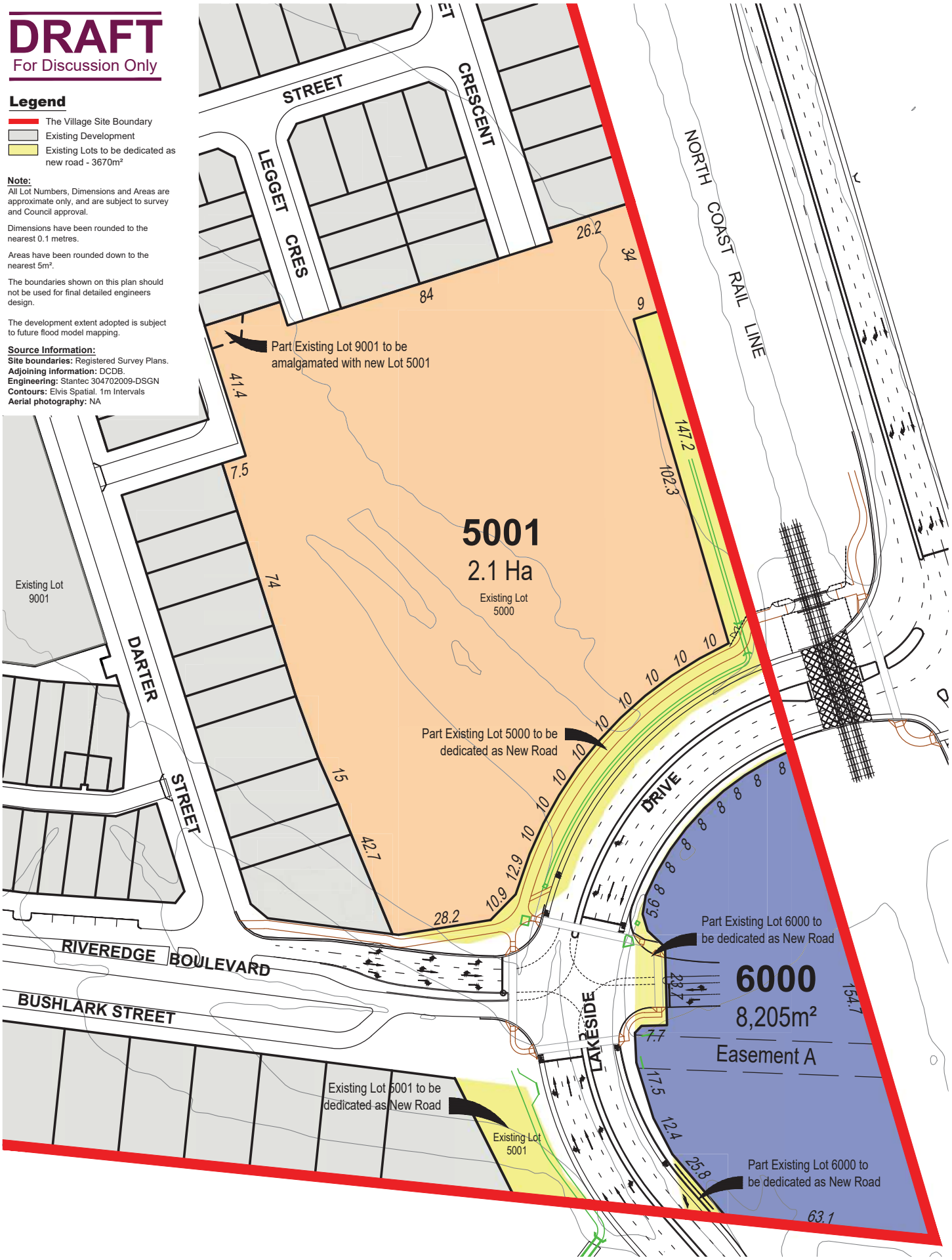
Dimensions have been rounded to the nearest 0.1 metres.

Areas have been rounded down to the nearest 5m².

The boundaries shown on this plan should not be used for final detailed engineers design.

The development extent adopted is subject to future flood model mapping.

Source Information:
Site boundaries: Registered Survey Plans.
Adjoining information: DCDB.
Engineering: Stantec 304702009-DSGN
Contours: Elvis Spatial. 1m Intervals
Aerial photography: NA



PLAN REF: AU13015703 – 12
Rev No: A
DATE: 28th MAY 2025
CLIENT: ECONOMIC DEVELOPMENT QUEENSLAND
DRAWN BY: MJB
CHECKED BY: MJB

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THE VILLAGE, OONOONBA
RAL PROPOSAL PLAN - 3 into 1 Lots, Boundary Realignment & New Road - Cancelling Lots 5000 & 5001 SP302846

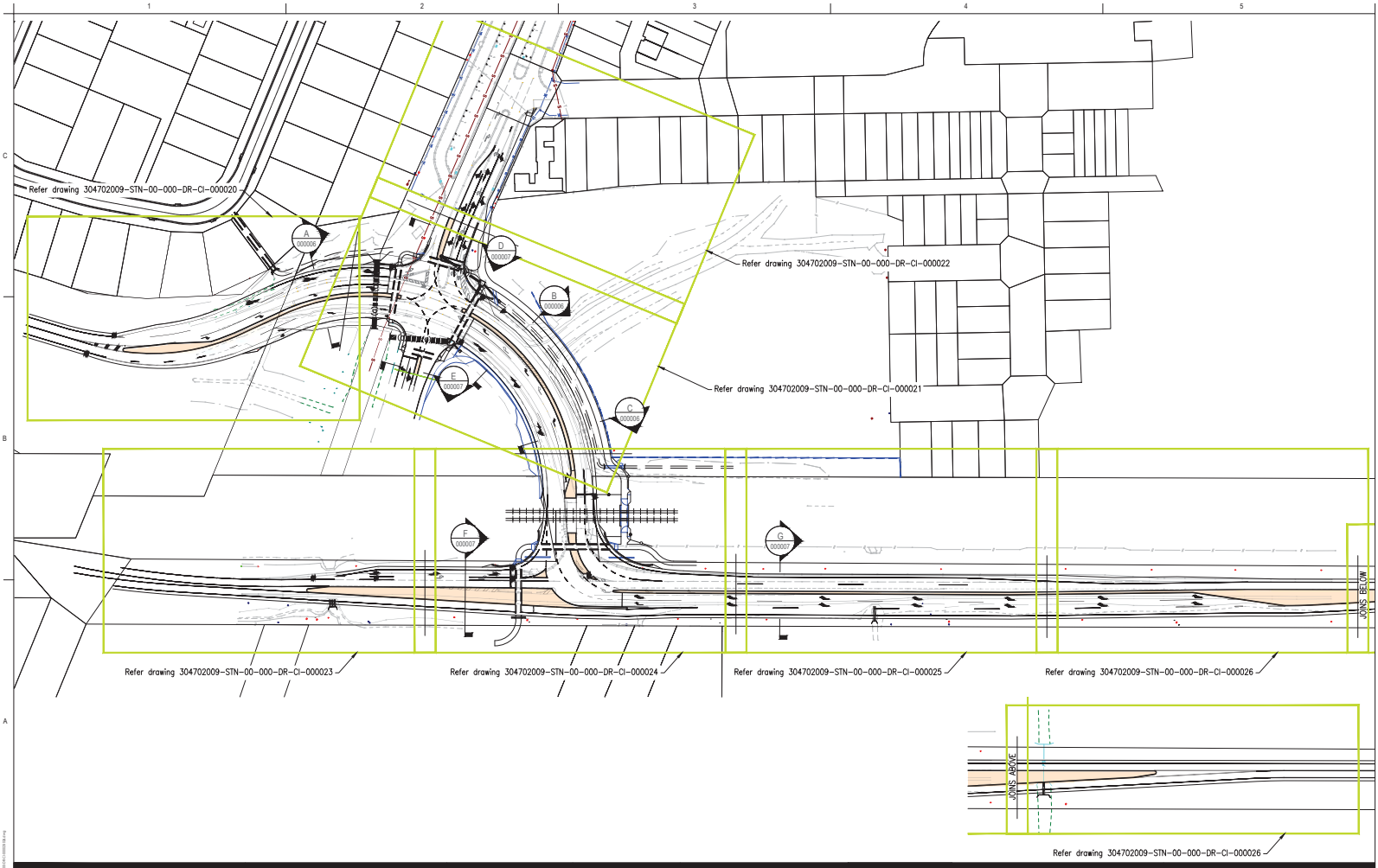
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Unit 1
5-7 Barlow Street
South Townsville QLD 4810
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APPENDIX B INTERSECTION SKETCH (STANTEC)

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P04 INTERSECTION LAYOUT CHANGE	LV	GJ	2025.05.30
P03 LINE MARKING CHANGE	RM	GJ	2025.05.07
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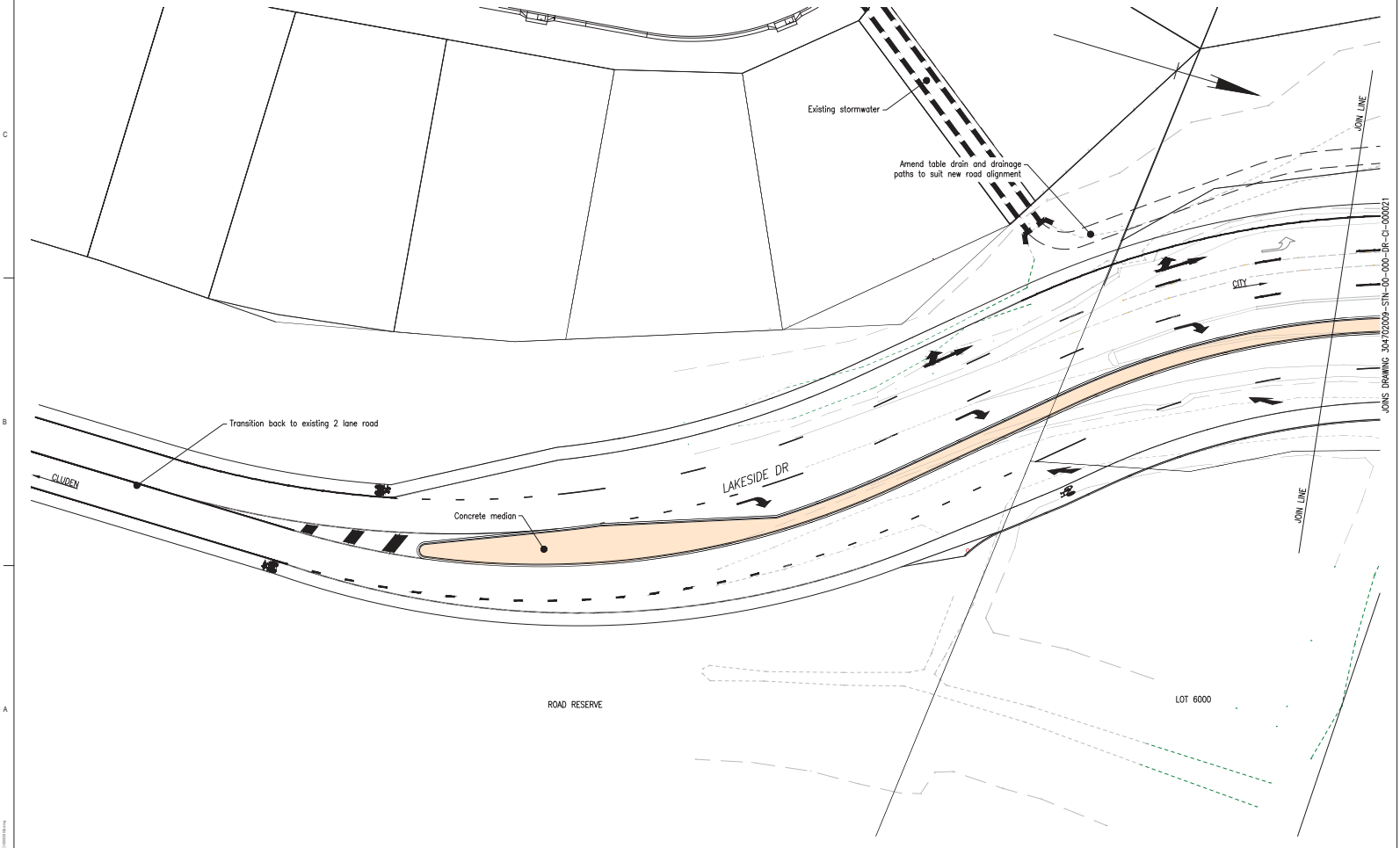
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P03 LOT 6000 WALL CHANGES	RM	GJ	2025.05.07
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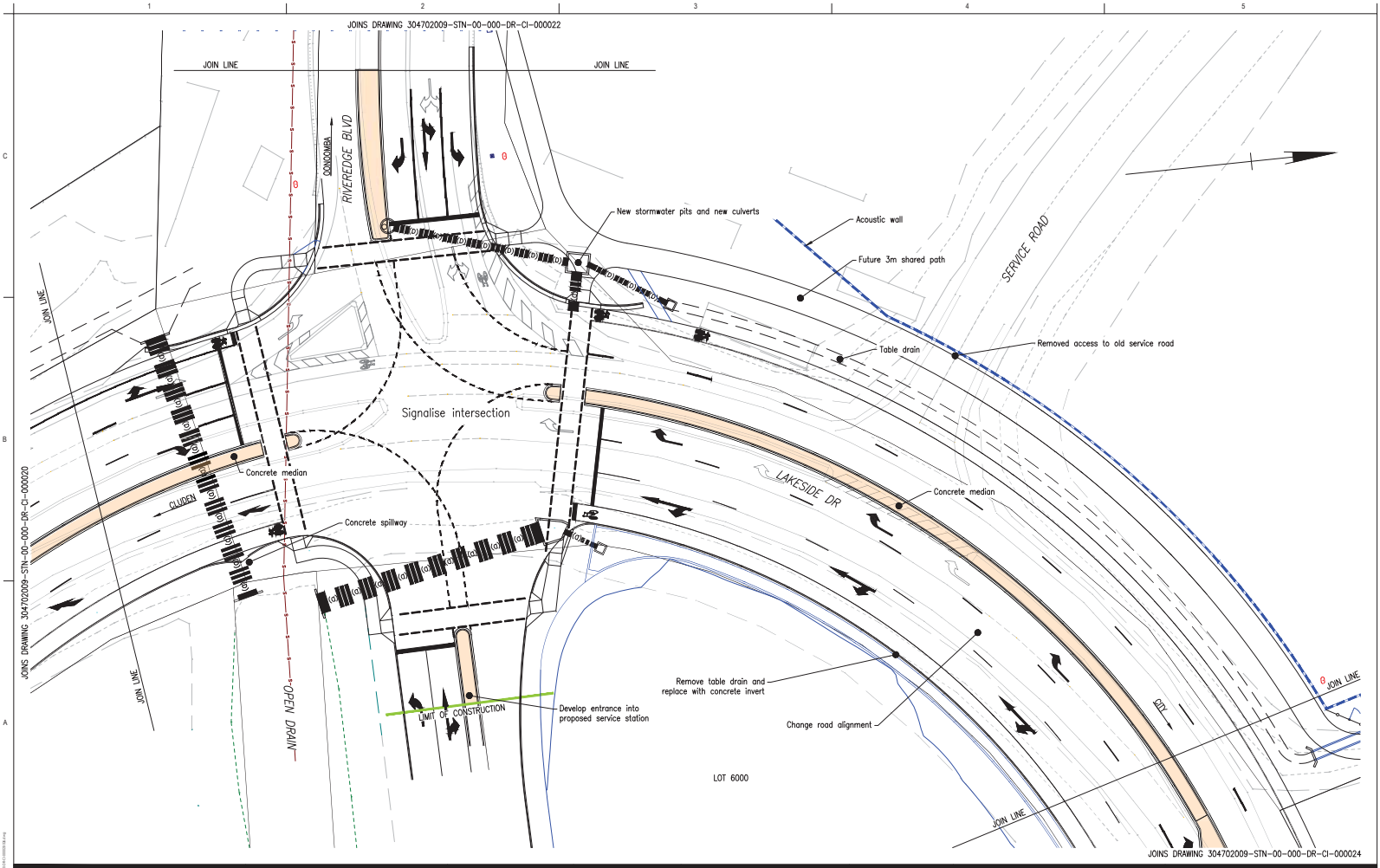
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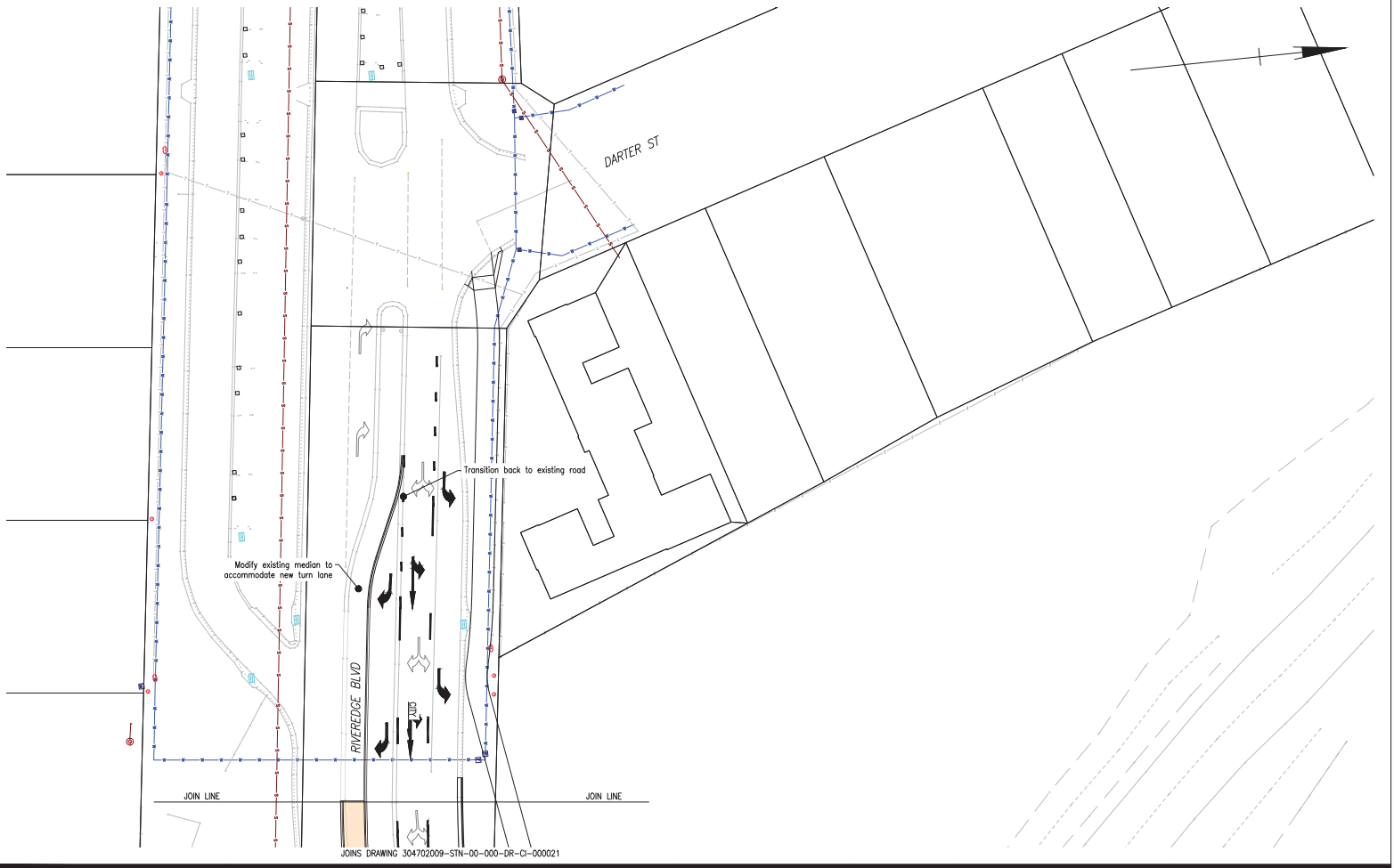
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P03 INTERSECTION LAYOUT CHANGE	LV	GJ	2025.05.20
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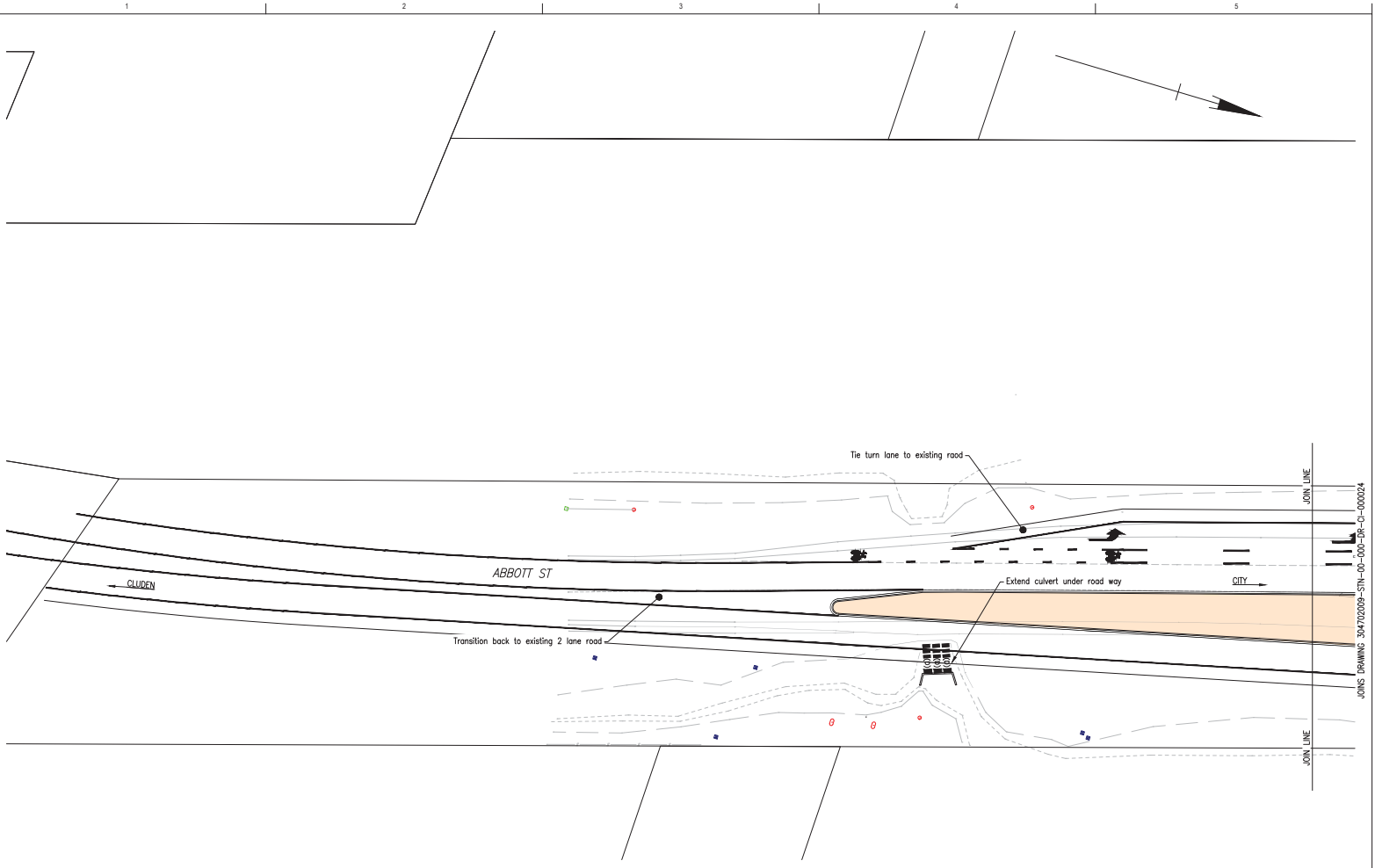
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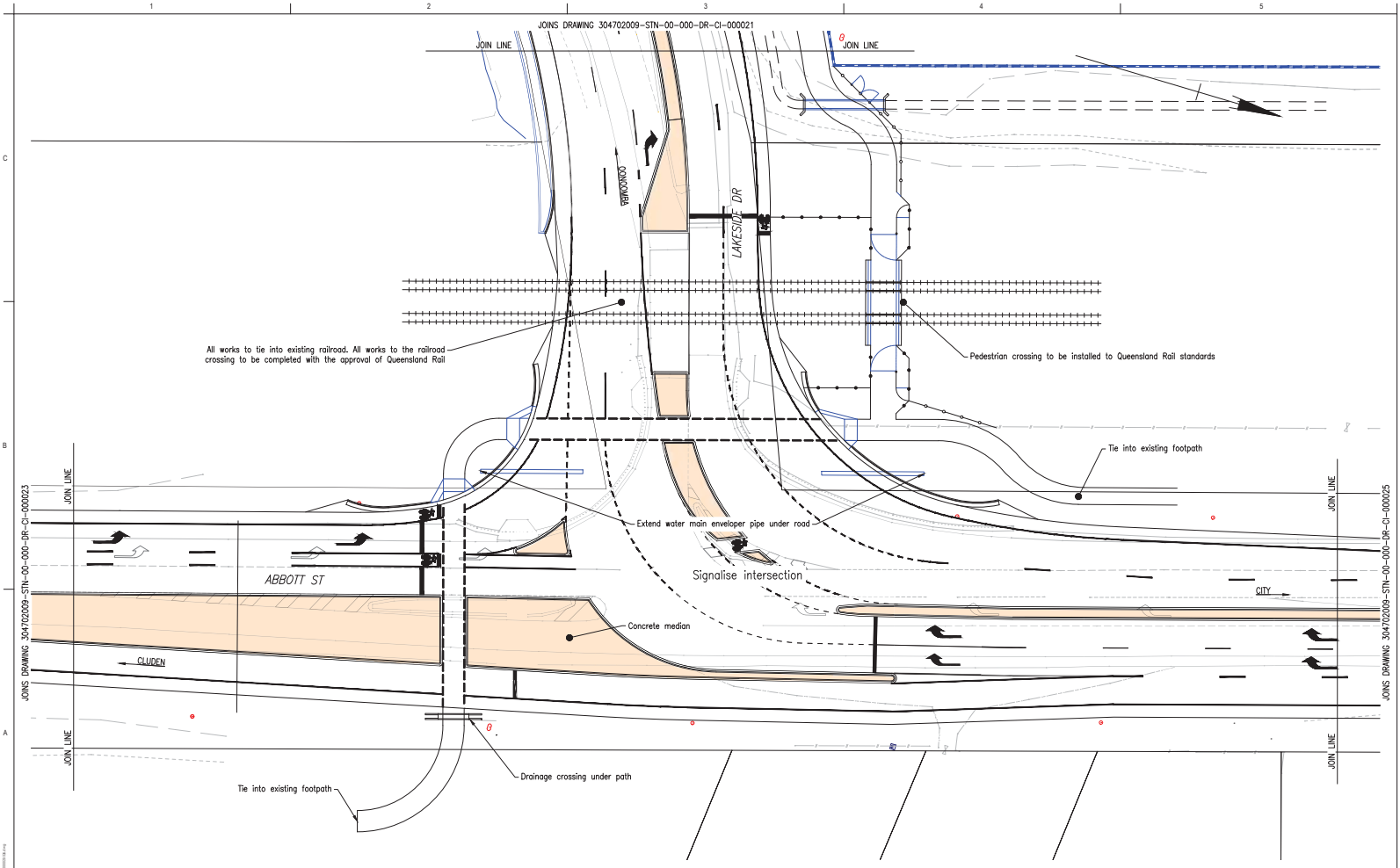
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Version: 1, Version Date: 25/06/2025



