APPENDIX 7

Traffic Impact Assessment for Teven Quarry

FINAL REPORT

TRAFFIC IMPACT ASSESSMENT

FOR

TEVEN QUARRY

AT

STOKERS LANE
TEVEN

Ref. 13082r

11 November 2014

Prepared By

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ILLUSTRATIONS

EXECUTIVE SUMMARY

This report documents the assessment of the traffic impacts of a proposal to increase the maximum annual production of Teven Quarry from 265,000 tpa (in 2014) to 500,000 tpa to meet increasing demand of the quarry products associated with the current and future road upgrade works in the area, as well as significant development growth in the region.

Teven Quarry has operated since the 1940's and is located in Stokers Lane, off Teven Road at Teven. The quarry supplies filling, sub base and aggregate materials to the Ballina and Lismore regions.

The existing quarry employs 11 full time equivalent employees and operates from 7.00am to 5.00pm Monday to Friday and 7.00am to 4.00pm on Saturdays.

The existing quarry operation generates:

- *Some 60 two way vehicle trips per day for light vehicles (employees and visitors) based on 30 inbound trips and 30 outbound trips; and*

- *78 two way heavy vehicle truck trips per day (on an average day for 265,000 tpa) based on 39 inbound truck trips and 39 outbound truck trips.*

Currently 70% of the quarry products travel south in Teven Road to Bruxner Highway where they disperse to the east, south and west and 30% travel north in Teven Road to Tintenbar and Tamarind Drive. The proportion travelling north is mostly for the road upgrade works associated with the Pacific Highway, north of Ballina.

The Project seeks to increase maximum production to 500,000 tpa. The proposed hours of operation are 7.00am – 6.00pm Monday to Saturday, with extended hours for product loading and transport, stockpile management and plant maintenance between 6.00pm to 10.00pm Monday to Friday, on a campaign basis (i.e. only when required to meet the needs of a particular project).

The maximum number of product truck movements per hour will be;

- *7.00am – 6.00pm* *12 truck and dog trailer combination (total of 24 truck movements with return trip)*

- *6.00pm-10.00pm* *6 loads truck and dog trailer combinations (total of 12 truck movements with return trip)*

As part of the Project it also proposed to use the section of Teven Road between Stokers Lane and Bruxner Highway as the principal transport route. The section of Teven Road north of Stokers Lane and Tintenbar Road/Tamarind Drive would be retained as a local route for local deliveries only.

It is recommended that improvements to the delineation in Teven Road between Stokers Lane and Bruxner Highway (i.e Principal Transport Route) be undertaken as part of the Project. Details of the recommended improvements are provided in Section 4.3.

The Project is expected to increase the number of employees by three full time equivalents to a total of 14.

For extraction of 500,000 tpa the Project is expected to generate on average;

- *70 two way light vehicles per day associated with employees, visitors (i.e. 35 in/35 out);*
- *146 two way heavy vehicle trips per day (on an average day) (i.e. 73 in/73 out); and*

The additional traffic generation from the project (on an average day) based on 500,000 tpa is estimated to be:

- *10 two way light vehicles per day based on 5 inbound trips and 5 outbound trips; and*
- *68 two way heavy vehicle trips per day based on 34 inbound trips and 34 outbound trips.*

During peak periods, the Project would result in a maximum hourly total traffic generation of 24 two way heavy vehicle trips (i.e. 12 in/12 out).

The results of modelling indicate that:

- *the impacts of the additional traffic generated by the Project on the road network are expected to be satisfactory;.*

- *Teven Road, between Stokers Lane and Bruxner Highway, carries relatively low traffic volumes and as such, the increase in traffic from the Project can be easily absorbed without any change in the Level of Service or overall vehicle delay;*

- *traffic conditions at the principal intersections of Stokers Lane/Teven Road and Bruxner Highway/Teven Road will remain satisfactory with the additional traffic from the Project.*

On the wider state road network the increase in traffic volumes as a result of the Project will be relatively small, with minimal impacts on traffic conditions on these roads.

Holcim Australia currently pays contributions to Ballina Shire Council for road maintenance and expects that this will continue under any new consent that is granted.

In summary, the Project is not expected to result in any adverse impacts on other road users (pedestrians, cyclists and school buses), road safety, or the road network.

1.0 INTRODUCTION

1.1 Background

Holcim (Australia) Pty Ltd (Holcim Australia) operates Teven Quarry, an existing hard rock quarry located at Stokers Lane, Teven (Lots 1, 2 and 3 DP 732288), approximately eight kilometres north west of Ballina (refer to **Figure 1**). Teven Quarry has been in operation since the 1940s and supplies filling, sub-base and aggregate material to the Ballina and Lismore regions.

The quarry operates in accordance with two existing approvals, these being:

- Development Consent 1995/263 - through Court Order 10722 of 1995; and
- Development Consent 2000/431 – issued by Ballina Shire Council.

DA1995/263 originally provided for an annual production of 200,000 tonnes of product with a 1.5 per cent annual increase, resulting in a current approved production of approximately 265,000 tonnes per annum in 2014.

Due to increasing demand for quarry products associated with current and future road upgrade works in the region and significant population growth, Holcim Australia proposes to increase maximum production at the Teven Quarry from 265,000 tonnes per annum to 500,000 tonnes per annum.

1.2 Authority Requirements

The Director General's Requirements for traffic and transport include:

- Accurate predictions of project-related traffic and a detailed assessment of the potential impacts of project-related traffic on the capacity, safety and efficiency of road networks, including modelling to predict queue lengths and intersection performance; and
- A detailed description of the measures that would be implemented to upgrade and/or maintain the capacity, efficiency and safety of effected roads and intersections over the life of the project, including concept plans for any proposed works.

The RMS also recommended that a Road Safety Audit be undertaken on the road haulage route(s).

1.3 Structure of this Report

This report has been prepared to support an Environmental Impact Statement, to assess the traffic impacts associated with the proposed increase in production from Teven Quarry.

The assessment has been undertaken in accordance with the requirements of the NSW Roads and Traffic Authority's Guide to Traffic Generating Developments October 2002.

Other technical standards/publications referenced in this assessment include:

- Austroads Guide to Road Design and RMS supplements;
- Austroads Guide to Traffic Management and RMS supplements.

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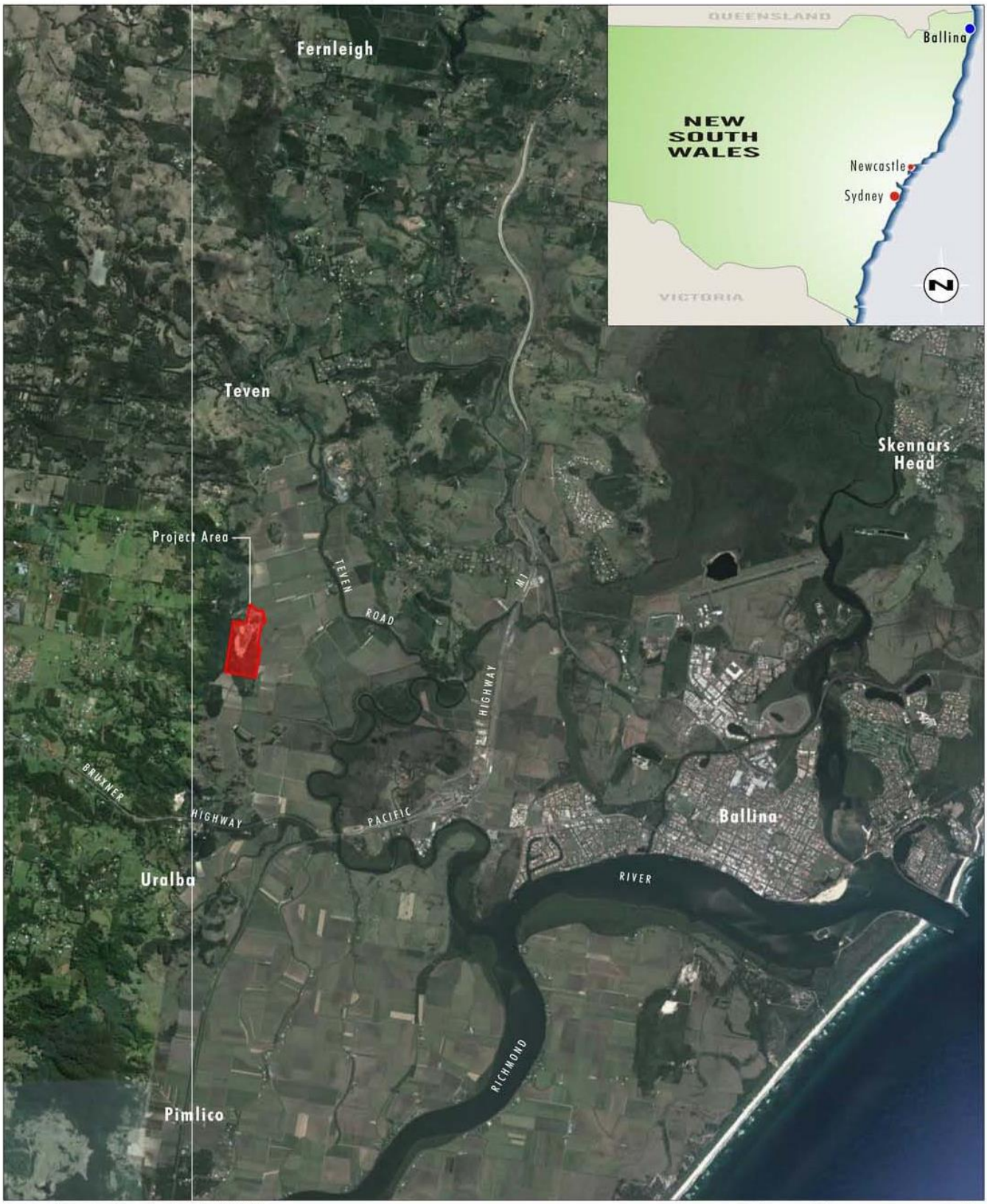

Image Source: Google Earth (2012)

0 1.0 2.0 4.0km
1:75 000

Legend
Project Area

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FIGURE 1

TEVEN QUARRY,
BALLINA

LOCATION

JOB NO.13082

The remaining sections of this report address the following:

- Section 2 – provides an overview of the existing operations at the Quarry and describes the Project;
- Section 3 – examines the existing traffic conditions on the road network;
- Section 4 – evaluates the traffic impacts of the proposed production increase; and
- Section 5 – presents conclusions.

2.0 EXISTING QUARRY OPERATIONS AND PROPOSED PROJECT

As noted in Section 1.1 Teven Quarry operates in accordance with two existing approvals and has a current approved production rate of 265,000 tpa in 2014.

Teven Quarry operates fixed enclosed primary, secondary and tertiary crushing and screening plant and transports quarry products by road throughout the region. Operations at Teven Quarry are approved for the hours of 7.00am and 5.00pm Monday to Friday and 7.00am and 4.00pm Saturdays.

Due to increasing demand for quarry products associated with current and future road upgrade works in the region and significant population growth, Holcim Australia proposes to increase production at the Teven Quarry from a maximum of 265,000 tpa to a maximum of 500,000 tpa. This will be achieved by maximising use of existing fixed plant (350,000 tonnes per annum capacity) and adding an in-pit mobile plant to cater for periods of peak demand (150,000 tonnes per annum capacity). Holcim Australia also proposes the addition of processing options which will add value to the products produced on site, including the addition of a mobile pugmill and allowance for recycling of surplus concrete from local approved batching facilities in the region for re-use as product. To accommodate the needs of future major road upgrade projects, Holcim Australia is also seeking to extend the hours of operation of the Teven Quarry for a limited range of activities, including:

- truck loading and product transport;
- stockpile management; and
- maintenance.

It is proposed to extend the operating hours to allow the above activities to operate up to 10.00pm Monday to Friday. The stockpile management, truck loading and product transport would be undertaken up to 10.00pm on a campaign basis (i.e. only when required to meet the needs of a particular project). No blasting, quarrying, crushing or screening would be undertaken during the proposed extended hours of operation.

The proposed Project does not involve any change to the existing approved disturbance footprint, pit design or depth of the Teven Quarry (refer to **Figure 2**).

Table 2.1 shows a comparison between the existing operations and the Proposed Project.

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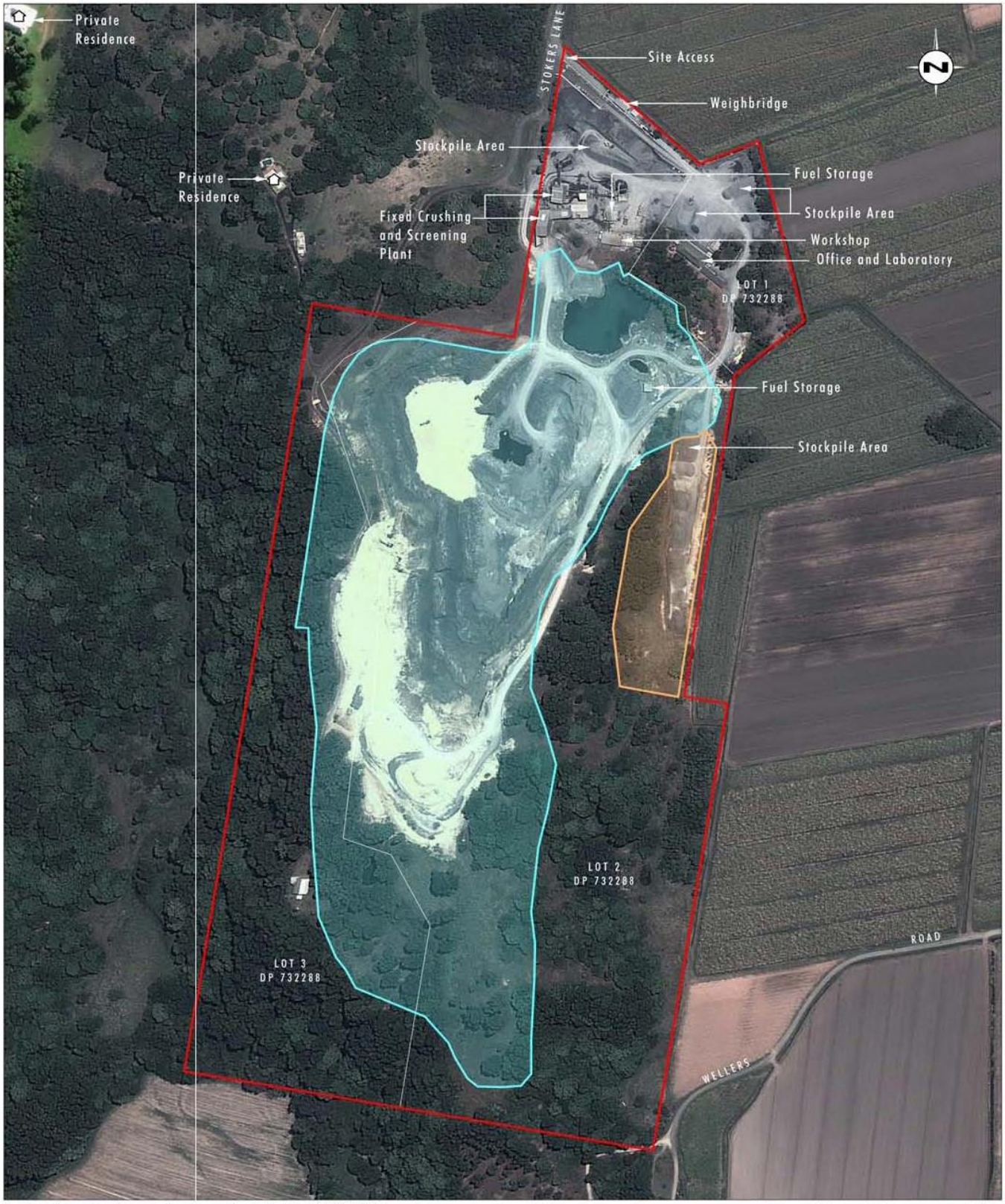

Image Source: Image Source: Google Earth (2012)
Data Source: Holcim (Australia) Pty Ltd (2014)

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1:5 000

Legend
Project Area

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FIGURE 2

TEVEN QUARRY, BALLINA

PROJECT AREA

JOB NO. 13082

Table 2.1 – Comparison of Existing Operations and Proposed Project

Project Component	Currently Approved	Proposed Project
Quarry life	Quarry operations permitted until 2056	30 years from date of approval.
Limits of production	200,000 tonnes per annum in 1995, increasing annually by 1.5% to 495,974 tonnes per annum in 2056.	500,000 tonnes per annum.
Quarry footprint	Shown on **Figure 2**.	Unchanged
Overburden management	Shown on **Figure 2**.	Unchanged
Hours of operation	Blasting: 9.00am – 3.00pm Monday to Friday All other activities: 7.00am – 5.00pm Monday to Friday 7.00am – 4.00pm Saturday	Blasting: 9.00am – 3.00pm Monday to Friday All other activities: 7.00am – 6.00pm Monday to Saturday Extended hours for product loading and transport, stockpile management and maintenance: 6.00pm to 10.00pm Monday to Friday
Transport	Road transport at current approved production level	Road transport at proposed production level
Employment	11 Full Time Equivalent positions	14 Full Time Equivalent positions
Infrastructure	Fixed primary, secondary and tertiary crushing and screening plant	Fixed primary, secondary and tertiary crushing and screening plant; Mobile crushing and screening plant; Mobile pug mill.
Site Access	Off Stokers Lane	Unchanged
Concrete recycling for re-use as product	Not currently undertaken	Commence recycling of up to 10,000 tonnes per annum of clean surplus concrete material on site using existing processing infrastructure for re-use as product.

Figure 3 shows the proposed transport routes for the Project. The existing main transport routes for quarry trucks include:

- Route 1 - Stokers Lane, south along Teven Road to Bruxner Highway and then west towards Lismore and or east, to travel to the Pacific Highway (for trips north or south) or to Ballina (east) via River Street.

- Route 2 - Stokers Lane, north along Teven Road to Tintenbar Road and then north along Tintenbar Road to Tamarind Drive to travel west, north or east.

Currently, approximately 70% of product travels on Route 1 and 30% of product on Route 2.

Most of the product travelling on Route 2 is for local deliveries and road upgrade works to the north around Tintenbar.

Under the Project, it is proposed to use Route 1 for all product trips to the Pacific Highway to travel north (including future highway upgrading works). Therefore, Route 1 would accommodate approximately 95% of all product trucks while Route 2 would become a local route only, with approximately 5% of product trucks using this route for local deliveries only.

Improvements to the delineation in Teven Road south of Stokers Lane (ie. Route 1) is recommended as part of the Project. This includes providing a centreline along Teven Road between Stokers Lane and Bruxner Highway and maintenance / improvements to delineation of the existing guardrail at several locations (see section 4.3 for details). In addition, Holcim Australia expects to continue to pay a contribution for road maintenance under any new approval to Ballina Shire Council in accordance with Council's 'Ballina Shire Heavy Haulage Contributions Plan 2011' (currently $0.6455/tonne), if consent is granted to the proposed increase in production. It is proposed, however, that an alternative contribution rate be levied on the project, in accordance with Section 3.3.1 of the Contributions Plan (2011). Further detail is provided in Section 4.5.

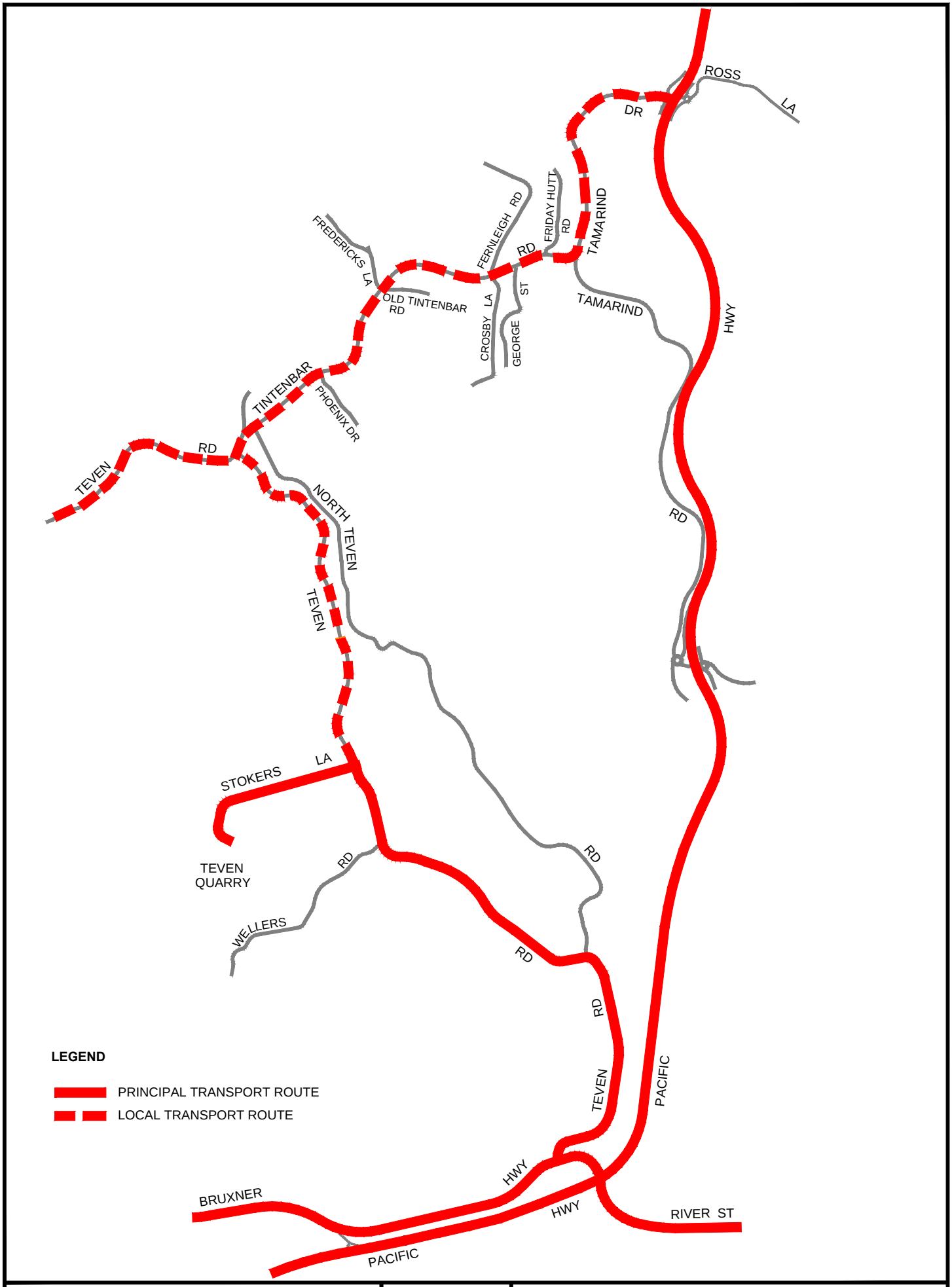

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FIGURE 3

TEVEN QUARRY,
BALLINA

TRANSPORT ROUTES

JOB NO. 13082

3.0 EXISTING TRAFFIC CONDITIONS

3.1 Principal Road Network

The principal road network that services Teven Quarry includes Stokers Lane, Teven Road, Bruxner Highway, Pacific Highway, Tintenbar Road and River Street (Old Pacific Highway).

3.2 Description of Existing Roads and Principal Intersections

3.2.1 Stokers Lane

Stokers Lane is a local road which provides direct vehicle access to Teven Quarry at its western end and intersects with Teven Road as a T junction at its eastern end.

Stokers Lane has a 7.0 metre wide sealed pavement, with grass shoulders 2.0 – 3.0 metres wide. It has a 90º bend (alignment change) 200 metres north of the quarry entrance and a flat grade.

Sight distance in Stokers Lane is good and it has a speed limit of 80km/h. The quarry generates most of the traffic in Stokers Lane, although a residential property and adjacent agriculture uses also generate traffic in Stokers Lane.

Sight distance at the Teven Road/Stokers Lane intersection is good and exceeds 200 metres in both directions of Teven Road. A painted median is also provided in both approaches of Teven Road at the intersection, together with Give Way Control and double barrier centreline in Stokers Lane. Intersection warning signs (trucks) are also provided on all approaches. Large corner radii are provided for the truck left turn movements into and out of Stokers Lane at the intersection. The intersection has BAR and BAL (i.e. basic right and left turn) treatments in Teven Road, which is satisfactory based on the relatively low volumes that use the intersection. Guardrail is also provided on the eastern side of Teven Road, at the intersection.

The operating speed limit in Teven Road at the intersection is 80km/h.

3.2.2 Teven Road

Teven Road is a major local road that connects between Bruxner Highway at West Ballina and Tintenbar Road at Teven.

<u>South of Stokers Lane</u>

Teven Road, south of Stokers Lane provides direct access to Bruxner Highway and the Pacific Highway interchange, as well as to Ballina via River Street (Old Pacific Highway).

The section of Teven Road between Stokers Lane and Bruxner Highway provides a sealed road pavement of variable width. Most sections provide a width of 7.0 metres or wider providing 2 x 3.5 metre wide travel lanes, although there are several sections where the pavement width is 6.5 metres. Road shoulders vary up to 2.0 metres and are typically grass. The traffic management along Teven Road includes isolated centre line markings, guide posts and reflectors, warning signs at intersections and on curves.

The horizontal alignment follows the creek with a series of gentle curves and new bridge structures and alignment change near the intersection with North Teven Road.

The section between North Teven Road and Bruxner Highway passes through a small industrial area.

The speed limit in Teven Road is 60km/h near Bruxner Highway reducing to 50km/h near the North Teven Road intersection and bridges and increasing to 80km/h north of the northern bridge.

Sight distance along Teven Road is generally good and the vertical alignment is mostly flat, except at the new bridge structures.

Intersections in Teven Road between Stokers Lane and Bruxner Highway include:

- Stokers Lane – T junction intersection (see description above);
- Wellers Road – minor T junction intersection;
- North Teven Road – channelised T junction intersection;
- New Place – minor T junction intersection;
- Bruxner Highway – channelised T junction intersection

Sight distance at all these intersections is considered satisfactory for the posted speed limits and the estimated vehicle operating speeds at the intersections.

The distance between Stokers Lane and Bruxner Highway is approximately 4.5 kms.

Teven Road forms a T junction intersection at Bruxner Highway. There is also a left turn into a truck stop area from the eastern approach of Bruxner Highway. The intersection channelisation includes:

- Give way control together with right and left turn lanes in Teven Road at Bruxner Highway;

- Two through lanes in the eastern approach of Bruxner Highway, together with a right turn bay (CHR) and left turn bay (AUL) for left turn access into the adjacent property.

- One through lane and a left turn lane (AUL) in the western approach of Bruxner Highway.

Sight distance in Bruxner Highway at the intersection is good (250 metres in both directions) and the operating speed limit is 60km/h. The intersection has been recently reconstructed and satisfies current Austroad standards.

<u>North of Stokers Lane</u>

The section of Teven Road, north of Stokers Lane provides access to Tintenbar Road.

This section is approximately 3.5km long with a series of curves and bends with a sealed pavement of 6.5 – 6.7 metres wide and 1.0 – 2.0 metres grass shoulders. The vertical alignment is flat. Traffic management includes isolated guide posts/reflectors on bends and at drainage structures. The speed limit in this section of Teven Road is 80km/h.

Intersections include several minor agricultural roads, as well as the Tintenbar Road/Teven Road intersection, all of which are T junction intersections.

Teven Road forms a T junction intersection with Tintenbar Road. The intersection geometry includes:

- Stop sign control on Teven Road (eastern approach);

- A single lane approach in the southern approach of Teven Road, which is constructed around a 90º bend;

- A single lane plus short auxiliary lane in northern approach of Tintenbar Road. The auxiliary lane extends to the departure side of the intersection to assist left turns into and out of the eastern leg of Teven Road.

Sight distance is reduced to around 140 metres by the bend/curve in the southern approach of Teven Road to the intersection, which also reduce vehicle speeds in this approach. A narrow two lane bridge, is located in the northern approach of Tintenbar Road approximately 25 metres from the intersection. Sight distance in this approach is approximately 190 metres.

The speed limit at the intersection is 80km/h, however operating vehicle speeds would be less than this, due to the alignment and constraints of the Tintenbar Road northern approach and the Teven Road southern approach.

3.2.3 Bruxner Highway

The Bruxner Highway is a state highway that links to the Pacific Highway at Ballina and travels west to Alstonville, Lismore and Casino.

The section adjacent to the Pacific Highway at Ballina has recently been upgraded as part of the Pacific Highway upgrade works, including a new interchange at Pacific Highway and Bruxner Highway.

This section of Bruxner Highway between Teven Road and the Pacific Highway interchange is a four lane divided road with a high level of traffic management.

The interchange includes a large two lane roundabout connecting the Bruxner Highway with Pacific Highway (north and south) and to River Street (Old Pacific Highway) which provides access to the Ballina township. The speed limit at the roundabout is 60km/h.

3.2.4 Pacific Highway

The Pacific Highway is the main north south national highway along the east coast of Australia connecting Sydney and Brisbane. The Highway is currently being upgraded to provide a four lane highway.

In the section at Ballina, the highway north of Bruxner Highway is four lanes with a divided carriageway and upgrade works are progressing near Tintenbar and to the north on those sections not widened. South of Ballina, Pacific Highway is a two lane highway, with a high level of traffic management.

3.2.5 River Street

River Street (Old Pacific Highway) is a state road and provides the main connection to the township of Ballina from the Pacific and Bruxner Highways. A high level of traffic management has been implemented along its full length including roundabout and traffic signal control at major intersections, marked centre lines and medians and auxiliary turning lanes at major intersections. The speed limit in River Street is generally 60km/h.

3.2.6 Tintenbar Road/Tamarind Drive

Tintenbar Road/Tamarind Drive route connects between Teven Road at Teven and the Pacific Highway. The route is an unclassified regional road and is approximately 5.5km in length.

Tintenbar Road is a two lane rural road with a high level of traffic management including turning lanes at principal intersections, guideposts/reflectors centreline road marking, warning signs and edgelines in sections.

The road passes through rolling terrain and the road's alignment matches the terrain. There is a narrow bridge just north of Teven Road intersection which is effectively a one lane bridge with no passing or overtaking permitted on the bridge.

Intersections along Tintenbar Road include;

- Teven Road – a T junction intersection (see description in 3.2.2 above);
- North Teven Road – a channelised T junction intersection;
- Phoenix Drive - a channelised T junction intersection;
- Fredericks Lane/Old Tintenbar Road – a channelised offset cross junction;
- Crosby Lane/Fernleigh Road – a minor offset cross junction;
- George Street – a channelised T junction intersection;
- Friday Hutt Road – a channelised T junction intersection;
- Tamarind Drive – a channelised seagull intersection where Tintenbar Road forms a T junction with Tamarind Drive.

Tamarind Drive is generally a two lane rural road constructed to a good standard with a section of overtaking lane and a high level of traffic management.

Tamarind Drive forms roundabout intersections adjacent the Pacific Highway with Saddle Road and Kinvara Ridge Road which provide north facing ramps to the Pacific Highway, between Tintenbar and Knocknow.

The speed limit in Tintenbar Road and Tamarind Drive is generally 80km/h except at roundabout intersections in Tamarind Drive at the Pacific Highway where the speed limit is 60km/h.

3.3 Existing Traffic Conditions on the Road Network

3.3.1 Existing Traffic Volumes

Traffic volumes using the principal road network adjacent to Teven Quarry were collected as part of this assessment. This included daily volume and vehicle classification counts on a number of roads as well as intersection counts at the Bruxner Highway/Teven Road intersection and at the roundabout interchange intersection with the Pacific Highway between 6am and 6pm on a weekday. **Figure 4** shows the count locations.

The daily volumes and vehicle classification counts were undertaken between 3-10 February 2014. The intersection counts were undertaken on 4 February 2014 between 6.00am-6.00pm. **Figures 5** and **6A and 6B** show a summary of daily volume and vehicle classification counts (**Figure 5**) and the weekday intersection peak hour traffic counts (**Figures 6A and 6B**).

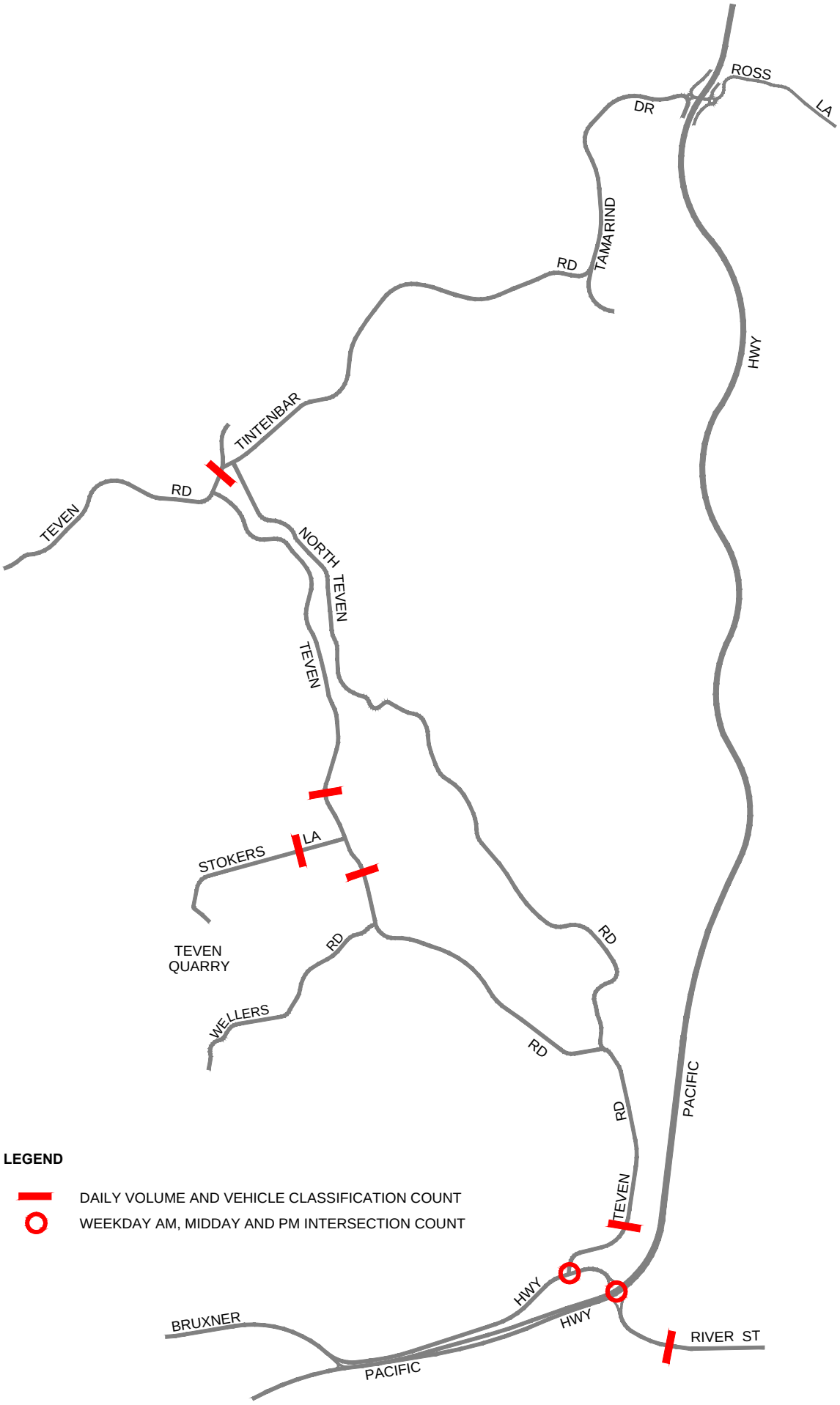

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FIGURE 4

TEVEN QUARRY,
BALLINA

TRAFFIC COUNT LOCATIONS

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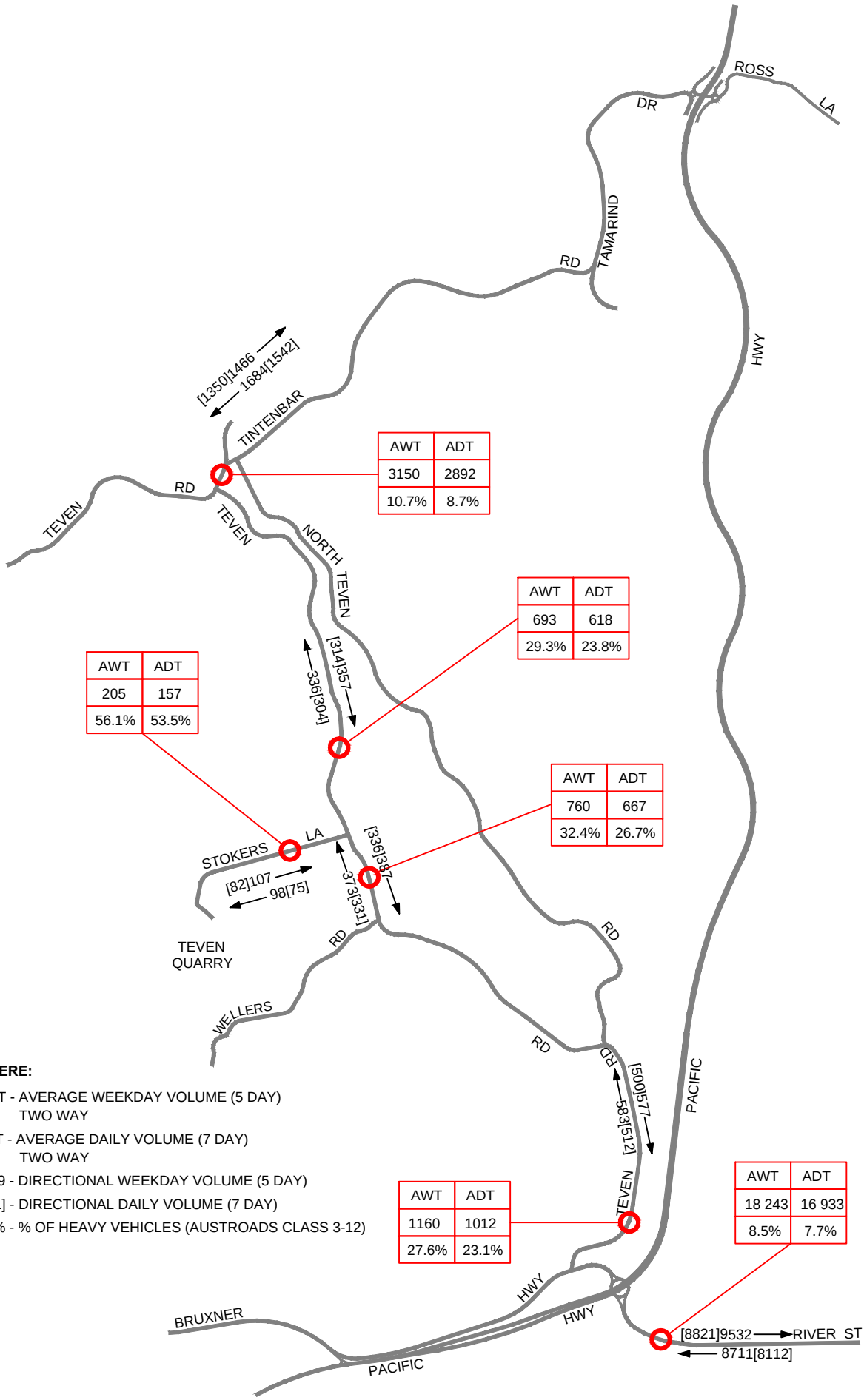

WHERE:

AWT - AVERAGE WEEKDAY VOLUME (5 DAY) TWO WAY

ADT - AVERAGE DAILY VOLUME (7 DAY) TWO WAY

1429 - DIRECTIONAL WEEKDAY VOLUME (5 DAY)

[1381] - DIRECTIONAL DAILY VOLUME (7 DAY)

7.7% - % OF HEAVY VEHICLES (AUSTROADS CLASS 3-12)

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FIGURE 5

TEVEN QUARRY, BALLINA

EXISTING DAILY VOLUMES AND VEHICLE CLASSIFICATION

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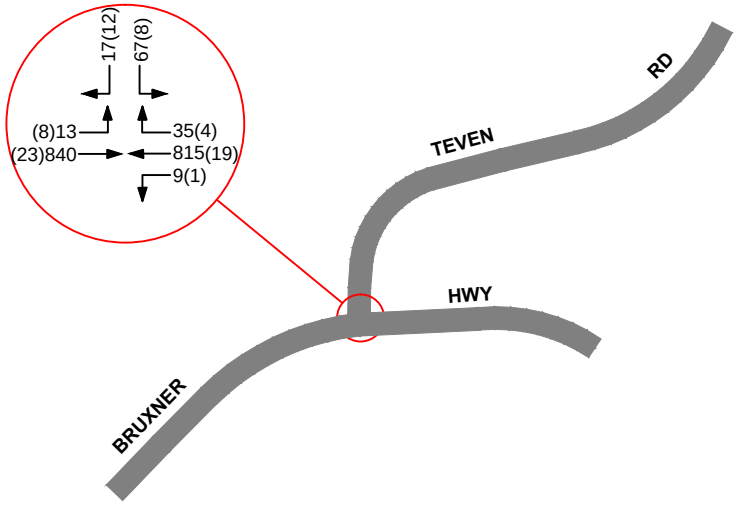
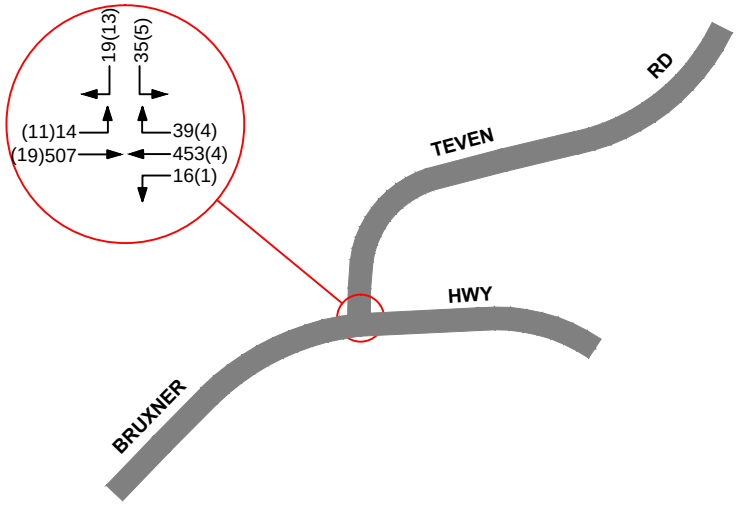
AM PEAK HOUR
7.45 - 8.45am



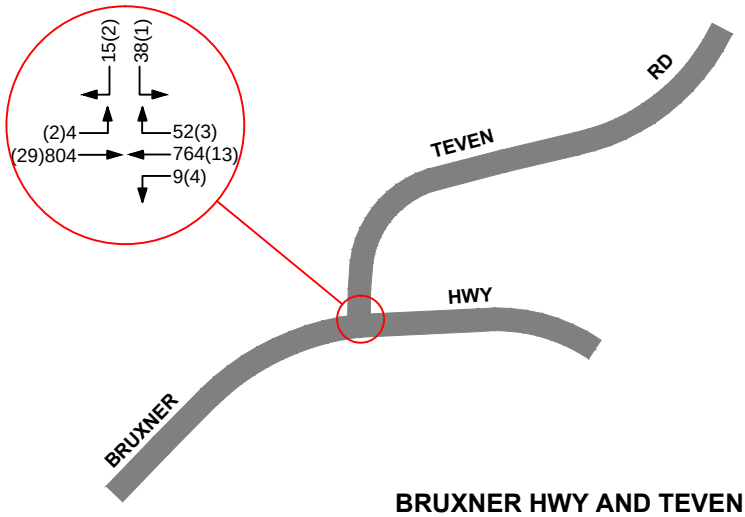
LEGEND
67 - TOTAL VOLUME OF VEHICLES
(8) - HEAVY VEHICLE VOLUME

MIDDAY PEAK HOUR
11.15am - 12.15pm



LEGEND
67 - TOTAL VOLUME OF VEHICLES
(8) - HEAVY VEHICLE VOLUME

PM PEAK HOUR
4.00 - 5.00pm



LEGEND
67 - TOTAL VOLUME OF VEHICLES
(8) - HEAVY VEHICLE VOLUME

BRUXNER HWY AND TEVEN RD INTERSECTION

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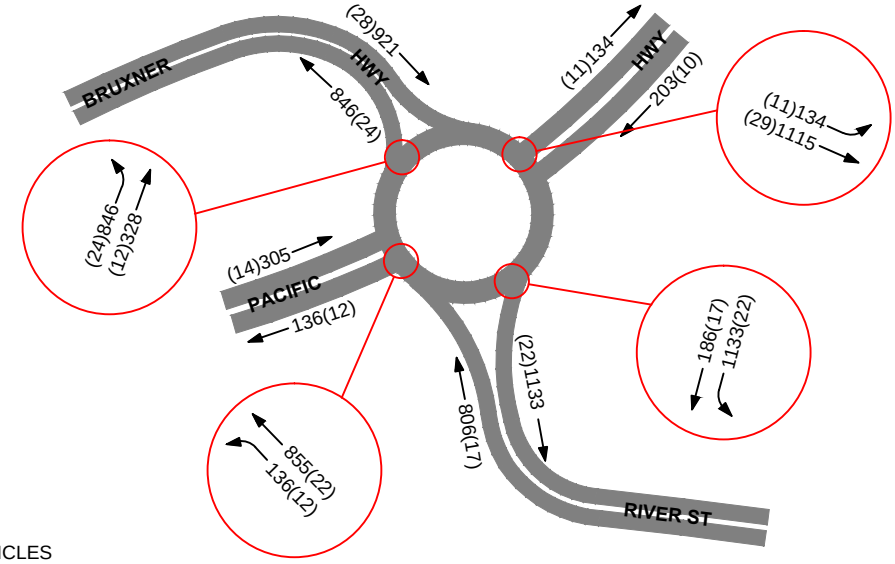
FIGURE 6A

TEVEN QUARRY, BALLINA

EXISTING WEEKDAY AM, MIDDAY AND PM PEAK HOUR TRAFFIC VOLUMES

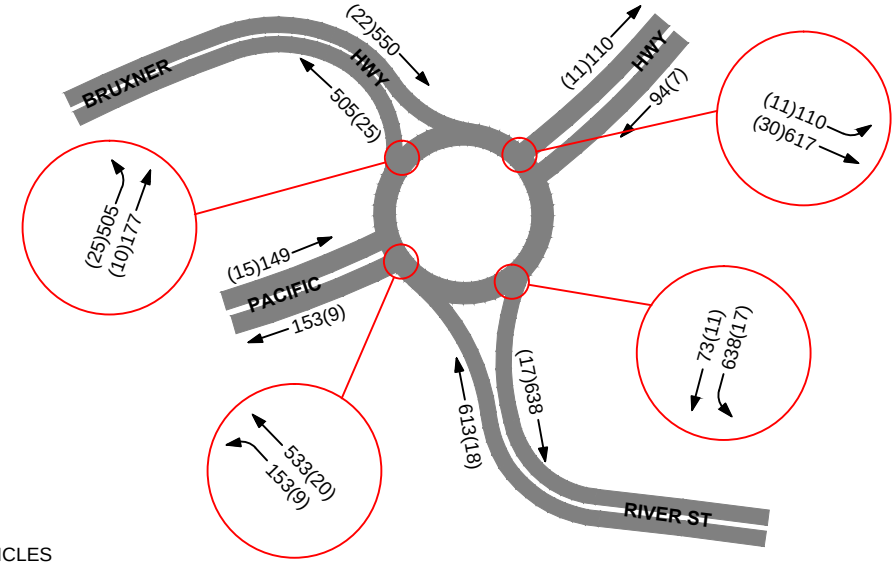
JOB NO. 13082

AM PEAK HOUR
7.45 - 8.45am



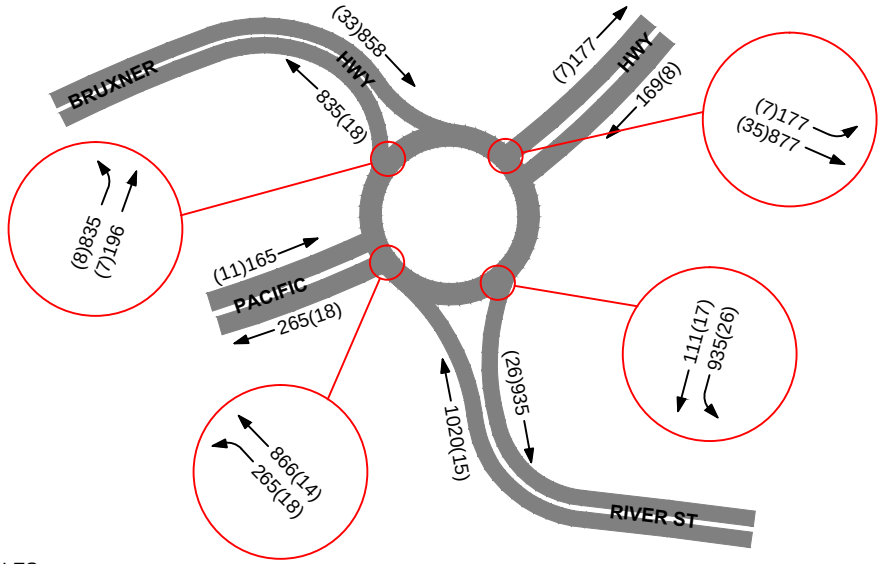
LEGEND
67 - TOTAL VOLUME OF VEHICLES
(8) - HEAVY VEHICLE VOLUME

MIDDAY PEAK HOUR
11.15am - 12.15pm



LEGEND
67 - TOTAL VOLUME OF VEHICLES
(8) - HEAVY VEHICLE VOLUME

PM PEAK HOUR
4.00 - 5.00pm



LEGEND
67 - TOTAL VOLUME OF VEHICLES
(8) - HEAVY VEHICLE VOLUME

PACIFIC HWY, BRUXNER HWY AND RIVER STREET INTERCHANGE

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FIGURE 6B

TEVEN QUARRY, BALLINA

EXISTING WEEKDAY AM, MIDDAY AND PM PEAK HOUR TRAFFIC VOLUMES

JOB NO. 13082

3.3.2 Daily Volumes

Stokers Lane

Table 3.1 shows the daily volumes including heavy vehicles using Stokers Lane.

Reference to Table 3.1 shows that on a typical weekday (5 day average) Stokers Lane carries two way traffic volumes of 205 vehicles per day (vpd). Heavy vehicles (Austroad Class 3 to 12) total 115vpd. Heavy vehicles represent around 56.1% of the total volumes using Stokers Lane on an average weekday.

TABLE 3.1

STOKERS LANE WEST OF TEVEN ROAD TEVEN
5 DAY AVERAGE AND 7 DAY AVERAGE TRAFFIC VOLUMES
AND VEHICLE CLASSIFICATION

Direction of Travel	5 Day Average (Weekday)			7 Day Average (ADT)		
	Light[1]	Heavy[2]	Total	Light[1]	Heavy[2]	Total
East	49	58	107	40	42	82
West	41	57	98	33	42	75
Total	90	115	205	73	84	157
Proportion of Total	43.9%	56.1%	100%	46.5%	53.5%	100%

Source: Traffic Counts undertaken 3-10 February 2014
[1]Light Vehicles – Austroads 1 and 2 vehicle classification and motorbikes
[2]Heavy Vehicles – Austroads 3-12 vehicle classifications

Teven Road

Table 3.2 shows the daily traffic volumes including heavy vehicles using Teven Road, north of Stokers Lane.

Reference to Table 3.2 shows that on a typical weekday (5 day average) Teven Road, north of Stokers Lane carries two way traffic volumes of 693vpd. Heavy vehicles (Austroad Classes 3 to 12) total 203vpd. Heavy vehicles represent around 29.3% of total volumes using Teven Road, north of Stokers Lane, on an average weekday.

TABLE 3.2

TEVEN ROAD NORTH OF STOKERS LANE TEVEN
5 DAY AVERAGE AND 7 DAY AVERAGE TRAFFIC VOLUMES
AND VEHICLE CLASSIFICATION

Direction of Travel	5 Day Average (Weekday)			7 Day Average (ADT)		
	Light[1]	Heavy[2]	Total	Light[1]	Heavy[2]	Total
North	243	93	336	237	67	304
South	247	110	357	234	80	314
Total	490	203	693	471	147	618
Proportion of Total	70.7%	29.3%	100%	76.2%	23.8%	100%

Source: Traffic Counts undertaken 3-10 February 2014
[1]Light Vehicles – Austroads 1 and 2 vehicle classification and motorbikes
[2]Heavy Vehicles – Austroads 3-12 vehicle classifications

Tables 3.3 and 3.4 shows the daily traffic volumes using Teven Road, south of Stokers Lane (Table 3.3) and also north of Bruxner Highway (Table 3.4).

Reference to Table 3.3 shows that on a typical weekday (5 day average) Teven Road, south of Stokers Lane carries two way traffic volumes of 760vpd. Heavy vehicles (Austroads Classes 3 to 12) total 246vpd and represent around 32.4% of total volumes using this section of Teven Road, on an average weekday.

TABLE 3.3

TEVEN ROAD SOUTH OF STOKERS LANE TEVEN
5 DAY AVERAGE AND 7 DAY AVERAGE TRAFFIC VOLUMES
AND VEHICLE CLASSIFICATION

Direction of Travel	5 Day Average (Weekday)			7 Day Average (ADT)		
	Light[1]	Heavy[2]	Total	Light[1]	Heavy[2]	Total
North	257	116	373	247	84	331
South	257	130	387	242	94	336
Total	514	246	760	489	178	667
Proportion of Total	67.6%	32.4%	100%	73.3%	26.7%	100%

Source: Traffic Counts undertaken 3-10 February 2014
[1]Light Vehicles – Austroads 1 and 2 vehicle classification and motorbikes
[2]Heavy Vehicles – Austroads 3-12 vehicle classifications

Reference to Table 3.4 shows that on a typical weekday (5 day average) Teven Road, north of Bruxner Highway carries two way traffic volumes of 1,160vpd. Heavy vehicles (Austroad Classes 3 to 12) total 340vpd and represent around 27.6% of total volumes using Teven Road, north of Bruxner Highway, on an average weekday.

TABLE 3.4

TEVEN ROAD NORTH OF BRUXNER HIGHWAY WEST BALLINA
5 DAY AVERAGE AND 7 DAY AVERAGE TRAFFIC VOLUMES
AND VEHICLE CLASSIFICATION

Direction of Travel	5 Day Average (Weekday)			7 Day Average (ADT)		
	Light[1]	Heavy[2]	Total	Light[1]	Heavy[2]	Total
North	431	172	583	401	111	512
South	409	168	577	377	123	500
Total	840	340	1160	778	234	1012
Proportion of Total	72.4%	27.6%	100%	76.9%	23.1%	100%

Source: Traffic Counts undertaken 3-10 February 2014
[1]Light Vehicles – Austroads 1 and 2 vehicle classification and motorbikes
[2]Heavy Vehicles – Austroads 3-12 vehicle classifications

Tintenbar Road

Table 3.5 shows the daily volumes including heavy vehicles using Tintenbar Road north of Teven Road.

Reference to Table 3.5 shows that on a typical weekday (5 day average), Tintenbar Road, north of Teven Road carries two way traffic volumes of 3,150vpd. Heavy vehicles (Austroads Classes 3 to 12) total 338vpd and represent around 10.7% of total volumes using this section of Tintenbar Road, on an average weekday.

TABLE 3.5

TINTENBAR ROAD
5 DAY AVERAGE AND 7 DAY AVERAGE TRAFFIC VOLUMES
AND VEHICLE CLASSIFICATION

Direction of Travel	5 Day Average (Weekday)			7 Day Average (ADT)		
	Light[1]	Heavy[2]	Total	Light[1]	Heavy[2]	Total
North/East	1317	149	1466	1240	110	1350
South/West	1495	189	1684	1399	143	1542
Total	2812	338	3150	2639	243	2892
Proportion of Total	89.3%	10.7%	100%	91.3%	8.7%	100%

Source: Traffic Counts undertaken 3-10 February 2014
[1]Light Vehicles – Austroads 1 and 2 vehicle classification and motorbikes
[2]Heavy Vehicles – Austroads 3-12 vehicle classifications

River Street

Table 3.6 shows the daily volumes including heavy vehicles using River Street east of Pacific Highway, West Ballina.

Reference to Table 3.6 shows that on a typical weekday (5 day average) River Street carries two way traffic volumes in the order of 18,243vpd. Heavy vehicles (Austroad Classes 3 to 12) total 1,558vpd. Heavy vehicles represent around 8.5% of total volumes using this section of River Street on a typical weekday.

TABLE 3.6

RIVER STREET (OLD PACIFIC HIGHWAY) EAST OF PACIFIC HIGHWAY,
WEST BALLINA
5 DAY AVERAGE AND 7 DAY AVERAGE TRAFFIC VOLUMES
AND VEHICLE CLASSIFICATION

Direction of Travel	5 Day Average (Weekday)			7 Day Average (ADT)		
	Light[1]	Heavy[2]	Total	Light[1]	Heavy[2]	Total
East	8855	677	9532	8262	559	8821
West	7830	881	8711	7371	741	8112
Total	16685	1558	18243	15633	1300	16933
Proportion of Total	91.5%	8.5%	100%	92.3%	7.7%	100%

Source: Traffic Counts undertaken 3-10 February 2014
[1]Light Vehicles – Austroads 1 and 2 vehicle classification and motorbikes
[2]Heavy Vehicles – Austroads 3-12 vehicle classifications

3.3.3 Weekday Hourly Traffic Volumes in AM, PM and Midday Periods

Table 3.7 shows the two way hourly traffic volumes using the road network adjacent Teven Quarry during the AM, midday and PM peak periods.

Reference to Table 3.7 shows that:

- Stokers Lane carries low two way traffic volumes in the order of 10-29 vehicles per hour (vph) on weekdays.

- Teven Road also carries relatively low two way traffic volumes in the order of 42-83vph north and south of Stokers Lane, increasing to 75-110vph near Bruxner Highway.

- Tintenbar Road carries moderate two way traffic volumes ranging from 162-346vph reflecting its role as a regional road.

- Bruxner Highway near Teven Road and the interchange with Pacific Highway carries moderately high two way traffic volumes between 912 to 1,706vph.

- Similarly River Street which provides the main traffic route into Ballina from the Pacific and Bruxner Highways also carries moderately high two way traffic volumes in the order of 1,186 – 1,744vph.

TABLE 3.7

WEEKDAY TWO WAY HOURLY TRAFFIC VOLUMES ON ROAD NETWORK IN AM, MIDDAY AND PM PEAK PERIODS

Road	Hourly Traffic Volumes		
	7.00-9.00am	**11.00am-1.00pm**	**3.00-5.00pm**
Stokers Lane	26-29	13-17	10-12
Teven Road north of Stokers Lane	42-76	51-56	50-65
Tintenbar Road north of Teven Road	284-346	162-163	297-299
Teven Road south of Stokers Lane	57-83	54-65	50-68
Teven Road north of Bruxner Highway	80-110	75-96	85-99
Bruxner Highway east of Teven Road	1287-1706	968-1034	1380-1667
Bruxner Highway west of Teven Road	1210-1632	912-993	1344-1587
River Street east of Pacific Highway	1186-1744	1231-1234	1584-1625

Source: Traffic Counts undertaken 3-10 February 2014

3.4 Road Safety

Road crash statistics were provided by the RMS for the sections of the road network adjacent to Teven Quarry for the 5 year period between 1 July 2008 and 30 June 2013.