0 2 4 6 8m

P05 DESIGN UPDATE	RM	GJ	2025.06.10
P04 INTERSECTION LAYOUT CHANGE	LV	GJ	2025.05.30
P03 LOT 6000 WALL CHANGES	RM	GJ	2025.05.07
P02 REVISED LAYOUT	RM	GJ	2025.05.02
P01 FOR INFORMATION	RM	GJ	2025.03.14
Issued/Revision	By	Appd	YYYY.MM.DD

Issue Status

S0

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MGA/YY-Zone
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Economic Development Queensland

Client/Project

ECONOMIC DEVELOPMENT QUEENSLAND
OONOONBA PDA
SCHEMATIC LAYOUT

RM	MM	GJ		
Dsgn.	Dsgn.	Chkd.	Appd.	YYYY.MM.DD

Title

GENERAL ARRANGEMENT
SHEET 5 OF 7

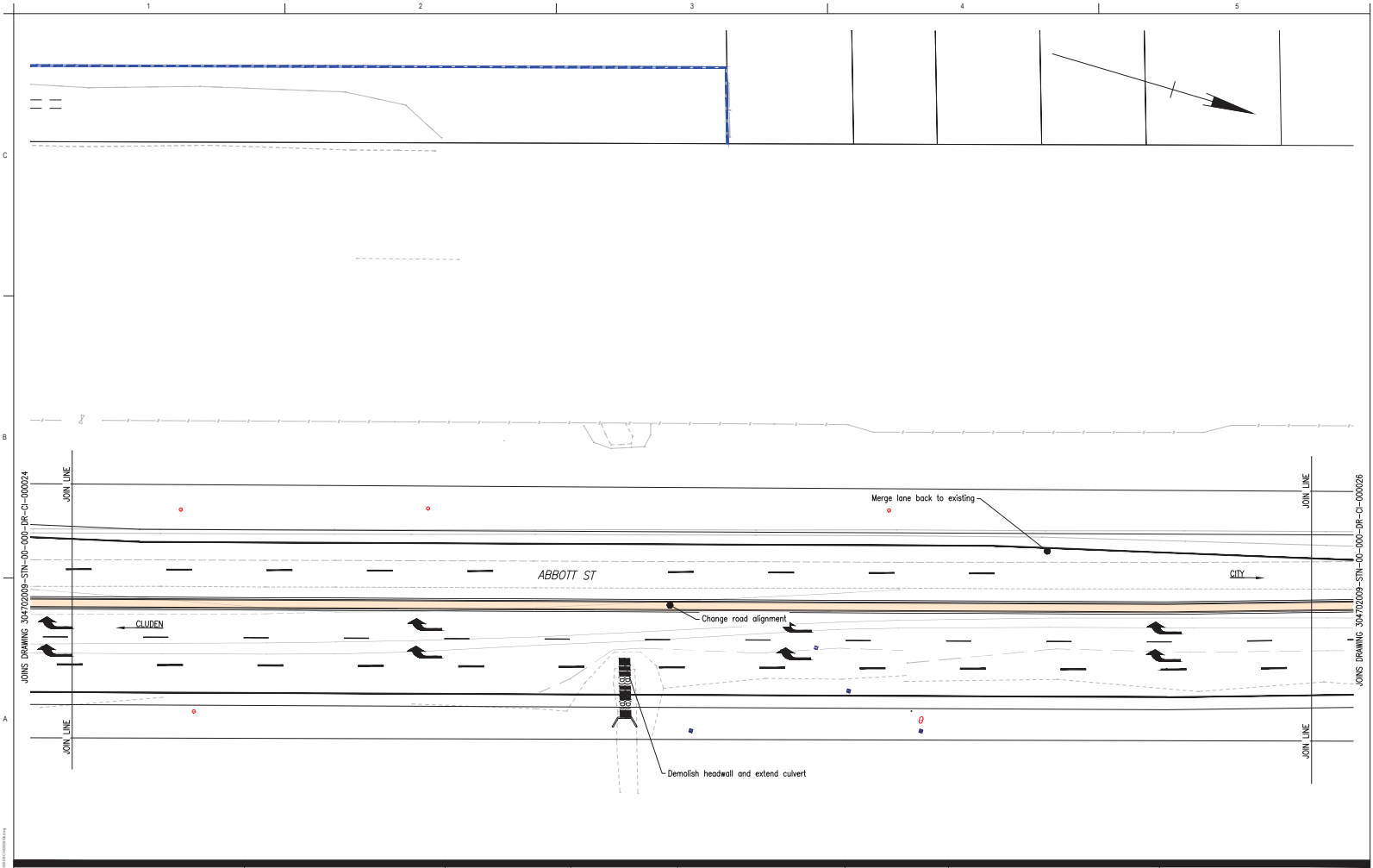
Project No.
304702009

Scale at A1

Revision
P05

Drawing No.
304702009-STN-00-000-DR-CI-000024

CREATED: 2025.03.10
Document Set ID: 27254459
Version: 1, Version Date: 25/06/2025



0 2 4 6 8m

P04 DESIGN UPDATE	RM	GJ	2025.06.10
P03 INTERSECTION LAYOUT CHANGE	LV	GJ	2025.05.20
P02 REVISED LAYOUT	RM	GJ	2025.05.02
P01 FOR INFORMATION	RM	GJ	2025.03.14
Issued/Revision	By	Appd	YYYY.MM.DD

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OONOONBA PDA
SCHEMATIC LAYOUT

RM	MM	GJ		
Dsgn.	Dsgn.	Chkd.	Appd.	YYYY.MM.DD

Title

GENERAL ARRANGEMENT
SHEET 6 OF 7

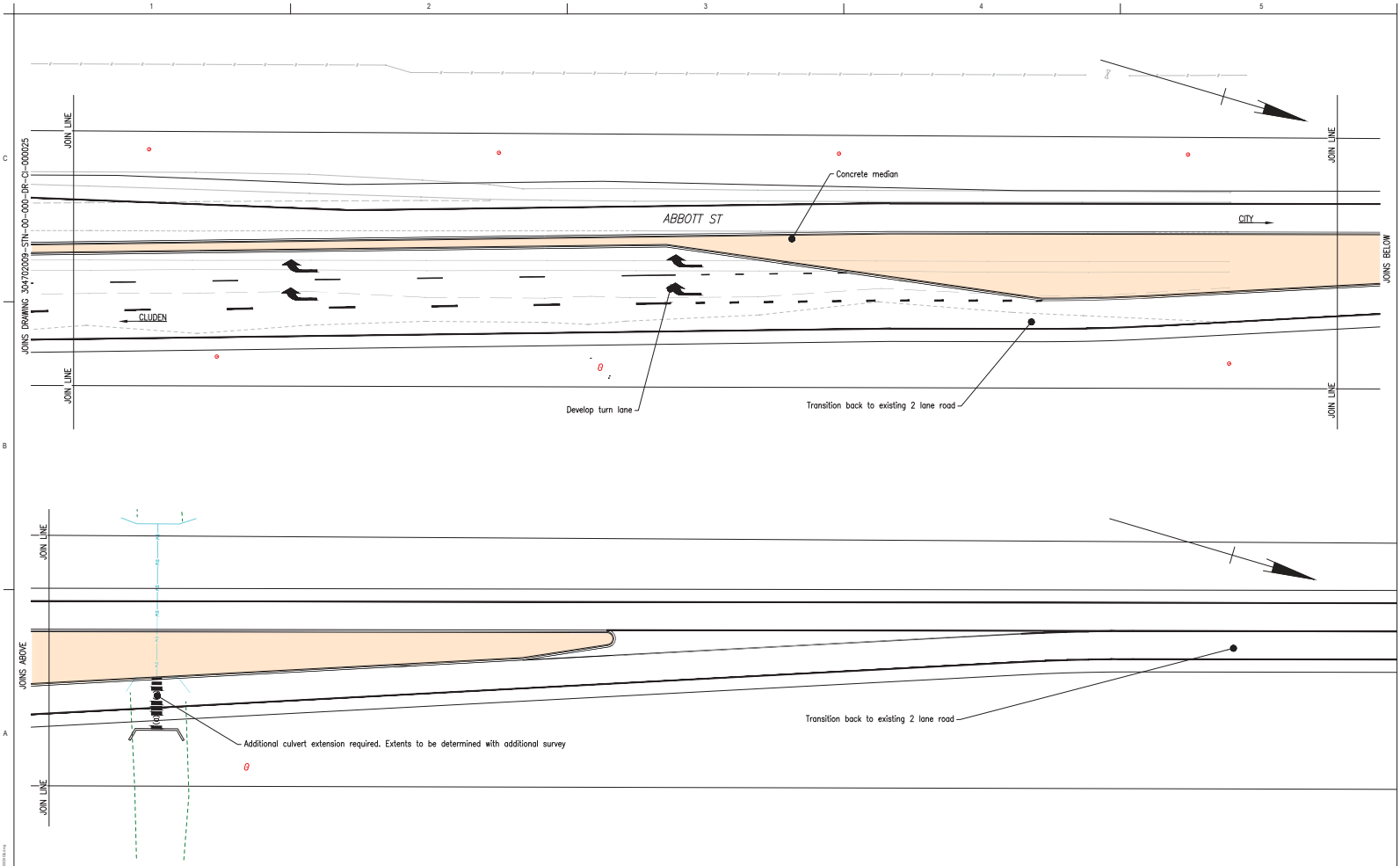
Project No.
304702009

Scale at A1

Revision
P04

Drawing No.
304702009-STN-00-000-DR-CI-000025

ORIGINAL SHEET - ISO A1
Document Set ID: 27254459
Version: 1, Version Date: 25/06/2025



0 2 4 6 8m

P04 DESIGN UPDATE	RM	GJ	2025.06.10
P03 INTERSECTION LAYOUT CHANGE	LV	GJ	2025.05.20
P02 REVISED LAYOUT	RM	GJ	2025.05.02
P01 FOR INFORMATION	RM	GJ	2025.03.14
Issued/Revision	By	Appd	YYYY.MM.DD

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ECONOMIC DEVELOPMENT QUEENSLAND
OONOONBA PDA
SCHEMATIC LAYOUT

RM	MM	GJ		
Dsgn.	Dsgn.	Chkd.	Appd.	YYYY.MM.DD

Title

GENERAL ARRANGEMENT
SHEET 7 OF 7

Project No.
304702009

Scale at A1

Revision
P04

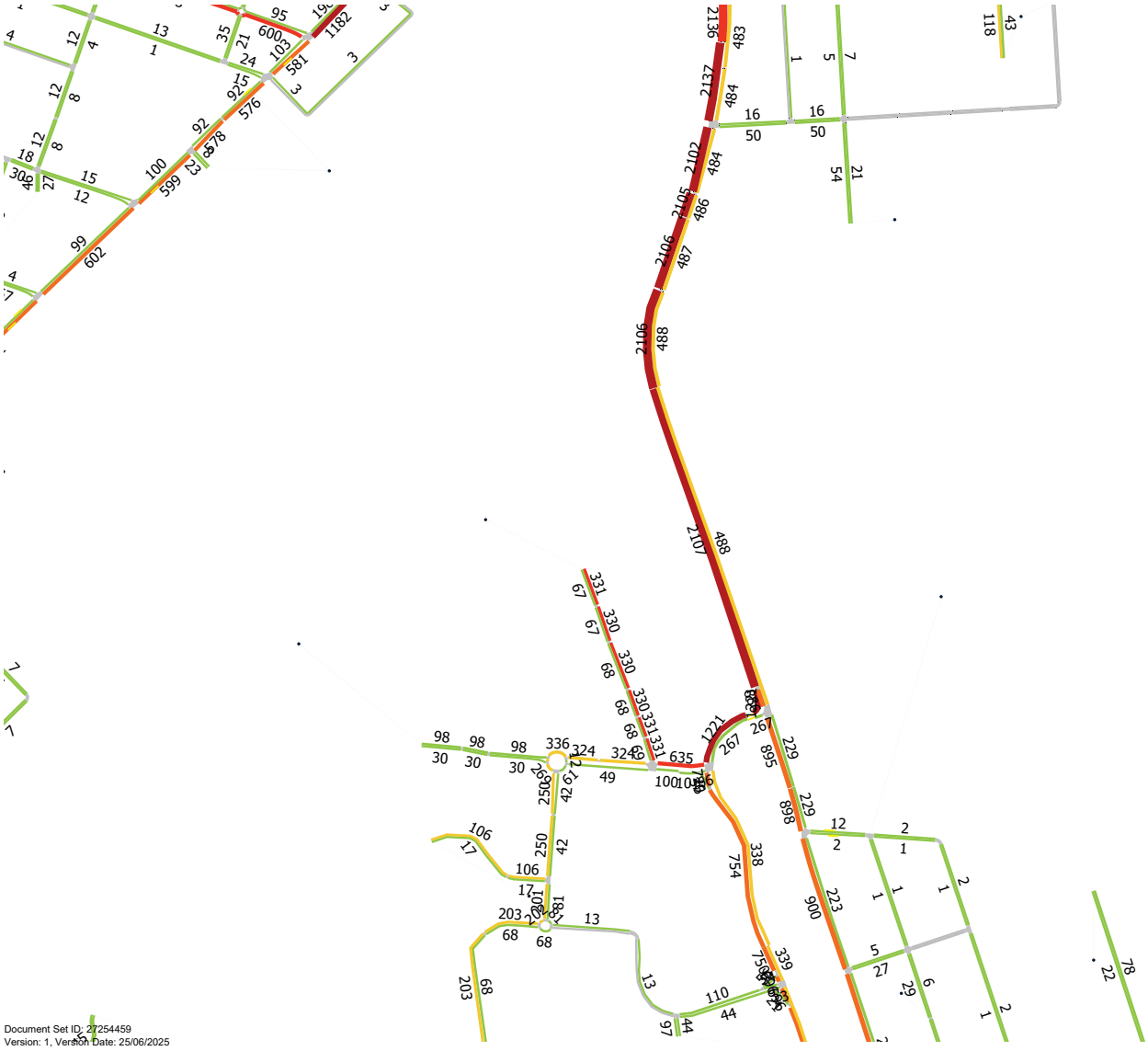
Drawing No.
304702009-STN-00-000-DR-CI-000026

ORIGINAL SHEET - ISO A1
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Version: 1, Version Date: 25/06/2025

APPENDIX C TMR TRAFFIC MODELLING OUTPUTS

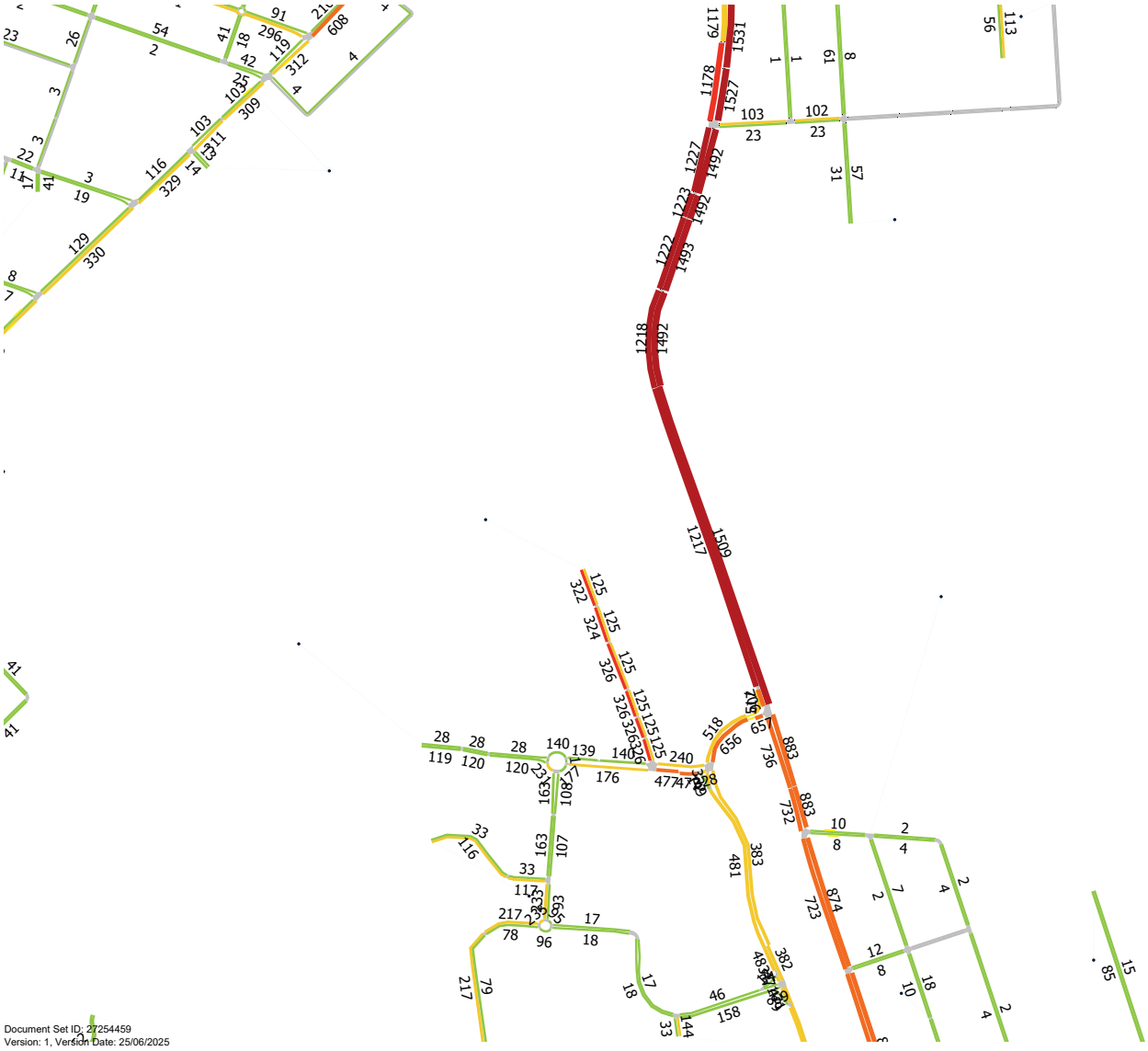
Document Set ID: 27254459
Version: 1, Version Date: 25/06/2025

TAMM Volumes
2036 0800-0900



Document Set ID: 27254459
Version: 1, Version Date: 25/06/2025

TAMM Volumes
2036 1700-1800



Document Set ID: 27254459
Version: 1, Version Date: 25/06/2025

APPENDIX D SIDRA OUTPUTS

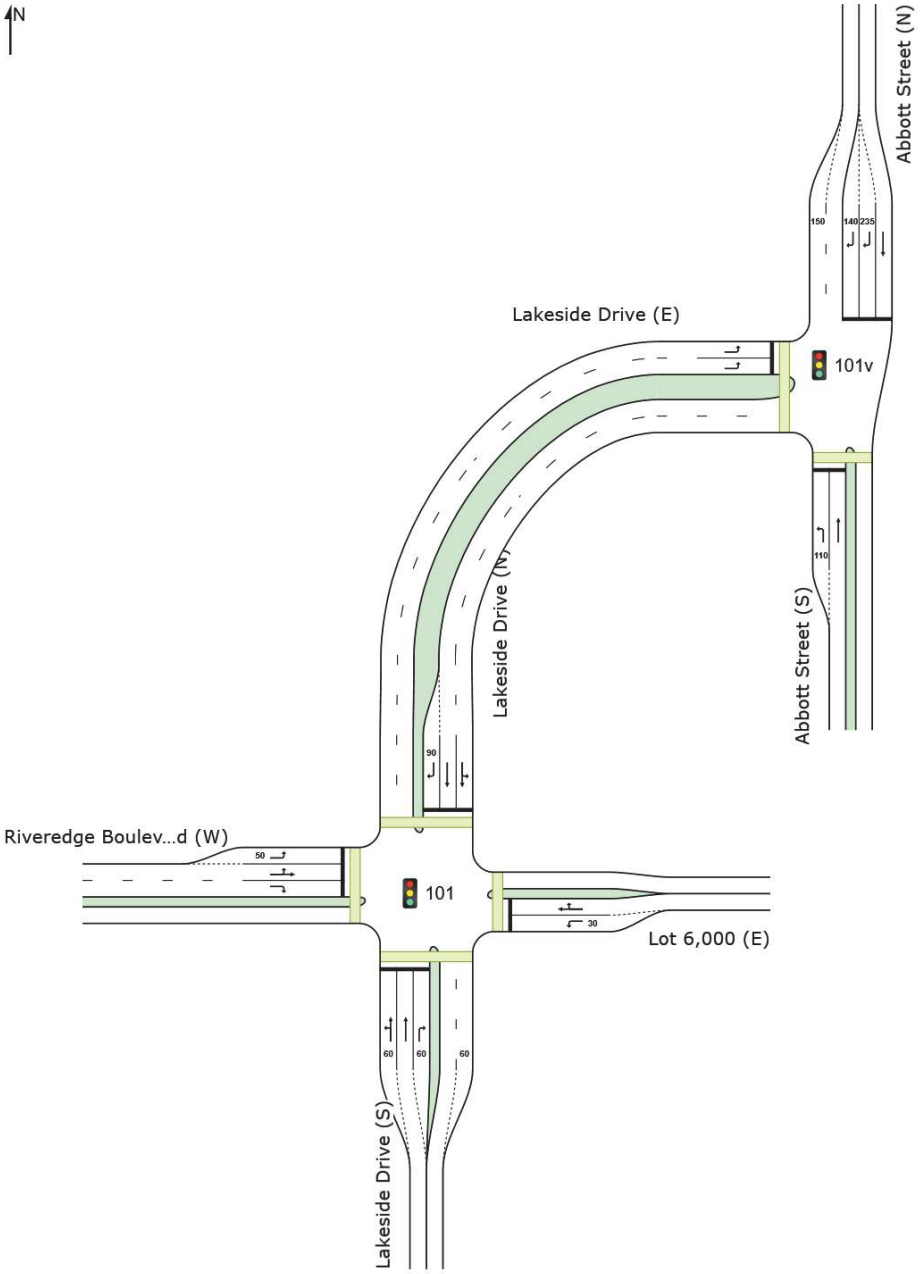
Document Set ID: 27254459
Version: 1, Version Date: 25/06/2025

NETWORK LAYOUT

Network: N101 [2039 PM Ultimate - TAMM Adjust Volumes- Modified Layout TMR Comments Abbott St Lanes (Network Folder: TAMM Volumes - Abbott St Lanes)]

New Network
Network Category: (None)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



SITES IN NETWORK		
Site ID	**CCG ID**	**Site Name**
101v	NA	Lakeside Dr - Abbott St - 2039BG+DEV - PM Peak - TAMM Adjust Volumes - Modified Layout - Abbott St L
101	NA	Lakeside Dr - Riveredge Blvd - 2039BG+Dev PM -TAMM Adjust Volumes - Modified Layout - Abbott St Lane

LANE SUMMARY

Site: 101v [Lakeside Dr - Abbott St - 2039BG+DEV - AM Peak - TAMM Adjust Volumes - Modified Layout - Abbott St L (Site Folder: 2039 with Full Dev)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Network: N101 [2039 AM Ultimate - TAMM Adjust Volumes-Modified Layout TMR Comments Abbott St Lanes (Network Folder: TAMM Volumes - Abbott St Lanes)]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 150 seconds (Network Site User-Given Phase Times)

Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Abbott Street (S)															
Lane 1	9	0.0	9	0.0	1040	0.009	100	36.7	LOS D	0.3	2.0	Short	110	0.0	NA
Lane 2	922	7.0	922	7.0	1039[1]	0.888	100	193.4	LOS F	61.2	454.5	Full	500	0.0	0.0
Approach	931	6.9	931	6.9		0.888		191.9	LOS F	61.2	454.5				
North: Abbott Street (N)															
Lane 1	239	19.0	239	19.0	972	0.246	100	17.7	LOS B	8.7	71.0	Full	500	0.0	0.0
Lane 2	131	3.0	131	3.0	655	0.199	100	40.7	LOS D	6.5	46.5	Short	235	0.0	NA
Lane 3	131	3.0	131	3.0	655	0.199	100	40.7	LOS D	6.5	46.5	Short	140	0.0	NA
Approach	500	10.6	500	10.6		0.246		29.7	LOS C	8.7	71.0				
West: Lakeside Drive (E)															
Lane 1	441	1.0	441	1.0	664	0.665	81[6]	175.7	LOS F	22.2	156.5	Full	115	0.0	33.1
Lane 2	545	1.0	545	1.0	664	0.820	100	37.6	LOS D	26.6[N4]	187.7[N4]	Full	115	0.0	50.0
Approach	986	1.0	986	1.0		0.820		99.4	LOS F	26.6	187.7				
All Vehicles	2417	5.3	2417	5.3		0.888		120.6	LOS F	61.2	454.5				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Delay and stops experienced by drivers upstream of short lane entry have been accounted for.
6 Lane under-utilisation due to downstream effects
N4 Average back of queue has been restricted to the available queue storage space.

Approach Lane Flows (veh/h)

South: Abbott Street (S)

Mov. From S To Exit:	L2 W	T1 N	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	9	-	9	0.0	1040	0.009	100	0.0	2
Lane 2	-	922	922	7.0	1039[1]	0.888	100	NA	NA
Approach	9	922	931	6.9		0.888			

North: Abbott Street (N)									
Mov. From N To Exit:	T1 S	R2 W	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	239	-	239	19.0	972	0.246	100	NA	NA
Lane 2	-	131	131	3.0	655	0.199	100	0.0	1
Lane 3	-	131	131	3.0	655	0.199	100	0.0	2
Approach	239	261	500	10.6		0.246			
West: Lakeside Drive (E)									
Mov. From W To Exit:	L2 N		Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	441		441	1.0	664	0.665	81[6]	NA	NA
Lane 2	545		545	1.0	664	0.820	100	NA	NA
Approach	986		986	1.0		0.820			

	Total	%HV	Deg.Satn (v/c)
All Vehicles	2417	5.3	0.888

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Delay and stops experienced by drivers upstream of short lane entry have been accounted for.

6 Lane under-utilisation due to downstream effects

Merge Analysis

	Exit Lane Number	Short Lane Length m	Percent Opng in Lane %	Opposing Flow Rate veh/h	Opposing Flow Rate pcu/h	Critical Gap sec	Follow-up Headway sec	Lane Flow Rate veh/h	Capacity veh/h	Deg. Satn v/c	Min. Delay sec	Merge Delay sec
North Exit: Abbott Street (N) Merge Type: **Priority**												
Exit Short Lane	1	150	0.0	545	547	3.08	2.05	1363	1185	1.150	1.0	142.4
Merge Lane	2	-	100.0	Merge Lane is not Opposed				545	1800	0.303	0.0	0.0

Variable Demand Analysis

	Initial Queued Demand veh	Residual Queued Demand veh	Time for Residual Demand to Clear sec	Duration of Oversatn sec
South: Abbott Street (S)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	0.0	0.0	0.0
North: Abbott Street (N)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	0.0	0.0	0.0
Lane 3	0.0	0.0	0.0	0.0
West: Lakeside Drive (E)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	0.0	0.0	0.0

Document Set ID: 27254459
Version: 1, Version Date: 25/06/2025

PHASING SUMMARY

Site: 101v [Lakeside Dr - Abbott St - 2039BG+DEV - AM Peak - TAMM Adjust Volumes - Modified Layout - Abbott St L (Site Folder: 2039 with Full Dev)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Network: N101 [2039 AM Ultimate - TAMM Adjust Volumes-Modified Layout TMR Comments Abbott St Lanes (Network Folder: TAMM Volumes - Abbott St Lanes)]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 150 seconds (Network Site User-Given Phase Times)

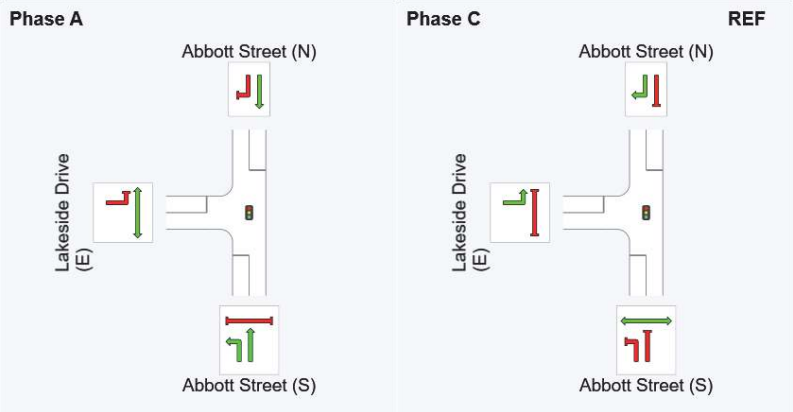
Timings based on settings in the Network Timing dialog
Phase Times specified by the user
Phase Sequence: Convert Function Default
Input Phase Sequence: A, C
Output Phase Sequence: A, C
Reference Phase: Phase C
Offset: 0 seconds (User)

Phase Timing Summary

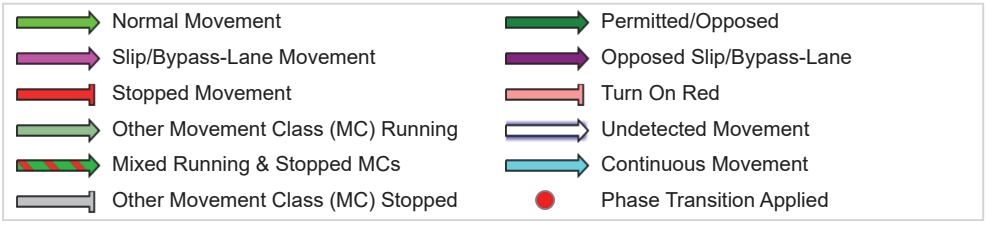
Phase	A	C
Phase Change Time (sec)	60	0
Green Time (sec)	84	54
Phase Time (sec)	90	60
Phase Split	60%	40%
Phase Frequency (%)	100.0	100.0

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase



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Organisation: URBIS | Licence: NETWORK / 1PC | Processed: Monday, 28 April 2025 4:34:14 PM
Project: C:\Users\ashi\Urbis Ltd\P0051836 SUB Oonoonba Village Traffic Assessment - General\02_Workspace\08_Transport\01_Analysis\P0051836 - SIDRA - 250327_V6.sip9

LANE SUMMARY

Site: 101 [Lakeside Dr - Riveredge Blvd - 2039BG+Dev AM - TAMM Adjust Volumes - Modified Layout - Abbott St Lane (Site Folder: 2039 with Full Dev)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Network: N101 [2039 AM Ultimate - TAMM Adjust Volumes-Modified Layout TMR Comments Abbott St Lanes (Network Folder: TAMM Volumes - Abbott St Lanes)]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 150 seconds (Network Site User-Given Phase Times)

Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Lakeside Drive (S)															
Lane 1	546	1.6	546	1.6	735[1]	0.742	100	43.9	LOS D	30.7	217.9	Short	60	-28.4[N3]	NA
Lane 2	312	2.0	312	2.0	421[1]	0.742	100	45.2	LOS D	18.4	131.2	Full	400	-50.0[N3]	0.0
Lane 3	60	0.0	60	0.0	87	0.692	100	87.6	LOS F	4.7	32.7	Short	60	0.0	NA
Approach	918	1.6	918	1.6		0.742		47.2	LOS D	30.7	217.9				
East: Lot 6,000 (E)															
Lane 1	64	0.0	64	0.0	334	0.191	100	41.4	LOS D	3.1	22.0	Short	30	0.0	NA
Lane 2	56	0.0	56	0.0	153	0.365	100	69.0	LOS E	3.9	27.1	Full	60	-39.1[N3]	0.0
Approach	120	0.0	120	0.0		0.365		54.2	LOS D	3.9	27.1				
North: Lakeside Drive (N)															
Lane 1	124	1.4	124	1.4	1002	0.124	100	5.4	LOS A	0.9	6.4	Full	115	0.0	0.0
Lane 2	125	2.0	125	2.0	1014	0.124	100	2.7	LOS A	0.7	5.2	Full	115	0.0	0.0
Lane 3	61	0.0	61	0.0	87	0.704	100	89.5	LOS F	4.8	33.4	Short	90	0.0	NA
Approach	310	1.3	310	1.3		0.704		20.9	LOS C	4.8	33.4				
West: Riveredge Boulevard (W)															
Lane 1	154	0.0	154	0.0	273	0.564	100	62.6	LOS E	10.2	71.7	Short	50	-33.1[N3]	NA
Lane 2	102	0.0	102	0.0	180	0.564	100	67.1	LOS E	7.1	49.4	Full	250	-44.6[N3]	0.0
Lane 3	43	0.0	43	0.0	248	0.174	100	68.2	LOS E	2.8	19.7	Full	250	0.0	0.0
Approach	299	0.0	299	0.0		0.564		65.0	LOS E	10.2	71.7				
All Vehicles	1647	1.2	1647	1.2		0.742		46.0	LOS D	30.7	217.9				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Delay and stops experienced by drivers upstream of short lane entry have been accounted for.
N3 Capacity Adjustment due to downstream lane blockage determined by the program.