A summary of the analysis of these statistics is outlined below.

Stokers Lane

There were no reported collisions in Stokers Lane or at the intersection of Stokers Lane and Teven Road.

Teven Road (South of Stokers Lane)

There were 7 crashes in Teven Road between Stokers Lane and Bruxner Highway, including one (1) injury crash, over the 5 year period, which is an average of 1.4 crashes per year.

Six (6) of these occurred in a section which has the bends and new bridge structures over Emigrant Creek including one which occurred at the intersection of North Teven Road, which was a non injury crash involving 2 trucks (rear end).

The other crashes included 2 head on crashes, one (1) of which was an injury crash, 2 single vehicle run off the road type crashes and another involving a reversing vehicle. All of these crashes were non injury crashes. The section of road where these crashes occurred has recently been upgraded to improve the road alignment.

The remaining crash involved a single vehicle (car) running off the road on a bend, north of Bruxner Highway, which was a non injury crash.

There were no reported crashes at the intersection of Teven Road and Bruxner Highway in the 5 year period.

Teven Road (North of Stokers Lane)

In the section of Teven Road between Stokers Lane and Tintenbar Road (i.e. north of Stokers Lane), there were 8 reported crashes including 4 injury accidents, which is an average of 1.6 crashes per year. Four (4) of these crashes were head on crashes and 4 were run off the road single vehicle crashes. All of these crashes involved cars/vans (i.e. Austroad Class 1 vehicles) and speed was a determining factor in 4 of the crashes.

The road alignment of this section of Teven Road has a number of curves and excessive speed for the road conditions appears to have been a major factor in most of the crashes.

Tintenbar Road/Tamarind Drive

This section of road between Teven Road and Pacific Highway had a total of 35 crashes, 13 of which were injury crashes, over the 5 year period. This is an average of 7 crashes per year.

Six (6) crashes occurred at intersections along the route and 20 crashes involved single vehicle crashes with vehicles either leaving the road or striking an object. The remainder involved run off the road crashes involving 2 vehicles, head on, rear end, miscellaneous and right through crashes.

Eight (8) of the total number of crashes involved trucks, 2 of which were injury crashes. These were a mixture of off road, rear end and head on crashes. Trucks were at fault in 4 of these crashes.

Excessive speed for the road conditions was a contributing factor in 16 of the total number of crashes and fatigue a factor in another 3 crashes.

3.5 Road Safety Audit

A Road Safety Audit was undertaken on the existing local roads that form the transport routes as part of this assessment.

The main findings of the Road Safety Audit are:

- Transport Route 1 which includes Stokers Lane, south along Teven Road to Bruxner Highway and then west towards Lismore and or east to travel to the Pacific Highway (for trips north or south) or to Ballina (east) via River Street should be maintained as the principal transport route from Teven Quarry including the route for any deliveries associated with future upgrading works associated with the Pacific Highway.

- Transport Route 2 which includes Stokers Lane, north along Teven Road to Tintenbar Road and then north along Tintenbar Road to Tamarind Drive should be maintained as a local route only and be restricted to local deliveries (ie. approximately 5% of deliveries).

- For Transport Route 1, improved delineation in Teven Road between Stokers Lane and Bruxner Highway is recommended due to the proposed special circumstances night time haulage. This includes:

    (i) Centreline markings in Teven Road between Stokers Lane and Bruxner Highway including the maintenance of the existing linemarking (where required) in Teven Road.

    (ii) Provision of reflectors on the existing guardrail fencing at the intersections of Stokers Lane and Wellers Road, with Teven Road.

    (iii) Maintenance of existing end treatment of guardrail in Teven Road at Stokers Lane.

Further details of the Road Safety Audit are contained in the Road Safety Audit Report which is reproduced in **Appendix 2**.

3.6 Bus Routes

Ballina Bus Lines operates country area route bus services between Ballina and Alstonville/Lismore which travels via River Street and Bruxner Highway. Some 12 buses on a weekday operate in both directions between 6.00am and 5.00pm.

The bus line also operates a bus service between Lismore/Alstonville and Lennox Head which travels via Tintenbar Road and Tamarind Drive. Two (2) buses a day operate in both directions on weekdays.

Ballina Bus Lines also operates school bus services that use a section of Tintenbar Road, and Teven Road (south of Tintenbar Road) and Bruxner Highway.

Two (2) school buses use Tintenbar Road and Teven Road in the AM between 7.45am and 9.15am and (2) buses in the PM between 3.15pm and 4.30pm, on school days.

4.0 ASSESSMENT OF TRAFFIC IMPACTS OF PROJECT

4.1 Existing Traffic Generation

Based on traffic counts and Holcim Australia's gate records for the week of 3-10 February 2013 the existing weekday average traffic generation of the quarry during a busy week is:

- A total of 60 two way trips per day for cars, light vehicles based on 30 inbound trips/30 outbound trips. This included employee trips, visitors and some ex bin sales in small vehicles.

- A total of 106 two way product truck trips (truck, truck and dog trailers and semi trailers) based on 53 inbound trips/53 outbound trips.

The daily traffic generation of product trucks at 265,000 tonnes per annum based on 300 days of sales and transportation and average loads of 23 tonnes is 39 loads per day i.e. 78 truck trips (39 inbound trucks/39 outbound truck).

The existing traffic generation at Teven Quarry varies considerably from day to day, as well as by each hour during the day, based on sales and load sizes. Typically the busiest hours occur in the mornings with deliveries tapering off in the afternoon.

Average hourly traffic generation is calculated to be 4-5 loads (i.e. 8-10 truck trips) per hour for an average hour i.e. 4-5 inbound trucks/4-5 outbound trucks.

A busy hour is currently 8-10 loads (i.e. 16-20 truck trips per hour) with 8-10 inbound trucks and 8-10 outbound trucks.

A maximum hour occurs when the full loading capacity is used and this is 12 truck and dog loads per hour (i.e. 24 truck trips per hour) with 12 inbound trucks/12 outbound trucks.

4.2 Traffic Generation of Project

The project seeks approval for production of up to 500,000 tonnes per annum of quarry product.

Additional employees will be three persons, taking the total to 14 persons (FTEP).

Light vehicle trips, assuming that some increase in visitor trips also occurs, is estimated to be a total of 70 two way trips per day based on 35 trips in/35 trips out which is an increase of 10 light vehicle trips per day (i.e. 5 in/5 out).

Product truck trips for 500,000 tpa based on sales and transport for 300 days per year with average load of 23 tonnes, (same as the existing loads) calculates to an average of 73 loads per day or 146 truck movements per day, between 7.00am and 6.00pm.

It should be noted that load sizes are likely to increase over the life of the Project to around 30 tonnes (per load), which would reduce the traffic generation from 73 loads on an average day. Most truck and dog trailer combinations can carry loads of 32-33 tonnes and most of the additional tonnage is likely to be absorbed by the future road works associated with the Pacific Highway upgrade. The existing lower average load sizes for Teven Quarry of 23 tonnes, reflects current ex bin sales requiring smaller loads. However for the purpose of assessing the impacts of the project, no increase in load sizes is assumed.

There will be no increase in truck trips due to the mobile pug mill or the concrete recycling operation, as neither of these would result in any separate additional traffic generation.

Concrete for recycling will be delivered as part of the back trip from product trucks making deliveries to customers or the concrete batching plants and the pug mill allows variations to quarry product, which has been factored into the overall sales and traffic generation for the project.

Whilst the proposal seeks to increase its hours of operation on Monday to Friday to up to 10pm (i.e. 7.00am – 10.00pm) the additional 4 hours from 6.00pm to 10.00pm will only be for special circumstances, where delivery of product on a particular job/project is required out of normal work hours.

For the purpose of calculating the traffic generation of the product trucks it is assumed this will occur between 7.00am to 6.00pm.

The hourly traffic generation of the product trucks due to the project is calculated to be:

- 7 loads i.e. 14 truck trips (7 inbound trucks/7 outbound trucks) during an average hour; and

- 10 loads (20 truck trips) 10 inbound trucks/10 outbound trucks during a busy hour.

Holcim Australia have determined the maximum hourly traffic generation of Teven Quarry during the daytime (7.00am-6.00pm) and evening (6.00pm-10.00pm) periods would be:

- 12 loads (i.e. 12 in/12 out) during the 7.00am-6.00pm day period; and

- 6 loads (i.e. 6 in/6 out) during the 6.00pm-10.00pm evening period.

4.3 Proposed Improvement Works

The proposed improvement works include upgrading to the existing delineation in Teven Road between Stokers Lane and Bruxner Highway due to proposed special circumstances night time road haulage. These improvements include:

(i) Centreline markings in Teven Road between Stokers Lane and Bruxner Highway including the maintenance of the existing linemarking (where required) in Teven Road.

(ii) Provision of reflectors on the existing guardrail fencing at the intersections of Stokers Lane and Wellers Road, with Teven Road; and

(iii) Maintenance of existing end treatment of guardrail in Teven Road and Stokers Lane.

4.4 Assessment of Impacts of Project Associated with Increased Traffic Levels

4.4.1 Traffic Increases

Tables 4.1 and 4.2 show the increase in product truck trips per day and per hour from the project.

Reference to Tables 4.1 and 4.2 show projected increases for the average day of 34 loads (i.e. 68 truck trips) and 2 loads (4 truck trips) in the average hour.

There will be no increase in the maximum hour, as the quarry has the capacity to load 12 truck and dog combination vehicles per hour and currently does load at this rate at times of very high demand.

Similarly the increase in truck volumes during a busy hour is of the same order as the increase in the average hour (i.e. 2 truck loads or 4 truck trips per hour).

TABLE 4.1

INCREASE IN DAILY PRODUCT TRUCK LOADS AND TRIPS WITH PROJECT

Existing Approval 265,000 tpa		Project 500,000 tpa		Difference	
Loads	**Two Way Trips**	**Loads**	**Two Way Trips**	**Loads**	**Two Way Trips**
39	78	73	146	+34	+68

TABLE 4.2

INCREASE IN HOURLY PRODUCT TRUCK LOADS AND TRIPS WITH PROJECT

	Existing Approval 265,000 tpa		Project 500,000 tpa		Difference	
	Loads	**Two Way Trips**	**Loads**	**Two Way Trips**	**Loads**	**Two Way Trips**
Average Hour	5	10	7	14	+2	+4
Busy Hour	8-10	16-20	10	20	+2	+4
Maximum Hour	12	24	12	24	Nil	Nil

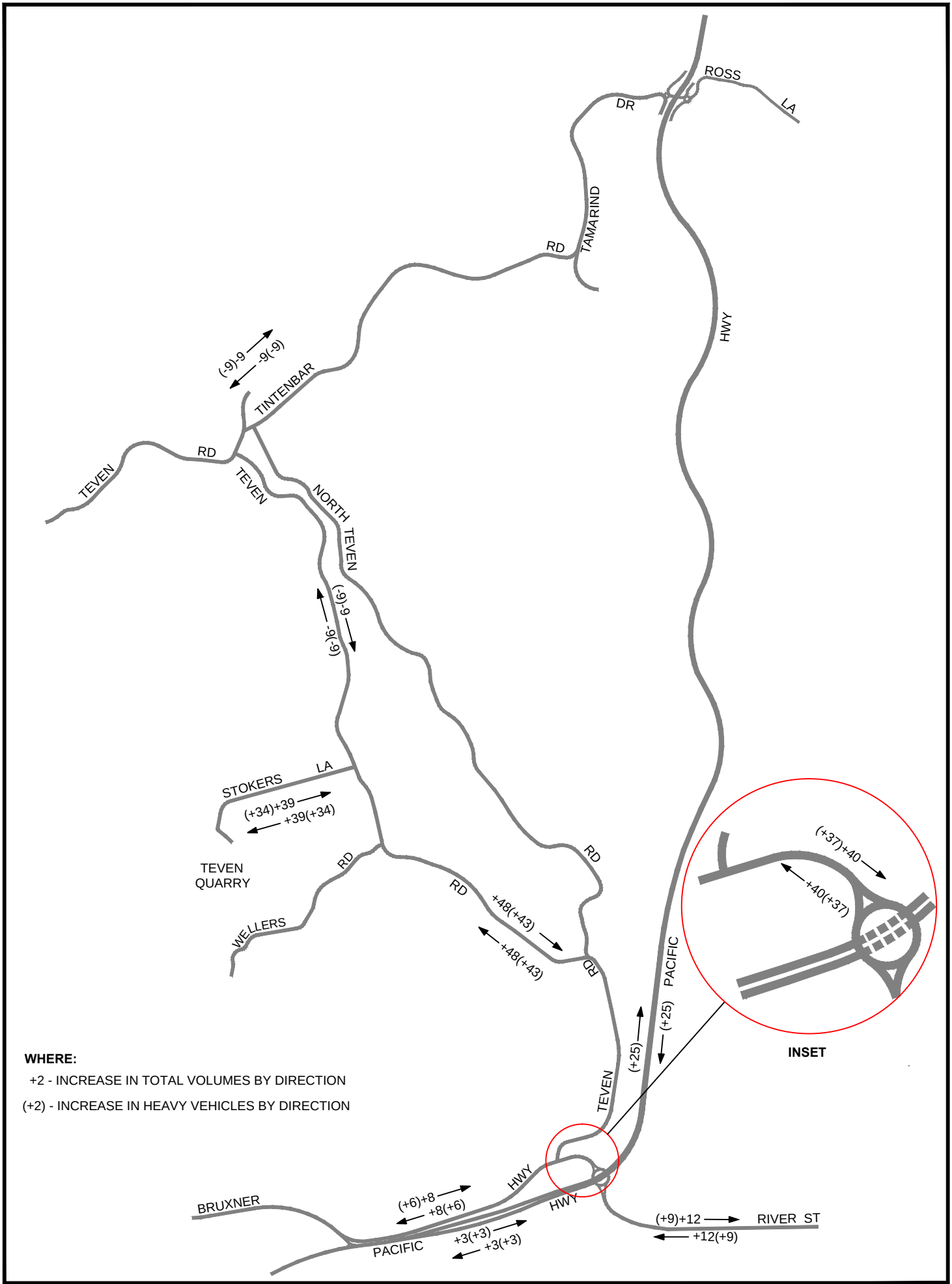
4.4.2 Traffic Impacts

Figure 7 shows the changes (increases and decreases) in the weekday traffic volumes on the road network due to the Project, on an average weekday.

At the section of Teven Road north of Stokers Lane and in Tintenbar Road/Tamarind Drive there will be a reduction in the number of heavy vehicles generated by the quarry using these roads and two way heavy vehicle trips will be reduced by 18 truck trips per day.

The weekday increases on other sections of the road network due to the Project would be as follows:

- Stokers Lane – an increase of 78 two way trips per day including 68 heavy vehicle trips.
- Teven Road, south of Stokers Lane – an increase of 96 two way trips including 86 heavy vehicle trips;
- Bruxner Highway west of Teven Road – an increase of 16 two way trips including 12 heavy vehicle trips;
- Bruxner Highway, east of Teven Road – an increase of 80 two way trips including 74 heavy vehicles;
- Pacific Highway north of Bruxner Highway – an increase of 50 two way heavy vehicle trips;



WHERE:

+2 - INCREASE IN TOTAL VOLUMES BY DIRECTION

(+2) - INCREASE IN HEAVY VEHICLES BY DIRECTION

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FIGURE 7

TEVEN QUARRY,
BALLINA

ADDITIONAL WEEKDAY TRAFFIC FROM PROJECT ON AVERAGE DAY

JOB NO. 13082

- Pacific Highway, south of Bruxner Highway – an increase of 6 two way heavy vehicle trips; and

- River Street, east of Pacific Highway – an increase of 24 two way trips including 18 heavy vehicle trips.

The impact of these increases across the road network would be relatively minor.

Two way weekday traffic volumes in Stokers Lane would increase from 205 vehicles per day (vpd) to 273 vpd, with the proportion of heavy vehicles increasing from 56.1% to 66.8%.

In Teven Road, south of Stokers Lane, two way weekday traffic volumes would increase from 760vpd to 856vpd, with the proportion of heavy vehicles increasing from 32.4% to 38.6%.

On the wider state road network of Bruxner Highway, Pacific Highway and River Street the daily volume increases associated with the Project would be an extremely small proportion of the total traffic using these roads and would have negligible impact, given the relatively high volumes of existing traffic using these roads.

Figure 7 shows the traffic volume changes (increases and decreases) in an average and busy hour on a weekday associated with the Project.

For the Project, including the route change, the overall increase of 3 heavy vehicle trips in each direction per hour (i.e. total of 6 two way truck trips per hour) using Stokers Lane and Teven Road, south of the Stokers Lane, would also have relatively minor impacts on these roads and intersections as well as on the adjoining road network.

Figure 8 shows the product truck trips of the quarry in the maximum hour, assigned to the road network. Reference to **Figure 8** shows that a maximum of 12 trucks per hour would travel to and from the quarry via Teven Road, south of Stokers Lane and these vehicles would be dispersed via Bruxner and Pacific Highways and River Street.

To examine the impacts of the Project's maximum hour on the principal intersections of Stokers Lane/Teven Road and Teven Road/Bruxner Highway traffic modelling has been undertaken using the SIDRA software package.

The modelling has been undertaken for peak hour periods in the AM, Midday and PM periods, using the existing traffic volumes using the intersections, together with the additional trucks for the maximum hour generated by the Project.

For intersections controlled by Give Way/Stop signs, the Level of Service of the intersection is determined by the movement with the highest average vehicle delay and not the average vehicle delay for all vehicles using the intersection.

SIDRA assesses the operational performance of intersections under traffic signal, roundabout or sign control. The best criteria for assessing intersections controlled by sign control are Level of Service (LS), Degree of Saturation (DS) and Average Vehicle Delay (AVD). Table 4.3 shows the Level of Service Criteria for intersections as reproduced from the RTA's Guide to Traffic Generating Developments. The desirable design criteria for intersections is a Level of Service D or better.

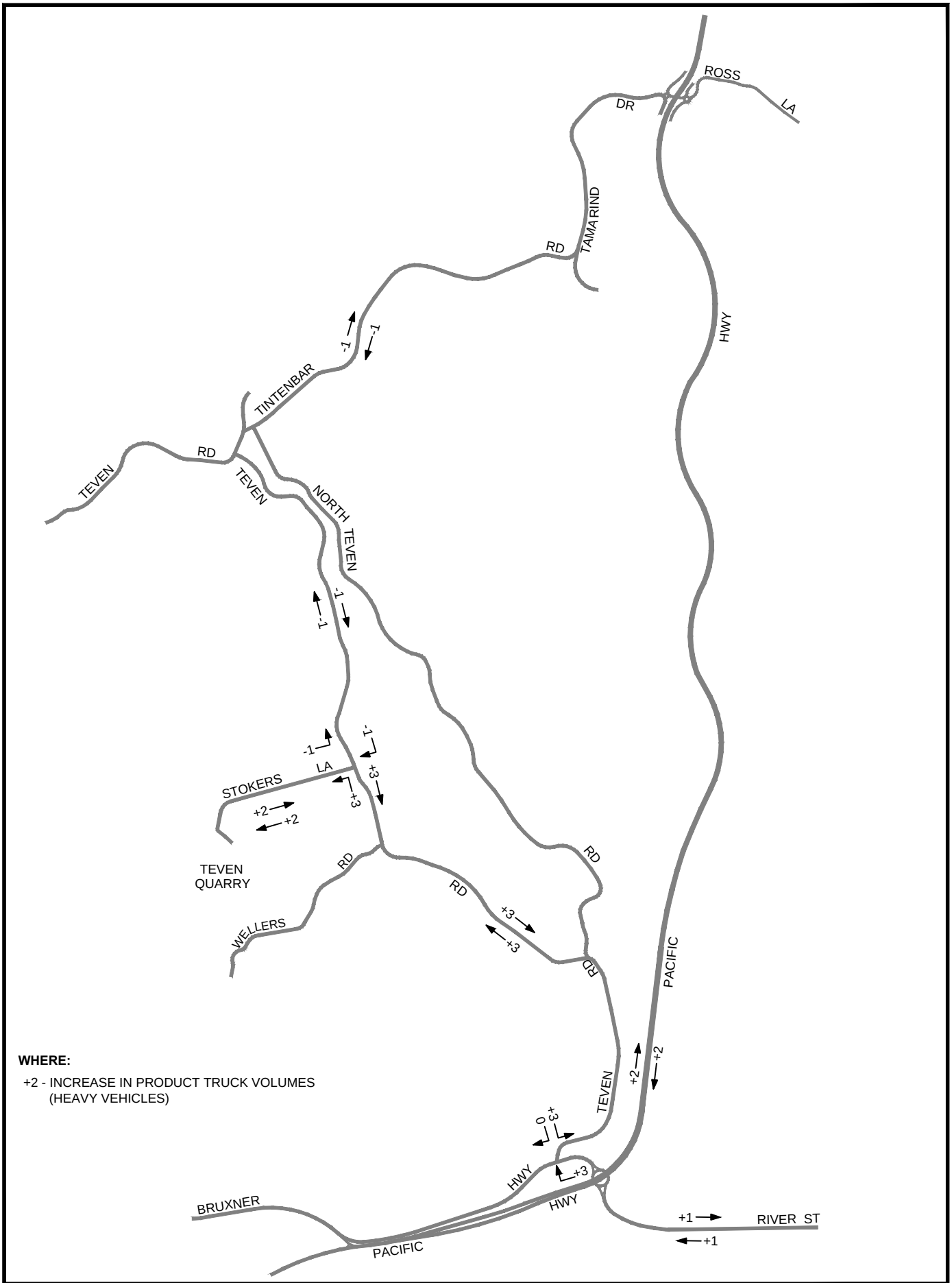

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FIGURE 8

TEVEN QUARRY, BALLINA

ADDITIONAL TRAFFIC VOLUMES FROM PROJECT IN AVERAGE AND BUSY HOUR

JOB NO. 13082

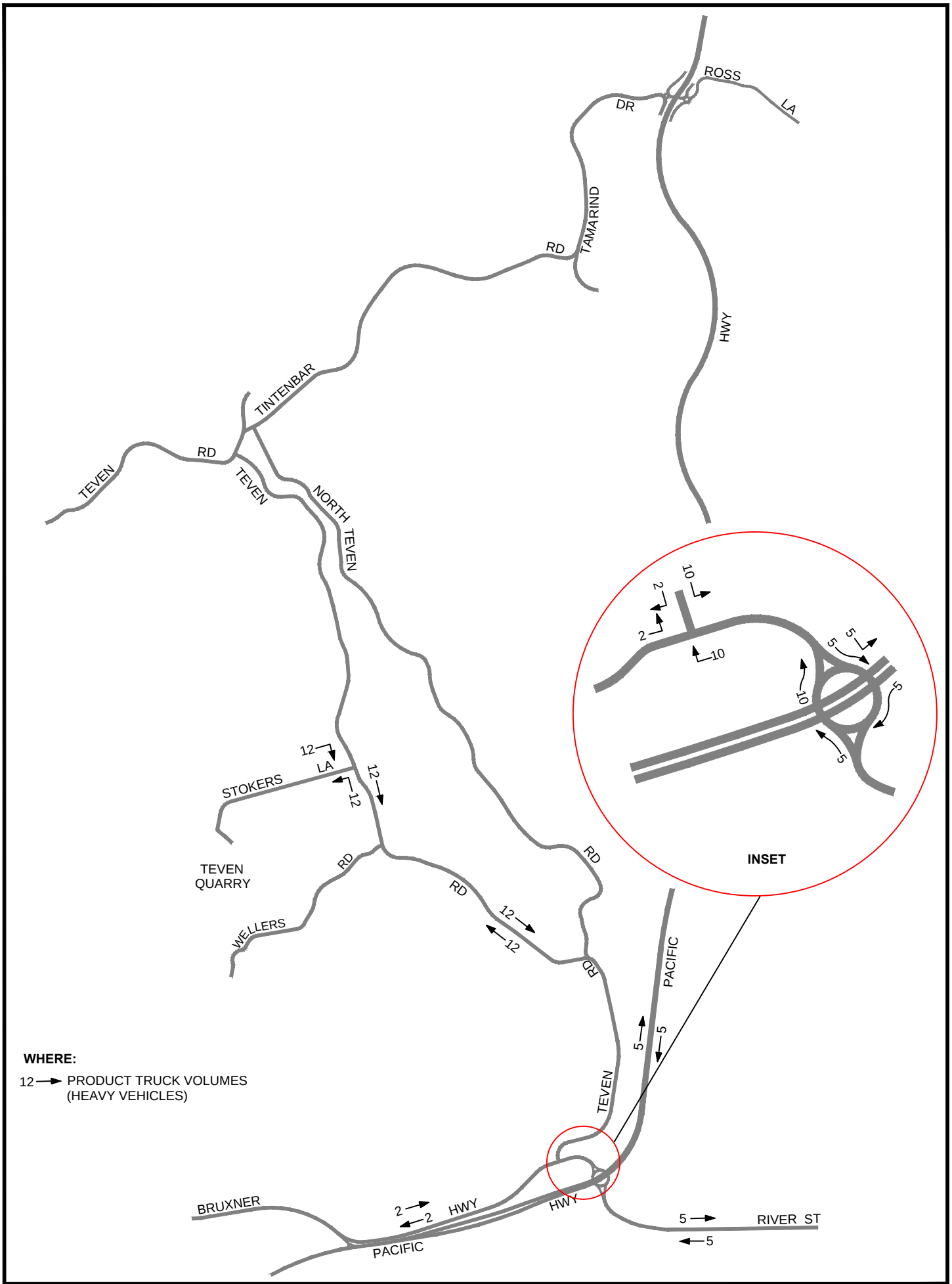

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FIGURE 9

TEVEN QUARRY,
BALLINA

TRAFFIC VOLUMES FROM PROJECT IN MAXIMUM HOUR

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TABLE 4.3

LEVEL OF SERVICE CRITERIA FOR INTERSECTIONS

Level of Service	Average Delay per Vehicle (secs/veh)	Traffic Signals, Roundabout	Give Way & Stop Signs
A	<14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity; at signals, incidents will cause excessive delays. Roundabouts require other control mode	At capacity, requires other control mode
F	>70	Intersection is oversaturated	Oversaturated, requires other control mode

Source: Table 4.1 RTA Guide to Traffic Generating Developments October 2002

The results for the traffic modelling for the Teven Road/Stokers Lane intersection are shown in Table 4.4. Reference to Table 4.4 indicates that this intersection will continue to have a very good operation in terms of Level of Service (Level of Service A operation) with low vehicle delays, during the maximum hour with the Project in place, throughout the day.

Table 4.5 shows that results of the traffic modelling for the intersection of Bruxner Highway/Teven Road. Reference to Table 4.4 shows that the AM peak hour is critical peak hour, with slightly higher delays than the other peak hour periods. The right turn out of Teven Road into Bruxner Highway is the critical movement.

The intersection will retain a Level of Service C operation (based on the delay to the right turn movement out of Teven Road) during the maximum hour in the AM peak, which is a satisfactory operation.

During the midday and PM peak hours the intersection will have a Level of Service B operation during the maximum hour, which as noted above is a satisfactory operation.

As noted in Section 3.5 there have been no reported crashes at this intersection during the 5 year period ending in June 2013 and observations at the intersection indicate that the modelled delays (as shown in Table 4.5) are higher than the actual observed delays for those movements that are required to give way at the intersection.

There is little change in overall vehicle delay between the existing conditions and with the Project during the maximum hour indicating the impacts of the Project on intersection capacity are relatively small.

On the wider road network, including the roundabout interchange intersection at Bruxner Highway/Pacific Highway and River Street the additional volumes associated with the maximum one hour will be easily accommodated without any measureable change in the Level of Service, or vehicle delay.

TABLE 4.4

SIDRA RESULTS FOR TEVEN ROAD/STOKERS LANE FOR EXISTING CONDITIONS AND WITH PROJECT DURING THE MAXIMUM HOUR IN AM, MIDDAY AND PM PEAK HOURS.

AM PEAK HOUR

Movement	Existing				With Project			
	DS	AVD (secs)	LS	95% Queue Length (m)	DS	AVD (secs)	LS	95% Queue Length (m)
West: Stokers Lane								
Left	0.015	8.5	A	0.5	0.019	8.7	A	0.7
Right	0.015	8.8	A	0.5	0.019	8.9	A	0.7
South: Teven Road								
Left	0.018	8.2	A	0	0.023	8.2	A	0
Through	0.018	0	A	0	0.023	0	A	0
North: Teven Road								
Through	0.032	0.1	A	1.4	0.029	0	A	1.1
Right	0.032	8.6	A	1.4	0.029	8.6	A	1.1
All Vehicles	**0.032**	**2.7**	**A**	**1.4**	**0.029**	**3.0**	**A**	**1.1**

MIDDAY PEAK HOUR

Movement	Existing				With Project			
	DS	AVD (secs)	LS	95% Queue Length (m)	DS	AVD (secs)	LS	95% Queue Length (m)
West: Stokers Lane								
Left	0.009	8.6	A	0.4	0.016	8.6	A	0.6
Right	0.009	8.6	A	0.4	0.016	8.9	A	0.6
South: Teven Road								
Left	0.020	8.2	A	0	0.026	8.2	A	0
Through	0.020	0	A	0	0.026	0	A	0
North: Teven Road								
Through	0.019	0.2	A	1.0	0.017	0.1	A	0.6
Right	0.019	8.7	A	1.0	0.017	8.6	A	0.6
All Vehicles	**0.020**	**2.1**	**A**	**1.0**	**0.026**	**2.9**	**A**	**0.6**

PM PEAK HOUR

Movement	Existing				With Project			
	DS	AVD (secs)	LS	95% Queue Length (m)	DS	AVD (secs)	LS	95% Queue Length (m)
West: Stokers Lane								
Left	0.008	8.3	A	0.2	0.018	8.5	A	0.7
Right	0.008	8.6	A	0.2	0.018	8.8	A	0.7
South: Teven Road								
Left	0.016	8.2	A	0	0.026	8.2	A	0
Through	0.016	0	A	0	0.026	0	A	0
North: Teven Road								
Through	0.012	0.1	A	0.4	0.012	0.1	A	0.4
Right	0.012	8.5	A	0.4	0.012	8.6	A	0.4
All Vehicles	**0.016**	**1.9**	**A**	**0.4**	**0.026**	**3.4**	**A**	**0.7**

Where: *DS* *Degree of Saturation*
AVD *Average Vehicle Delay in seconds*
LS *Level of Service*
95%tile Queue Length *95%tile Back of Queue Length in metres*

TABLE 4.5

SIDRA RESULTS FOR BRUXNER HIGHWAY/TEVEN ROAD FOR EXISTING CONDITIONS AND WITH PROJECT DURING THE MAXIMUM HOUR IN AM, MIDDAY AND PM PEAK HOURS.