Approach Lane Flows (veh/h)

South: Lakeside Drive (S)

Mov. From S To Exit:	L2 W	T1 N	R2 E	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	108	438	-	546	1.6	735[1]	0.742	100	100.0	2
Lane 2	-	312	-	312	2.0	421[1]	0.742	100	NA	NA
Lane 3	-	-	60	60	0.0	87	0.692	100	0.0	2
Approach	108	750	60	918	1.6		0.742			

East: Lot 6,000 (E)

Mov. From E To Exit:	L2 S	T1 W	R2 N	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	64	-	-	64	0.0	334	0.191	100	0.0	2
Lane 2	-	20	36	56	0.0	153	0.365	100	NA	NA
Approach	64	20	36	120	0.0		0.365			

North: Lakeside Drive (N)

Mov. From N To Exit:	L2 E	T1 S	R2 W	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	40	84	-	124	1.4	1002	0.124	100	NA	NA
Lane 2	-	125	-	125	2.0	1014	0.124	100	NA	NA
Lane 3	-	-	61	61	0.0	87	0.704	100	0.0	2
Approach	40	209	61	310	1.3		0.704			

West: Riveredge Boulevard (W)

Mov. From W To Exit:	L2 N	T1 E	R2 S	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	154	-	-	154	0.0	273	0.564	100	37.9	2
Lane 2	82	20	-	102	0.0	180	0.564	100	NA	NA
Lane 3	-	-	43	43	0.0	248	0.174	100	NA	NA
Approach	236	20	43	299	0.0		0.564			

	Total	%HV	Deg.Satn (v/c)
All Vehicles	1647	1.2	0.742

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Delay and stops experienced by drivers upstream of short lane entry have been accounted for.

Merge Analysis

	Exit Lane Number	Short Lane Length m	Percent Opng in Lane %	Opposing Flow Rate veh/h	Opposing Flow Rate pcu/h	Critical Gap sec	Follow-up Headway sec	Lane Flow Rate veh/h	Capacity veh/h	Deg. Satn v/c	Min. Delay sec	Merge Delay sec
South Exit: Lakeside Drive (S) Merge Type: **Priority**												
Exit Short Lane	1	60	0.0	168	169	3.02	2.01	148	1618	0.091	0.2	0.3
Merge Lane	2	-	100.0	Merge Lane is not Opposed				168	1800	0.093	0.0	0.0

Variable Demand Analysis

	Initial Queued Demand veh	Residual Queued Demand veh	Time for Residual Demand to Clear sec	Duration of Oversatn sec
South: Lakeside Drive (S)				
Lane 1	0.0	0.0	0.0	0.0

Lane 2	0.0	0.0	0.0	0.0
Lane 3	0.0	0.0	0.0	0.0
East: Lot 6,000 (E)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	0.0	0.0	0.0
North: Lakeside Drive (N)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	0.0	0.0	0.0
Lane 3	0.0	0.0	0.0	0.0
West: Riveredge Boulevard (W)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	0.0	0.0	0.0
Lane 3	0.0	0.0	0.0	0.0

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PHASING SUMMARY

Site: 101 [Lakeside Dr - Riveredge Blvd - 2039BG+Dev AM - TAMM Adjust Volumes - Modified Layout - Abbott St Lane (Site Folder: 2039 with Full Dev)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Network: N101 [2039 AM Ultimate - TAMM Adjust Volumes-Modified Layout TMR Comments Abbott St Lanes (Network Folder: TAMM Volumes - Abbott St Lanes)]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 150 seconds (Network Site User-Given Phase Times)

Timings based on settings in the Network Timing dialog
Phase Times specified by the user
Phase Sequence: Convert Function Default - Import
Input Phase Sequence: A, B, C, D
Output Phase Sequence: A, B, C, D
Reference Phase: Phase A
Offset: 0 seconds (User)

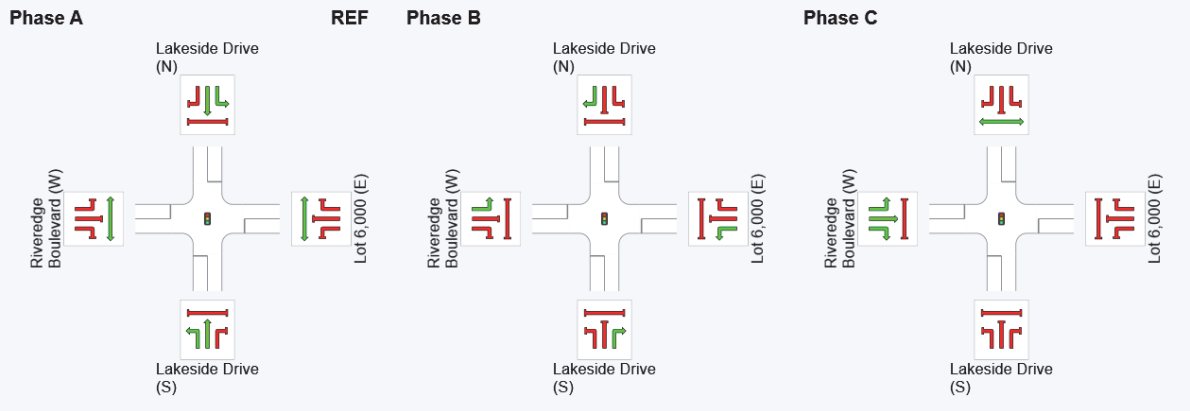
Phase Timing Summary

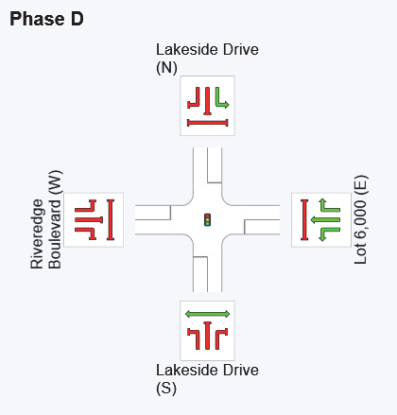
Phase	A	B	C	D
Phase Change Time (sec)	0	85	98	124
Green Time (sec)	79	7	20	20
Phase Time (sec)	85	13	26	26
Phase Split	57%	9%	17%	17%
Phase Frequency (%)	100.0	100.0	96.3[2]	96.3[2]

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

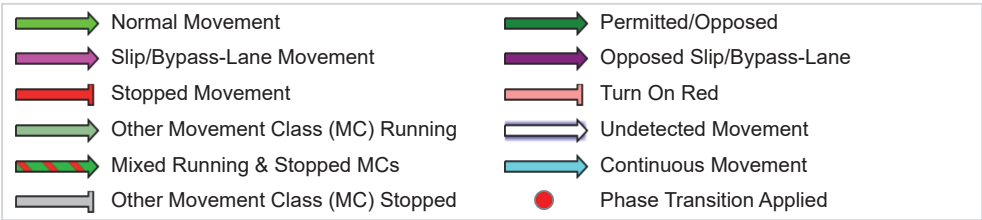
2 Phase Frequency is implied by a Phase Time specified by the user that is less than the Required Movement Time.

Output Phase Sequence





REF: Reference Phase
VAR: Variable Phase



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Organisation: URBIS | Licence: NETWORK / 1PC | Processed: Monday, 28 April 2025 4:34:14 PM
Project: C:\Users\ashi\Urbis Ltd\P0051836 SUB Oonoonba Village Traffic Assessment - General\02_Workspace\08_Transport\01_Analysis\P0051836 - SIDRA - 250327_V6.sip9

LANE SUMMARY

Site: 101v [Lakeside Dr - Abbott St - 2039BG+DEV - PM Peak - TAMM Adjust Volumes - Modified Layout - Abbott St L (Site Folder: 2039 with Full Dev)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Network: N101 [2039 PM Ultimate - TAMM Adjust Volumes-Modified Layout TMR Comments Abbott St Lanes (Network Folder: TAMM Volumes - Abbott St Lanes)]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 150 seconds (Network Site User-Given Phase Times)

Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Abbott Street (S)															
Lane 1	37	0.0	37	0.0	1213	0.030	100	17.1	LOS B	0.9	6.5	Short	110	0.0	NA
Lane 2	726	7.0	726	7.0	1210[1]	0.600	100	19.4	LOS B	29.6	219.5	Full	500	0.0	0.0
Approach	763	6.7	763	6.7		0.600		19.3	LOS B	29.6	219.5				
North: Abbott Street (N)															
Lane 1	916	19.0	916	19.0	1134	0.808	100	20.1	LOS C	48.2	392.5	Full	500	0.0	0.0
Lane 2	427	3.0	427	3.0	485	0.880	100	72.1	LOS E	33.0	237.2	Short	235	0.0	NA
Lane 3	235	3.0	235	3.0	268	0.880	100	80.1	LOS F	19.6	140.6	Short	140	-44.8[N3]	NA
Approach	1578	12.3	1578	12.3		0.880		43.1	LOS D	48.2	392.5				
West: Lakeside Drive (E)															
Lane 1	216	1.0	216	1.0	492	0.440	81[6]	69.0	LOS E	15.0	106.2	Full	115	0.0	0.0
Lane 2	267	1.0	267	1.0	492	0.543	100	62.8	LOS E	17.8	125.6	Full	115	0.0	13.0
Approach	483	1.0	483	1.0		0.543		65.6	LOS E	17.8	125.6				
All Vehicles	2824	8.8	2824	8.8		0.880		40.5	LOS D	48.2	392.5				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Delay and stops experienced by drivers upstream of short lane entry have been accounted for.
6 Lane under-utilisation due to downstream effects
N3 Capacity Adjustment due to downstream lane blockage determined by the program.

Approach Lane Flows (veh/h)

South: Abbott Street (S)

Mov. From S To Exit:	L2 W	T1 N	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	37	-	37	0.0	1213	0.030	100	0.0	2
Lane 2	-	726	726	7.0	1210[1]	0.600	100	NA	NA
Approach	37	726	763	6.7		0.600			

North: Abbott Street (N)									
Mov. From N To Exit:	T1 S	R2 W	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	916	-	916	19.0	1134	0.808	100	NA	NA
Lane 2	-	427	427	3.0	485	0.880	100	5.8	1
Lane 3	-	235	235	3.0	268	0.880	100	5.4	2
Approach	916	662	1578	12.3		0.880			
West: Lakeside Drive (E)									
Mov. From W To Exit:	L2 N		Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	216		216	1.0	492	0.440	81[6]	NA	NA
Lane 2	267		267	1.0	492	0.543	100	NA	NA
Approach	483		483	1.0		0.543			

	Total	%HV	Deg.Satn (v/c)
All Vehicles	2824	8.8	0.880

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Delay and stops experienced by drivers upstream of short lane entry have been accounted for.

6 Lane under-utilisation due to downstream effects

Merge Analysis

	Exit Lane Number	Short Lane Length m	Percent Opng in Lane %	Opposing Flow Rate veh/h	Opposing Flow Rate pcu/h	Critical Gap sec	Follow-up Headway sec	Lane Flow Rate veh/h	Capacity veh/h	Deg. Satn v/c	Min. Delay sec	Merge Delay sec
North Exit: Abbott Street (N) Merge Type: **Priority**												
Exit Short Lane	1	150	0.0	267	268	3.08	2.06	942	1475	0.639	0.4	1.8
Merge Lane	2	-	100.0	Merge Lane is not Opposed				267	1800	0.148	0.0	0.0

Variable Demand Analysis

	Initial Queued Demand veh	Residual Queued Demand veh	Time for Residual Demand to Clear sec	Duration of Oversatn sec
South: Abbott Street (S)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	0.0	0.0	0.0
North: Abbott Street (N)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	0.0	0.0	0.0
Lane 3	0.0	0.0	0.0	0.0
West: Lakeside Drive (E)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	0.0	0.0	0.0

Document Set ID: 27254459
Version: 1, Version Date: 25/06/2025

PHASING SUMMARY

Site: 101v [Lakeside Dr - Abbott St - 2039BG+DEV - PM Peak - TAMM Adjust Volumes - Modified Layout - Abbott St L (Site Folder: 2039 with Full Dev)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Network: N101 [2039 PM Ultimate - TAMM Adjust Volumes-Modified Layout TMR Comments Abbott St Lanes (Network Folder: TAMM Volumes - Abbott St Lanes)]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 150 seconds (Network Site User-Given Phase Times)

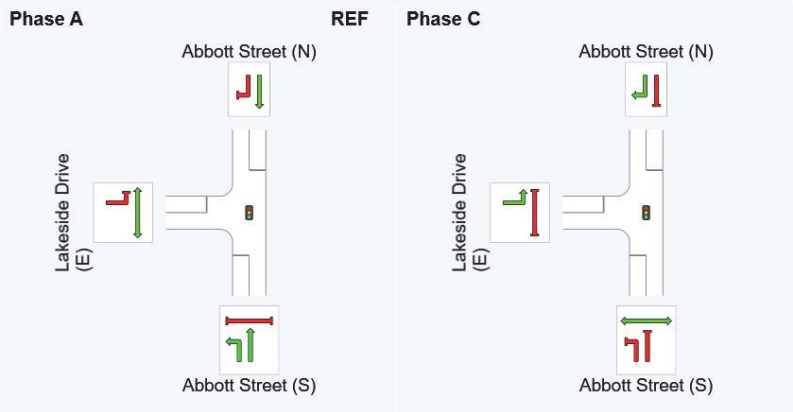
Timings based on settings in the Network Timing dialog
Phase Times specified by the user
Phase Sequence: Convert Function Default
Input Phase Sequence: A, C
Output Phase Sequence: A, C
Reference Phase: Phase A
Offset: 0 seconds (User)

Phase Timing Summary

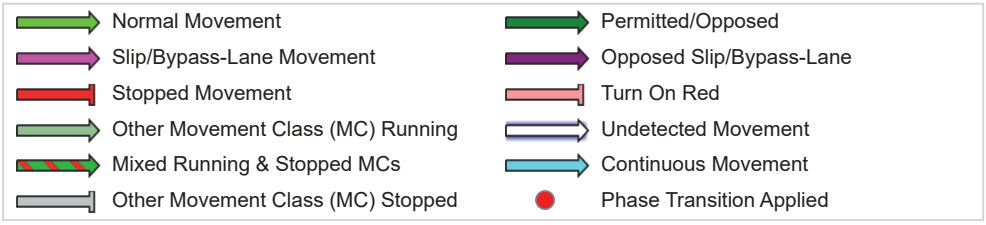
Phase	A	C
Phase Change Time (sec)	0	104
Green Time (sec)	98	40
Phase Time (sec)	104	46
Phase Split	69%	31%
Phase Frequency (%)	100.0	100.0

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase



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Project: C:\Users\ashi\Urbis Ltd\P0051836 SUB Oonoonba Village Traffic Assessment - General\02_Workspace\08_Transport\01_Analysis\P0051836 - SIDRA - 250327_V6.sip9

LANE SUMMARY

Site: 101 [Lakeside Dr - Riveredge Blvd - 2039BG+Dev PM - TAMM Adjust Volumes - Modified Layout - Abbott St Lane (Site Folder: 2039 with Full Dev)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Network: N101 [2039 PM Ultimate - TAMM Adjust Volumes-Modified Layout TMR Comments Abbott St Lanes (Network Folder: TAMM Volumes - Abbott St Lanes)]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 150 seconds (Network Site User-Given Phase Times)

Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Lakeside Drive (S)															
Lane 1	236	1.2	236	1.2	416[1]	0.566	100	60.9	LOS E	15.5	109.3	Short	60	0.0	NA
Lane 2	202	2.0	202	2.0	357	0.566	100	59.0	LOS E	13.3	95.0	Full	400	-13.0[N3]	0.0
Lane 3	63	0.0	63	0.0	669	0.094	100	39.1	LOS D	3.0	20.9	Short	60	0.0	NA
Approach	501	1.4	501	1.4		0.566		57.4	LOS E	15.5	109.3				
East: Lot 6,000 (E)															
Lane 1	77	0.0	77	0.0	916	0.084	100	15.9	LOS B	1.7	11.8	Short	30	0.0	NA
Lane 2	59	0.0	59	0.0	230	0.256	100	66.4	LOS E	3.9	27.5	Full	60	-8.6[N3]	0.0
Approach	136	0.0	136	0.0		0.256		37.8	LOS D	3.9	27.5				
North: Lakeside Drive (N)															
Lane 1	195	1.5	195	1.5	407	0.478	100	66.7	LOS E	13.6	96.6	Full	115	0.0	0.0
Lane 2	196	2.0	196	2.0	411	0.478	100	72.8	LOS E	13.9	98.8	Full	115	0.0	44.8[8]
Lane 3	353	0.0	353	0.0	631[1]	0.560	100	73.4	LOS E	25.4	177.5	Short	90	0.0	NA
Approach	744	0.9	744	0.9		0.560		71.5	LOS E	25.4	177.5				
West: Riveredge Boulevard (W)															
Lane 1	128	0.0	128	0.0	990	0.129	100	23.9	LOS C	4.6	32.0	Short	50	0.0	NA
Lane 2	33	0.0	33	0.0	255	0.129	100	63.0	LOS E	2.1	14.9	Full	250	-4.7[N3]	0.0
Lane 3	86	0.0	86	0.0	248	0.347	100	70.1	LOS E	5.8	40.6	Full	250	0.0	0.0
Approach	247	0.0	247	0.0		0.347		45.2	LOS D	5.8	40.6				
All Vehicles	1628	0.8	1628	0.8		0.566		60.4	LOS E	25.4	177.5				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Delay and stops experienced by drivers upstream of short lane entry have been accounted for.
8 Probability of Blockage has been set on the basis of a queue that overflows from a short lane.
N3 Capacity Adjustment due to downstream lane blockage determined by the program.

Approach Lane Flows (veh/h)

South: Lakeside Drive (S)

Mov. From S To Exit:	L2 W	T1 N	R2 E	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	93	143	-	236	1.2	416[1]	0.566	100	60.4	2
Lane 2	-	202	-	202	2.0	357	0.566	100	NA	NA
Lane 3	-	-	63	63	0.0	669	0.094	100	0.0	2
Approach	93	345	63	501	1.4		0.566			

East: Lot 6,000 (E)

Mov. From E To Exit:	L2 S	T1 W	R2 N	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	77	-	-	77	0.0	916	0.084	100	0.0	2
Lane 2	-	22	37	59	0.0	230	0.256	100	NA	NA
Approach	77	22	37	136	0.0		0.256			

North: Lakeside Drive (N)

Mov. From N To Exit:	L2 E	T1 S	R2 W	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	51	144	-	195	1.5	407	0.478	100	NA	NA
Lane 2	-	196	-	196	2.0	411	0.478	100	NA	NA
Lane 3	-	-	353	353	0.0	631[1]	0.560	100	68.0	2
Approach	51	340	353	744	0.9		0.560			

West: Riveredge Boulevard (W)

Mov. From W To Exit:	L2 N	T1 E	R2 S	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	128	-	-	128	0.0	990	0.129	100	0.0	2
Lane 2	11	22	-	33	0.0	255	0.129	100	NA	NA
Lane 3	-	-	86	86	0.0	248	0.347	100	NA	NA
Approach	139	22	86	247	0.0		0.347			

	Total	%HV	Deg.Satn (v/c)
All Vehicles	1628	0.8	0.566

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Delay and stops experienced by drivers upstream of short lane entry have been accounted for.

Merge Analysis

	Exit Lane Number	Short Lane Length m	Percent Opng in Lane %	Opposing Flow Rate veh/h	Opposing Flow Rate pcu/h	Critical Gap sec	Follow-up Headway sec	Lane Flow Rate veh/h	Capacity veh/h	Deg. Satn v/c	Min. Delay sec	Merge Delay sec
South Exit: Lakeside Drive (S) Merge Type: **Priority**												
Exit Short Lane	1	60	0.0	282	284	3.02	2.01	221	1498	0.147	0.4	0.6
Merge Lane	2	-	100.0	Merge Lane is not Opposed				282	1800	0.157	0.0	0.0

Variable Demand Analysis

	Initial Queued Demand veh	Residual Queued Demand veh	Time for Residual Demand to Clear sec	Duration of Oversatn sec
South: Lakeside Drive (S)				
Lane 1	0.0	0.0	0.0	0.0

Lane 2	0.0	0.0	0.0	0.0
Lane 3	0.0	0.0	0.0	0.0
East: Lot 6,000 (E)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	0.0	0.0	0.0
North: Lakeside Drive (N)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	0.0	0.0	0.0
Lane 3	0.0	0.0	0.0	0.0
West: Riveredge Boulevard (W)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	0.0	0.0	0.0
Lane 3	0.0	0.0	0.0	0.0

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PHASING SUMMARY

Site: 101 [Lakeside Dr - Riveredge Blvd - 2039BG+Dev PM - TAMM Adjust Volumes - Modified Layout - Abbott St Lane (Site Folder: 2039 with Full Dev)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Network: N101 [2039 PM Ultimate - TAMM Adjust Volumes-Modified Layout TMR Comments Abbott St Lanes (Network Folder: TAMM Volumes - Abbott St Lanes)]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 150 seconds (Network Site User-Given Phase Times)

Timings based on settings in the Network Timing dialog
Phase Times specified by the user
Phase Sequence: Convert Function Default - Import
Input Phase Sequence: A, B, C, D
Output Phase Sequence: A, B, C, D
Reference Phase: Phase A
Offset: 0 seconds (User)

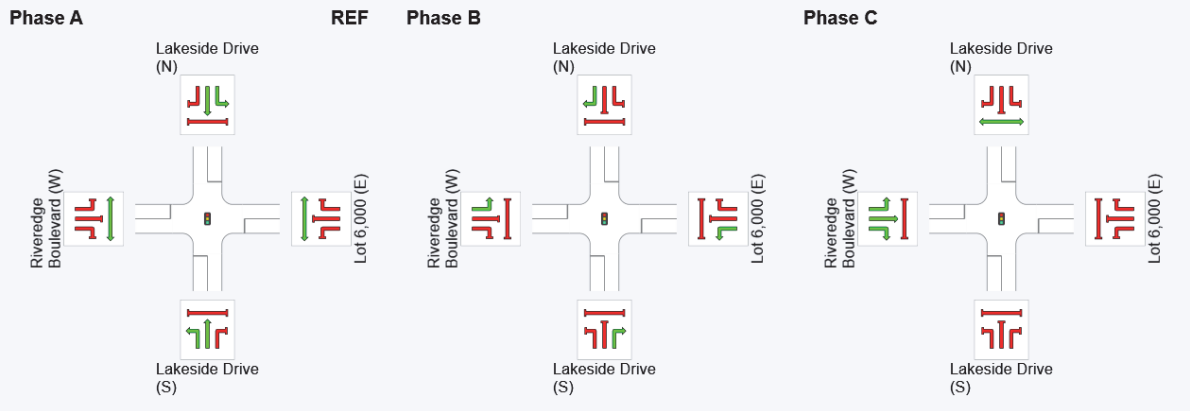
Phase Timing Summary

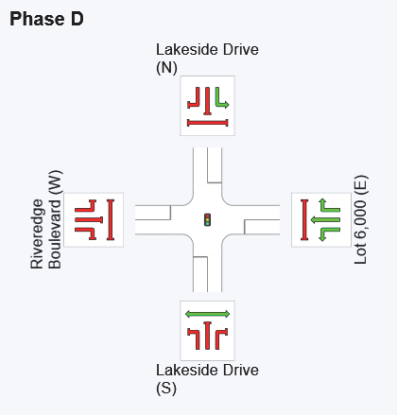
Phase	A	B	C	D
Phase Change Time (sec)	0	38	98	124
Green Time (sec)	32	54	20	20
Phase Time (sec)	38	60	26	26
Phase Split	25%	40%	17%	17%
Phase Frequency (%)	100.0	100.0	96.3[2]	96.3[2]

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

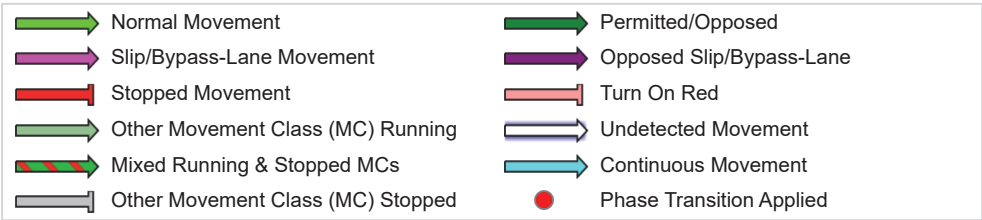
2 Phase Frequency is implied by a Phase Time specified by the user that is less than the Required Movement Time.

Output Phase Sequence





REF: Reference Phase
VAR: Variable Phase



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Project: C:\Users\ashi\Urbis Ltd\P0051836 SUB Oonoonba Village Traffic Assessment - General\02_Workspace\08_Transport\01_Analysis\P0051836 - SIDRA - 250327_V6.sip9

APPENDIX F
Noise Impact Assessment Report

PLANS AND DOCUMENTS
referred to in the PDA
DEVELOPMENT APPROVAL
Approval no: DEV-2026-OBA-4225
Date: 25 February 2026
Queensland Government

Colliers

Noise Impact Assessment Report

The Village - Stage 7C and 7D Residential Subdivision

At Abbott Street, Oonoonba

On behalf of Economic Development Queensland

24GCA0050 R01_2



Disclaimer

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Revision Record

No.	Author	Reviewed/Approved	Description	Date
A.	J. Fox MAAS		Internal review	27/02/2025
0.	J. Fox MAAS		Issued to client	27/02/2025
1.	D. Prostamo-Brown	A. Ashworth MAAS	Revised lot layout	19/09/2025
2.	J. Fox MAAS		Revision 2	30/10/2025

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Executive Summary

Colliers (formally TTM) conducted a noise impact assessment of Stage 7C and 7D of The Village development located at Abbott Street, Oonoonba.

The noise assessment considered rail noise from the adjacent corridor and road traffic noise from Lakeside Drive. While some road traffic noise is experienced from the State-controlled road Abbott Street, rail noise impacts the eastern side of the development at a much higher level (QDC MP4.4 Noise Category 4 compared to Noise Category 2), and therefore a road traffic noise assessment of Abbott Street was deemed to be not required.

Noise measurements were previously undertaken to establish the existing rail noise environment at the site. SoundPLAN noise modelling was conducted to verify the measured and predict future rail noise levels at the development. Rail noise levels were assessed in accordance with the State Development Assessment Provisions State Code 2 and QDC MP4.4. Compliance with the outdoor rail noise criteria of L_{max} 84dB(A) was achieved with the inclusion of the proposed acoustic barrier. Building treatment requirements for rail noise range from QDC MP4.4 Noise Category 1 to 4.

Road traffic noise from Lakeside Drive was assessed at the site in accordance with State Code 1. Noise levels were predicted to exceed the free-field outdoor criteria at the most exposed lots. An acoustic barrier was recommended along the southern boundary to achieve compliance at the lots. Building treatment requirements for road traffic noise range from QDC MP4.4 Noise Category 0 to 2. Therefore, future building treatment requirements were based on the rail noise impacts in all instances.

Compliance with the criteria outlined in Section 5 is predicted to be achieved based on the implementation of the recommendations outlined in Section 8 of this report.

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Contents

1 Introduction 7

1.1 Background 7

1.2 References 7

1.3 Scope 7

2 Site Description 8

2.1 Site Location 8

2.2 Acoustic Environment 9

3 Proposed Development 10

3.1 Proposal Description 10

4 Noise Measurements 11

4.1 Equipment 11

4.2 Attended Rail Noise Measurements 11

4.3 Results of Measurements 12

4.3.1 Rail Noise Levels 12

5 Noise Criteria 14

5.1 Rail Noise 14

5.1.1 State Development Assessment Provisions 14

5.1.2 Queensland Development Code 15

5.2 Road Traffic Noise 15

5.2.1 State Development Assessment Provisions 15

5.2.2 Queensland Development Code 16

6 Rail Noise Assessment 18

6.1 Rail Volumes 18

6.2 Noise Model 18

6.2.1 Noise Modelling Parameters 18

6.2.2 Noise Model Verification 19

6.3 Predicted Rail Noise Levels 19

7 Road Traffic Noise Assessment 22

7.1 Assessment Criteria 22

7.2 Traffic Volumes 22

7.3 Noise Model 22
7.3.1 Noise Modelling Parameters 22
7.4 Predicted Road Traffic Noise Levels 23
8 Colliers Recommendations 27
8.1 Acoustic Barriers 27
8.1.1 Rail Noise 27
8.1.2 Road Traffic Noise 27
8.1.3 Dwelling Treatments 29
9 Conclusion 32
Appendix A Development Plans 33
Appendix B SoundPLAN Noise Modelling Outputs 36
Appendix C Schedule 1 and 2 of QDC MP4.4 38

Table Index

Table 1: Measured Noise Levels from Passing Trains 12
Table 2: SDAP State Code 2 – Rail Noise Criteria 14
Table 3: Rail Noise Category Levels - QDC MP4.4 (Schedule 3) 15
Table 4: SDAP State Code 1– Road Traffic Noise Criteria 16
Table 5: Road Traffic Noise Category Levels - QDC MP4.4 (Schedule 3) 17
Table 6: Rail Noise Modelling Parameters 18
Table 7: Comparison between Measured and Modelled Rail Noise Level 19
Table 8: Traffic Volumes used in the Noise Model 22
Table 9: Road Traffic Noise Modelling Parameters 22
Table 10: QDC MP4.4 Noise Categories Applicable to Stage 7C and 7D 29
Table 11: QDC Noise Category Levels and Associated Sound Reduction Rating (R_w) Requirements for Habitable Rooms (QDC MP4.4 - Schedule 1) 31

Figure Index

Figure 1: Site Locality 8
Figure 2: Proposed Development Concept Plan 10
Figure 3: Rail Noise Measurement Locations 11
Figure 4: Predicted Rail Noise Levels Compared to the Free-Field Outdoor Criteria 19
Figure 5: Predicted QDC MP4.4 Rail Noise Levels – Ground Floor 20
Figure 6: Predicted QDC MP4.4 Rail Noise Levels – First Floor 21
Figure 7: Predicted Road Traffic Noise Levels Compared to the Free-Field Noise Criteria – No Additional Barriers 23
Figure 8: Predicted Road Traffic Noise Levels Compared to the Free-Field Noise Criteria – With Acoustic Barriers 24
Figure 9: Predicted QDC MP4.4 Road Traffic Noise Levels – Ground Floor 25
Figure 10: Predicted QDC MP4.4 Road Traffic Noise Levels – First Floor 25
Figure 11: Recommended Acoustic Barriers for Stage 7C and 7D 28

1 Introduction

1.1 Background

Colliers (formally TTM) was engaged by Economic Development Queensland to undertake a noise impact assessment of Stage 7C and 7D of The Village development located at Abbott Street, Oonoonba. The report assesses the potential noise impact from the adjacent rail and road traffic noise sources on the development.

TTM previously prepared an acoustic report for the development in October 2018. This report is generally a revision to that TTM report ref: 14BRA0091 R02_4 based on the current site conditions, layout and acoustic barrier alignment.

1.2 References

This report is based on the following:

- State Development Assessment Provisions (SDAP) Version 3.0 – State Code 1.
- State Development Assessment Provisions (SDAP) Version 3.0 – State Code 2.
- Queensland Development Code (QDC) MP4.4 – Buildings in a Transport Noise Corridor (August 2015).
- Development information provided by Economic Development Queensland.
- Train movement information provided by Queensland Rail (QR).
- Site inspection, noise measurements, analysis and calculations conducted by Colliers.

1.3 Scope

The assessment includes the following:

- Description of the site;
- Measurement of existing rail noise levels and statement of the assessment criteria;
- Prediction of future rail noise levels at the development;
- Prediction of future road traffic noise levels from Lakeside Drive at the development;
- Analysis of predicted noise levels;
- Details of the noise control recommendations to be incorporated to achieve predicted compliance.

2 Site Description

2.1 Site Location

The Oonoonba Urban Development Area is approximately 4km south of the Townsville City Centre. The site is bounded by the Ross River to the west and north, a rail corridor and Abbott Street to the east, and the suburb of Idalia to the south.

The site is described by the following:

- Lot 5000 SP302846
- Lakeside Drive, Oonoonba

The site locality is shown in Figure 1.

Figure 1: Site Locality



2.2 Acoustic Environment

The site is primarily affected by railway noise associated with the North Coast Rail Line, which separates the site from Abbott Street. While some road traffic noise is experienced from Abbott Street, rail noise impacts the development at a much higher level (QDC MP4.4 Noise Category 4 compared to Noise Category 2), and therefore rail noise is the primary consideration on the eastern aspect of the site. The southern part of the site is also potentially noise affected by road traffic on Lakeside Drive. Noise from this road is therefore included in the assessment.

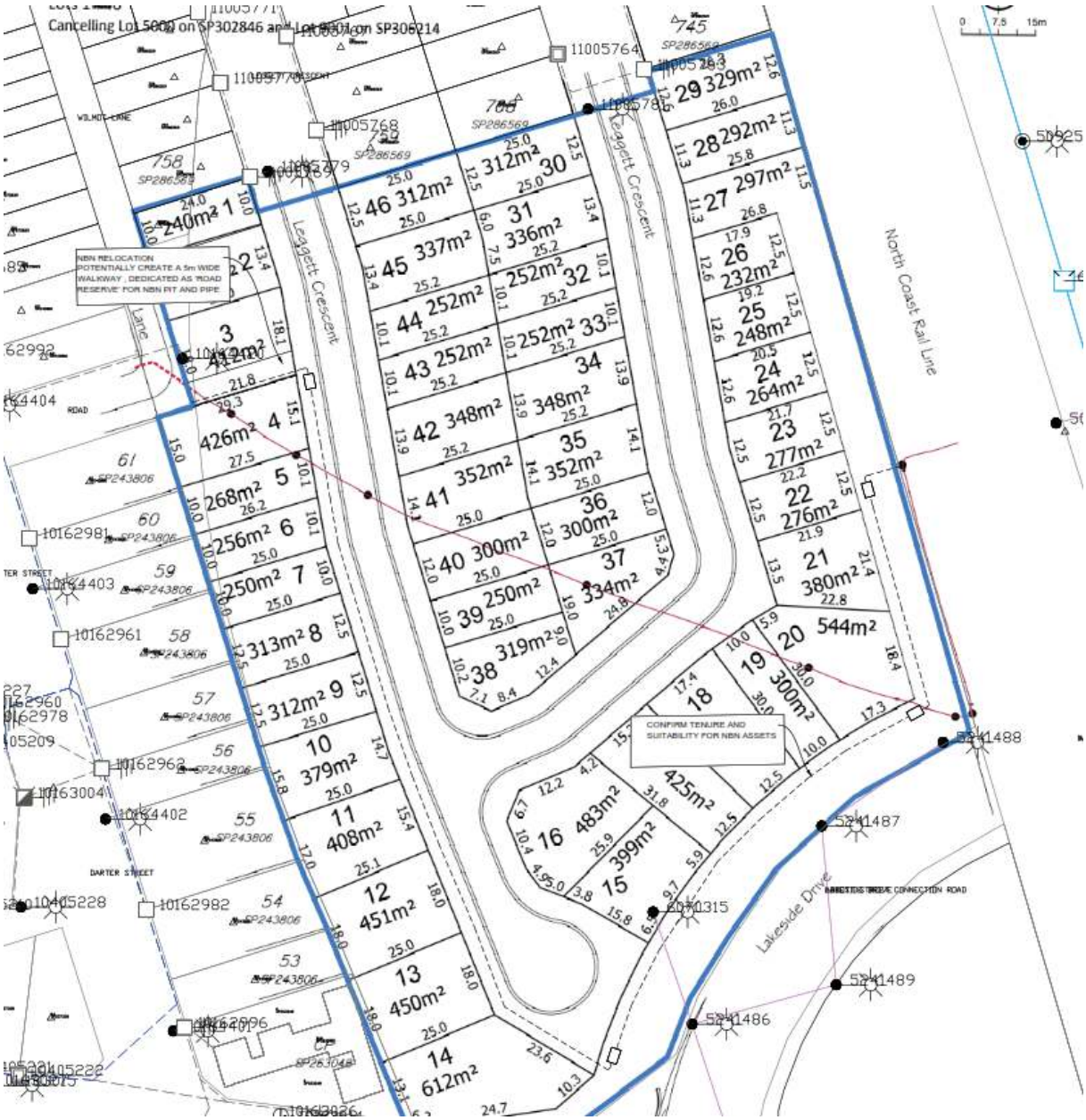
It is understood that freight trains will in future, be diverted to a new rail corridor east of the existing corridor. The Townsville Eastern Access Rail Corridor (TEARC) is a proposed freight line which will connect the North Coast Line directly into the Port of Townsville. The construction of this line is likely to reduce the number and type of trains which currently pass the development site. The timing of construction of the Townsville Eastern Access Rail Corridor is currently unknown and therefore the current use of the rail line is represented in this noise assessment.

3 Proposed Development

3.1 Proposal Description

The proposal is for the development of the Stage 7C and 7D residential subdivision in the Oonoonba Urban Development Area. The current Concept Plan of the site is shown in Figure 2 below.

Figure 2: Proposed Development Concept Plan



4 Noise Measurements

4.1 Equipment

The following equipment was used to measure existing rail noise levels:

- RION NA-28 Sound Level Meter (SLM) (SN# 01060055).
- RION NA-74 Sound Calibrator (SN# 35073393).

All equipment was calibrated by a National Association of Testing Authorities (NATA) accredited laboratory. The equipment was field calibrated before and after the measurement session. No significant drift from the reference signal was recorded.

4.2 Attended Rail Noise Measurements

Rail noise measurements were conducted during Colliers (formally TTM) initial involvement in the Oonoonba project. Attended noise measurements of train passes were conducted during separate site visits to Oonoonba on the 22nd and 30th July 2010 and 18th February 2015. The SLM was positioned at multiple locations to obtain representative measurements of trains passing the site and at the bridge northeast of the site. The SLM was located in a free-field position approximately 1.5 metres above ground level and directed at the nearest point to the track. The measurement locations are shown in Figure 3.

Figure 3: Rail Noise Measurement Locations



Noise measurements were conducted using "A" weighting, "Fast' response, and 5-minute statistical intervals. Statistics recorded included the L_{Amax}, SEL\LAE, and L_{Aeq}. The SEL or LAE is the sound exposure level. A parameter closely related to L_{Aeq} for assessment of train events that have similar characteristics but are of different duration. The LAE value contains the same amount of acoustic energy over a 'normalised' one second period as the actual noise event under consideration.

The measurements were conducted generally in accordance with Australian Standards AS1055 and AS2377. Weather conditions during the attended measurements were fine with light winds.

4.3 Results of Measurements

4.3.1 Rail Noise Levels

Measurements of 18 individual train passes were recorded along the North Coast Rail Line over 3 separate site visits to Oonoonba. The measured noise levels are summarised in Table 1.