AM PEAK HOUR

Movement	Existing				With Project			
	DS	AVD (secs)	LS	95% Queue Length (m)	DS	AVD (secs)	LS	95% Queue Length (m)
North: Teven Road								
Left	0.117	11.9	A	4.4	0.139	12.4	A	5.7
Right	0.104	29.7	C	4.2	0.120	30.8	C	4.9
West: Bruxner Hwy								
Left	0.010	6.3	A	0	0.012	6.3	A	0
Through	0.438	0.1	A	0	0.438	0.1	A	0
East: Bruxner Hwy								
Through	0.212	0	A	0	0.212	0	A	0
Right	0.054	11.0	A	1.7	0.076	11.8	A	2.8
All Vehicles	**0.438**	**1.0**	**C**	**4.4**	**0.438**	**1.2**	**C**	**5.7**

MIDDAY PEAK HOUR

Movement	Existing				With Project			
	DS	AVD (secs)	LS	95% Queue Length (m)	DS	AVD (secs)	LS	95% Queue Length (m)
North: Teven Road								
Left	0.042	8.5	A	1.7	0.058	9.0	A	2.6
Right	0.054	15.2	B	2.4	0.062	15.6	B	2.8
West: Bruxner Hwy								
Left	0.012	6.4	A	0	0.014	6.5	A	0
Through	0.266	0	A	0	0.266	0	A	0
East: Bruxner Hwy								
Through	0.117	0	A	0	0.117	0	A	0
Right	0.042	8.2	A	1.4	0.057	8.6	A	2.2
All Vehicles	**0.266**	**1.0**	**B**	**2.4**	**0.266**	**1.2**	**B**	**2.8**

PM PEAK HOUR

Movement	Existing				With Project			
	DS	AVD (secs)	LS	95% Queue Length (m)	DS	AVD (secs)	LS	95% Queue Length (m)
North: Teven Road								
Left	0.063	11.3	A	2.2	0.087	12.2	A	3.5
Right	0.062	21.0	B	1.8	0.076	22.7	B	2.4
West: Bruxner Hwy								
Left	0.003	6.2	A	0	0.005	6.3	A	0
Through	0.441	0.1	A	0	0.441	0.1	A	0
East: Bruxner Hwy								
Through	0.198	0	A	0	0.198	0	A	0
Right	0.080	11.7	A	2.5	0.101	11.7	A	3.6
All Vehicles	**0.441**	**0.8**	**B**	**2.5**	**0.441**	**1.0**	**B**	**3.6**

Where: *DS* *Degree of Saturation*
AVD *Average Vehicle Delay in seconds*
LS *Level of Service*
95%tile Queue Length *95%tile Back of Queue Length in metres*

4.4.3 Summary

The impacts of the additional traffic generated by the Project on the road network are expected to be satisfactory.

Teven Road, between Stokers Lane and Bruxner Highway, carries relatively low traffic volumes and the increase in traffic from the Project can be easily absorbed without any change in the Level of Service or overall vehicle delay.

Traffic modelling confirms that traffic conditions at the principal intersection of Stokers Lane/Teven Road and Bruxner Highway/Teven Road will remain satisfactory with the additional traffic from the Project.

On the wider state road network the increase in traffic volumes as a result of the Project will be relatively small, with minimal impacts on traffic conditions on these roads.

4. 5 Road Maintenance

It is noted that Holcim Australia currently pays a contribution rate of $0.345/tonne. Analysis of the proposed haul routes detailed in **Figure 3** show that Route 1 traverses 5.8 km of Council-managed road (Teven Quarry to Teven Rd/Bruxner Highway), while Route 2 traverses 9.6 km of Council-managed road (Teven Quarry to Tamarind Drive/Pacific Highway). As detailed in Section 2, it is proposed that under the project, the proportion of product hauled on Route 1 will increase from the existing 70 % to 95 %, while on Route 2, it will decrease from the existing 30 % to 5 %. This is due to geographic changes to the forecast market demand for quarry product at the proposed higher extraction rates.

Section 3.3.1 of the Contributions Plan (2011) provides for Council's discretion to apply a different formula for calculation of the contribution as follows:

> *'Council however may at its discretion use a different travel distance for the purpose of this formula where there is sufficient evidence provided or obtained that indicates that there is a significant difference between the typical/average travel distance and the standard 12 km assumed travel distance.'*

Section 3.3.1 of Council's 'Ballina Shire Heavy Haulage Contributions Plan 2011' also stipulates an average replacement cost of $0.053 tonne/km for the damage to pavement by a typical heavy vehicle used to transport quarry material for a typical shire road. Under the proposed haulage split outlined above, based on a weighted average travel distance of 5.99 km (half the 12 km assumed travel distance), a pro rata application of the replacement cost for damage to Council roads caused by haul trucks from Teven Quarry would be $0.317/tonne. This rate is slightly less than the current contribution rate of $0.345/tonne paid by Teven Quarry.

Hence, given that the current Contributions Plan rate of $0.6455/tonne is approximately double a pro rata contribution rate and the existing rate paid by Teven Quarry, it is proposed that an equitable contribution rate for Teven Quarry would be maintenance of the existing contribution rate of $0.345/tonne, subject to CPI increases as detailed in the Contributions Plan (2011).

4.6 Road Safety

The Project is not expected to have any negative impacts on road safety. The proposed change in the transport routes for all product trucks to use the Pacific Highway when travelling north (in lieu of Tintenbar/Tamarind Drive) for all deliveries other than local deliveries, should enhance potential road safety on the network and will reduce the potential for a quarry product truck to be involved in an incident on the Tintenbar Road route.

The principal intersections that will be used by the Product trucks all provide a good to satisfactory Level of Service and meet current standards.

The Pacific Highway around Ballina is gradually being upgraded and this work will continue over the next 10 years, generally improving road safety outcomes.

4.7 Impact on Other Road Users

Pedestrian and bicycle activity on the transport routes and intersections used by the product quarry trucks is minimal, with no pedestrians or cyclists observed using the road network adjacent Teven Quarry during the site inspections and or in the traffic counts. The impact on pedestrians and cyclists of the Project are assessed as minimal.

School buses currently use Teven Road in the morning and afternoon periods on school days and co-exist with Teven Quarry product trucks and other trucks and vehicles that use Teven Road. No adverse impacts are expected to school bus services due to the Project. The actual increase in product trucks of an average of 2 truck movements per hour in each direction of Teven Road, south of Stokers Lane is relatively small in real terms. School buses are highly visible and operate at times that would be known to Holcim Australia's truck drivers and other local truck drivers who deliver material sourced from the quarry.

4.8 Future Traffic Conditions

Traffic conditions on the road network adjacent Teven Quarry are expected to remain satisfactory in future years with the Project in place.

Current and future highway upgrade works will continue to improve the capacity and the standard of the state road network around Ballina and should result in improved road safety outcomes on these roads.

Teven Road between Stokers Lane and Bruxner Highway carries relatively low traffic volumes and the road has plenty of capacity to cater for future incremental traffic growth associated with development growth in the region.

5.0 CONCLUSIONS

This report documents the assessment of the traffic impacts of a proposal to increase maximum production at Teven Quarry from 265,000 tonnes per annum to 500,000 tonnes per annum. The proposed increased maximum annual production is required to meet increasing demand for quarry products associated with current and future road upgrade works in the region and significant population growth.

The existing quarry operation generates:

- Some 60 two way vehicle trips per day for light vehicles based on 30 inbound trips and 30 outbound trips;

- 78 two way heavy vehicle truck trips per day (on an average day for 265,000 tpa) based on 39 inbound truck trips and 39 outbound truck trips.

The additional traffic generation from the Project based on 500,000 tpa is estimated to be on average:

- 10 two way light vehicle trips per day based on 5 inbound trips and 5 outbound trips; and

- 68 two way heavy vehicle trips per day based on 34 inbound trips and 34 outbound trips.

The assessment has found that the impacts of the Project on the road network and principal intersections would be satisfactory.

Due to the proposed changes in product haulage hours up to 10pm on a campaign basis, night time road haulage improvements in delineation are proposed in Teven Road between Stokers Lane and Bruxner Highway.

REFERENCES

1. Austroads Guide to Road Design

2. Austroads Guide to Road Safety – Version 1 Dec 2010

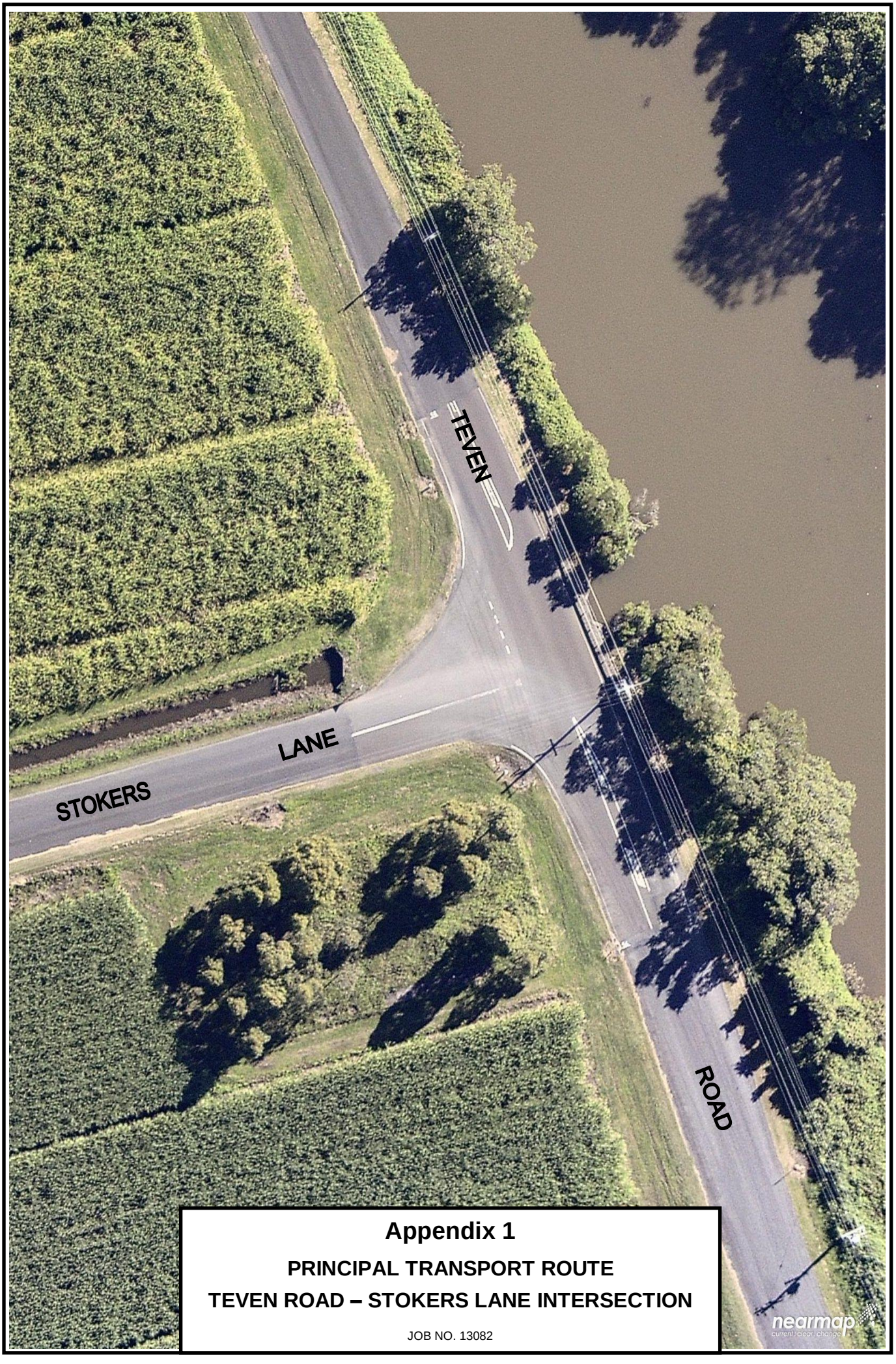
3. Austroads Guide to Traffic Management

4. RTA (now RMS) Austroads Guide Supplements – Austroads Guide to Traffic Management – January 2011

5. RTA (now RMS) Supplement to Austroads Guide to Road Design Parts 1-5, 6 and 8

6. RMS Supplements to Austroads Guide to Road Safety

7. RMS Northern Region – Crash Statistics for 1 July 2008 to 30 June 2013



Appendix 1

PRINCIPAL TRANSPORT ROUTE

TEVEN ROAD – STOKERS LANE INTERSECTION

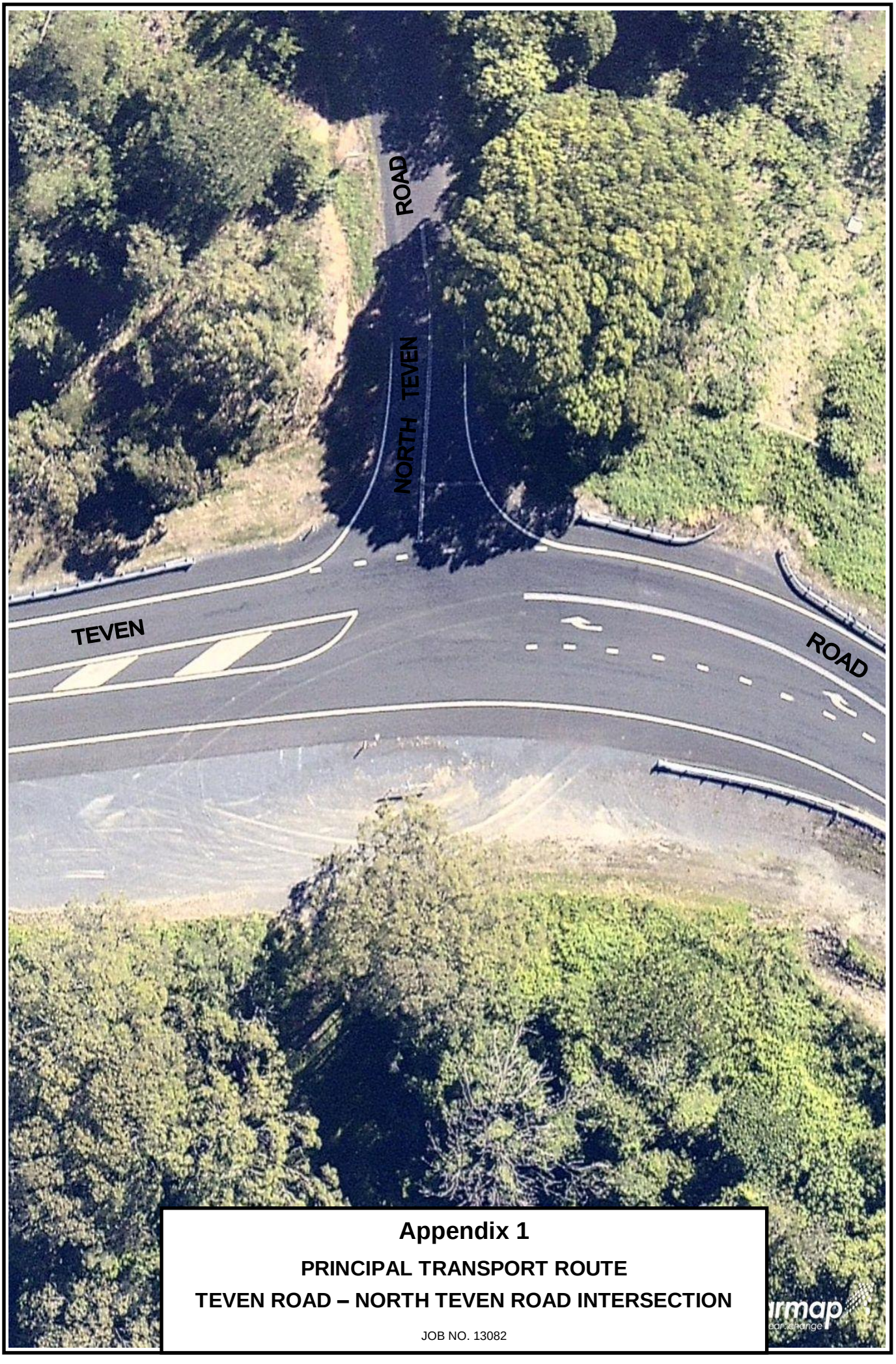
JOB NO. 13082

Appendix 1

PRINCPAL TRANSPORT ROUTE

TEVEN ROAD – WELLERS ROAD INTERSECTION

JOB NO. 13082



Appendix 1

PRINCIPAL TRANSPORT ROUTE

TEVEN ROAD – NORTH TEVEN ROAD INTERSECTION

JOB NO. 13082

Appendix 1

PRINCIPAL TRANSPORT ROUTE

TEVEN ROAD – BRUXNER HIGHWAY INTERSECTION

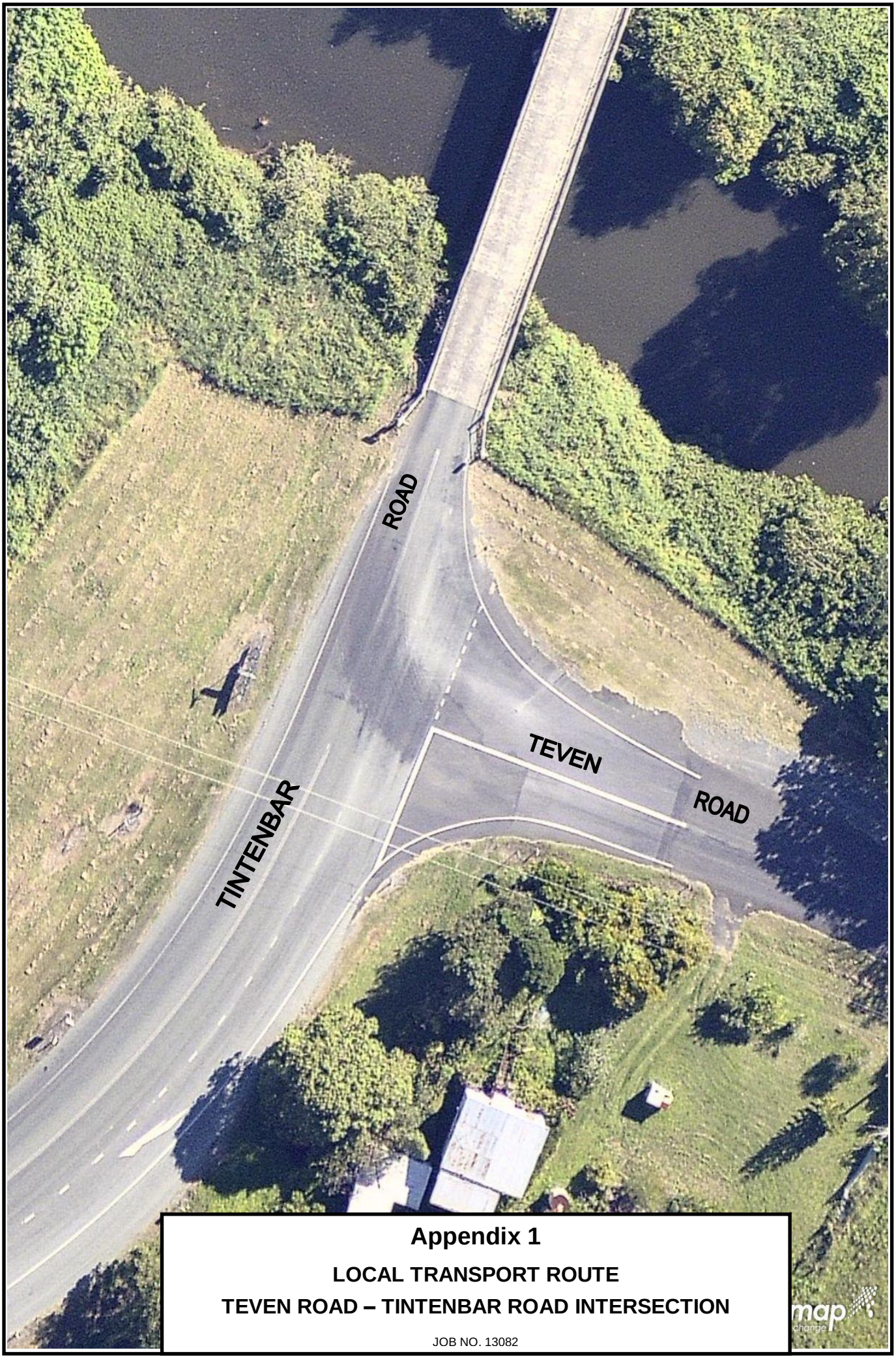
JOB NO. 13082

Appendix 1

PRINCIPAL TRANSPORT ROUTE

PACIFIC HIGHWAY – BRUXNER HIGHWAY INTERCHANGE

JOB NO. 13082



Appendix 1

LOCAL TRANSPORT ROUTE

TEVEN ROAD – TINTENBAR ROAD INTERSECTION

JOB NO. 13082

Appendix 1

LOCAL TRANSPORT ROUTE

TINTENBAR ROAD – TAMARIND DRIVE INTERSECTION

JOB NO. 13082

Appendix 1

LOCAL TRANSPORT ROUTE

PACIFIC HIGHWAY – TAMARIND DRIVE INTERCHANGE

JOB NO. 13082

ROAD SAFETY AUDIT REPORT

STAGE 5 AUDIT

OF TRANSPORT ROUTES ON LOCAL ROADS FOR

TEVEN QUARRY

AT

TEVEN

Ref. 13082RSA2

30 May 2014

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CONTENTS

APPENDICES

ILLUSTRATIONS

1.0 INTRODUCTION

1.1 Auditors and Audit Process

This report details the results of a Stage 5 Road Safety Audit of the existing transport routes on local roads for Teven Quarry at Teven on the far north coast of NSW.

The provision of a Stage 5 Road Safety Audit of the transport routes was requested by the RMS as part of the investigation and assessment of transport impacts of a proposal to increase sales and production of Teven Quarry. A road safety audit is a formal process that seeks to identify potential safety issues on existing roads or with proposed road projects. Its recommendations are restricted to road safety considerations.

The audit was carried out by:

- Terry Lawrence - Level 3 Road Safety Auditor (Team Leader)
- Geoff Morris - Road Safety Auditor

The day/night audit inspections of the transport routes were undertaken on Monday 26 May 2014 and the audit report prepared following the audit inspections.

The audit has generally been carried out following the procedures set out in the Roads and Maritime Services Guidelines for Road Safety Audit Practice.

The audit examines the features of the local roads that form the transport routes which may affect road user safety and it has sought to identify potential safety hazards. However, the auditors point out that no guarantee is made that every deficiency has been identified. Further, if all the recommendations in this report were to be followed, this would not confirm that the existing roads are 'safe'; rather, adoption of any recommendations may improve the level of safety on the transport routes.

As the road safety audit was not commissioned in a formal process, there was no entry or exit meetings, or any Correction Action Reports (CARS) issued. The audit findings are presented in section 4 of the report.

The audit findings include specific recommendations about the Transport Routes as well as improvements to Transport Route 1, which is the Principal Transport Route.

2.0 DESCRIPTION OF THE TRANSPORT ROUTES AND BACKGROUND INFORMATION

There are two transport routes to and from the quarry as follows;

- Route 1 - which is the main transport route and includes Stokers Lane, south along Teven Road to Bruxner Highway and then via the state highway/state road system to Lismore, Ballina and or north and south via the Pacific Highway.

- Route 2 – which is a local transport route and includes Stokers Lane, north along Teven Road to Tintenbar Road and then Tamarind Drive to travel west, north or east.

Figure 1 shows the existing transport routes on local roads.

The existing split for trucks generated by Teven Quarry is:

- 70% via Route 1
- 30% via Route 2

The bulk of the truck trips using Route 2 has been/is associated with the Pacific Highway upgrade works at/near Tintenbar which is north of Teven Quarry.

Transport Route 1

Stokers Lane

Stokers Lane is a local road which provides direct vehicle access to Teven Quarry at its western end and intersects with Teven Road at a T junction at its eastern end.

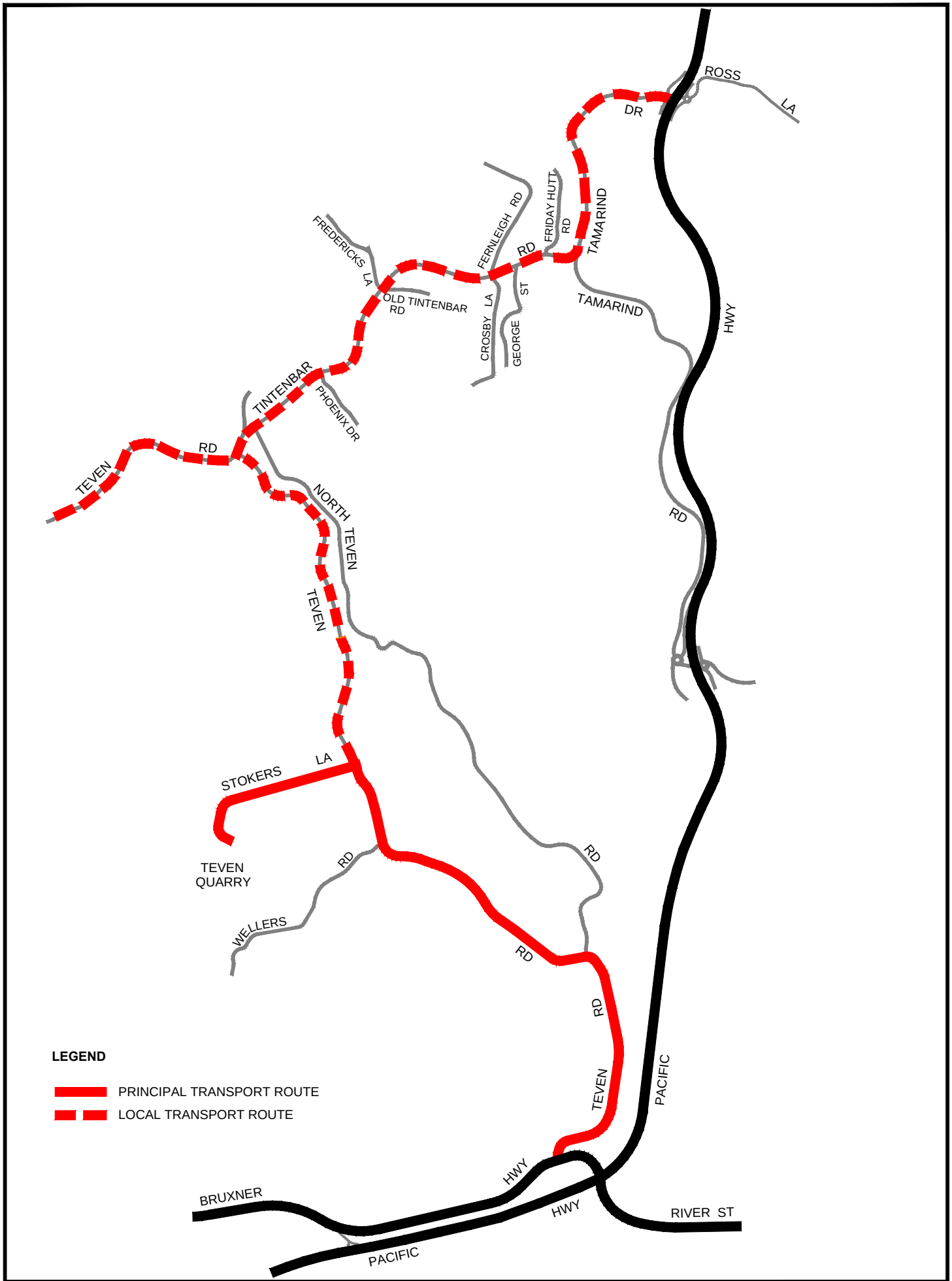
Stokers Lane has a 7.0 metre wide sealed pavement, with grass shoulders 2.0 – 3.0 metres wide. It has a 90º bend (alignment change) 200 metres north of the quarry entrance and a flat grade.

Sight distance in Stokers Lane is good and it has a speed limit of 80km/h.

Average weekday two way traffic volumes in Stokers Lane are 205 vehicles per day (vpd).

Sight distance at the Teven Road/Stokers Lane intersection is good and exceeds 200 metres in both directions of Teven Road. A painted median is also provided in both approaches of Teven Road at the intersection, together with Give Way Control and double barrier centreline in Stokers Lane. Intersection warning signs (trucks) are also provided on all approaches. Large corner radii are provided for the truck left turn movements into and out of Stokers Lane at the intersection. The intersection has BAR and BAL (i.e. basic right and left turn) treatments in Teven Road. Guardrail is also provided on the eastern side of Teven Road, at the intersection.

The operating speed limit in Teven Road at the intersection is 80km/h.



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NOT TO SCALE

FIGURE 1

TEVEN QUARRY,
BALLINA

TRANSPORT ROUTES ON LOCAL ROADS

JOB NO. 13082-RSA

Teven Road, South of Stokers Lane

Teven Road is a major local road that connects between Bruxner Highway at West Ballina and Tintenbar Road at Teven.

Teven Road, south of Stokers Lane provides direct access to Bruxner Highway and the Pacific Highway interchange, as well as to Ballina via River Street (Old Pacific Highway).

The section of Teven Road between Stokers Lane and Bruxner Highway provides a sealed road pavement of variable width. Most sections provide a width of 7.0 metres or wider providing 2 x 3.5 metre wide travel lanes, although there are several sections where the pavement width is 6.5 metres. Road shoulders vary up to 2.0 metres and are typically grass. The traffic management along Teven Road includes isolated centre line markings, guide posts and reflectors, warning signs at intersections and on curves.

The horizontal alignment follows the creek with a series of gentle curves and new bridge structures and alignment change near the intersection with North Teven Road.

The section between North Teven Road and Bruxner Highway passes through a small industrial area.

The speed limit in Teven Road is 60km/h near Bruxner Highway reducing to 50km/h near the North Teven Road intersection and bridges and increasing to 80km/h north of the northern bridge.

Sight distance along Teven Road is generally good and the vertical alignment is mostly flat, except at the new bridge structures.

Average weekday two way traffic volumes in Teven Road, south of Stokers Lane are 760vpd, increasing to 1160vpd near the Bruxner Highway.

Intersections in Teven Road between Stokers Lane and Bruxner Highway include:

- Stokers Lane – T junction intersection;
- Wellers Road – minor T junction intersection;
- North Teven Road – channelised T junction intersection;
- New Place – minor T junction intersection;
- Bruxner Highway – channelised T junction intersection

Sight distance at all these intersections is considered satisfactory for the posted speed limits and the estimated vehicle operating speeds at the intersections.

The distance between Stokers Lane and Bruxner Highway is approximately 4.5 kms.

Teven Road forms a T junction intersection at Bruxner Highway. There is also a left turn into a truck stop area from the eastern approach of Bruxner Highway. The intersection channelisation includes:

- Give way control together with right and left turn lanes in Teven Road at Bruxner Highway;

- Two through lanes in the eastern approach of Bruxner Highway, together with a right turn bay (CHR) and left turn bay (AUL) for left turn access into the adjacent property.

- One through lane and a left turn lane (AUL) in the western approach of Bruxner Highway.

Sight distance in Bruxner Highway at the intersection is good (250 metres in both directions) and the operating speed limit is 60km/h. The intersection has been recently reconstructed and satisfies current Austroad standards.

Transport Route 2

Teven Road, North of Stokers Lane

The section of Teven Road, north of Stokers Lane provides access to Tintenbar Road.

This section is approximately 3.5km long with a series of curves and bends with a sealed pavement of 6.5 – 6.7 metres wide and 1.0 – 2.0 metres grass shoulders. The vertical alignment is flat. Traffic management includes isolated guide posts/reflectors on bends and at drainage structures. The speed limit in this section of Teven Road is 80km/h.

Intersections include several minor agricultural roads, as well as the Tintenbar Road/Teven Road intersection, all of which are T junction intersections.

Teven Road forms a T junction intersection with Tintenbar Road. The intersection geometry includes:

- Stop sign control on Teven Road (eastern approach);

- A single lane approach in the southern approach of Teven Road, which is constructed around a 90º bend;

- A single lane plus short auxiliary lane in northern approach of Tintenbar Road. The auxiliary lane extends to the departure side of the intersection to assist left turns into and out of the eastern leg of Teven Road.

Sight distance is reduced to around 140 metres by the bend/curve in the southern approach of Teven Road to the intersection, which also reduces vehicle speeds in this approach. A narrow two way bridge, (5.8 metres wide) is located in the northern approach of Tintenbar Road approximately 25 metres from the intersection. Sight distance in this approach is approximately 190 metres.

The speed limit at the intersection is 80km/h, however operating vehicle speeds would be less than this, due to the alignment and constraints of the Tintenbar Road northern approach and the Teven Road southern approach.

Average weekday two way traffic volumes using this section of Teven Road are 693vpd.

Tintenbar Road/Tamarind Drive

Tintenbar Road/Tamarind Drive route connects between Teven Road at Teven and the Pacific Highway. The route is an unclassified regional road and is approximately 5.5km in length.

Tintenbar Road is a two lane rural road with a high level of traffic management including turning lanes at principal intersections, guideposts/reflectors centreline road marking, warning signs, edgelines and Raised Reflective Pavement Markers (RRPM's).

The road passes through rolling terrain and the road's alignment matches the terrain. There is a narrow two way bridge just north of Teven Road intersection. No overtaking is permitted on the bridge, due to the close distance (25 metres) of the Teven Road intersection.

A passing or overtaking lane is provided for the northbound direction, north of North Teven Road.

Intersections along Tintenbar Road include;

- Teven Road – a T junction intersection;
- North Teven Road – a channelised T junction intersection;
- Phoenix Drive - a channelised T junction intersection;
- Fredericks Lane/Old Tintenbar Road – a channelised offset cross junction;
- Crosby Lane/Fernleigh Road – a minor offset cross junction;
- George Street – a channelised T junction intersection;
- Friday Hutt Road – a channelised T junction intersection;
- Tamarind Drive – a channelised seagull intersection where Tintenbar Road forms a T junction with Tamarind Drive.

Average weekday two way traffic volumes in Tintenbar Road north of Teven Road is 3150vpd.

Tamarind Drive is generally a two lane rural road constructed to a good standard with a section of overtaking lane and a high level of traffic management.

Tamarind Drive forms roundabout intersections adjacent the Pacific Highway with Saddle Road and Kinvara Ridge Road which provide north facing ramps to the Pacific Highway, between Tintenbar and Knocknow.

The speed limit in Tintenbar Road and Tamarind Drive is generally 80km/h except at roundabout intersections in Tamarind Drive at the Pacific Highway where the speed limit is 60km/h.

3.0 RECOMMENDATIONS FROM PREVIOUS AUDITS

It is not known if any previous road safety audits have been undertaken on the above local roads that form the transport routes.

4.0 AUDIT FINDINGS AND RECOMMENDATIONS

4.1 Findings and Risk Ranking

Tables 4.1 and 4.2 below presents the auditor's comments on the various matters where a risk or a potential safety issue has been identified, and or where the auditors have made a specific recommendation, based on the audit findings and the inspection of the local road network.

If applicable, where risks and potential safety issues have been identified, these have been ranked using Austroads Ranking method, based on frequency, severity, overall level of risk and treatment approach presented in Tables 4.1 to 4.4 in Guide to Road Safety Part 6: Road Safety Audit (See Appendix 3).

The risk rankings and Austroads Suggested treatment approach are defined as follows;

- Intolerable - Must be corrected
- High - Should be corrected or the risk significantly reduced, even if the treatment cost is high
- Medium - Should be corrected or the risk significantly reduced, if the treatment cost is moderate, but not high
- Low - Should be corrected or the risk reduced, if the treatment cost is low

In addition Appendix 2 (Audit checklists) shows the auditors comments on all matters considered as part of the Stage 5 audit. Separate checklists have been prepared for Transport Route 1 and Transport Route 2.

4.2 Audit Findings and Recommendations

The audit team found that the alignment of Teven Road between Stokers Lane and Bruxner Highway is superior to the section north of Stokers Lane, with fewer curves and better sight lines.

In addition, the alignment of Pacific Highway between Bruxner Highway and Tamarind Drive which has been upgraded to a 4 lane divided carriageway is superior to Tintenbar Road/Tamarind Drive route and is better suited to heavy vehicles.

Based on the above reasons, the Audit team recommends that Transport Route 1 be retained as the Principal Transport Route and be used for all future deliveries for road upgrade works north of Ballina.

Several other relatively minor issues were identified in Teven Road between Stokers Lane and Bruxner Highway and these are outlined below.

The main findings of the Road Safety Audit are:

- Transport Route 1 which includes Stokers Lane, south along Teven Road to Bruxner Highway and then west towards Lismore and or east to travel to the Pacific Highway (for trips north or south) or to Ballina (east) via River Street should be maintained as the principal transport route from Teven Quarry including the route for any deliveries associated with future upgrading works

associated with the Pacific Highway. This should account for approximately 95% of all deliveries from Teven Quarry.

- Transport Route 2 which includes Stokers Lane, north along Teven Road to Tintenbar Road and then north along Tintenbar Road to Tamarind Drive should be maintained as a local route only and be restricted to local deliveries (ie. approximately 5% of deliveries).

- For Transport Route 1, improved delineation in Teven Road between Stokers Lane and Bruxner Highway is recommended due to the proposed special circumstances night time haulage. This includes:

    (i) Centreline markings in Teven Road between Stokers Lane and Bruxner Highway including the maintenance of the existing linemarking (where required) in Teven Road.

    (ii) Provision of reflectors on the existing guardrail fencing at the intersections of Stokers Lane and Wellers Road, with Teven Road.

    (iii) Maintenance of existing end treatment of guardrail in Teven Road at Stokers Lane.

No specific recommendations are made for Transport Route 2 which will be a local transport route only. Table 4.2 shows the audit findings for Transport Route 2.

TABLE 4.1

AUDIT FINDINGS

Transport Route 1

No.	Issue	Risk or Potential Safety Issue	Preliminary Risk Rating (low, Medium, high, intolerable)
1	Transport Route 1 (i.e. Tevens Road between Stokers Lane and Bruxner Highway) should be retained as the principal road haulage route, with all deliveries other than local deliveries using this route to the state road network including the Pacific Highway.	Alignment of Teven Road between Stokers Lane and Bruxner Highway is superior to the section north of Stokers Lane, with fewer curves and better sight lines. Pacific Highway between Bruxner Highway and Tamarind Drive interchange is a superior route in terms of alignment, lanes etc to the Tintenbar Road/Tamarind Drive route and is better suited to heavy vehicles.	Medium

No.	Issue	Risk or Potential Safety Issue	Preliminary Risk Rating (low, Medium, high, intolerable)
2	Due to proposed special circumstances night time road haulage, it is recommended that delineation be improved in Teven Road between Stokers Lane and Bruxner Highway, this includes; (i) Centreline marking in Tevens Road including maintenance of existing linemarking where required; (ii) Provision of reflections on the existing guardrail fencing in Tevens Road at the intersections of Stokers Lane and Wellers Road.	Delineation for night time driving conditions needs to be improved / upgraded to suit proposed higher usage during night time hours.	Medium
3	Replace damaged end treatment of existing guardrail in Tevens Road at Stokers Lane.	Damaged end represents a potential risk to safety for an out of control vehicle travelling southbound at/near Stokers Lane that may collide with the guardrail.	Medium

TABLE 4.2

AUDIT FINDINGS

Transport Route 2

No.	Issue	Risk or Potential Safety Issue	Preliminary Risk Rating (low, Medium, high, intolerable)
1	Pipe and rail fencing used on narrow bridge in Tintenbar Road north of Teven Road	Out of control vehicle may crash through pipe and rail fence into creek	Medium

5.0 FORMAL STATEMENT

We have examined the existing local roads that form the transport routes for Teven Quarry and we have audited these roads in accordance with the procedures set out in the RMS Guidelines for Road Safety Audit Practice. The audit has been carried out for the sole purpose of identifying any features of the existing roads that could be changed to improve safety. The audit findings and recommendations are presented in Section 4.

30 May 2014
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Terry Lawrence

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Geoff Morris

APPENDIX 1

1. Austroads Guide to Road Safety
   Part 6: Road Safety Audit

2. Roads and Maritime Services - Guidelines for Road Safety Audit Practice

3. Roads and Maritime Services – Road Environment Safety Guidelines

4. Austroads – Guide to Road Design and RMS Supplements

5. Austroads – Guide to Traffic Management and RMS Supplements

APPENDIX 2A

TRANSPORT ROUTE 1 – STOKERS LANE AND TEVEN ROAD BETWEEN STOKERS LANE AND BRUXNER HIGHWAY

CHECKLIST 6: ROAD SAFETY AUDIT OF EXISTING ROADS

No.	Issue	Yes	No	Comments
6.1 1	**ROAD ALIGNMENT AND CROSS SECTION** **Visibility; Sight Distance** Is sight distance appropriate for the speed of traffic using the route?	✓		
	Is adequate sight distance provided for intersections and crossings? (for example pedestrian, cyclist, cattle, railway)	✓		
	Is adequate sight distance provided for all private driveways and property entrances?	✓		
2	**Design Speed** Is the horizontal and vertical alignment suitable for the (85th percentile) traffic speed?			
	If not: – Are warning signs installed? – Are advisory speed signs installed?			
	Are the posted advisory speeds for curves appropriate?	✓		
3	**Speed Limit / Speed Zoning** Is the speed limit compatible with the function, road geometry, landuse and sight distance?	✓		
4	**Overtaking** Are safe overtaking opportunities provided?	✓		Two lane low volume road. Limited opportunities to overtake.
5	**Readability** Is the road free of elements that may cause confusion? For example: Is alignment of the roadway clearly defined? Has disused pavement (if any) been removed or treated? Have old pavement markings been removed properly? Do tree lines follow the road alignment? Does the line of street lights or poles follow the road alignment?	 ✓ ✓ 	 N/A N/A N/A	 On sections of the road.
	Is the road free of misleading curves or combinations of curves?	✓		
6	**Widths** Are medians and islands of adequate width for likely users?			N/A
	Are traffic lane and carriageway widths adequate for the traffic volume and mix?	✓		
	Are bridge widths adequate?	✓		
7	**Shoulders** Are shoulders wide enough to allow drivers to regain control of errant vehicles?			Shoulder widths vary and are typical for low volume rural roads.
	Are shoulders wide enough for broken down vehicles and emergencies to stop safely?	✓		In most locations.
	Are shoulders sealed?		✓	
	Are shoulders trafficable for all vehicles and road users? (ie. are shoulders in good condition)			Shoulders are grass and trafficable in most sections.

No.	Issue	Yes	No	Comments
	Is the transition from road to shoulder safe? (no drop offs.)	✓		
8	**Crossfalls** Is the appropriate super elevation provided on curves?	✓		
	Is any adverse crossfall safely managed (for cars, trucks, etc.)?	✓		
	Do cross falls (carriageway and shoulder) provide adequate drainage?	✓		
9	**Batter Slopes** Are batter slopes traversable by cars and trucks that run off the road?			N/A. No batter slopes.
10	**Drains** Are roadside drains and culvert end walls traversable?		✓	
6.2 1	**AUXILIARY LANES** **Tapers** Are starting and finishing tapers located and aligned correctly?			N/A. No auxillary lanes.
	Is there sufficient sight distance to the end of the auxiliary lane?			N/A
2	**Shoulders** Are appropriate shoulder widths provided at merges?			N/A
	Have shoulder widths been maintained beside the auxiliary lane?			N/A
3	**Signs and Markings** Have all signs been installed in accordance with the appropriate guidelines?			N/A
	Are all signs conspicuous and clear?			N/A
	Does all linemarking conform with these guidelines?			N/A
	Is there advance warning of approaching auxiliary lanes?			N/A
4	**Turning Traffic** Have all right turns from the through lane been avoided?			N/A
	Is there advance warning of turn lanes?			N/A
6.3 1	**INTERSECTIONS** **Location** Are all intersections located safely with respect to the horizontal and vertical alignment?	✓		
	Where intersections occur at the end of high speed environments (eg. at approaches to towns), are there traffic control devices (eg. rumble strips) to alert drivers?			N/A
2	**Visibility; Sight Distance** Is the presence of the intersection obvious to all road users?	✓		
	Is the sight distance appropriate for all movements and all users?	✓		
	Is there safe stopping sight distance to the rear of any queue or slow moving turning vehicles?	✓		
	Has the appropriate sight distance been provided for entering and leaving vehicles?	✓		

No.	Issue	Yes	No	Comments
3	**Controls and Delineation** Are pavement markings and intersection control signs satisfactory?	✓		
	Are vehicle paths through intersections delineated satisfactorily?	✓		
	Are all lanes properly marked (including any arrows)?	✓		
4	**Layout** Are all conflict points between vehicles safely managed?	✓		
	Is the intersection layout obvious to all road users?	✓		
	Is the alignment of kerbs obvious and appropriate?	✓		
	Is the alignment of traffic islands obvious and appropriate?	✓		
	Is the alignment of medians obvious and appropriate?	✓		
	Can all likely vehicle types be accommodated?	✓		
	Are merge tapers long enough?			N/A
	Is the intersection free of capacity problems that may produce safety problems?	✓		
5	**Miscellaneous** Particularly at rural sites, are all intersections free of loose gravel?			
6.4 1	**SIGNS AND LIGHTING** **Lighting** Is lighting required and, if so, has it been adequately provided?		✓	Street lighting provided at Bruxner/Teven Road intersection. No street lighting on rest of route.
	Is the road free of features that interrupt illumination (for example trees or overbridges)?			N/A
	Is the road free of lighting poles that are a fixed roadside hazard?			N/A
	Are frangible or slip base poles provided?			N/A
	Ambient lighting: if it creates special lighting needs, have these been satisfied?			N/A
	Is the lighting scheme free of confusing or misleading effects on signals or signs?			N/A
	Is the scheme free of any lighting black patches?			N/A
2	**General signs issues** Are all necessary regulatory, warning and direction signs in place? Are they conspicuous and clear?	✓		
	Are the correct signs used for each situation and is each sign necessary?	✓		
	Are all signs effective for all likely conditions (for example day, night, rain, fog, rising or setting sun, oncoming headlights, poor lighting)?	✓		
	If restrictions apply for any class of vehicle are drivers adequately advised?			N/A
	If restrictions apply for any class of vehicle are drivers advised of alternative routes?			N/A

No.	Issue	Yes	No	Comments
3	**Sign Legibility** In daylight and darkness, are signs satisfactory regarding visibility? – Clarity of message? – Readibility / legibility at the required distance?	✓		
	Is sign retroreflectivity or illumination satisfactory?	✓		
	Are signs able to be seen without being hidden by their background or adjacent distractions?	✓		
	Is driver confusion due to too many signs avoided?	✓		
4	**Signs Supports** Are sign supports out of the clear zone?		✓	Warning sign posts are frangible.
	If not, are they: – Frangible – Shielded by barriers (for example, guard fence, crash cushions)?	✓		 N/A N/A
6.5 1	**DELINEATION AND GUIDANCE** **General Issues** Is the linemarking and delineation: – Appropriate for the function of the road? – Consistent along the route – Likely to be effective under all expected conditions? (day, night, wet, dry, fog, rising and setting sun position, oncoming headlights, etc.)		✓	Centreline dividing separation line required in Teven Road for full length, particularly for night time conditions.
	Is the pavement free of excessive markings? (for example unnecessary turn arrows, unnecessary barrier lines, etc.)	✓		
2	**Centrelines, Edgelines, Lanelines** Are centrelines, edgelines, lanelines provided? If not, do drivers have adequate guidance?		✓	Double barrier lines provided along route at a number of locations. However centreline marking not provided on full route.
	Are RRPMs required?		✓	
	If RRPMs are installed, are they correctly placed, correct colours, in good condition?			N/A
	Are profiled (audible) edgelines provided where required?			N/A
	Is the linemarking in good condition?			Limited Linemarking. Some maintenance required.
	Is there sufficient contrast between linemarking and pavement colour?	✓		
3	**Guideposts and Reflectors** Are guideposts appropriately installed?	✓		
	Are delineators clearly visible?	✓		
	Are the correct colors used for the delineators?	✓		
	Are the delineators on guardfences, crash barriers and bridge railings consistent with those on the guideposts?		✓	Need for reflectors on guard rail in Tevens Road at Stokers Lane and Wellers Road.
4	**Curve Warning and Delineation** Are curve alignment markers installed where required?	✓		
	Are advisory signs consistent along the route?	✓		

No.	Issue	Yes	No	Comments
	Are the signs correctly located in relation to the curve? (ie. not too far in advance.)	✓		
	Are signs large enough?	✓		
	Are curve alignment markers (CAMs) installed where required?	✓		
	Is the positioning of CAMs satisfactory to provide guidance around the curve?	✓		
	Are the CAMs the correct size?	✓		
	Are CAMs confined to curves (not used to delineate islands, etc.)?	✓		
6.6 1	**CRASH BARRIERS AND CLEAR ZONES** **Clear Zones** Is the clear zone width traversable (ie. drivable)?		✓	No in all locations.
	Is the clear zone free of rigid fixtures? (If not, can all of these rigid fixtures be removed or shielded?)		✓	Trees located in clear zone in a number of locations. Not feasible to remove or shield.
	Are all power poles, trees, etc. at a safe distance from the traffic paths?		✓	Most poles are more than 3 metres from travel lane. Some are closer.
	Is the appropriate treatment or protection provided for any objects within the clear zone?			Not feasible or cost effective to protect trees and poles.
2	**Crash Barriers** Are crash barriers installed where necessary?	✓		
	Are crash barriers installed at all necessary locations in accordance with the relevant guidelines?	✓		
	Are the barrier systems suitable for the purpose?	✓		
	Are the crash barriers correctly installed?			
	Is the length of crash barrier at each installation adequate?	✓		
	Is the guard fence attached correctly to bridge railings?	✓		
	Is there sufficient width between barrier and the edge line to contain a broken down vehicle?		✓	Not in all locations.
3	**End Treatments** Are end treatments constructed correctly?	✓		End treatment at Stokers Lane requires maintenance.
	Is there a safe run off area behind breakaway terminals?		✓	
4	**Fences** Are pedestrian fences frangible?			N/A
	Are vehicles safe from being 'speared' by horizontal fence railings located within the clear zone?			N/A
5	**Visibility of Barriers and Fences** Is there adequate delineation and visibility of crash barriers and fences at night?	✓		
6.7 1	**TRAFFIC SIGNALS** **Operations** Are traffic signals operating correctly?			N/A
	Are the number, location and type of signal displays appropriate for the traffic mix and traffic environment?			N/A

No.	Issue	Yes	No	Comments
	Where necessary, are there provisions for visually impaired pedestrians ? (for example audio-tactile push buttons, tactile markings)			N/A
	Where necessary, are there provisions for elderly or disabled pedestrians? (for example, extended green or clearance phase)			N/A
	Is the controller located in a safe position? (ie. where it is unlikely to be hit, but maintenance access is safe.)			N/A
	Is the condition (especially skid resistance) of the road surface on the approaches satisfactory?			N/A
2	**Visibility** Are traffic signals clearly visible to approaching motorists?			N/A
	Is there adequate stopping sight distance to the ends of possible vehicle queues?			N/A
	Have any visibility problems that could be caused by the rising or setting sun been addressed?			N/A
	Are signal displays shielded so that they can be seen only by the motorists for whom they are intended?			N/A
	Where signal displays are not visible from an adequate distance, are signal warning signs and/or flashing lights installed?			N/A
	Where signals are mounted high for visibility over crests, is there adequate stopping sight distance to the ends of traffic queues?			N/A
	Is the primary signal free from obstructions on the nearside footway to approaching drivers? (trees, lamp columns, signs, bus stops etc.)			N/A
6.8 1	**PEDESTRIANS AND CYCLISTS** **General Issues** Are there appropriate travel paths and crossing points for pedestrians and cyclists?			N/A
	Is a safety fence installed where necessary to guide pedestrians and cyclists to crossings or overpasses?			N/A
	Is safety barrier installed where necessary to separate vehicle, pedestrian and cyclist flows?			N/A
	Are pedestrian and bicycle facilities suitable for night use?			N/A
2	**Pedestrians** Is there adequate separation distance between vehicular traffic and pedestrians on footways?			N/A
	Is there an adequate number of pedestrian crossings along the route?			N/A
	At crossing points is fencing orientated so that pedestrians face oncoming traffic?			N/A
	Is there adequate provision for the elderly, the disabled, children, wheelchairs and baby carriages? (for example, holding rails, kerb and median crossings, ramps)			N/A

No.	Issue	Yes	No	Comments
	Are adequate hand rails provided where necessary? (for example, on bridges, ramps)			N/A
	Is signing about pedestrians near schools adequate and effective?			N/A
	Is signing about pedestrians near any hospital adequate and effective?			N/A
	Is the distance from the stop line to a cross walk sufficient for truck drivers to see pedestrians?			N/A
3	**Cyclists** Is the pavement width adequate for the number of cyclists using the route?			No cyclists observed using road. Cyclist need to share travel lane.
	Is the bicycle route continuous, (ie. free of squeeze points or gaps?)			N/A
	Are drainage pit grates 'bicycle safe'?			N/A
4	**Public Transport** Are bus stops safely located with adequate visibility and clearance to the traffic lane?	✓		No formal bus stops. Buses stop on road shoulders.
	Are bus stops in rural areas signposted in advance?		✓	
	Are shelters and seats located safely to ensure that sight lines are not impeded? Is clearance to the road adequate?			N/A. No shelter.
	Is the height and shape of the kerb at bus stops suitable for pedestrians and bus drivers?			N/A
6.9 1	**BRIDGES AND CULVERTS** **Design Features** Are all bridges and culverts the full formation width?	✓		
	Are bridge and culvert carriageway widths consistent with the approach conditions?	✓		
	Is the approach alignment compatible with the 85th percentile travel speed?	✓		
	Have warning signs been erected if either of the above two conditions (ie. width and speed) are not met?			N/A
2	**Crash Barriers** Are there suitable traffic barriers on bridges and culverts and their approaches to protect errant vehicles?	✓		
	Is the connection between barrier and bridge safe?	✓		
	Is the bridge free of kerbing that would reduce the effectiveness of barriers or rails?	✓		
3	**Miscellaneous** Are pedestrian facilities on the bridge appropriate and safe?			N/A
	Is fishing from the bridge prohibited? If not, has provision been made for 'safe' fishing?			N/A. No footpaths.
	Does delineation continue over the bridge?	✓		
6.10 1	**PAVEMENT** **Pavement Defects** Is the pavement free of defects (for example, excessive roughness or rutting, potholes, loose material, etc) that could result in safety problems (for example, loss of steering control)?	✓		Generally

No.	Issue	Yes	No	Comments
	Is the condition of the pavement edges satisfactory?	✓		Generally
	Is the transition from pavement to shoulder free of dangerous edge drop offs?	✓		
2	**Skid Resistance** Does the pavement appear to have adequate skid resistance, particularly on curves, steep grades and approaches to intersections?	✓		
	Has skid resistance testing been carried out where necessary?			Not known.
3	**Ponding** Is the pavement free of areas where ponding or sheet flow of water could contribute to safety problems?	✓		
4	**Loose Stones / Material** Is the pavement free of loose stones and other material?	✓		
6.11 1	**PARKING** **General Issues** Are the provisions for, or restrictions on, parking satisfactory in relation to traffic safety?			N/A
	Is the frequency of the parking turnover compatible with the safety of the route?			N/A
	Is there sufficient parking for delivery vehicles so that safety problems due to double parking do not occur?			N/A
	Are parking manoeuvres along the route possible without causing safety problems (for example angle parking)?			N/A
	Is the sight distance at both intersections, and along the route, unaffected by parked vehicles?			N/A
6.12 1	**PROVISION FOR HEAVY VEHICLES** **Design Issues** Are overtaking opportunities available for heavy vehicles, where volumes are high?			Volumes on road are low. Overtaking opportunities are restricted to straight sections. Road is mostly flat which allows heavy vehicles to maintain speed.
	Does the route generally cater for the size of vehicle likely to use it?	✓		
	Is there adequate manoeuvring room for large vehicles along the route, at intersections, roundabouts, etc.?	✓		
	Is access to rest areas and truck parking areas adequate for the size of vehicle expected? (Consider acceleration, deceleration, shoulder widths, etc.)			N/A.
2	**Pavement / Shoulder Quality** Are shoulders sealed at bends to provide additional pavement for long vehicles?			Shoulders are not sealed except where new work completed at Emigrant Creek. However road pavements are wider on bends on rest of route.
	Is the pavement width adequate for heavy vehicles?			
	In general, is the pavement quality sufficient for the safe travel of heavy and oversized vehicles?	✓		

No.	Issue	Yes	No	Comments
	On truck routes, are reflective devices appropriate for truck drivers' eye heights?	✓		
3	**Delineation and Guidance** On truck routes, are reflective devices appropriate for truck drivers' eye heights?	✓		
6.13 1	**FLOODWAYS AND CAUSEWAYS** **Ponding, Flooding** Are all sections of the route free from ponding or flow across the road during wet weather?			Not known. Road is subject to flooding but there are no causeways.
	If there is ponding or flow across the road during wet weather , is there appropriate signposting?			N/A
	Are floodways/causeways correctly signposted?			N/A (No causeways)
2	**Safety of Devices** Are all culverts or drainage structures located outside the clear roadside recovery area?		✓	Locations of drainage structures are typical for most low volume rural roads.
	If not, are they shielded from the possibility of vehicle collision?		✓	
6.14 1	**MISCELLANEOUS** **Landscaping** Is landscaping in accordance with guidelines? (for example, clearances, sight distance)			N/A
	Will existing clearances and sight distances be maintained following future plant growth?			N/A
	Does the landscaping at roundabouts avoid visibility problems?			N/A
2	**Temporary Works** Are all locations free of construction or maintenance equipment that is no longer required?			N/A
	Are all locations free of signs or temporary traffic control devices that is no longer required?			N/A
3	**Headlight Glare** Have all problems that could be caused by headlight glare been addressed? (for example, a two-way service road close to main traffic lanes, the use of glare fencing or screening)			N/A
4	**Roadside Activities** Are the road boundaries free of any activities that are likely to distract drivers?	✓		
	Are all advertising signs installed so that they do not constitute a hazard?		✓	
5	**Errant Vehicles** Is the roadside furniture on the verges and footways free of damage from errant vehicles that could indicate a possible problem, hazard or conflict at the site?			
6	**Other Safety Issues** Is the embankment stability safe?	✓		
	Is the route free of unsafe overhanging branches?	✓		
	Is the route free of visibility obstructions caused by long grass?	✓		Grass shoulders need regular maintenance.
	Are any high wind areas safely dealt with?			N/A