The Department of Transport and Main Roads *Interim Guideline – Operational Railway Noise and Vibration* defines the single event maximum sound pressure level as the arithmetic average of maximum levels from the highest 15 single events over a 24-hour period. Based on previously provided rail noise modelling guidelines from DTMR, where attended noise measurements are used in calculating the single event maximum sound pressure level, the number of events used in the averaging should reflect the proportion of the total daily events. Therefore, based on the obtained 18 measurements of the previously scheduled 45 trains per day, the averaging is based on the highest 40% (7) of noise measurements, as detailed in Table 1.

Table 1: Measured Noise Levels from Passing Trains

Day/Date	Train Type	Direction of Travel	Measurement Distance (m)	Maximum Noise Level, L_{max} dB(A)	Instantaneous Noise Level, SEL dB(A)
Thursday, 22/07/2010	Freight	South	10	82	88
	Freight	South	10	78	88
	Diesel engine	North	7	91	92
	Freight	North	7	87	94
	Freight	North	55	75	85
	Freight	South	15	91	94
	Freight	North	18	79	89
	Freight	North	6	83	92
	Diesel engine	North	6	82	86
Friday, 30/07/2010	Freight	North	20	76	84
	Freight	South	17	92	91
	Freight	North	20	76	84
	Passenger (diesel)	North	20	80	88
	Freight	South	17	91	96
	Freight	South	17	79	85

Day/Date	Train Type	Direction of Travel	Measurement Distance (m)	Maximum Noise Level, L_{max} dB(A)	Instantaneous Noise Level, SEL dB(A)
	Freight	North	20	74	80
Wednesday, 18/02/2015	Freight	South	10	77	82
	Freight	South	10	82	85
Single Event Maximum Sound Pressure Level corrected to 10m				**89** (88.5)	-

5 Noise Criteria

5.1 Rail Noise

5.1.1 State Development Assessment Provisions

The site is within the transport noise corridor of the North Coast Rail Line and is required to be assessed in accordance with Version 3.0 of the State Development Assessment Provisions (SDAP) *State Code 2* and the *Queensland Development Code Part MP4.4 (QDC)*. The noise assessment requirements for the creation of new residential lots are summarised in Table 2 below.

Table 2: SDAP State Code 2 – Rail Noise Criteria

Performance Outcomes	Acceptable Outcomes
Involving the creation of 6 or more new residential lots adjacent to a railway or type 2 multi-modal corridor	
PO40 Reconfiguring a lot minimises free field noise intrusion from a railway.	**AO40.1** Development provides a noise barrier or earth mound which is designed, sited and constructed: 1. to achieve the maximum free field acoustic levels in reference table 2 (item 2.1); 2. in accordance with: a. Civil Engineering Standard Specification QR-CTS-Part 41 – Part 41, Design and Construction of Noise Fences/Barriers; b. Technical Specification-MRTS15 Noise Fences, Transport and Main Roads, 2019; c. Technical Specification-MRTS04 General Earthworks, Transport and Main Roads, 2020. OR **AO40.2** Development achieves the maximum free field acoustic levels in reference table 2 (item 2.1) by alternative noise attenuation measures where it is not practical to provide a noise barrier or earth mound.

Table 2 of State Code 2: Maximum free field acoustic levels	
2.1: Private open space for residential lots	a. ≤62 dB(A) Leq (24 hour) free field OR b. ≤84 dB(A) (single event maximum sound pressure level) free field

5.1.2 Queensland Development Code

The Queensland Development Code Part MP 4.4 - 'Buildings in a Transport Noise Corridor' August 2015 (QDC) specifies Noise Categories to ensure that habitable rooms of residential buildings are adequately protected from transport noise.

The Noise Categories list the minimum acoustic R_W ratings for each building component to comply with the indoor sound criteria. The triggers for each noise category are summarised in Table 3. Details regarding the noise categories and acceptable forms of construction can be found in Schedule 1 and 2 of the QDC.

Table 3: Rail Noise Category Levels - QDC MP4.4 (Schedule 3)

Noise Category	Single event maximum noise* L_{Amax} for railway land
Category 4	≥ 85 dB(A)
Category 3	80 – 84 dB(A)
Category 2	75 – 79 dB(A)
Category 1	70 – 74 dB(A)
Category 0	≤ 69 dB(A)

*Measured at 1m from the façade of the proposed or existing building.

5.2 Road Traffic Noise

The site is within the transport noise corridor of Lakeside Drive (State-controlled road) and is required to be assessed in accordance with Version 3.0 of the State Development Assessment Provisions (SDAP) State Code 1 and the Queensland Development Code Part MP 4.4 (QDC).

While some road traffic noise is experienced from the State-controlled road Abbott Street, rail noise impacts the development at a much higher level (QDC MP4.4 Noise Category 4 compared to Noise Category 2), and therefore rail noise is the primary consideration on the eastern aspect of the site. Therefore, a road traffic noise assessment of Abbott Street is not required.

5.2.1 State Development Assessment Provisions

The State Development Assessment Provisions *State Code 1: Development in a state-controlled road environment* outlines an external free-field noise criteria for developments involving the creation of 6 or more new residential lots. The noise assessment requirements are summarised in Table 4 below.

Table 4: SDAP State Code 1– Road Traffic Noise Criteria

Performance Outcomes	Acceptable Outcomes
Involving the creation of 6 or more new residential lots adjacent to a state-controlled road or type 1 multi-modal corridor	

PO38
Reconfiguring a lot minimises free field noise intrusion from a state-controlled road.
	AO38.1 Development provides a noise barrier or earth mound which is designed, sited and constructed:
	• to achieve the maximum free field acoustic levels in reference table 2 (item 2.1);
	• in accordance with:
	  • Chapter 7 integrated noise barrier design of the Transport Noise Management Code of Practice: Volume 1 (Road Traffic Noise), Department of Transport and Main Roads, 2013;
	  • Technical Specification-MRTS15 Noise Fences, Transport and Main Roads, 2019
	  • Technical Specification-MRTS04 General Earthworks, Transport and Main Roads, 2020
	OR
	AO38.2 Development achieves the maximum free field acoustic level in reference table 2 (item 2.1) by alternative noise attenuation measures where it is not practical to provide a noise barrier or earth mound.

Table 2 of State Code 1: Maximum free field acoustic levels	
2.1: Private open space for residential lots	a. ≤57 dB(A) $L_{10\ (18\ hour)}$ free field (measured $L_{90\ (18\ hour)}$ free field between 6am and 12 midnight ≤45 dB(A)) OR b. ≤60 dB(A) $L_{10\ (18\ hour)}$ free field (measured $L_{90\ (18\ hour)}$ free field between 6am and 12 midnight >45 dB(A))

5.2.2 Queensland Development Code

The Queensland Development Code Part MP 4.4 - 'Buildings in a Transport Noise Corridor' August 2015 (QDC) specifies Noise Categories to ensure that habitable rooms of residential buildings are adequately protected from transport noise.

The Noise Categories list the minimum acoustic R_W ratings for each building component to comply with the indoor sound levels of AS2107[1]. The triggers for each noise category are summarised in Table 5. Details regarding the noise categories and acceptable forms of construction can be found in Schedule 1 and 2 of the QDC.

[1] Australian Standard *AS2107:2016 Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors*

Table 5: Road Traffic Noise Category Levels - QDC MP4.4 (Schedule 3)

Noise Category	Level of Transport Noise* $L_{A10, 18Hour}$ for State-Controlled Roads and Designated Local Government Roads
Category 4	≥ 73 dB(A)
Category 3	68 – 72 dB(A)
Category 2	63 – 67 dB(A)
Category 1	58 – 62 dB(A)
Category 0	≤ 57 dB(A)

*Measured at 1m from the façade of the proposed or existing building.

6 Rail Noise Assessment

6.1 Rail Volumes

Rail volumes for a selection of dates were provided by Queensland Rail (email correspondence dated 20/05/2024) which indicates that there was an average 24 train passes per day in the latter half of 2023. Based on the QR information, 92% of those train passes are said to be freight trains.

Colliers have been advised by QR that all services are subject to alteration, addition and cancellation which may vary the number of actual trains passing on a daily basis. Due to confidentiality QR was unable to provide details of any future plans to upgrade the rail corridor or provide ultimate rail traffic volumes.

6.2 Noise Model

6.2.1 Noise Modelling Parameters

Rail noise predictions were conducted using 'SoundPLAN v9.1'. The basis of the SoundPLAN model is as follows:

Table 6: Rail Noise Modelling Parameters

Description	Value
Modelling program	SoundPLAN v9.1
Noise modelling standard	Nordic Rail Prediction Method (Kilde 67/130)
Angle increment	1 ^{O}
Grid spacing (noise maps)	2m squares
Train frequency	24 trains per day (approximate)
Train speed	40-60 km/h (approximate)
Ground contours	Natural surface contours provided by EDQ Stantec 'Oonoonba PDA Noise Barrier' proposed barrier and ground design levels
Noise source height above grade	Locomotive engines – 4.0m above top of track (3.5m plus default 0.5m from SoundPLAN rail source) Passenger and freight wagon – 0.5m above top of track
Ground floor receiver height	1.8m above ground level
First floor receiver height	4.6m above ground level
Façade correction	+2.5dB(A)

6.2.2 Noise Model Verification

The single event maximum noise level at the attended noise measurement location was verified in the noise model prior to modelling noise impacts at the development. Table 7 presents the results of the noise model verification. The SoundPLAN prediction is shown in Appendix B.

Table 7: Comparison between Measured and Modelled Rail Noise Level

SLM Location	Measured Single Event Maximum, L_{max}	Predicted Single Event Maximum, L_{max}	Required Correction
10m from rail line	88.5	88.6	0

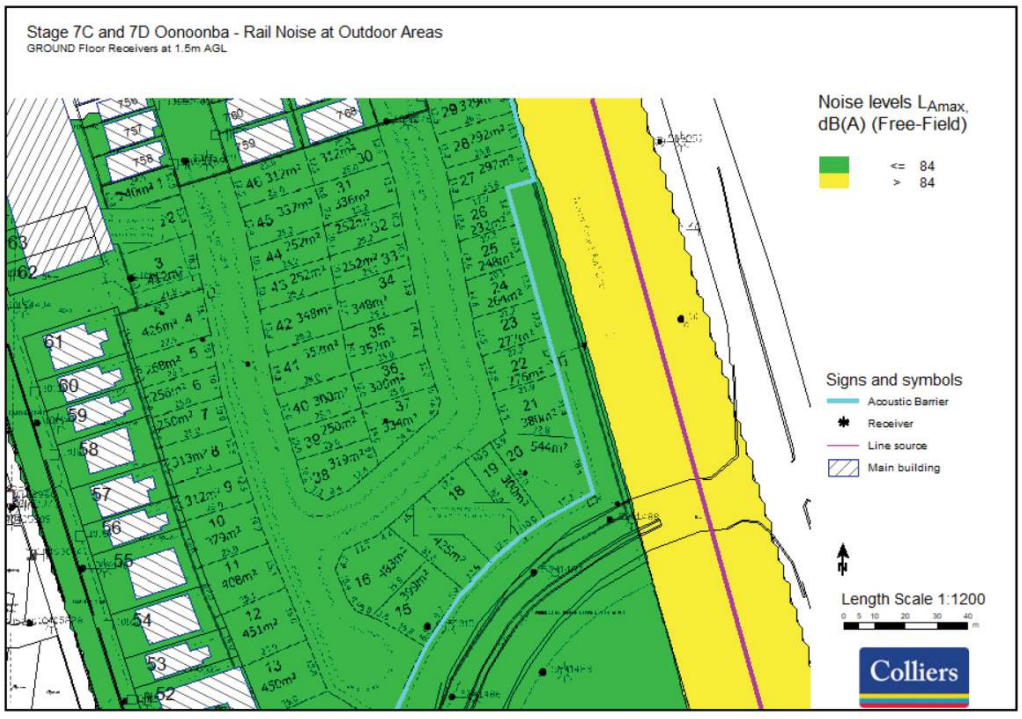
The modelled levels are within the acceptable 2dB tolerance of the measured levels and therefore no correction is required.

6.3 Predicted Rail Noise Levels

Noise modelling was conducted to determine rail noise levels at Stage 7C and 7D of the development. An existing acoustic barrier is located along the rail corridor north of the site which also extends approximately 35m into the site. EDQ propose to continue the acoustic barrier into the site to reduce the acoustic treatment requirements for future buildings within Stage 7C and 7D.

Figure 4 below presents the predicted free-field L_{max} rail noise levels compared to the outdoor criteria of 84dB(A).

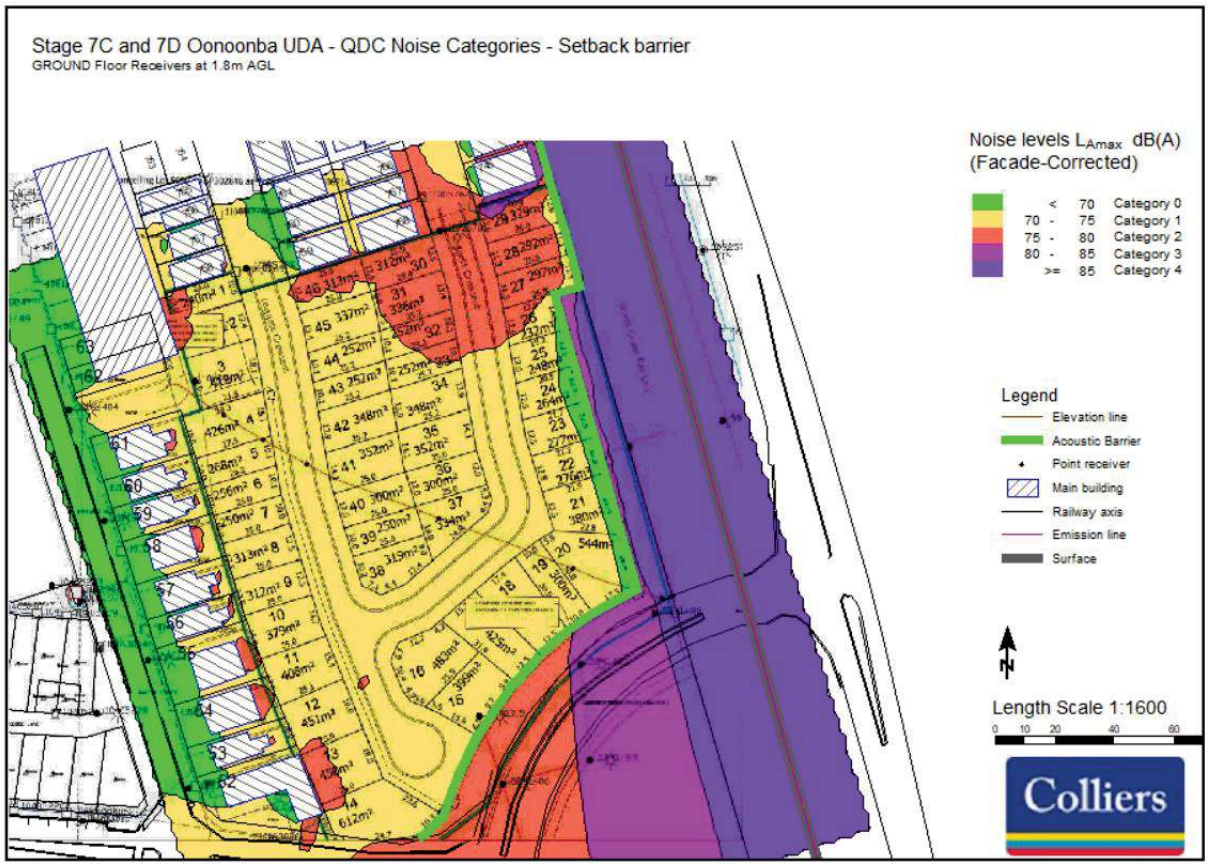
Figure 4: Predicted Rail Noise Levels Compared to the Free-Field Outdoor Criteria



Rail noise levels are predicted to comply with the outdoor criteria of L_{max} 84dB(A) (P40 of State Code 2) with inclusion of the acoustic barrier recommended in Section 8.1.

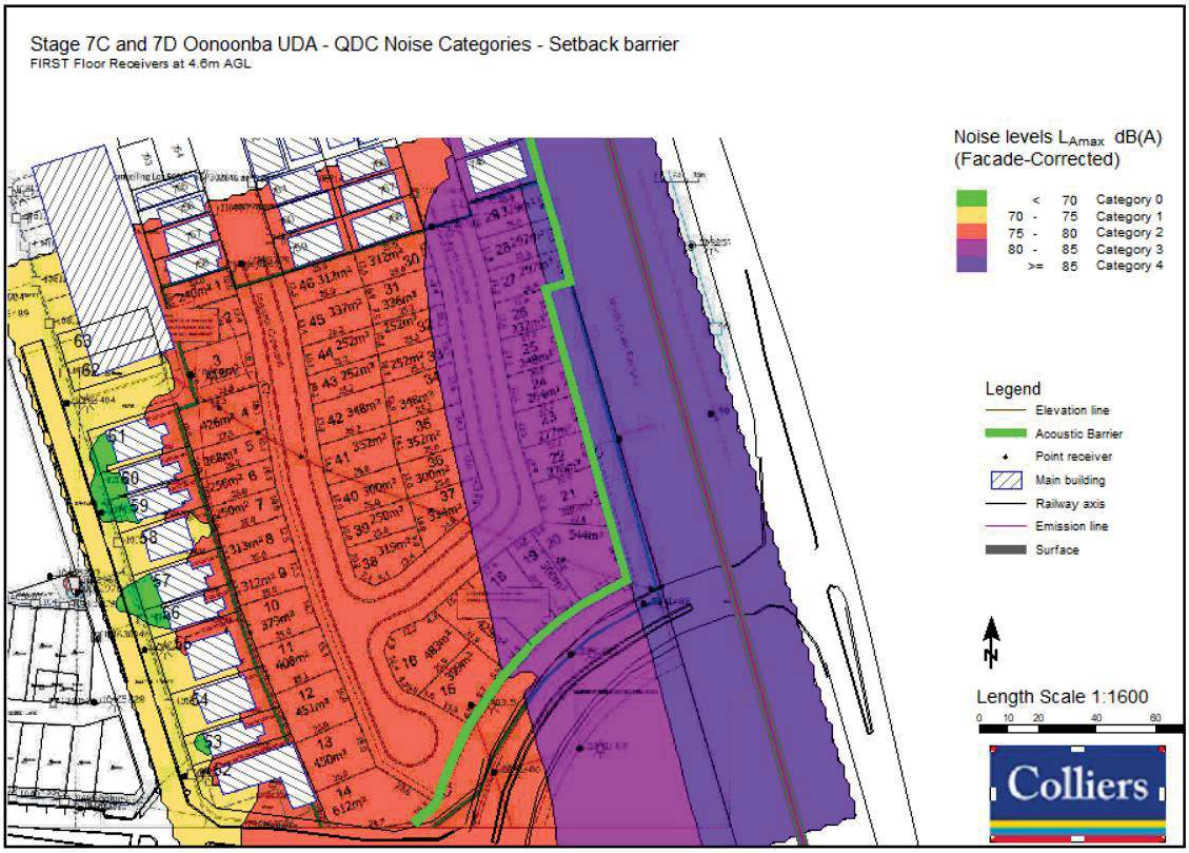
Rail noise contours are presented in the following figures for the purpose of determining future QDC MP4.4 acoustic building treatment requirements at the development.

Figure 5: Predicted QDC MP4.4 Rail Noise Levels – Ground Floor



With inclusion of the acoustic barrier, the acoustic treatments for the ground floor level of future dwellings are predicted to be no greater than QDC MP4.4 Noise Category 2.

Figure 6: Predicted QDC MP4.4 Rail Noise Levels – First Floor



For the upper floor level (first floor) of dwellings, the acoustic treatment requirements for future dwellings are predicted to range between QDC MP4.4 Noise Category 2 and Noise Category 4. It is therefore recommended that 2-storey dwellings are avoided on the eastern part of the site.

Details of dwelling construction requirements in accordance with the QDC MP4.4 are outlined in Section 8.

7 Road Traffic Noise Assessment

An assessment of road traffic noise from Lakeside Drive was conducted to determine the acoustic treatment requirements for predicted compliance with the criteria. While some road traffic noise is experienced from the State-controlled road Abbott Street, rail noise impacts the eastern side of the development at a much higher level (QDC MP4.4 Noise Category 4 compared to Noise Category 2), and therefore a road traffic noise assessment of Abbott Street is not required.