No.	Issue	Yes	No	Comments
	If back to back medians kerbing is used is it: – Adequately delineated? – Obvious where it starts? – Obvious at intersections? – Unlikely to be a hazard to pedestrians?			N/A
7	**Rest Areas** Is the location of rest areas and truck parking areas along the route appropriate?			N/A
	Is there adequate sight distance to the exit and entry points from rest areas and truck parking areas during all times of the day?			N/A
8	**Animals** Is the route free from large numbers of animals (for example, cattle, sheep, kangaroos, koalas, wombats, etc.)?	✓		
	If not, is the route protected by animal-proof fencing?			N/A

APPENDIX 2B

TRANSPORT ROUTE 2 – TEVEN ROAD NORTH OF STOKERS LANE, TINTENBAR ROAD AND TAMARIND DRIVE

CHECKLIST 6: ROAD SAFETY AUDIT OF EXISTING ROADS

No.	Issue	Yes	No	Comments
6.1 1	**ROAD ALIGNMENT AND CROSS SECTION** **Visibility; Sight Distance** Is sight distance appropriate for the speed of traffic using the route?	✓		
	Is adequate sight distance provided for intersections and crossings? (for example pedestrian, cyclist, cattle, railway)	✓		
	Is adequate sight distance provided for all private driveways and property entrances?	✓		
2	**Design Speed** Is the horizontal and vertical alignment suitable for the (85th percentile) traffic speed?	✓		
	If not: – Are warning signs installed? – Are advisory speed signs installed?			
	Are the posted advisory speeds for curves appropriate?			
3	**Speed Limit / Speed Zoning** Is the speed limit compatible with the function, road geometry, landuse and sight distance?	✓		
4	**Overtaking** Are safe overtaking opportunities provided?	✓		
5	**Readability** Is the road free of elements that may cause confusion? For example: Is alignment of the roadway clearly defined? Has disused pavement (if any) been removed or treated? Have old pavement markings been removed properly? Do tree lines follow the road alignment? Does the line of street lights or poles follow the road alignment?	 ✓ ✓ N/A ✓		
	Is the road free of misleading curves or combinations of curves?	✓		
6	**Widths** Are medians and islands of adequate width for likely users?	✓		Mostly painted islands.
	Are traffic lane and carriageway widths adequate for the traffic volume and mix?	✓		
	Are bridge widths adequate?		✓	Bridge in Tintenbar Road near Teven Road is narrow (5.8 metres).
7	**Shoulders** Are shoulders wide enough to allow drivers to regain control of errant vehicles?	✓		
	Are shoulders wide enough for broken down vehicles and emergencies to stop safely?	✓		

No.	Issue	Yes	No	Comments
	Are shoulders sealed?	✓		In Tintenbar Road and Tamarind Drive.
	Are shoulders trafficable for all vehicles and road users? (ie. are shoulders in good condition)	✓		
	Is the transition from road to shoulder safe? (no drop offs.)	✓		
8	**Crossfalls** Is the appropriate super elevation provided on curves?	✓		
	Is any adverse crossfall safely managed (for cars, trucks, etc.)?	✓		
	Do cross falls (carriageway and shoulder) provide adequate drainage?	✓		
9	**Batter Slopes** Are batter slopes traversable by cars and trucks that run off the road?	✓		
10	**Drains** Are roadside drains and culvert end walls traversable?		✓	
6.2 1	**AUXILIARY LANES** **Tapers** Are starting and finishing tapers located and aligned correctly?	✓		
	Is there sufficient sight distance to the end of the auxiliary lane?	✓		
2	**Shoulders** Are appropriate shoulder widths provided at merges?	✓		
	Have shoulder widths been maintained beside the auxiliary lane?	✓		
3	**Signs and Markings** Have all signs been installed in accordance with the appropriate guidelines?	✓		
	Are all signs conspicuous and clear?	✓		
	Does all linemarking conform with these guidelines?	✓		
	Is there advance warning of approaching auxiliary lanes?			
4	**Turning Traffic** Have all right turns from the through lane been avoided?		✓	No turn lanes at several minor intersections.
	Is there advance warning of turn lanes?		✓	
6.3 1	**INTERSECTIONS** **Location** Are all intersections located safely with respect to the horizontal and vertical alignment?	✓		
	Where intersections occur at the end of high speed environments (eg. at approaches to towns), are there traffic control devices (eg. rumble strips) to alert drivers?			N/A
2	**Visibility; Sight Distance** Is the presence of the intersection obvious to all road users?	✓		
	Is the sight distance appropriate for all movements and all users?	✓		

No.	Issue	Yes	No	Comments
	Is there safe stopping sight distance to the rear of any queue or slow moving turning vehicles?	✓		
	Has the appropriate sight distance been provided for entering and leaving vehicles?	✓		
3	**Controls and Delineation** Are pavement markings and intersection control signs satisfactory?	✓		
	Are vehicle paths through intersections delineated satisfactorily?	✓		
	Are all lanes properly marked (including any arrows)?	✓		
4	**Layout** Are all conflict points between vehicles safely managed?	✓		
	Is the intersection layout obvious to all road users?	✓		
	Is the alignment of kerbs obvious and appropriate?	✓		Limited use of kerbs at intersections.
	Is the alignment of traffic islands obvious and appropriate?	✓		
	Is the alignment of medians obvious and appropriate?	✓		
	Can all likely vehicle types be accommodated?	✓		
	Are merge tapers long enough?	✓		
	Is the intersection free of capacity problems that may produce safety problems?	✓		
5	**Miscellaneous** Particularly at rural sites, are all intersections free of loose gravel?	✓		
6.4 1	**SIGNS AND LIGHTING** **Lighting** Is lighting required and, if so, has it been adequately provided?			Rural roads. No street lighting except at interchange with Pacific Highway at Tintenbar.
	Is the road free of features that interrupt illumination (for example trees or overbridges)?			N/A
	Is the road free of lighting poles that are a fixed roadside hazard?	✓		See comments above
	Are frangible or slip base poles provided?	✓		See comments above
	Ambient lighting: if it creates special lighting needs, have these been satisfied?	✓		N/A
	Is the lighting scheme free of confusing or misleading effects on signals or signs?	✓		See comments above
	Is the scheme free of any lighting black patches?	✓		See comments above
2	**General signs issues** Are all necessary regulatory, warning and direction signs in place? Are they conspicuous and clear?	✓		
	Are the correct signs used for each situation and is each sign necessary?	✓		
	Are all signs effective for all likely conditions (for example day, night, rain, fog, rising or setting sun, oncoming headlights, poor lighting)?	✓		

No.	Issue	Yes	No	Comments
	If restrictions apply for any class of vehicle are drivers adequately advised?			N/A
	If restrictions apply for any class of vehicle are drivers advised of alternative routes?			N/A
3	**Sign Legibility** In daylight and darkness, are signs satisfactory regarding visibility? – Clarity of message? – Readibility / legibility at the required distance?	✓		
	Is sign retroreflectivity or illumination satisfactory?	✓		
	Are signs able to be seen without being hidden by their background or adjacent distractions?	✓		
	Is driver confusion due to too many signs avoided?	✓		
4	**Signs Supports** Are sign supports out of the clear zone?		✓	Sign supports are mostly frangible.
	If not, are they: – Frangible – Shielded by barriers (for example, guard fence, crash cushions)?	✓	- N/A	
6.5 1	**DELINEATION AND GUIDANCE** **General Issues** Is the linemarking and delineation: – Appropriate for the function of the road? – Consistent along the route – Likely to be effective under all expected conditions? (day, night, wet, dry, fog, rising and setting sun position, oncoming headlights, etc.)	✓ ✓ ✓		Limited linemarking in section of Teven Road between Stokers Lane and Tintenbar Road. Linemarking and delineation is satisfactory in Tintenbar Road and Tamarind Drive.
	Is the pavement free of excessive markings? (for example unnecessary turn arrows, unnecessary barrier lines, etc.)	✓		
2	**Centrelines, Edgelines, Lanelines** Are centrelines, edgelines, lanelines provided? If not, do drivers have adequate guidance?	✓		
	Are RRPMs required?	✓		
	If RRPMs are installed, are they correctly placed, correct colours, in good condition?	✓		Some maintenance required.
	Are profiled (audible) edgelines provided where required?		✓	Not required.
	Is the linemarking in good condition?	✓		
	Is there sufficient contrast between linemarking and pavement colour?	✓		
3	**Guideposts and Reflectors** Are guideposts appropriately installed?	✓		
	Are delineators clearly visible?	✓		
	Are the correct colors used for the delineators?	✓		
	Are the delineators on guardfences, crash barriers and bridge railings consistent with those on the guideposts?	✓		

No.	Issue	Yes	No	Comments
4	**Curve Warning and Delineation** Are curve alignment markers installed where required?	✓		
	Are advisory signs consistent along the route?	✓		
	Are the signs correctly located in relation to the curve? (ie. not too far in advance.)	✓		
	Are signs large enough?	✓		
	Are curve alignment markers (CAMs) installed where required?	✓		
	Is the positioning of CAMs satisfactory to provide guidance around the curve?	✓		
	Are the CAMs the correct size?	✓		
	Are CAMs confined to curves (not used to delineate islands, etc.)?	✓		
6.6 1	**CRASH BARRIERS AND CLEAR ZONES** **Clear Zones** Is the clear zone width traversable (ie. drivable)?		✓	Not in all locations.
	Is the clear zone free of rigid fixtures? (If not, can all of these rigid fixtures be removed or shielded?)	✓		Isolated trees in clear zone in a number of locations.
	Are all power poles, trees, etc. at a safe distance from the traffic paths?		✓	Isolated poles in clearzone.
	Is the appropriate treatment or protection provided for any objects within the clear zone?		✓	Not feasible or cost effective to protect trees and poles.
2	**Crash Barriers** Are crash barriers installed where necessary?	✓		
	Are crash barriers installed at all necessary locations in accordance with the relevant guidelines?	✓		
	Are the barrier systems suitable for the purpose?	✓		
	Are the crash barriers correctly installed?			
	Is the length of crash barrier at each installation adequate?	✓		
	Is the guard fence attached correctly to bridge railings?	✓		
	Is there sufficient width between barrier and the edge line to contain a broken down vehicle?		✓	Not in all locations.
3	**End Treatments** Are end treatments constructed correctly?	✓		
	Is there a safe run off area behind breakaway terminals?	✓		
4	**Fences** Are pedestrian fences frangible?			N/A
	Are vehicles safe from being 'speared' by horizontal fence railings located within the clear zone?			N/A
5	**Visibility of Barriers and Fences** Is there adequate delineation and visibility of crash barriers and fences at night?	✓		
6.7 1	**TRAFFIC SIGNALS** **Operations** Are traffic signals operating correctly?			N/A

No.	Issue	Yes	No	Comments
	Are the number, location and type of signal displays appropriate for the traffic mix and traffic environment?			N/A
	Where necessary, are there provisions for visually impaired pedestrians ? (for example audio-tactile push buttons, tactile markings)			N/A
	Where necessary, are there provisions for elderly or disabled pedestrians ? (for example, extended green or clearance phase)			N/A
	Is the controller located in a safe position? (ie. where it is unlikely to be hit, but maintenance access is safe.)			N/A
	Is the condition (especially skid resistance) of the road surface on the approaches satisfactory?			N/A
2	**Visibility** Are traffic signals clearly visible to approaching motorists?			N/A
	Is there adequate stopping sight distance to the ends of possible vehicle queues?			N/A
	Have any visibility problems that could be caused by the rising or setting sun been addressed?			N/A
	Are signal displays shielded so that they can be seen only by the motorists for whom they are intended?			N/A
	Where signal displays are not visible from an adequate distance, are signal warning signs and/or flashing lights installed?			N/A
	Where signals are mounted high for visibility over crests, is there adequate stopping sight distance to the ends of traffic queues?			N/A
	Is the primary signal free from obstructions on the nearside footway to approaching drivers? (trees, lamp columns, signs, bus stops etc.)			N/A
6.8 1	**PEDESTRIANS AND CYCLISTS** **General Issues** Are there appropriate travel paths and crossing points for pedestrians and cyclists?			N/A
	Is a safety fence installed where necessary to guide pedestrians and cyclists to crossings or overpasses?	✓		At Pacific Highway Interchange.
	Is safety barrier installed where necessary to separate vehicle, pedestrian and cyclist flows?			N/A
	Are pedestrian and bicycle facilities suitable for night use?			N/A
2	**Pedestrians** Is there adequate separation distance between vehicular traffic and pedestrians on footways?			No formal footway except at Pacific Highway Interchange at Tintenbar.
	Is there an adequate number of pedestrian crossings along the route?			N/A
	At crossing points is fencing orientated so that pedestrians face oncoming traffic?			N/A

No.	Issue	Yes	No	Comments
	Is there adequate provision for the elderly, the disabled, children, wheelchairs and baby carriages? (for example, holding rails, kerb and median crossings, ramps)			N/A
	Are adequate hand rails provided where necessary? (for example, on bridges, ramps)			N/A
	Is signing about pedestrians near schools adequate and effective?			N/A
	Is signing about pedestrians near any hospital adequate and effective?			N/A
	Is the distance from the stop line to a cross walk sufficient for truck drivers to see pedestrians?			N/A
3	**Cyclists** Is the pavement width adequate for the number of cyclists using the route?	✓ See comments		Very few cyclists. Tamarind Drive has wide sealed shoulders. In Tintenbar Road and Teven Road cyclists share travel lane.
	Is the bicycle route continuous, (ie. free of squeeze points or gaps?)			N/A
	Are drainage pit grates 'bicycle safe'?			N/A
4	**Public Transport** Are bus stops safely located with adequate visibility and clearance to the traffic lane?			N/A
	Are bus stops in rural areas signposted in advance?			
	Are shelters and seats located safely to ensure that sight lines are not impeded? Is clearance to the road adequate?			N/A. No shelters.
	Is the height and shape of the kerb at bus stops suitable for pedestrians and bus drivers?			N/A
6.9 1	**BRIDGES AND CULVERTS** **Design Features** Are all bridges and culverts the full formation width?		✓	Narrow bridge (5.8 metres) in Tintenbar Road near Teven Road.
	Are bridge and culvert carriageway widths consistent with the approach conditions?		✓	See comment above.
	Is the approach alignment compatible with the 85th percentile travel speed?	✓		
	Have warning signs been erected if either of the above two conditions (ie. width and speed) are not met?	✓		
2	**Crash Barriers** Are there suitable traffic barriers on bridges and culverts and their approaches to protect errant vehicles?			Most bridges meet standards. Bridge in Tintenbar Road near Teven Road does not have suitable barriers.
	Is the connection between barrier and bridge safe?	✓		
	Is the bridge free of kerbing that would reduce the effectiveness of barriers or rails?	✓		
3	**Miscellaneous** Are pedestrian facilities on the bridge appropriate and safe?			No pedestrian facilities on most bridges except at Pacific Highway overpass.
	Is fishing from the bridge prohibited? If not, has provision been made for 'safe' fishing?			N/A. No footpaths.
	Does delineation continue over the bridge?	✓		

No.	Issue	Yes	No	Comments
6.10 1	**PAVEMENT** **Pavement Defects** Is the pavement free of defects (for example, excessive roughness or rutting, potholes, loose material, etc) that could result in safety problems (for example, loss of steering control)?	✓		
	Is the condition of the pavement edges satisfactory?	✓		
	Is the transition from pavement to shoulder free of dangerous edge drop offs?	✓		
2	**Skid Resistance** Does the pavement appear to have adequate skid resistance, particularly on curves, steep grades and approaches to intersections?	✓		
	Has skid resistance testing been carried out where necessary?			Not known.
3	**Ponding** Is the pavement free of areas where ponding or sheet flow of water could contribute to safety problems?	✓		
4	**Loose Stones / Material** Is the pavement free of loose stones and other material?	✓		
6.11 1	**PARKING** **General Issues** Are the provisions for, or restrictions on, parking satisfactory in relation to traffic safety?			N/A
	Is the frequency of the parking turnover compatible with the safety of the route?			N/A
	Is there sufficient parking for delivery vehicles so that safety problems due to double parking do not occur?			N/A
	Are parking manoeuvres along the route possible without causing safety problems (for example angle parking)?			N/A
	Is the sight distance at both intersections, and along the route, unaffected by parked vehicles?			N/A
6.12 1	**PROVISION FOR HEAVY VEHICLES** **Design Issues** Are overtaking opportunities available for heavy vehicles, where volumes are high?	✓		
	Does the route generally cater for the size of vehicle likely to use it?	✓		
	Is there adequate manoeuvring room for large vehicles along the route, at intersections, roundabouts, etc.?	✓		
	Is access to rest areas and truck parking areas adequate for the size of vehicle expected? (Consider acceleration, deceleration, shoulder widths, etc.)			N/A.
2	**Pavement / Shoulder Quality** Are shoulders sealed at bends to provide additional pavement for long vehicles?	✓		

No.	Issue	Yes	No	Comments
	Is the pavement width adequate for heavy vehicles?			
	In general, is the pavement quality sufficient for the safe travel of heavy and oversized vehicles?	✓		
	On truck routes, are reflective devices appropriate for truck drivers' eye heights?	✓		
3	**Delineation and Guidance** On truck routes, are reflective devices appropriate for truck drivers' eye heights?	✓		
6.13 1	**FLOODWAYS AND CAUSEWAYS** **Ponding, Flooding** Are all sections of the route free from ponding or flow across the road during wet weather?			Teven Road subject to flooding but no causeway.
	If there is ponding or flow across the road during wet weather , is there appropriate signposting?			N/A
	Are floodways/causeways correctly signposted?			N/A
2	**Safety of Devices** Are all culverts or drainage structures located outside the clear roadside recovery area?		✓	Not in all locations.
	If not, are they shielded from the possibility of vehicle collision?		✓	
6.14 1	**MISCELLANEOUS** **Landscaping** Is landscaping in accordance with guidelines? (for example, clearances, sight distance)			N/A
	Will existing clearances and sight distances be maintained following future plant growth?			N/A
	Does the landscaping at roundabouts avoid visibility problems?	✓		
2	**Temporary Works** Are all locations free of construction or maintenance equipment that is no longer required?			N/A
	Are all locations free of signs or temporary traffic control devices that is no longer required?	✓		
3	**Headlight Glare** Have all problems that could be caused by headlight glare been addressed? (for example, a two-way service road close to main traffic lanes, the use of glare fencing or screening)			N/A
4	**Roadside Activities** Are the road boundaries free of any activities that are likely to distract drivers?	✓		
	Are all advertising signs installed so that they do not constitute a hazard?	✓		
5	**Errant Vehicles** Is the roadside furniture on the verges and footways free of damage from errant vehicles that could indicate a possible problem, hazard or conflict at the site?	✓		

No.	Issue	Yes	No	Comments
6	**Other Safety Issues** Is the embankment stability safe?	✓		
	Is the route free of unsafe overhanging branches?	✓		
	Is the route free of visibility obstructions caused by long grass?	✓		
	Are any high wind areas safely dealt with?			N/A
	If back to back medians kerbing is used is it: – Adequately delineated? – Obvious where it starts? – Obvious at intersections? – Unlikely to be a hazard to pedestrians?			N/A
7	**Rest Areas** Is the location of rest areas and truck parking areas along the route appropriate?			N/A
	Is there adequate sight distance to the exit and entry points from rest areas and truck parking areas during all times of the day?			N/A
8	**Animals** Is the route free from large numbers of animals (for example, cattle, sheep, kangaroos, koalas, wombats, etc.)?	✓		
	If not, is the route protected by animal-proof fencing?			N/A

APPENDIX 3

Austroads Risk Assessment Tables 4.1 to 4.4 Extract

C. Risk ranking of safety issues

The following tables may be useful to provide an indication of the level of risk and how to respond to it. Determine into which category in Table 4.1 and Table 4.2 the issue best fits. From this select the risk category in Table 4.3 and its suggested treatment approach in Table 4.4. This is not a scientific system and professional judgement should be used. Section 9.3 provides an evidence based approach to prioritising the treatment of works emanating from road safety audits of existing roads.

Table 4.1: How often is the problem likely to lead to a crash?

Frequency	Description
Frequent	Once or more per week
Probable	Once or more per year (but less than once a week)
Occasional	Once every five or ten years
Improbable	Less often than once every ten years

Table 4.2: What is the likely severity of the resulting crash type?

Severity	Description	Examples
Catastrophic	Likely multiple deaths	High-speed, multi-vehicle crash on a freeway. Car runs into crowded bus stop. Bus and petrol tanker collide. Collapse of a bridge or tunnel.
Serious	Likely death or serious injury	High or medium-speed vehicle/vehicle collision. High or medium-speed collision with a fixed roadside object. Pedestrian or cyclist struck by a car.
Minor	Likely minor injury	Some low-speed vehicle collisions. Cyclist falls from bicycle at low speed. Left-turn rear-end crash in a slip lane.
Limited	Likely trivial injury or property damage only	Some low-speed vehicle collisions. Pedestrian walks into object (no head injury). Car reverses into post.

Table 4.3: The resulting level of risk

	Frequent	Probable	Occasional	Improbable
Catastrophic	Intolerable	Intolerable	Intolerable	High
Serious	Intolerable	Intolerable	High	Medium
Minor	Intolerable	High	Medium	Low
Limited	High	Medium	Low	Low

Table 4.4: Treatment approach

Risk	Suggested treatment approach
Intolerable	Must be corrected.
High	Should be corrected or the risk significantly reduced, even if the treatment costs is high.
Medium	Should be corrected or the risk significantly reduced, if the treatment cost is moderate, but not high.
Low	Should be corrected or the risk reduced, if the treatment cost is low.

APPENDIX 8

Road Safety Audit

ROAD SAFETY AUDIT REPORT

STAGE 5 AUDIT

OF TRANSPORT ROUTES ON LOCAL ROADS FOR

TEVEN QUARRY

AT

TEVEN

Ref. 13082RSA2

30 May 2014

Prepared By

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1.0 INTRODUCTION

1.1 Auditors and Audit Process

This report details the results of a Stage 5 Road Safety Audit of the existing transport routes on local roads for Teven Quarry at Teven on the far north coast of NSW.

The provision of a Stage 5 Road Safety Audit of the transport routes was requested by the RMS as part of the investigation and assessment of transport impacts of a proposal to increase sales and production of Teven Quarry. A road safety audit is a formal process that seeks to identify potential safety issues on existing roads or with proposed road projects. Its recommendations are restricted to road safety considerations.

The audit was carried out by:

- Terry Lawrence - Level 3 Road Safety Auditor (Team Leader)
- Geoff Morris - Road Safety Auditor

The day/night audit inspections of the transport routes were undertaken on Monday 26 May 2014 and the audit report prepared following the audit inspections.

The audit has generally been carried out following the procedures set out in the Roads and Maritime Services Guidelines for Road Safety Audit Practice.

The audit examines the features of the local roads that form the transport routes which may affect road user safety and it has sought to identify potential safety hazards. However, the auditors point out that no guarantee is made that every deficiency has been identified. Further, if all the recommendations in this report were to be followed, this would not confirm that the existing roads are 'safe'; rather, adoption of any recommendations may improve the level of safety on the transport routes.

As the road safety audit was not commissioned in a formal process, there was no entry or exit meetings, or any Correction Action Reports (CARS) issued. The audit findings are presented in section 4 of the report.

The audit findings include specific recommendations about the Transport Routes as well as improvements to Transport Route 1, which is the Principal Transport Route.

2.0 DESCRIPTION OF THE TRANSPORT ROUTES AND BACKGROUND INFORMATION

There are two transport routes to and from the quarry as follows;

- Route 1 - which is the main transport route and includes Stokers Lane, south along Teven Road to Bruxner Highway and then via the state highway/state road system to Lismore, Ballina and or north and south via the Pacific Highway.

- Route 2 – which is a local transport route and includes Stokers Lane, north along Teven Road to Tintenbar Road and then Tamarind Drive to travel west, north or east.

Figure 1 shows the existing transport routes on local roads.

The existing split for trucks generated by Teven Quarry is:

- 70% via Route 1
- 30% via Route 2

The bulk of the truck trips using Route 2 has been/is associated with the Pacific Highway upgrade works at/near Tintenbar which is north of Teven Quarry.

Transport Route 1

Stokers Lane

Stokers Lane is a local road which provides direct vehicle access to Teven Quarry at its western end and intersects with Teven Road at a T junction at its eastern end.

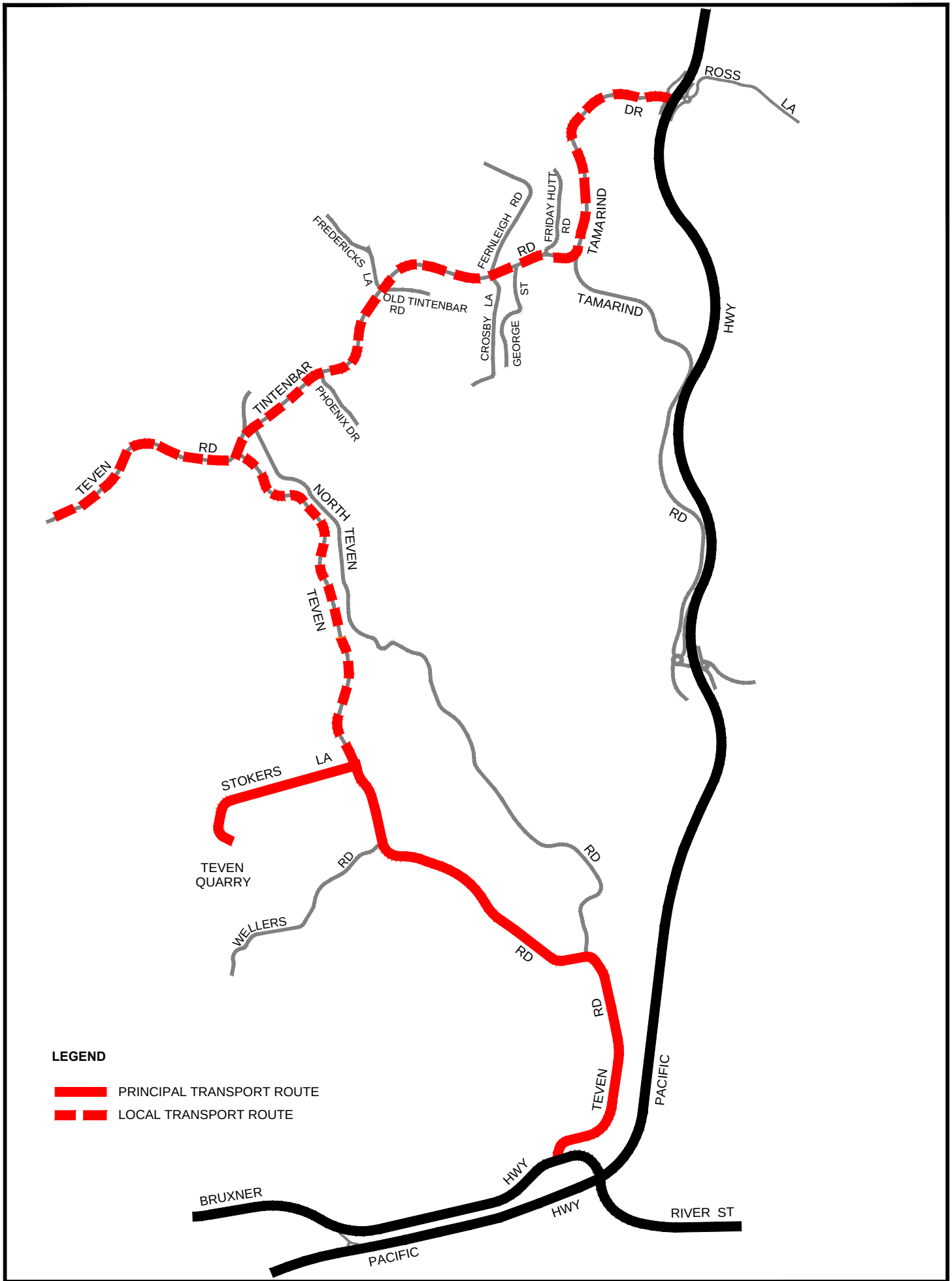
Stokers Lane has a 7.0 metre wide sealed pavement, with grass shoulders 2.0 – 3.0 metres wide. It has a 90º bend (alignment change) 200 metres north of the quarry entrance and a flat grade.

Sight distance in Stokers Lane is good and it has a speed limit of 80km/h.

Average weekday two way traffic volumes in Stokers Lane are 205 vehicles per day (vpd).

Sight distance at the Teven Road/Stokers Lane intersection is good and exceeds 200 metres in both directions of Teven Road. A painted median is also provided in both approaches of Teven Road at the intersection, together with Give Way Control and double barrier centreline in Stokers Lane. Intersection warning signs (trucks) are also provided on all approaches. Large corner radii are provided for the truck left turn movements into and out of Stokers Lane at the intersection. The intersection has BAR and BAL (i.e. basic right and left turn) treatments in Teven Road. Guardrail is also provided on the eastern side of Teven Road, at the intersection.

The operating speed limit in Teven Road at the intersection is 80km/h.



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N

NOT TO SCALE

FIGURE 1

TEVEN QUARRY,
BALLINA

TRANSPORT ROUTES ON LOCAL ROADS

JOB NO. 13082-RSA

Teven Road, South of Stokers Lane

Teven Road is a major local road that connects between Bruxner Highway at West Ballina and Tintenbar Road at Teven.

Teven Road, south of Stokers Lane provides direct access to Bruxner Highway and the Pacific Highway interchange, as well as to Ballina via River Street (Old Pacific Highway).

The section of Teven Road between Stokers Lane and Bruxner Highway provides a sealed road pavement of variable width. Most sections provide a width of 7.0 metres or wider providing 2 x 3.5 metre wide travel lanes, although there are several sections where the pavement width is 6.5 metres. Road shoulders vary up to 2.0 metres and are typically grass. The traffic management along Teven Road includes isolated centre line markings, guide posts and reflectors, warning signs at intersections and on curves.