7.1 Assessment Criteria

The lower external noise criteria as outlined in Section 5.2.1 was applied to this development in absence of ambient road traffic noise monitoring data. Therefore, the following external road traffic noise limits apply to the development:

- Outdoor free-field noise: An external noise level of 57 dB(A) $L_{A10\,(18\,hour)}$ free-field.

7.2 Traffic Volumes

Table 8 presents the forecast traffic volumes and percentage heavy vehicles for Lakeside Drive which were provided by Urbis traffic engineers.

Table 8: Traffic Volumes used in the Noise Model

Road	Traffic Volumes (AADT)	Heavy Vehicles (%)
	2039 Background Traffic + Development	
Lakeside Drive	19,935	1.0

The 18-hour traffic volumes used in the noise model are taken to be 95% of the AADT (Annual Average Daily Traffic).

7.3 Noise Model

7.3.1 Noise Modelling Parameters

Road traffic noise predictions were conducted using 'SoundPLAN v9.1', a CoRTN based modelling program. The basis of the 'SoundPLAN' model is as follows:

Table 9: Road Traffic Noise Modelling Parameters

Description	Value
Noise modelling standard	CoRTN
Angle increment	1 ^{O}
Grid spacing (noise maps)	2m squares
Road surface type	Impervious (+0dB)

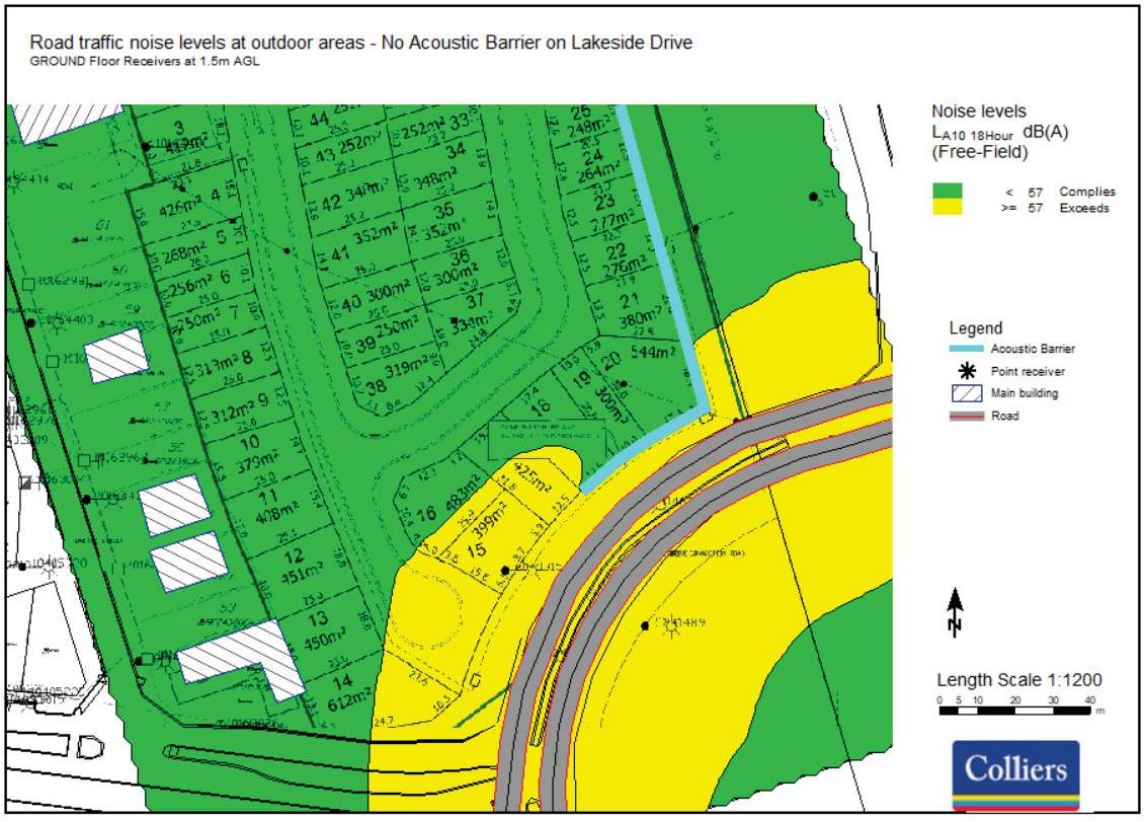
Description	Value
Ground levels	Natural surface and design contours provided by EDQ
Acoustic barriers (recommended)	Eastern and southern boundaries
Lakeside Drive speed limit	60km/h posted 50km/h near the site, due to the close proximity of traffic signals
Noise source height above grade	0.5m
Floor heights	2.8m
Receiver heights	1.8m above ground level
Free-field calibration factor	-0.7 dB(A) adjustment as per Table 4.3.2.1 of TMR Code of Practice
Receiver calibration factor	-1.7 dB(A) adjustment as per Table 4.3.2.1 of TMR Code of Practice
Façade correction	+2.5dB(A)

7.4 Predicted Road Traffic Noise Levels

Modelling was conducted to determine the road traffic noise levels at the development in the 10-year planning horizon to 2039.

Figure 4 below presents the predicted road traffic noise levels compared to the free-field assessment criteria of 57 dB(A) to determine whether acoustic barriers are necessary for lots in proximity to Lakeside Drive.

Figure 7: Predicted Road Traffic Noise Levels Compared to the Free-Field Noise Criteria – No Additional Barriers



Without an acoustic barrier, road traffic noise levels are predicted to exceed the free-field noise criteria at lots along the southern boundary. Acoustic barriers will be recommended along the lot boundaries to achieve compliance with the outdoor criteria. The predicted noise levels inclusive of the recommended acoustic barriers are shown in Figure 8 below.

Figure 8: Predicted Road Traffic Noise Levels Compared to the Free-Field Noise Criteria – With Acoustic Barriers



Figure 8 above shows that with inclusion of acoustic barriers along Lakeside Drive, road traffic noise levels are predicted to comply with the free-field noise criteria at all lots. Details of the recommended acoustic barriers are provided in Section 8.1.

Compliance with the internal noise criteria will be met by application of building treatments in accordance with the Queensland Development Code MP4.4. The predicted QDC MP4.4 road traffic noise contours at ground and first floor level facades are presented in Figure 9 and Figure 10 below. The QDC MP4.4 road traffic noise contours are inclusive of the receiver calibration factor described in Section 7.3.1. Noise levels are compared to the criteria of QDC MP4.4 for the purposes of determining the acoustic building treatment requirements for noise affected lots.

Figure 9: Predicted QDC MP4.4 Road Traffic Noise Levels – Ground Floor

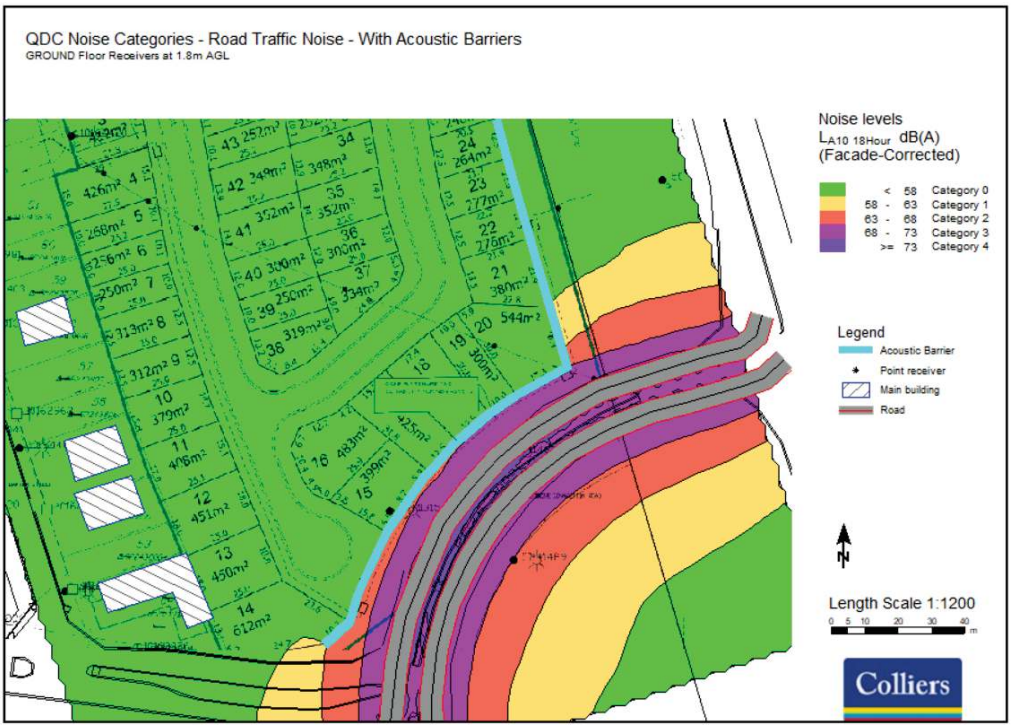
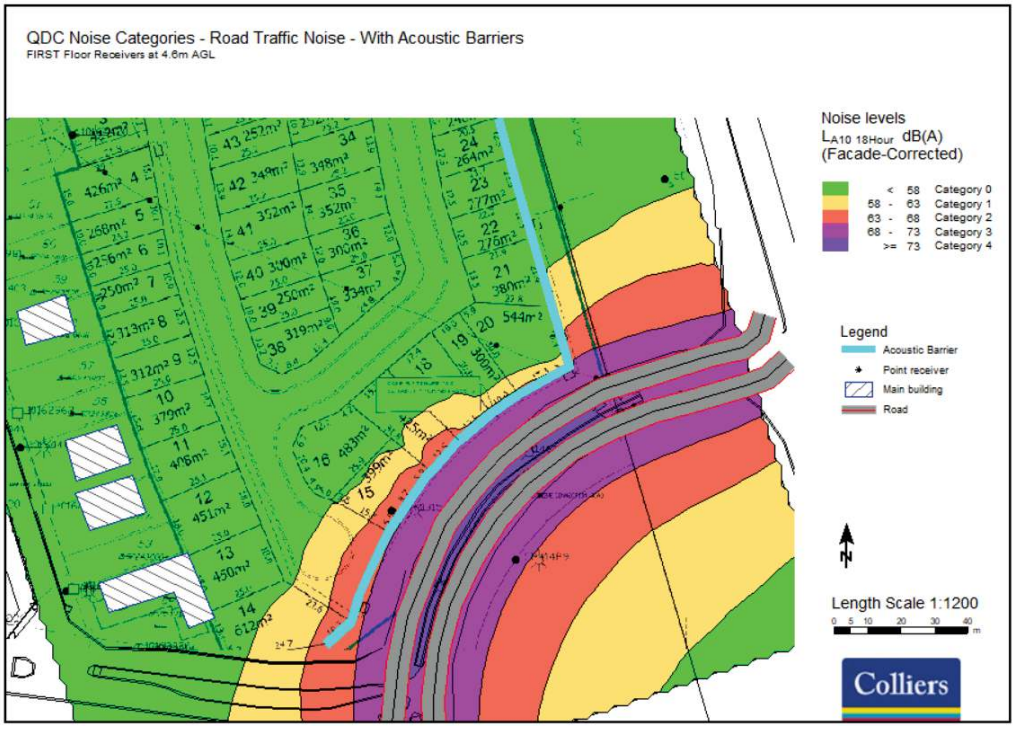


Figure 10: Predicted QDC MP4.4 Road Traffic Noise Levels – First Floor



Road traffic noise levels were predicted at Stage 7C and 7D of the development inclusive of acoustic barriers. The acoustic treatment requirements for ground floor and first floor of dwellings range from QDC MP4.4 Noise Category 0 to 2. Acoustic treatment in accordance with QDC MP4.4 will satisfy compliance with DTMR requirements for internal noise criteria.

Details of dwelling construction requirements in accordance with the QDC are outlined in Section 8. The QDC MP4.4 requirements are specified based on the highest noise category within each proposed lot.

Note: the impact from rail noise is predicted to be higher at all lots of the development and therefore future acoustic treatment requirements are based on the results of the rail noise assessment.

8 Colliers Recommendations

The following recommendations should be implemented for predicted compliance with the noise criteria detailed in Section 5.

8.1 Acoustic Barriers

8.1.1 Rail Noise

Acoustic barriers are recommended to reduce the QDC MP4.4 rail noise construction requirements for the ground floor level of dwellings. The location and extent of the acoustic barrier is shown in Figure 11.

The rail noise barrier recommendations are as follows:

a) The acoustic barrier along the eastern boundary (shown in red) must be minimum 3.0m high relative to the finished ground level of the lots (i.e. on top of the future retaining wall).

b) The 3.0m high barrier must return a minimum of approximately 50m along the southern boundary. A separate acoustic barrier at a lower height is recommended to continue along the southern boundary for the purposes of road traffic noise reduction. The step between 3.0m and 1.8m high barrier is to occur at the boundary between lot 17 and lot 18.

c) The barrier should be constructed of a material with a surface density of at least 15kg/m^2 and be constructed in accordance with

   I. Civil Engineering Standard Specification QR-CTS-Part 41 – Part 41, Design and Construction of Noise Fences/Barriers, and

   II. Technical Specification-MRTS15 Noise Fences, Transport and Main Roads, 2019;

d) No gaps or holes should be evident in the barrier construction.

8.1.2 Road Traffic Noise

Acoustic barriers are also recommended along the southern boundary to achieve compliance with the PO38 private open space requirements of State Code 1. The location and extent of the acoustic barrier is shown in Figure 11.

The road traffic acoustic barrier recommendations are as follows:

a) The acoustic barrier along the southern boundary (shown in orange colour) must be minimum 1.8m high relative to the finished ground level of the lots (i.e. on top of the future retaining wall).

b) The barrier must be constructed accordance with the requirements of:

   I. Chapter 7 Integrated noise barrier design of the Transport Noise Management Code of Practice: Volume 1 (Road Traffic Noise), Department of Transport and Main Roads 2013,

II. Transport and Main Roads Specifications MRTS15 Noise Fences,

III. Technical Specification-MRTS04 General Earthworks, Transport and Main Roads, 2020.

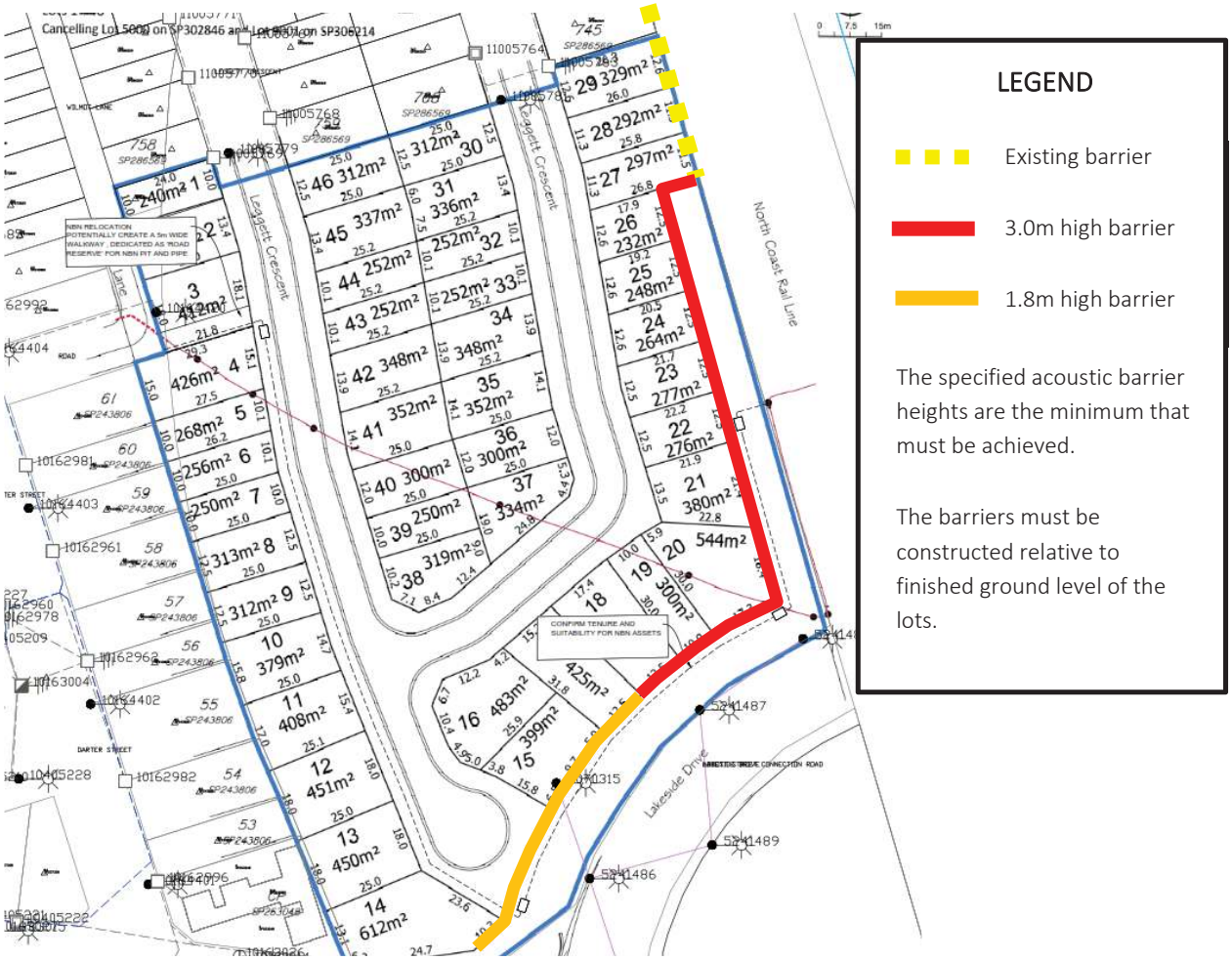
c) The noise barrier design may need to be submitted to the Department of Transport and Main Roads for review and endorsement, prior to the commencement of construction (check development approval conditions).

d) Be constructed of a material with a surface mass not less than 15kg/m^2 and be free of gaps or holes including at the base.

e) Suitable materials include earth mound, plywood, steel, masonry, and composite panels such as Modular Walls. A combination of materials can be used if desired provided they achieve compliance with MRTS15.

f) Note: Lapped timber palings may not be deemed as an accepted material by Department of Transport and Main Roads.

Figure 11: Recommended Acoustic Barriers for Stage 7C and 7D



8.1.3 Dwelling Treatments

The QDC MP4.4 requires that habitable rooms in residential buildings located in a transport noise corridor are adequately protected from transport noise to safeguard occupant's health and amenity.

In order to achieve the performance requirements of the QDC MP4.4, the external building envelope of habitable rooms must comply with the minimum R_W for each building component specified in Schedule 1 to achieve a minimum transport noise reduction level for the relevant noise category by either one of the following:

a) Using materials specified in Schedule 2 of the QDC MP4.4;

OR

b) Using materials with manufacturer's specifications that, in combination, achieve the minimum R_W value for the relevant building component and applicable noise category.

For application of Point (b), possible alternative constructions can be determined by the glazier (for glazing) and construction manuals such as 'The Red Book' by CSR (for walls and roof/ceiling).

Noise Categories applicable to Stage 7C and 7D of the development are listed in Table 10. The QDC MP4.4 requirements are specified based on the highest noise category within each proposed lot.

If the lot layout changes from that showed in Appendix A, it is recommended that the acoustic requirements for each lot are reviewed by a suitably qualified acoustic consultant.