The horizontal alignment follows the creek with a series of gentle curves and new bridge structures and alignment change near the intersection with North Teven Road.

The section between North Teven Road and Bruxner Highway passes through a small industrial area.

The speed limit in Teven Road is 60km/h near Bruxner Highway reducing to 50km/h near the North Teven Road intersection and bridges and increasing to 80km/h north of the northern bridge.

Sight distance along Teven Road is generally good and the vertical alignment is mostly flat, except at the new bridge structures.

Average weekday two way traffic volumes in Teven Road, south of Stokers Lane are 760vpd, increasing to 1160vpd near the Bruxner Highway.

Intersections in Teven Road between Stokers Lane and Bruxner Highway include:

- Stokers Lane – T junction intersection;
- Wellers Road – minor T junction intersection;
- North Teven Road – channelised T junction intersection;
- New Place – minor T junction intersection;
- Bruxner Highway – channelised T junction intersection

Sight distance at all these intersections is considered satisfactory for the posted speed limits and the estimated vehicle operating speeds at the intersections.

The distance between Stokers Lane and Bruxner Highway is approximately 4.5 kms.

Teven Road forms a T junction intersection at Bruxner Highway. There is also a left turn into a truck stop area from the eastern approach of Bruxner Highway. The intersection channelisation includes:

- Give way control together with right and left turn lanes in Teven Road at Bruxner Highway;

- Two through lanes in the eastern approach of Bruxner Highway, together with a right turn bay (CHR) and left turn bay (AUL) for left turn access into the adjacent property.

- One through lane and a left turn lane (AUL) in the western approach of Bruxner Highway.

Sight distance in Bruxner Highway at the intersection is good (250 metres in both directions) and the operating speed limit is 60km/h. The intersection has been recently reconstructed and satisfies current Austroad standards.

Transport Route 2

Teven Road, North of Stokers Lane

The section of Teven Road, north of Stokers Lane provides access to Tintenbar Road.

This section is approximately 3.5km long with a series of curves and bends with a sealed pavement of 6.5 – 6.7 metres wide and 1.0 – 2.0 metres grass shoulders. The vertical alignment is flat. Traffic management includes isolated guide posts/reflectors on bends and at drainage structures. The speed limit in this section of Teven Road is 80km/h.

Intersections include several minor agricultural roads, as well as the Tintenbar Road/Teven Road intersection, all of which are T junction intersections.

Teven Road forms a T junction intersection with Tintenbar Road. The intersection geometry includes:

- Stop sign control on Teven Road (eastern approach);

- A single lane approach in the southern approach of Teven Road, which is constructed around a 90º bend;

- A single lane plus short auxiliary lane in northern approach of Tintenbar Road. The auxiliary lane extends to the departure side of the intersection to assist left turns into and out of the eastern leg of Teven Road.

Sight distance is reduced to around 140 metres by the bend/curve in the southern approach of Teven Road to the intersection, which also reduces vehicle speeds in this approach. A narrow two way bridge, (5.8 metres wide) is located in the northern approach of Tintenbar Road approximately 25 metres from the intersection. Sight distance in this approach is approximately 190 metres.

The speed limit at the intersection is 80km/h, however operating vehicle speeds would be less than this, due to the alignment and constraints of the Tintenbar Road northern approach and the Teven Road southern approach.

Average weekday two way traffic volumes using this section of Teven Road are 693vpd.

Tintenbar Road/Tamarind Drive

Tintenbar Road/Tamarind Drive route connects between Teven Road at Teven and the Pacific Highway. The route is an unclassified regional road and is approximately 5.5km in length.

Tintenbar Road is a two lane rural road with a high level of traffic management including turning lanes at principal intersections, guideposts/reflectors centreline road marking, warning signs, edgelines and Raised Reflective Pavement Markers (RRPM's).

The road passes through rolling terrain and the road's alignment matches the terrain. There is a narrow two way bridge just north of Teven Road intersection. No overtaking is permitted on the bridge, due to the close distance (25 metres) of the Teven Road intersection.

A passing or overtaking lane is provided for the northbound direction, north of North Teven Road.

Intersections along Tintenbar Road include;

- Teven Road – a T junction intersection;
- North Teven Road – a channelised T junction intersection;
- Phoenix Drive - a channelised T junction intersection;
- Fredericks Lane/Old Tintenbar Road – a channelised offset cross junction;
- Crosby Lane/Fernleigh Road – a minor offset cross junction;
- George Street – a channelised T junction intersection;
- Friday Hutt Road – a channelised T junction intersection;
- Tamarind Drive – a channelised seagull intersection where Tintenbar Road forms a T junction with Tamarind Drive.

Average weekday two way traffic volumes in Tintenbar Road north of Teven Road is 3150vpd.

Tamarind Drive is generally a two lane rural road constructed to a good standard with a section of overtaking lane and a high level of traffic management.

Tamarind Drive forms roundabout intersections adjacent the Pacific Highway with Saddle Road and Kinvara Ridge Road which provide north facing ramps to the Pacific Highway, between Tintenbar and Knocknow.

The speed limit in Tintenbar Road and Tamarind Drive is generally 80km/h except at roundabout intersections in Tamarind Drive at the Pacific Highway where the speed limit is 60km/h.

3.0 RECOMMENDATIONS FROM PREVIOUS AUDITS

It is not known if any previous road safety audits have been undertaken on the above local roads that form the transport routes.

4.0 AUDIT FINDINGS AND RECOMMENDATIONS

4.1 Findings and Risk Ranking

Tables 4.1 and 4.2 below presents the auditor's comments on the various matters where a risk or a potential safety issue has been identified, and or where the auditors have made a specific recommendation, based on the audit findings and the inspection of the local road network.

If applicable, where risks and potential safety issues have been identified, these have been ranked using Austroads Ranking method, based on frequency, severity, overall level of risk and treatment approach presented in Tables 4.1 to 4.4 in Guide to Road Safety Part 6: Road Safety Audit (See Appendix 3).

The risk rankings and Austroads Suggested treatment approach are defined as follows;

- Intolerable - Must be corrected
- High - Should be corrected or the risk significantly reduced, even if the treatment cost is high
- Medium - Should be corrected or the risk significantly reduced, if the treatment cost is moderate, but not high
- Low - Should be corrected or the risk reduced, if the treatment cost is low

In addition Appendix 2 (Audit checklists) shows the auditors comments on all matters considered as part of the Stage 5 audit. Separate checklists have been prepared for Transport Route 1 and Transport Route 2.

4.2 Audit Findings and Recommendations

The audit team found that the alignment of Teven Road between Stokers Lane and Bruxner Highway is superior to the section north of Stokers Lane, with fewer curves and better sight lines.

In addition, the alignment of Pacific Highway between Bruxner Highway and Tamarind Drive which has been upgraded to a 4 lane divided carriageway is superior to Tintenbar Road/Tamarind Drive route and is better suited to heavy vehicles.

Based on the above reasons, the Audit team recommends that Transport Route 1 be retained as the Principal Transport Route and be used for all future deliveries for road upgrade works north of Ballina.

Several other relatively minor issues were identified in Teven Road between Stokers Lane and Bruxner Highway and these are outlined below.

The main findings of the Road Safety Audit are:

- Transport Route 1 which includes Stokers Lane, south along Teven Road to Bruxner Highway and then west towards Lismore and or east to travel to the Pacific Highway (for trips north or south) or to Ballina (east) via River Street should be maintained as the principal transport route from Teven Quarry including the route for any deliveries associated with future upgrading works

associated with the Pacific Highway. This should account for approximately 95% of all deliveries from Teven Quarry.

- Transport Route 2 which includes Stokers Lane, north along Teven Road to Tintenbar Road and then north along Tintenbar Road to Tamarind Drive should be maintained as a local route only and be restricted to local deliveries (ie. approximately 5% of deliveries).

- For Transport Route 1, improved delineation in Teven Road between Stokers Lane and Bruxner Highway is recommended due to the proposed special circumstances night time haulage. This includes:

    (i) Centreline markings in Teven Road between Stokers Lane and Bruxner Highway including the maintenance of the existing linemarking (where required) in Teven Road.

    (ii) Provision of reflectors on the existing guardrail fencing at the intersections of Stokers Lane and Wellers Road, with Teven Road.

    (iii) Maintenance of existing end treatment of guardrail in Teven Road at Stokers Lane.

No specific recommendations are made for Transport Route 2 which will be a local transport route only. Table 4.2 shows the audit findings for Transport Route 2.

TABLE 4.1

AUDIT FINDINGS

Transport Route 1

No.	Issue	Risk or Potential Safety Issue	Preliminary Risk Rating (low, Medium, high, intolerable)
1	Transport Route 1 (i.e. Tevens Road between Stokers Lane and Bruxner Highway) should be retained as the principal road haulage route, with all deliveries other than local deliveries using this route to the state road network including the Pacific Highway.	Alignment of Teven Road between Stokers Lane and Bruxner Highway is superior to the section north of Stokers Lane, with fewer curves and better sight lines. Pacific Highway between Bruxner Highway and Tamarind Drive interchange is a superior route in terms of alignment, lanes etc to the Tintenbar Road/Tamarind Drive route and is better suited to heavy vehicles.	Medium

No.	Issue	Risk or Potential Safety Issue	Preliminary Risk Rating (low, Medium, high, intolerable)
2	Due to proposed special circumstances night time road haulage, it is recommended that delineation be improved in Teven Road between Stokers Lane and Bruxner Highway, this includes; (i) Centreline marking in Tevens Road including maintenance of existing linemarking where required; (ii) Provision of reflections on the existing guardrail fencing in Tevens Road at the intersections of Stokers Lane and Wellers Road.	Delineation for night time driving conditions needs to be improved / upgraded to suit proposed higher usage during night time hours.	Medium
3	Replace damaged end treatment of existing guardrail in Tevens Road at Stokers Lane.	Damaged end represents a potential risk to safety for an out of control vehicle travelling southbound at/near Stokers Lane that may collide with the guardrail.	Medium

TABLE 4.2

AUDIT FINDINGS

Transport Route 2

No.	Issue	Risk or Potential Safety Issue	Preliminary Risk Rating (low, Medium, high, intolerable)
1	Pipe and rail fencing used on narrow bridge in Tintenbar Road north of Teven Road	Out of control vehicle may crash through pipe and rail fence into creek	Medium

5.0 FORMAL STATEMENT

We have examined the existing local roads that form the transport routes for Teven Quarry and we have audited these roads in accordance with the procedures set out in the RMS Guidelines for Road Safety Audit Practice. The audit has been carried out for the sole purpose of identifying any features of the existing roads that could be changed to improve safety. The audit findings and recommendations are presented in Section 4.

30 May 2014
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Terry Lawrence

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Geoff Morris

APPENDIX 1

1. Austroads Guide to Road Safety
   Part 6: Road Safety Audit

2. Roads and Maritime Services - Guidelines for Road Safety Audit Practice

3. Roads and Maritime Services – Road Environment Safety Guidelines

4. Austroads – Guide to Road Design and RMS Supplements

5. Austroads – Guide to Traffic Management and RMS Supplements

APPENDIX 2A

TRANSPORT ROUTE 1 – STOKERS LANE AND TEVEN ROAD BETWEEN STOKERS LANE AND BRUXNER HIGHWAY

CHECKLIST 6: ROAD SAFETY AUDIT OF EXISTING ROADS

No.	Issue	Yes	No	Comments
6.1 1	**ROAD ALIGNMENT AND CROSS SECTION** **Visibility; Sight Distance** Is sight distance appropriate for the speed of traffic using the route?	✓		
	Is adequate sight distance provided for intersections and crossings? (for example pedestrian, cyclist, cattle, railway)	✓		
	Is adequate sight distance provided for all private driveways and property entrances?	✓		
2	**Design Speed** Is the horizontal and vertical alignment suitable for the (85th percentile) traffic speed?			
	If not: – Are warning signs installed? – Are advisory speed signs installed?			
	Are the posted advisory speeds for curves appropriate?	✓		
3	**Speed Limit / Speed Zoning** Is the speed limit compatible with the function, road geometry, landuse and sight distance?	✓		
4	**Overtaking** Are safe overtaking opportunities provided?	✓		Two lane low volume road. Limited opportunities to overtake.
5	**Readability** Is the road free of elements that may cause confusion? For example: Is alignment of the roadway clearly defined? Has disused pavement (if any) been removed or treated? Have old pavement markings been removed properly? Do tree lines follow the road alignment? Does the line of street lights or poles follow the road alignment?	 ✓ ✓ 	 N/A N/A N/A	 On sections of the road.
	Is the road free of misleading curves or combinations of curves?	✓		
6	**Widths** Are medians and islands of adequate width for likely users?			N/A
	Are traffic lane and carriageway widths adequate for the traffic volume and mix?	✓		
	Are bridge widths adequate?	✓		
7	**Shoulders** Are shoulders wide enough to allow drivers to regain control of errant vehicles?			Shoulder widths vary and are typical for low volume rural roads.
	Are shoulders wide enough for broken down vehicles and emergencies to stop safely?	✓		In most locations.
	Are shoulders sealed?		✓	
	Are shoulders trafficable for all vehicles and road users? (ie. are shoulders in good condition)			Shoulders are grass and trafficable in most sections.

No.	Issue	Yes	No	Comments
	Is the transition from road to shoulder safe? (no drop offs.)	✓		
8	**Crossfalls** Is the appropriate super elevation provided on curves?	✓		
	Is any adverse crossfall safely managed (for cars, trucks, etc.)?	✓		
	Do cross falls (carriageway and shoulder) provide adequate drainage?	✓		
9	**Batter Slopes** Are batter slopes traversable by cars and trucks that run off the road?			N/A. No batter slopes.
10	**Drains** Are roadside drains and culvert end walls traversable?		✓	
6.2 1	**AUXILIARY LANES** **Tapers** Are starting and finishing tapers located and aligned correctly?			N/A. No auxillary lanes.
	Is there sufficient sight distance to the end of the auxiliary lane?			N/A
2	**Shoulders** Are appropriate shoulder widths provided at merges?			N/A
	Have shoulder widths been maintained beside the auxiliary lane?			N/A
3	**Signs and Markings** Have all signs been installed in accordance with the appropriate guidelines?			N/A
	Are all signs conspicuous and clear?			N/A
	Does all linemarking conform with these guidelines?			N/A
	Is there advance warning of approaching auxiliary lanes?			N/A
4	**Turning Traffic** Have all right turns from the through lane been avoided?			N/A
	Is there advance warning of turn lanes?			N/A
6.3 1	**INTERSECTIONS** **Location** Are all intersections located safely with respect to the horizontal and vertical alignment?	✓		
	Where intersections occur at the end of high speed environments (eg. at approaches to towns), are there traffic control devices (eg. rumble strips) to alert drivers?			N/A
2	**Visibility; Sight Distance** Is the presence of the intersection obvious to all road users?	✓		
	Is the sight distance appropriate for all movements and all users?	✓		
	Is there safe stopping sight distance to the rear of any queue or slow moving turning vehicles?	✓		
	Has the appropriate sight distance been provided for entering and leaving vehicles?	✓		

No.	Issue	Yes	No	Comments
3	**Controls and Delineation** Are pavement markings and intersection control signs satisfactory?	✓		
	Are vehicle paths through intersections delineated satisfactorily?	✓		
	Are all lanes properly marked (including any arrows)?	✓		
4	**Layout** Are all conflict points between vehicles safely managed?	✓		
	Is the intersection layout obvious to all road users?	✓		
	Is the alignment of kerbs obvious and appropriate?	✓		
	Is the alignment of traffic islands obvious and appropriate?	✓		
	Is the alignment of medians obvious and appropriate?	✓		
	Can all likely vehicle types be accommodated?	✓		
	Are merge tapers long enough?			N/A
	Is the intersection free of capacity problems that may produce safety problems?	✓		
5	**Miscellaneous** Particularly at rural sites, are all intersections free of loose gravel?			
6.4 1	**SIGNS AND LIGHTING** **Lighting** Is lighting required and, if so, has it been adequately provided?		✓	Street lighting provided at Bruxner/Teven Road intersection. No street lighting on rest of route.
	Is the road free of features that interrupt illumination (for example trees or overbridges)?			N/A
	Is the road free of lighting poles that are a fixed roadside hazard?			N/A
	Are frangible or slip base poles provided?			N/A
	Ambient lighting: if it creates special lighting needs, have these been satisfied?			N/A
	Is the lighting scheme free of confusing or misleading effects on signals or signs?			N/A
	Is the scheme free of any lighting black patches?			N/A
2	**General signs issues** Are all necessary regulatory, warning and direction signs in place? Are they conspicuous and clear?	✓		
	Are the correct signs used for each situation and is each sign necessary?	✓		
	Are all signs effective for all likely conditions (for example day, night, rain, fog, rising or setting sun, oncoming headlights, poor lighting)?	✓		
	If restrictions apply for any class of vehicle are drivers adequately advised?			N/A
	If restrictions apply for any class of vehicle are drivers advised of alternative routes?			N/A

No.	Issue	Yes	No	Comments
3	**Sign Legibility** In daylight and darkness, are signs satisfactory regarding visibility? – Clarity of message? – Readibility / legibility at the required distance?	✓		
	Is sign retroreflectivity or illumination satisfactory?	✓		
	Are signs able to be seen without being hidden by their background or adjacent distractions?	✓		
	Is driver confusion due to too many signs avoided?	✓		
4	**Signs Supports** Are sign supports out of the clear zone?		✓	Warning sign posts are frangible.
	If not, are they: – Frangible – Shielded by barriers (for example, guard fence, crash cushions)?	✓		 N/A N/A
6.5 1	**DELINEATION AND GUIDANCE** **General Issues** Is the linemarking and delineation: – Appropriate for the function of the road? – Consistent along the route – Likely to be effective under all expected conditions? (day, night, wet, dry, fog, rising and setting sun position, oncoming headlights, etc.)		✓	Centreline dividing separation line required in Teven Road for full length, particularly for night time conditions.
	Is the pavement free of excessive markings? (for example unnecessary turn arrows, unnecessary barrier lines, etc.)	✓		
2	**Centrelines, Edgelines, Lanelines** Are centrelines, edgelines, lanelines provided? If not, do drivers have adequate guidance?		✓	Double barrier lines provided along route at a number of locations. However centreline marking not provided on full route.
	Are RRPMs required?		✓	
	If RRPMs are installed, are they correctly placed, correct colours, in good condition?			N/A
	Are profiled (audible) edgelines provided where required?			N/A
	Is the linemarking in good condition?			Limited Linemarking. Some maintenance required.
	Is there sufficient contrast between linemarking and pavement colour?	✓		
3	**Guideposts and Reflectors** Are guideposts appropriately installed?	✓		
	Are delineators clearly visible?	✓		
	Are the correct colors used for the delineators?	✓		
	Are the delineators on guardfences, crash barriers and bridge railings consistent with those on the guideposts?		✓	Need for reflectors on guard rail in Tevens Road at Stokers Lane and Wellers Road.
4	**Curve Warning and Delineation** Are curve alignment markers installed where required?	✓		
	Are advisory signs consistent along the route?	✓		

No.	Issue	Yes	No	Comments
	Are the signs correctly located in relation to the curve? (ie. not too far in advance.)	✓		
	Are signs large enough?	✓		
	Are curve alignment markers (CAMs) installed where required?	✓		
	Is the positioning of CAMs satisfactory to provide guidance around the curve?	✓		
	Are the CAMs the correct size?	✓		
	Are CAMs confined to curves (not used to delineate islands, etc.)?	✓		
6.6 1	**CRASH BARRIERS AND CLEAR ZONES** **Clear Zones** Is the clear zone width traversable (ie. drivable)?		✓	No in all locations.
	Is the clear zone free of rigid fixtures? (If not, can all of these rigid fixtures be removed or shielded?)		✓	Trees located in clear zone in a number of locations. Not feasible to remove or shield.
	Are all power poles, trees, etc. at a safe distance from the traffic paths?		✓	Most poles are more than 3 metres from travel lane. Some are closer.
	Is the appropriate treatment or protection provided for any objects within the clear zone?			Not feasible or cost effective to protect trees and poles.
2	**Crash Barriers** Are crash barriers installed where necessary?	✓		
	Are crash barriers installed at all necessary locations in accordance with the relevant guidelines?	✓		
	Are the barrier systems suitable for the purpose?	✓		
	Are the crash barriers correctly installed?			
	Is the length of crash barrier at each installation adequate?	✓		
	Is the guard fence attached correctly to bridge railings?	✓		
	Is there sufficient width between barrier and the edge line to contain a broken down vehicle?		✓	Not in all locations.
3	**End Treatments** Are end treatments constructed correctly?	✓		End treatment at Stokers Lane requires maintenance.
	Is there a safe run off area behind breakaway terminals?		✓	
4	**Fences** Are pedestrian fences frangible?			N/A
	Are vehicles safe from being 'speared' by horizontal fence railings located within the clear zone?			N/A
5	**Visibility of Barriers and Fences** Is there adequate delineation and visibility of crash barriers and fences at night?	✓		
6.7 1	**TRAFFIC SIGNALS** **Operations** Are traffic signals operating correctly?			N/A
	Are the number, location and type of signal displays appropriate for the traffic mix and traffic environment?			N/A

No.	Issue	Yes	No	Comments
	Where necessary, are there provisions for visually impaired pedestrians ? (for example audio-tactile push buttons, tactile markings)			N/A
	Where necessary, are there provisions for elderly or disabled pedestrians? (for example, extended green or clearance phase)			N/A
	Is the controller located in a safe position? (ie. where it is unlikely to be hit, but maintenance access is safe.)			N/A
	Is the condition (especially skid resistance) of the road surface on the approaches satisfactory?			N/A
2	**Visibility** Are traffic signals clearly visible to approaching motorists?			N/A
	Is there adequate stopping sight distance to the ends of possible vehicle queues?			N/A
	Have any visibility problems that could be caused by the rising or setting sun been addressed?			N/A
	Are signal displays shielded so that they can be seen only by the motorists for whom they are intended?			N/A
	Where signal displays are not visible from an adequate distance, are signal warning signs and/or flashing lights installed?			N/A
	Where signals are mounted high for visibility over crests, is there adequate stopping sight distance to the ends of traffic queues?			N/A
	Is the primary signal free from obstructions on the nearside footway to approaching drivers? (trees, lamp columns, signs, bus stops etc.)			N/A
6.8 1	**PEDESTRIANS AND CYCLISTS** **General Issues** Are there appropriate travel paths and crossing points for pedestrians and cyclists?			N/A
	Is a safety fence installed where necessary to guide pedestrians and cyclists to crossings or overpasses?			N/A
	Is safety barrier installed where necessary to separate vehicle, pedestrian and cyclist flows?			N/A
	Are pedestrian and bicycle facilities suitable for night use?			N/A
2	**Pedestrians** Is there adequate separation distance between vehicular traffic and pedestrians on footways?			N/A
	Is there an adequate number of pedestrian crossings along the route?			N/A
	At crossing points is fencing orientated so that pedestrians face oncoming traffic?			N/A
	Is there adequate provision for the elderly, the disabled, children, wheelchairs and baby carriages? (for example, holding rails, kerb and median crossings, ramps)			N/A

No.	Issue	Yes	No	Comments
	Are adequate hand rails provided where necessary? (for example, on bridges, ramps)			N/A
	Is signing about pedestrians near schools adequate and effective?			N/A
	Is signing about pedestrians near any hospital adequate and effective?			N/A
	Is the distance from the stop line to a cross walk sufficient for truck drivers to see pedestrians?			N/A
3	**Cyclists** Is the pavement width adequate for the number of cyclists using the route?			No cyclists observed using road. Cyclist need to share travel lane.
	Is the bicycle route continuous, (ie. free of squeeze points or gaps?)			N/A
	Are drainage pit grates 'bicycle safe'?			N/A
4	**Public Transport** Are bus stops safely located with adequate visibility and clearance to the traffic lane?	✓		No formal bus stops. Buses stop on road shoulders.
	Are bus stops in rural areas signposted in advance?		✓	
	Are shelters and seats located safely to ensure that sight lines are not impeded? Is clearance to the road adequate?			N/A. No shelter.
	Is the height and shape of the kerb at bus stops suitable for pedestrians and bus drivers?			N/A
6.9 1	**BRIDGES AND CULVERTS** **Design Features** Are all bridges and culverts the full formation width?	✓		
	Are bridge and culvert carriageway widths consistent with the approach conditions?	✓		
	Is the approach alignment compatible with the 85th percentile travel speed?	✓		
	Have warning signs been erected if either of the above two conditions (ie. width and speed) are not met?			N/A
2	**Crash Barriers** Are there suitable traffic barriers on bridges and culverts and their approaches to protect errant vehicles?	✓		
	Is the connection between barrier and bridge safe?	✓		
	Is the bridge free of kerbing that would reduce the effectiveness of barriers or rails?	✓		
3	**Miscellaneous** Are pedestrian facilities on the bridge appropriate and safe?			N/A
	Is fishing from the bridge prohibited? If not, has provision been made for 'safe' fishing?			N/A. No footpaths.
	Does delineation continue over the bridge?	✓		
6.10 1	**PAVEMENT** **Pavement Defects** Is the pavement free of defects (for example, excessive roughness or rutting, potholes, loose material, etc) that could result in safety problems (for example, loss of steering control)?	✓		Generally

No.	Issue	Yes	No	Comments
	Is the condition of the pavement edges satisfactory?	✓		Generally
	Is the transition from pavement to shoulder free of dangerous edge drop offs?	✓		
2	**Skid Resistance** Does the pavement appear to have adequate skid resistance, particularly on curves, steep grades and approaches to intersections?	✓		
	Has skid resistance testing been carried out where necessary?			Not known.
3	**Ponding** Is the pavement free of areas where ponding or sheet flow of water could contribute to safety problems?	✓		
4	**Loose Stones / Material** Is the pavement free of loose stones and other material?	✓		
6.11 1	**PARKING** **General Issues** Are the provisions for, or restrictions on, parking satisfactory in relation to traffic safety?			N/A
	Is the frequency of the parking turnover compatible with the safety of the route?			N/A
	Is there sufficient parking for delivery vehicles so that safety problems due to double parking do not occur?			N/A
	Are parking manoeuvres along the route possible without causing safety problems (for example angle parking)?			N/A
	Is the sight distance at both intersections, and along the route, unaffected by parked vehicles?			N/A
6.12 1	**PROVISION FOR HEAVY VEHICLES** **Design Issues** Are overtaking opportunities available for heavy vehicles, where volumes are high?			Volumes on road are low. Overtaking opportunities are restricted to straight sections. Road is mostly flat which allows heavy vehicles to maintain speed.
	Does the route generally cater for the size of vehicle likely to use it?	✓		
	Is there adequate manoeuvring room for large vehicles along the route, at intersections, roundabouts, etc.?	✓		
	Is access to rest areas and truck parking areas adequate for the size of vehicle expected? (Consider acceleration, deceleration, shoulder widths, etc.)			N/A.
2	**Pavement / Shoulder Quality** Are shoulders sealed at bends to provide additional pavement for long vehicles?			Shoulders are not sealed except where new work completed at Emigrant Creek. However road pavements are wider on bends on rest of route.
	Is the pavement width adequate for heavy vehicles?			
	In general, is the pavement quality sufficient for the safe travel of heavy and oversized vehicles?	✓		

No.	Issue	Yes	No	Comments
	On truck routes, are reflective devices appropriate for truck drivers' eye heights?	✓		
3	**Delineation and Guidance** On truck routes, are reflective devices appropriate for truck drivers' eye heights?	✓		
6.13 1	**FLOODWAYS AND CAUSEWAYS** **Ponding, Flooding** Are all sections of the route free from ponding or flow across the road during wet weather?			Not known. Road is subject to flooding but there are no causeways.
	If there is ponding or flow across the road during wet weather , is there appropriate signposting?			N/A
	Are floodways/causeways correctly signposted?			N/A (No causeways)
2	**Safety of Devices** Are all culverts or drainage structures located outside the clear roadside recovery area?		✓	Locations of drainage structures are typical for most low volume rural roads.
	If not, are they shielded from the possibility of vehicle collision?		✓	
6.14 1	**MISCELLANEOUS** **Landscaping** Is landscaping in accordance with guidelines? (for example, clearances, sight distance)			N/A
	Will existing clearances and sight distances be maintained following future plant growth?			N/A
	Does the landscaping at roundabouts avoid visibility problems?			N/A
2	**Temporary Works** Are all locations free of construction or maintenance equipment that is no longer required?			N/A
	Are all locations free of signs or temporary traffic control devices that is no longer required?			N/A
3	**Headlight Glare** Have all problems that could be caused by headlight glare been addressed? (for example, a two-way service road close to main traffic lanes, the use of glare fencing or screening)			N/A
4	**Roadside Activities** Are the road boundaries free of any activities that are likely to distract drivers?	✓		
	Are all advertising signs installed so that they do not constitute a hazard?		✓	
5	**Errant Vehicles** Is the roadside furniture on the verges and footways free of damage from errant vehicles that could indicate a possible problem, hazard or conflict at the site?			
6	**Other Safety Issues** Is the embankment stability safe?	✓		
	Is the route free of unsafe overhanging branches?	✓		
	Is the route free of visibility obstructions caused by long grass?	✓		Grass shoulders need regular maintenance.
	Are any high wind areas safely dealt with?			N/A

No.	Issue	Yes	No	Comments
	If back to back medians kerbing is used is it: – Adequately delineated? – Obvious where it starts? – Obvious at intersections? – Unlikely to be a hazard to pedestrians?			N/A
7	**Rest Areas** Is the location of rest areas and truck parking areas along the route appropriate?			N/A
	Is there adequate sight distance to the exit and entry points from rest areas and truck parking areas during all times of the day?			N/A
8	**Animals** Is the route free from large numbers of animals (for example, cattle, sheep, kangaroos, koalas, wombats, etc.)?	✓		
	If not, is the route protected by animal-proof fencing?			N/A