Table 10: QDC MP4.4 Noise Categories Applicable to Stage 7C and 7D

Lot	QDC MP4.4 Noise Category (Ground floor)	QDC MP4.4 Noise Category (First floor)
1	2	2
2	2	2
3	1	2
4	1	2
5	1	2
6	1	2
7	1	2
8	1	2
9	1	2
10	1	2
11	1	2
12	2	2
13	2	2
14	2	2
15	1	2

Lot	QDC MP4.4 Noise Category (Ground floor)	QDC MP4.4 Noise Category (First floor)
16	1	2
17	1	3
18	1	3
19	1	3
20	1	3
21	1	3
22	1	3
23	1	3
24	1	3
25	1	3
26	2	3
27	2	4
28	2	4
29	2	4
30	2	3
31	2	3
32	2	3
33	2	3
34	1	3
35	1	3
36	1	3
37	1	3
38	1	2
39	1	2
40	1	2
41	1	2
42	1	2
43	1	2
44	1	2
45	1	2
46	2	2

Details regarding QDC noise categories and associated sound reduction rating (R_w) requirements for habitable rooms can be found within Schedule 1 of the QDC MP4.4.

Table 11: QDC Noise Category Levels and Associated Sound Reduction Rating (R_w) Requirements for Habitable Rooms (QDC MP4.4 - Schedule 1)

QDC Noise Category	Required Acoustic Rating (R_w) for Habitable Rooms			
	Glazing > 1.8m²*	Glazing ≤ 1.8m²*	External Walls	Roof and Ceiling
Category 4	R_W 43	R_W 43	R_W 52	R_W 45
Category 3	R_W 38	R_W 35	R_W 47	R_W 41
Category 2	R_W 35	R_W 32	R_W 41	R_W 38
Category 1	R_W 27	R_W 24	R_W 35	R_W 35
Category 0	None	None	None	None

*Total glazing area for room

QDC MP 4.4 Schedule 1 and 2 which includes acceptable forms of construction for each noise category is provided in Appendix C of this report.

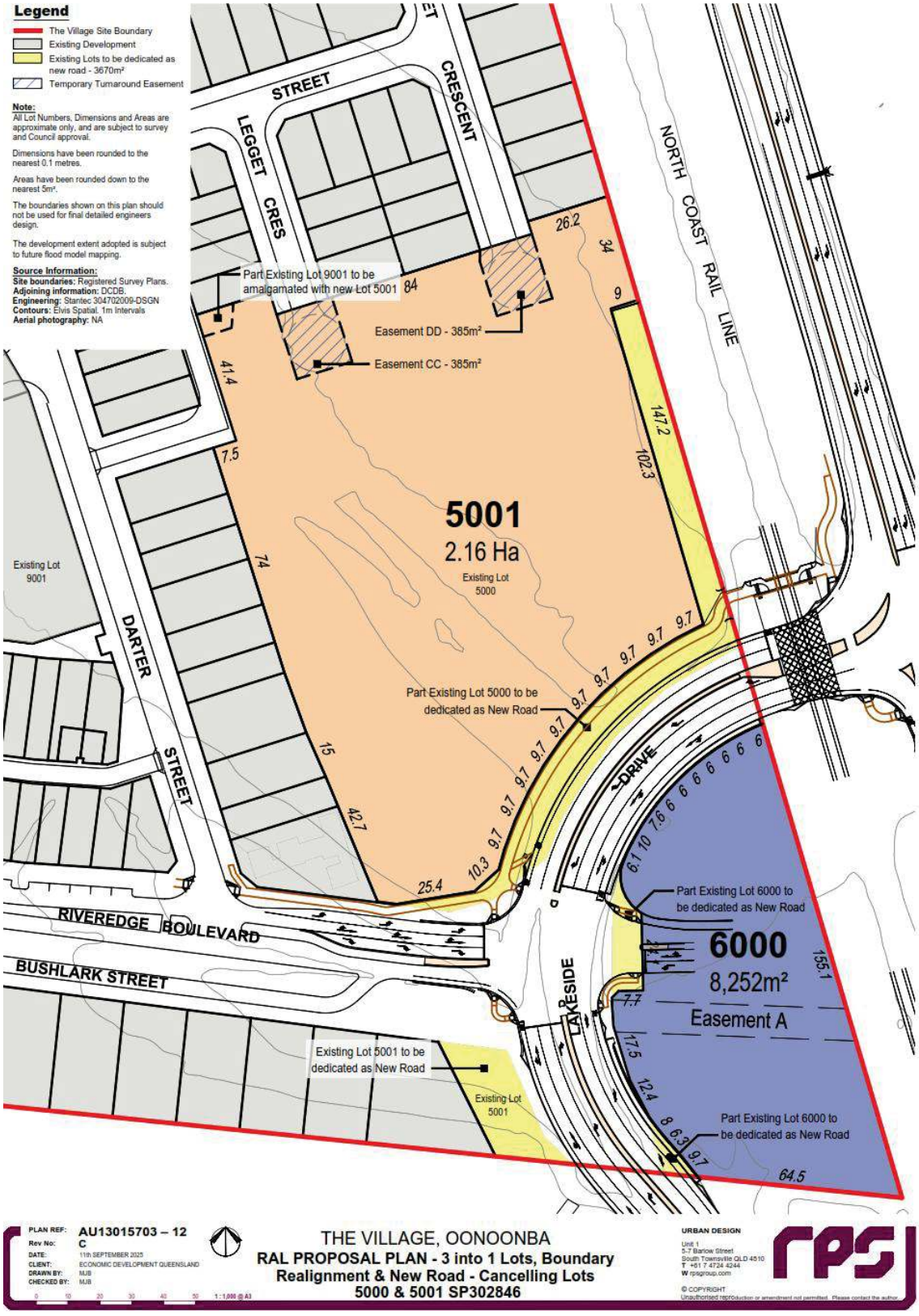
Dwellings on noise affected lots may be constructed in accordance with the QDC noise category construction requirements for the nominated lot. However, as the QDC requirements are conservative and apply to all facades equally, it is recommended that an individual acoustic assessment be conducted for each noise affected dwelling, once building plans are available, to optimise acoustic treatments for quality and cost savings. A site-specific report is generally recommended for QDC Noise Category 2 or higher.

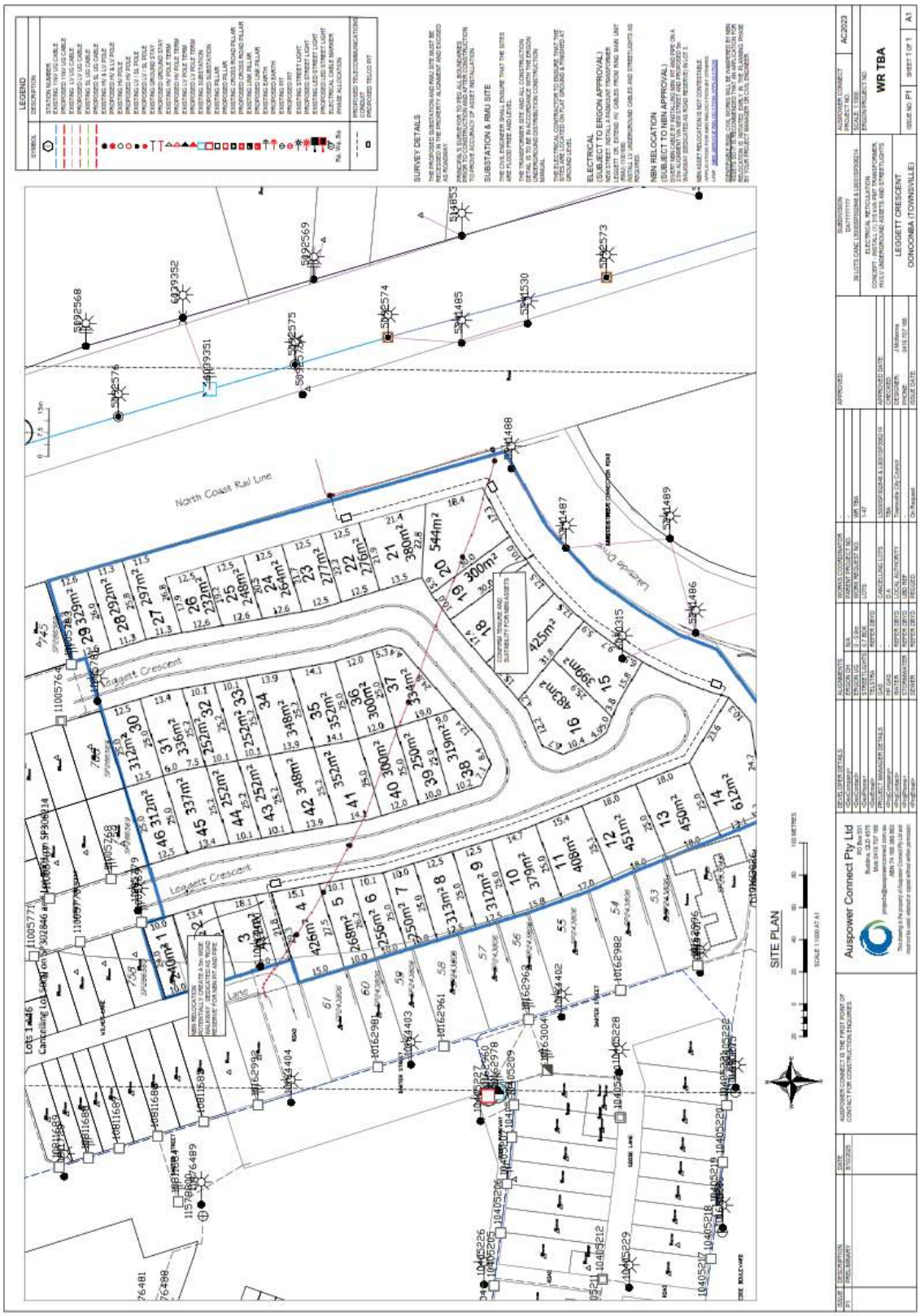
9 Conclusion

An environmental noise assessment was undertaken of the proposed Stage 7C and 7D of The Village development located at Abbott Street, Oonoonba.

Compliance with the criteria outlined in Section 5 is predicted to be achieved based on the implementation of the recommendations outlined in Section 8 of this report.

Appendix A Development Plans


Legend
The Village Site Boundary
Existing Development
Existing Lots to be dedicated as new road - 3670m²
Temporary Turnaround Easement
Note:
All Lot Numbers, Dimensions and Areas are approximate only, and are subject to survey and Council approval.
Dimensions have been rounded to the nearest 0.1 metres.
Areas have been rounded down to the nearest 5m².
The boundaries shown on this plan should not be used for final detailed engineers design.
The development extent adopted is subject to future flood model mapping.
Source Information:
Site boundaries: Registered Survey Plans.
Adjoining information: DCDB.
Engineering: Stantec 304702009-DSGN
Contours: Elvis Spatial. 1m Intervals
Aerial photography: NA
LEGGET CRES
STREET
CRESCENT
NORTH COAST RAIL LINE
Part Existing Lot 9001 to be amalgamated with new Lot 5001
Easement DD - 385m²
Easement CC - 385m²
5001
2.16 Ha
Existing Lot 5000
Existing Lot 9001
DARTER
STREET
Part Existing Lot 5000 to be dedicated as New Road
DRIVE
Part Existing Lot 6000 to be dedicated as New Road
6000
8,252m²
Easement A
LAKESIDE
RIVEREDGE BOULEVARD
BUSHLARK STREET
Existing Lot 5001 to be dedicated as New Road
Existing Lot 5001
Part Existing Lot 6000 to be dedicated as New Road
PLAN REF: AU13015703 – 12
Rev No: C
DATE: 11th SEPTEMBER 2025
CLIENT: ECONOMIC DEVELOPMENT QUEENSLAND
DRAWN BY: MJB
CHECKED BY: MJB
THE VILLAGE, OONOONBA
RAL PROPOSAL PLAN - 3 into 1 Lots, Boundary Realignment & New Road - Cancelling Lots
5000 & 5001 SP302846
URBAN DESIGN
Unit 1
5-7 Barlow Street
South Townsville QLD 4510
T +61 7 4724 4244
W rpsgroup.com
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LEGEND
SURVEY DETAILS
SUBSTATION & RMU SITE
ELECTRICAL
(SUBJECT TO ERGON APPROVAL)
NBN RELOCATION
(SUBJECT TO NBN APPROVAL)
North Coast Rail Line
Leggett Crescent
Lane
SITE PLAN
LEGGETT CRESCENT
OONOONBA (TOWNSVILLE)
WR TBA
Auspower Connect Pty Ltd

Appendix B SoundPLAN Noise Modelling Outputs

Oonoonba UDA
M17 - RAIL Noise - 24GCA0050 Stage 7C&D - Verifications - Receivers

Receiver	Floor	Lmax, rail Free Field dB(A)	
SLM Bridge (Approx)	GF	86.7	
SLM Site	GF	88.6	
SLM South	GF	88.6	

Appendix C Schedule 1 and 2 of QDC MP4.4

Schedule 1

Noise category	Minimum *transport noise reduction* (dB (A)) required for *habitable rooms*	Component of building's *external envelope*	Minimum R_w required for each component
Category 4	40	Glazing	43
		External walls	52
		Roof	45
		Floors	51
		Entry doors	35
Category 3	35	Glazing	38 (where total area of glazing for a *habitable room* is greater than 1.8m²)
			35 (where total area of glazing for a *habitable room* is less than or equal to 1.8m²)
		External walls	47
		Roof	41
		Floors	45
		Entry doors	33

Noise category	Minimum *transport noise reduction* (dB (A)) required for *habitable rooms*	Component of building's *external envelope*	Minimum R_w required for each component
Category 2	30	Glazing	35 (where total area of glazing for a *habitable room* is greater than 1.8m²)
			32 (where total area of glazing for a *habitable room* is less than or equal to 1.8m²)
		External walls	41
		Roof	38
		Floors	45
		Entry doors	33
Category 1	25	Glazing	27 (where total area of glazing for a *habitable room* is greater than 1.8m²)
			24 (where total area of glazing for a *habitable room* is less than or equal to 1.8m²)
		External walls	35
		Roof	35
		Entry Doors	28
Category 0	No additional acoustic treatment required – standard building assessment provisions apply.		

Schedule 2

Component of building's *external envelope*	Minimum R_w	Acceptable forms of construction
Glazing	43	Double glazing consisting of two panes of minimum 5mm thick glass with at least 100mm air gap and full perimeter *acoustically rated seals*.
	38	Minimum 14.38mm thick laminated glass, with full perimeter *acoustically rated seals*; OR Double glazing consisting of one pane of minimum 5mm thick glass and one pane of minimum 6mm thick glass with at least 44mm air gap, and full perimeter *acoustically rated seals*
	35	Minimum 10.38mm thick laminated glass, with full perimeter *acoustically rated seals*.
	32	Minimum 6.38mm thick laminated glass with full perimeter *acoustically rated seals*.
	27	Minimum 4mm thick glass with full perimeter *acoustically rated seals*
	24	Minimum 4mm thick glass with standard weather seals

Component of building's *external envelope*	Minimum R_w	Acceptable forms of construction
External walls	52	Two leaves of clay brick masonry, at least 270mm in total, with subfloor vents fitted with noise attenuators.
	47	Two leaves of clay brick masonry at least 110mm thick with: (i) cavity not less than 50mm between leaves; and (ii) 50mm thick mineral insulation or 50mm thick glass wool insulation with a density of 11kg/m³ or 50mm thick polyester insulation with a density of 20kg/m³ in the cavity. OR Two leaves of clay brick masonry at last 110mm thick with: (i) cavity not less than 50mm between leaves; and (ii) at least 13mm thick cement render on each face OR Single leaf of clay brick masonry at least 110mm thick with: (i) a row of at least 70mm x 35mm timber studs or 64mm steel studs at 600mm centres, spaced at least 20mm from the masonry wall; and (ii) Mineral insulation or glass wool insulation at least 50mm thick with a density of at least 11 kg/m³ positioned between studs; and (iii) One layer of plasterboard at least 13mm thick fixed to outside face of studs. OR Single leaf of minimum 150mm thick masonry of hollow, dense concrete blocks, with mortar joints laid to prevent moisture bridging.

Component of building's *external envelope*	Minimum R_w	Acceptable forms of construction
	41	Two leaves of clay brick masonry at least 110mm thick with cavity not less than 50mm between leaves OR Single leaf of clay brick masonry at last 110mm thick with: (i) a row of at least 70mm x 35mm timber studs or 64mm steel studs at 600mm centres, spaced at least 20mm from the masonry wall; and (ii) mineral insulation or glass wool insulation at least 50mm thick with a density of at least 11 kg/m³ positioned between studs; and (iii) One layer of plasterboard at least 10mm thick fixed to outside face of studs OR Single leaf of brick masonry at least 110mm thick with at least 13mm thick render on each face OR Concrete brickwork at least 110mm thick OR In-situ concrete at least 100mm thick OR Precast concrete at least 100mm thick and without joints.

Component of building's *external envelope*	Minimum R_w	Acceptable forms of construction
	35	Single leaf of clay brick masonry at least 110mm thick with: (i) a row of at least 70mm x 35mm timber studs or 64mm steel studs at 600mm centres, spaced at least 20mm from the masonry wall; and (ii) One layer of plasterboard at least 10mm thick fixed to outside face of studs OR Minimum 6mm thick fibre cement sheeting or weatherboards or plank cladding externally, minimum 90mm deep timber stud or 92mm metal stud, standard plasterboard at least 13mm thick internally.
Roof	45	Concrete or terracotta tile or sheet metal roof with sarking, *acoustically rated plasterboard* ceiling at least 13mm thick fixed to ceiling joists, cellulose fibre insulation at least 100mm thick with a density of at least 45kg/m³ in the cavity. OR Concrete or terracotta tile or sheet metal roof with sarking, 2 layers of *acoustically rated plasterboard* at least 16mm thick fixed to ceiling joists, glass wool insulation at least 50mm thick with a density of at least 11kg/m³ or polyester insulation at least 50mm thick with a density of at least 20kg/m³ in the cavity.
	41	Concrete or terracotta tile or metal sheet roof with sarking, plasterboard ceiling at least 10mm thick fixed to ceiling joists, glass wool insulation at least 50mm thick with a density of at least 11kg/m³ or polyester insulation at least 50mm thick with a density of at least 20kg/m³ in the cavity. OR Concrete suspended slab at least 100mm thick.
	38	Concrete or terracotta tile or metal sheet roof with sarking, plasterboard ceiling at least 10mm thick fixed to ceiling cavity, mineral insulation or glass wool insulation at least 50mm thick with a density of at least 11 kg/m³.

Component of building's *external envelope*	Minimum R_w	Acceptable forms of construction
	35	Concrete or terracotta tile or metal sheet roof with sarking, plasterboard ceiling at least 10mm thick fixed to ceiling cavity.
Floors	51	Concrete slab at least 150mm thick.
	45	Concrete slab at least 100mm thick OR Tongued and grooved boards at least 19mm thick with: (i) timber joists not less than 175mm x 50mm; and (ii) mineral insulation or glass wool insulation at least 75mm thick with a density of at least 11kg/m³ positioned between joists and laid on plasterboard at least 10mm thick fixed to underside of joists; and (iii) mineral insulation or glass wool insulation at least 25mm thick with a density of at least 11kg/m³ laid over entire floor, including tops of joists before flooring is laid; and (iv) secured to battens at least 75mm x 50mm; and (v) the assembled flooring laid over the joists, but not fixed to them, with battens lying between the joists.
Entry Doors	35	Solid core timber not less than 45mm thick, fixed so as to overlap the frame or rebate of the frame by not less than 10mm, with full perimeter *acoustically rated seals*.
	33	Fixed so as to overlap the frame or rebate of the frame by not less than 10mm, fitted with full perimeter *acoustically rated seals* and constructed of - (i) solid core, wood, particleboard or blockboard not less than 45mm thick; and/or (ii) acoustically laminated glass not less than 10.38mm thick.

Component of building's *external envelope*	Minimum R_w	Acceptable forms of construction
	28	Fixed so as to overlap the frame or rebate of the frame, constructed of - (i) Wood, particleboard or blockboard not less than 33mm thick; or (ii) Compressed fibre reinforced sheeting not less than 9mm thick; or (iii) Other suitable material with a mass per unit area not less than 24.4kg/m²; or (iv) Solid core timber door not less than 35mm thick fitted with full perimeter *acoustically rated seals*.