APPENDIX 2B

TRANSPORT ROUTE 2 – TEVEN ROAD NORTH OF STOKERS LANE, TINTENBAR ROAD AND TAMARIND DRIVE

CHECKLIST 6: ROAD SAFETY AUDIT OF EXISTING ROADS

No.	Issue	Yes	No	Comments
6.1 1	**ROAD ALIGNMENT AND CROSS SECTION** **Visibility; Sight Distance** Is sight distance appropriate for the speed of traffic using the route?	✓		
	Is adequate sight distance provided for intersections and crossings? (for example pedestrian, cyclist, cattle, railway)	✓		
	Is adequate sight distance provided for all private driveways and property entrances?	✓		
2	**Design Speed** Is the horizontal and vertical alignment suitable for the (85th percentile) traffic speed?	✓		
	If not: – Are warning signs installed? – Are advisory speed signs installed?			
	Are the posted advisory speeds for curves appropriate?			
3	**Speed Limit / Speed Zoning** Is the speed limit compatible with the function, road geometry, landuse and sight distance?	✓		
4	**Overtaking** Are safe overtaking opportunities provided?	✓		
5	**Readability** Is the road free of elements that may cause confusion? For example: Is alignment of the roadway clearly defined? Has disused pavement (if any) been removed or treated? Have old pavement markings been removed properly? Do tree lines follow the road alignment? Does the line of street lights or poles follow the road alignment?	 ✓ ✓ N/A ✓		
	Is the road free of misleading curves or combinations of curves?	✓		
6	**Widths** Are medians and islands of adequate width for likely users?	✓		Mostly painted islands.
	Are traffic lane and carriageway widths adequate for the traffic volume and mix?	✓		
	Are bridge widths adequate?		✓	Bridge in Tintenbar Road near Teven Road is narrow (5.8 metres).
7	**Shoulders** Are shoulders wide enough to allow drivers to regain control of errant vehicles?	✓		
	Are shoulders wide enough for broken down vehicles and emergencies to stop safely?	✓		

No.	Issue	Yes	No	Comments
	Are shoulders sealed?	✓		In Tintenbar Road and Tamarind Drive.
	Are shoulders trafficable for all vehicles and road users? (ie. are shoulders in good condition)	✓		
	Is the transition from road to shoulder safe? (no drop offs.)	✓		
8	**Crossfalls** Is the appropriate super elevation provided on curves?	✓		
	Is any adverse crossfall safely managed (for cars, trucks, etc.)?	✓		
	Do cross falls (carriageway and shoulder) provide adequate drainage?	✓		
9	**Batter Slopes** Are batter slopes traversable by cars and trucks that run off the road?	✓		
10	**Drains** Are roadside drains and culvert end walls traversable?		✓	
6.2 1	**AUXILIARY LANES** **Tapers** Are starting and finishing tapers located and aligned correctly?	✓		
	Is there sufficient sight distance to the end of the auxiliary lane?	✓		
2	**Shoulders** Are appropriate shoulder widths provided at merges?	✓		
	Have shoulder widths been maintained beside the auxiliary lane?	✓		
3	**Signs and Markings** Have all signs been installed in accordance with the appropriate guidelines?	✓		
	Are all signs conspicuous and clear?	✓		
	Does all linemarking conform with these guidelines?	✓		
	Is there advance warning of approaching auxiliary lanes?			
4	**Turning Traffic** Have all right turns from the through lane been avoided?		✓	No turn lanes at several minor intersections.
	Is there advance warning of turn lanes?		✓	
6.3 1	**INTERSECTIONS** **Location** Are all intersections located safely with respect to the horizontal and vertical alignment?	✓		
	Where intersections occur at the end of high speed environments (eg. at approaches to towns), are there traffic control devices (eg. rumble strips) to alert drivers?			N/A
2	**Visibility; Sight Distance** Is the presence of the intersection obvious to all road users?	✓		
	Is the sight distance appropriate for all movements and all users?	✓		

No.	Issue	Yes	No	Comments
	Is there safe stopping sight distance to the rear of any queue or slow moving turning vehicles?	✓		
	Has the appropriate sight distance been provided for entering and leaving vehicles?	✓		
3	**Controls and Delineation** Are pavement markings and intersection control signs satisfactory?	✓		
	Are vehicle paths through intersections delineated satisfactorily?	✓		
	Are all lanes properly marked (including any arrows)?	✓		
4	**Layout** Are all conflict points between vehicles safely managed?	✓		
	Is the intersection layout obvious to all road users?	✓		
	Is the alignment of kerbs obvious and appropriate?	✓		Limited use of kerbs at intersections.
	Is the alignment of traffic islands obvious and appropriate?	✓		
	Is the alignment of medians obvious and appropriate?	✓		
	Can all likely vehicle types be accommodated?	✓		
	Are merge tapers long enough?	✓		
	Is the intersection free of capacity problems that may produce safety problems?	✓		
5	**Miscellaneous** Particularly at rural sites, are all intersections free of loose gravel?	✓		
6.4 1	**SIGNS AND LIGHTING** **Lighting** Is lighting required and, if so, has it been adequately provided?			Rural roads. No street lighting except at interchange with Pacific Highway at Tintenbar.
	Is the road free of features that interrupt illumination (for example trees or overbridges)?			N/A
	Is the road free of lighting poles that are a fixed roadside hazard?	✓		See comments above
	Are frangible or slip base poles provided?	✓		See comments above
	Ambient lighting: if it creates special lighting needs, have these been satisfied?	✓		N/A
	Is the lighting scheme free of confusing or misleading effects on signals or signs?	✓		See comments above
	Is the scheme free of any lighting black patches?	✓		See comments above
2	**General signs issues** Are all necessary regulatory, warning and direction signs in place? Are they conspicuous and clear?	✓		
	Are the correct signs used for each situation and is each sign necessary?	✓		
	Are all signs effective for all likely conditions (for example day, night, rain, fog, rising or setting sun, oncoming headlights, poor lighting)?	✓		

No.	Issue	Yes	No	Comments
	If restrictions apply for any class of vehicle are drivers adequately advised?			N/A
	If restrictions apply for any class of vehicle are drivers advised of alternative routes?			N/A
3	**Sign Legibility** In daylight and darkness, are signs satisfactory regarding visibility? – Clarity of message? – Readibility / legibility at the required distance?	✓		
	Is sign retroreflectivity or illumination satisfactory?	✓		
	Are signs able to be seen without being hidden by their background or adjacent distractions?	✓		
	Is driver confusion due to too many signs avoided?	✓		
4	**Signs Supports** Are sign supports out of the clear zone?		✓	Sign supports are mostly frangible.
	If not, are they: – Frangible – Shielded by barriers (for example, guard fence, crash cushions)?	✓	- N/A	
6.5 1	**DELINEATION AND GUIDANCE** **General Issues** Is the linemarking and delineation: – Appropriate for the function of the road? – Consistent along the route – Likely to be effective under all expected conditions? (day, night, wet, dry, fog, rising and setting sun position, oncoming headlights, etc.)	✓ ✓ ✓		Limited linemarking in section of Teven Road between Stokers Lane and Tintenbar Road. Linemarking and delineation is satisfactory in Tintenbar Road and Tamarind Drive.
	Is the pavement free of excessive markings? (for example unnecessary turn arrows, unnecessary barrier lines, etc.)	✓		
2	**Centrelines, Edgelines, Lanelines** Are centrelines, edgelines, lanelines provided? If not, do drivers have adequate guidance?	✓		
	Are RRPMs required?	✓		
	If RRPMs are installed, are they correctly placed, correct colours, in good condition?	✓		Some maintenance required.
	Are profiled (audible) edgelines provided where required?		✓	Not required.
	Is the linemarking in good condition?	✓		
	Is there sufficient contrast between linemarking and pavement colour?	✓		
3	**Guideposts and Reflectors** Are guideposts appropriately installed?	✓		
	Are delineators clearly visible?	✓		
	Are the correct colors used for the delineators?	✓		
	Are the delineators on guardfences, crash barriers and bridge railings consistent with those on the guideposts?	✓		

No.	Issue	Yes	No	Comments
4	**Curve Warning and Delineation** Are curve alignment markers installed where required?	✓		
	Are advisory signs consistent along the route?	✓		
	Are the signs correctly located in relation to the curve? (ie. not too far in advance.)	✓		
	Are signs large enough?	✓		
	Are curve alignment markers (CAMs) installed where required?	✓		
	Is the positioning of CAMs satisfactory to provide guidance around the curve?	✓		
	Are the CAMs the correct size?	✓		
	Are CAMs confined to curves (not used to delineate islands, etc.)?	✓		
6.6 1	**CRASH BARRIERS AND CLEAR ZONES** **Clear Zones** Is the clear zone width traversable (ie. drivable)?		✓	Not in all locations.
	Is the clear zone free of rigid fixtures? (If not, can all of these rigid fixtures be removed or shielded?)	✓		Isolated trees in clear zone in a number of locations.
	Are all power poles, trees, etc. at a safe distance from the traffic paths?		✓	Isolated poles in clearzone.
	Is the appropriate treatment or protection provided for any objects within the clear zone?		✓	Not feasible or cost effective to protect trees and poles.
2	**Crash Barriers** Are crash barriers installed where necessary?	✓		
	Are crash barriers installed at all necessary locations in accordance with the relevant guidelines?	✓		
	Are the barrier systems suitable for the purpose?	✓		
	Are the crash barriers correctly installed?			
	Is the length of crash barrier at each installation adequate?	✓		
	Is the guard fence attached correctly to bridge railings?	✓		
	Is there sufficient width between barrier and the edge line to contain a broken down vehicle?		✓	Not in all locations.
3	**End Treatments** Are end treatments constructed correctly?	✓		
	Is there a safe run off area behind breakaway terminals?	✓		
4	**Fences** Are pedestrian fences frangible?			N/A
	Are vehicles safe from being 'speared' by horizontal fence railings located within the clear zone?			N/A
5	**Visibility of Barriers and Fences** Is there adequate delineation and visibility of crash barriers and fences at night?	✓		
6.7 1	**TRAFFIC SIGNALS** **Operations** Are traffic signals operating correctly?			N/A

No.	Issue	Yes	No	Comments
	Are the number, location and type of signal displays appropriate for the traffic mix and traffic environment?			N/A
	Where necessary, are there provisions for visually impaired pedestrians ? (for example audio-tactile push buttons, tactile markings)			N/A
	Where necessary, are there provisions for elderly or disabled pedestrians ? (for example, extended green or clearance phase)			N/A
	Is the controller located in a safe position? (ie. where it is unlikely to be hit, but maintenance access is safe.)			N/A
	Is the condition (especially skid resistance) of the road surface on the approaches satisfactory?			N/A
2	**Visibility** Are traffic signals clearly visible to approaching motorists?			N/A
	Is there adequate stopping sight distance to the ends of possible vehicle queues?			N/A
	Have any visibility problems that could be caused by the rising or setting sun been addressed?			N/A
	Are signal displays shielded so that they can be seen only by the motorists for whom they are intended?			N/A
	Where signal displays are not visible from an adequate distance, are signal warning signs and/or flashing lights installed?			N/A
	Where signals are mounted high for visibility over crests, is there adequate stopping sight distance to the ends of traffic queues?			N/A
	Is the primary signal free from obstructions on the nearside footway to approaching drivers? (trees, lamp columns, signs, bus stops etc.)			N/A
6.8 1	**PEDESTRIANS AND CYCLISTS** **General Issues** Are there appropriate travel paths and crossing points for pedestrians and cyclists?			N/A
	Is a safety fence installed where necessary to guide pedestrians and cyclists to crossings or overpasses?	✓		At Pacific Highway Interchange.
	Is safety barrier installed where necessary to separate vehicle, pedestrian and cyclist flows?			N/A
	Are pedestrian and bicycle facilities suitable for night use?			N/A
2	**Pedestrians** Is there adequate separation distance between vehicular traffic and pedestrians on footways?			No formal footway except at Pacific Highway Interchange at Tintenbar.
	Is there an adequate number of pedestrian crossings along the route?			N/A
	At crossing points is fencing orientated so that pedestrians face oncoming traffic?			N/A

No.	Issue	Yes	No	Comments
	Is there adequate provision for the elderly, the disabled, children, wheelchairs and baby carriages? (for example, holding rails, kerb and median crossings, ramps)			N/A
	Are adequate hand rails provided where necessary? (for example, on bridges, ramps)			N/A
	Is signing about pedestrians near schools adequate and effective?			N/A
	Is signing about pedestrians near any hospital adequate and effective?			N/A
	Is the distance from the stop line to a cross walk sufficient for truck drivers to see pedestrians?			N/A
3	**Cyclists** Is the pavement width adequate for the number of cyclists using the route?	✓ See comments		Very few cyclists. Tamarind Drive has wide sealed shoulders. In Tintenbar Road and Teven Road cyclists share travel lane.
	Is the bicycle route continuous, (ie. free of squeeze points or gaps?)			N/A
	Are drainage pit grates 'bicycle safe'?			N/A
4	**Public Transport** Are bus stops safely located with adequate visibility and clearance to the traffic lane?			N/A
	Are bus stops in rural areas signposted in advance?			
	Are shelters and seats located safely to ensure that sight lines are not impeded? Is clearance to the road adequate?			N/A. No shelters.
	Is the height and shape of the kerb at bus stops suitable for pedestrians and bus drivers?			N/A
6.9 1	**BRIDGES AND CULVERTS** **Design Features** Are all bridges and culverts the full formation width?		✓	Narrow bridge (5.8 metres) in Tintenbar Road near Teven Road.
	Are bridge and culvert carriageway widths consistent with the approach conditions?		✓	See comment above.
	Is the approach alignment compatible with the 85th percentile travel speed?	✓		
	Have warning signs been erected if either of the above two conditions (ie. width and speed) are not met?	✓		
2	**Crash Barriers** Are there suitable traffic barriers on bridges and culverts and their approaches to protect errant vehicles?			Most bridges meet standards. Bridge in Tintenbar Road near Teven Road does not have suitable barriers.
	Is the connection between barrier and bridge safe?	✓		
	Is the bridge free of kerbing that would reduce the effectiveness of barriers or rails?	✓		
3	**Miscellaneous** Are pedestrian facilities on the bridge appropriate and safe?			No pedestrian facilities on most bridges except at Pacific Highway overpass.
	Is fishing from the bridge prohibited? If not, has provision been made for 'safe' fishing?			N/A. No footpaths.
	Does delineation continue over the bridge?	✓		

No.	Issue	Yes	No	Comments
6.10 1	**PAVEMENT** **Pavement Defects** Is the pavement free of defects (for example, excessive roughness or rutting, potholes, loose material, etc) that could result in safety problems (for example, loss of steering control)?	✓		
	Is the condition of the pavement edges satisfactory?	✓		
	Is the transition from pavement to shoulder free of dangerous edge drop offs?	✓		
2	**Skid Resistance** Does the pavement appear to have adequate skid resistance, particularly on curves, steep grades and approaches to intersections?	✓		
	Has skid resistance testing been carried out where necessary?			Not known.
3	**Ponding** Is the pavement free of areas where ponding or sheet flow of water could contribute to safety problems?	✓		
4	**Loose Stones / Material** Is the pavement free of loose stones and other material?	✓		
6.11 1	**PARKING** **General Issues** Are the provisions for, or restrictions on, parking satisfactory in relation to traffic safety?			N/A
	Is the frequency of the parking turnover compatible with the safety of the route?			N/A
	Is there sufficient parking for delivery vehicles so that safety problems due to double parking do not occur?			N/A
	Are parking manoeuvres along the route possible without causing safety problems (for example angle parking)?			N/A
	Is the sight distance at both intersections, and along the route, unaffected by parked vehicles?			N/A
6.12 1	**PROVISION FOR HEAVY VEHICLES** **Design Issues** Are overtaking opportunities available for heavy vehicles, where volumes are high?	✓		
	Does the route generally cater for the size of vehicle likely to use it?	✓		
	Is there adequate manoeuvring room for large vehicles along the route, at intersections, roundabouts, etc.?	✓		
	Is access to rest areas and truck parking areas adequate for the size of vehicle expected? (Consider acceleration, deceleration, shoulder widths, etc.)			N/A.
2	**Pavement / Shoulder Quality** Are shoulders sealed at bends to provide additional pavement for long vehicles?	✓		

No.	Issue	Yes	No	Comments
	Is the pavement width adequate for heavy vehicles?			
	In general, is the pavement quality sufficient for the safe travel of heavy and oversized vehicles?	✓		
	On truck routes, are reflective devices appropriate for truck drivers' eye heights?	✓		
3	**Delineation and Guidance** On truck routes, are reflective devices appropriate for truck drivers' eye heights?	✓		
6.13 1	**FLOODWAYS AND CAUSEWAYS** **Ponding, Flooding** Are all sections of the route free from ponding or flow across the road during wet weather?			Teven Road subject to flooding but no causeway.
	If there is ponding or flow across the road during wet weather , is there appropriate signposting?			N/A
	Are floodways/causeways correctly signposted?			N/A
2	**Safety of Devices** Are all culverts or drainage structures located outside the clear roadside recovery area?		✓	Not in all locations.
	If not, are they shielded from the possibility of vehicle collision?		✓	
6.14 1	**MISCELLANEOUS** **Landscaping** Is landscaping in accordance with guidelines? (for example, clearances, sight distance)			N/A
	Will existing clearances and sight distances be maintained following future plant growth?			N/A
	Does the landscaping at roundabouts avoid visibility problems?	✓		
2	**Temporary Works** Are all locations free of construction or maintenance equipment that is no longer required?			N/A
	Are all locations free of signs or temporary traffic control devices that is no longer required?	✓		
3	**Headlight Glare** Have all problems that could be caused by headlight glare been addressed? (for example, a two-way service road close to main traffic lanes, the use of glare fencing or screening)			N/A
4	**Roadside Activities** Are the road boundaries free of any activities that are likely to distract drivers?	✓		
	Are all advertising signs installed so that they do not constitute a hazard?	✓		
5	**Errant Vehicles** Is the roadside furniture on the verges and footways free of damage from errant vehicles that could indicate a possible problem, hazard or conflict at the site?	✓		

No.	Issue	Yes	No	Comments
6	**Other Safety Issues** Is the embankment stability safe?	✓		
	Is the route free of unsafe overhanging branches?	✓		
	Is the route free of visibility obstructions caused by long grass?	✓		
	Are any high wind areas safely dealt with?			N/A
	If back to back medians kerbing is used is it: – Adequately delineated? – Obvious where it starts? – Obvious at intersections? – Unlikely to be a hazard to pedestrians?			N/A
7	**Rest Areas** Is the location of rest areas and truck parking areas along the route appropriate?			N/A
	Is there adequate sight distance to the exit and entry points from rest areas and truck parking areas during all times of the day?			N/A
8	**Animals** Is the route free from large numbers of animals (for example, cattle, sheep, kangaroos, koalas, wombats, etc.)?	✓		
	If not, is the route protected by animal-proof fencing?			N/A

APPENDIX 3

Austroads Risk Assessment Tables 4.1 to 4.4 Extract

C. Risk ranking of safety issues

The following tables may be useful to provide an indication of the level of risk and how to respond to it. Determine into which category in Table 4.1 and Table 4.2 the issue best fits. From this select the risk category in Table 4.3 and its suggested treatment approach in Table 4.4. This is not a scientific system and professional judgement should be used. Section 9.3 provides an evidence based approach to prioritising the treatment of works emanating from road safety audits of existing roads.

Table 4.1: How often is the problem likely to lead to a crash?

Frequency	Description
Frequent	Once or more per week
Probable	Once or more per year (but less than once a week)
Occasional	Once every five or ten years
Improbable	Less often than once every ten years

Table 4.2: What is the likely severity of the resulting crash type?

Severity	Description	Examples
Catastrophic	Likely multiple deaths	High-speed, multi-vehicle crash on a freeway. Car runs into crowded bus stop. Bus and petrol tanker collide. Collapse of a bridge or tunnel.
Serious	Likely death or serious injury	High or medium-speed vehicle/vehicle collision. High or medium-speed collision with a fixed roadside object. Pedestrian or cyclist struck by a car.
Minor	Likely minor injury	Some low-speed vehicle collisions. Cyclist falls from bicycle at low speed. Left-turn rear-end crash in a slip lane.
Limited	Likely trivial injury or property damage only	Some low-speed vehicle collisions. Pedestrian walks into object (no head injury). Car reverses into post.

Table 4.3: The resulting level of risk

	Frequent	Probable	Occasional	Improbable
Catastrophic	Intolerable	Intolerable	Intolerable	High
Serious	Intolerable	Intolerable	High	Medium
Minor	Intolerable	High	Medium	Low
Limited	High	Medium	Low	Low

Table 4.4: Treatment approach

Risk	Suggested treatment approach
Intolerable	Must be corrected.
High	Should be corrected or the risk significantly reduced, even if the treatment costs is high.
Medium	Should be corrected or the risk significantly reduced, if the treatment cost is moderate, but not high.
Low	Should be corrected or the risk reduced, if the treatment cost is low.

APPENDIX 9

Greenhouse Gas and Energy Assessment

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Greenhouse Gas and Energy Assessment

Teven Quarry Project

FINAL

July 2014

Greenhouse Gas and Energy Assessment

Teven Quarry Project

July 2014

Prepared by
Umwelt (Australia) Pty Limited

on behalf of
Holcim (Australia) Pty Limited

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Report No.	**3230/R03/Final**
Date:	**July 2014**

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Executive Summary

The Teven Quarry Project (the Project) will seek approval to replace the existing incremental production limit at the Teven Quarry, with a flat production limit of 500,000 tonnes per annum. The Project is also seeking approval to recycle up to 10,000 tonnes of concrete per annum and include a mobile in-pit crusher and a pug mill.

Approval for the Project is being sought under Part 4 of the *Environmental Planning and Assessment (EP&A) Act 1979*. This report has been prepared as part of the environmental assessment process required under the EP&A Act, and it includes greenhouse gas emission projections, an evaluation of climate change impacts and mitigation options. The scope of the greenhouse gas and energy assessment (GHGEA) includes:

- estimating direct and indirect (Scopes 1, 2 and 3) greenhouse gas emissions associated with the Project;
- estimating energy use directly associated with the Project;
- qualifying how the Project's greenhouse gas emissions may impact the environment;
- estimating the impact of the Project's emissions on national and international greenhouse gas emission targets; and
- assessing reasonable and feasible measures to minimise the greenhouse gas emissions and ensure energy use efficiency.

The GHGEA found that the Project does not significantly change the generation of greenhouse gases over the life of the quarry, as the total quantity of resource extracted by the quarry does not change as a result of the Project.

The net emissions associated with the Project can be distributed to the following greenhouse gas emission classes.

	Net Project Emissions (t CO_2-e)
Scope 1	3,750
Scope 2	-3,900
Scope 3	-600

The combined impacts of the Project are expected to increase Scope 1 emissions by approximately 3,750 t CO_2-e and reduce Scope 2 emissions by 3,900 t CO_2-e over the life of the quarry. Scope 2 emissions are reduced as the Project proposes to process approximately 30 per cent of its production using diesel powered in-pit crushing plant, instead of the fixed crushing plant, which consumes a combination of diesel and electricity. The Project effectively substitutes a proportion of its electrical energy demand with diesel.

The Project is unlikely to impact national greenhouse gas policy objectives, given the Project's direct emissions are only forecast to generate an additional 3,750 t CO_2-e of greenhouse gas emissions over the life of the quarry.

The Project will mitigate greenhouse gas emissions through ongoing energy efficiency initiatives and optimising productivity.

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1.0 Introduction

Holcim (Australia) Pty Ltd (Holcim Australia) operates the Teven Quarry, an existing hard rock quarry located at Stokers Lane, Teven (Lots 1, 2 and 3 DP 732288), approximately eight kilometres north west of Ballina. Teven Quarry has been in operation since the 1940s and supplies filling, sub-base and aggregate material to the Ballina and Lismore regions.

The quarry operates in accordance with two existing approvals, these being:

- Development Consent 1995/263 - through Court Order 10722 of 1995; and
- Development Consent 2000/431 – issued by Ballina Shire Council.

DA1995/263 originally provided for an annual production of 200,000 tonnes of product, which could be increased by 1.5 per cent per annum, up to a maximum production limit of 495,974 tonnes per annum in 2056. The maximum production limit for 2014 is approximately 265,000 tonnes per annum.

Due to increasing demand for quarry products associated with current and future road upgrade works in the region and significant population growth, Holcim Australia is seeking approval to replace the existing incremental production limit at the Teven Quarry, with a flat production limit of 500,000 tonnes per annum, from a total resource (reserves) of approximately 6.6 million tonnes.

The Teven Quarry meets the definition of 'extractive industries' under schedule 3 of the *Environmental Planning and Assessment Regulation 2000* and therefore is considered designated development. As such, an EIS will be required to support a development application for the project. The Teven Quarry also satisfies the State Environmental Planning Policy (State and Regional Development) 2011 definition of 'extractive industries' as it extracts from a resource of more than five million tonnes and as such is classified also as State significant development.

This Greenhouse Gas and Energy Assessment (GHGEA) was prepared to meet the Director-General's Environmental Impact Statement (EIS) requirements in relation to greenhouse gas issues for the development application.

1.1 The Project

The Teven Quarry Project (the Project) is seeking approval to replace the existing incremental production limit, with a flat production limit of 500,000 tonnes per annum (see **Table 1.1**). Holcim Australia proposes to achieve the maximum production limit by maximising use of existing fixed plant (350,000 tonnes per annum capacity) and adding an in-pit mobile crushing plant to cater for periods of peak demand (150,000 tonnes per annum capacity).

Holcim Australia also proposes the addition of processing options which will add value to the products produced on site, including the addition of a mobile pugmill and an allowance for recycling of surplus concrete washout from local approved batching facilities.

The proposed Project does not involve any change to the existing approved disturbance footprint or depth of the Teven Quarry, and there is no change to the overall quantity of reserves to be extracted by the Quarry.

Table 1 – Comparison of Existing Operations and Proposed Project

Project Component	Currently Approved	Proposed Project
Quarry life	Quarry operations permitted until 2056	30 years from date of approval.
Limits of production	200,000 tonnes per annum in 1995, increasing annually by 1.5% to 495,974 tonnes per annum in 2056.	500,000 tonnes per annum.
Quarry footprint	Shown on **Figure 2**.	Unchanged
Overburden management	Shown on **Figure 2**.	Unchanged
Hours of operation	Blasting: 9.00am – 3.00pm Monday to Friday All other activities: 7.00 am – 5.00 pm Monday to Friday 7.00 am – 4.00 pm Saturday	Blasting: 9.00am – 3.00 pm Monday to Friday All other activities: 7.00 am – 6.00 pm Monday to Saturday Extended hours for product loading and transport, stockpile management and maintenance: 6.00 pm to 10.00 pm Monday to Friday
Transport	Road transport at current approved production level	Road transport at proposed production level
Employment	11 Full Time Equivalent positions	14 Full Time Equivalent positions
Infrastructure	Fixed primary, secondary and tertiary crushing and screening plant	Fixed primary, secondary and tertiary crushing and screening plant; Mobile crushing and screening plant; Mobile pug mill.
Site Access	Off Stokers Lane	Unchanged
Concrete recycling for re-use as product	Not currently undertaken	Commence recycling of up to 10,000 tonnes per annum of clean surplus concrete material on site using existing processing infrastructure for re-use in product.

2.0 Assessment Framework

2.1 Objectives

The objective of this assessment is to evaluate the greenhouse gas and energy use implications of the Project, in a manner that satisfies the Director-General's EIS requirements for the Project. **Table 2.1** includes the Director-General's requirements, and the location where each requirement has been addressed in the GHGEA.

Table 2.1 - Checklist of the Director-General's Requirements

Objective	Director-General's requirements	Location in Assessment Report
1	A quantitative assessment of potential scope 1, 2 and 3 emissions	**Section 3.0**
2	A qualitative assessment of the potential impacts of these emissions on the environment	**Section 4.0**
3	An assessment of reasonable and feasible measures to minimise the greenhouse gas emissions and ensure energy use efficiency	**Section 5.0**

2.2 Scope

The scope of the GHGEA includes:

- estimating direct and indirect (Scopes 1, 2 and 3) greenhouse gas emissions associated with the Project;
- estimating energy use directly associated with the Project;
- qualifying how the Project's greenhouse gas emissions may impact the environment;
- estimating the impact of the Project's emissions on national and international greenhouse gas emission targets; and
- assessing reasonable and feasible measures to minimise the greenhouse gas emissions and ensure energy use efficiency.

2.3 Definitions

Table 2.2 contains concepts and a glossary of terms relevant to this GHGEA.

Table 2.2 - Glossary of Terms[1]

Concept	Definition
Greenhouse gases	The greenhouse gases covered by the Kyoto Protocol and referred to in this GHGEA include: • Carbon dioxide; • Methane; • Nitrous oxide; • Hydrofluorocarbons; • Perfluorocarbons; and • Sulphur hexafluoride.
Scope 1 emissions	Direct emissions occur from sources that are owned or controlled by the Project (in this case, the proponent, Holcim Australia) (e.g. fuel use). Scope 1 emissions are emissions over which the Project has a high level of control.
Scope 2 emissions	Emissions from the generation of purchased electricity consumed by the Project.
Scope 3 emissions	Indirect emissions that are a consequence of the activities of the Project, but occur at sources owned or controlled by other entities (e.g. outsourced services). Scope 3 emissions can include emissions generated upstream of the Project by providers of energy, materials and transport. Scope 3 emissions can also include emissions generated downstream of the Project by transport providers and product use.

2.4 Impact Assessment Methodology

The GHGEA framework is based on the methodologies and emission factors contained in the National Greenhouse Accounts (NGA) Factors 2013. The assessment framework also incorporates the principles of The Greenhouse Gas Protocol 2004.

The Greenhouse Gas Protocol (The GHG Protocol) provides an internationally accepted approach to greenhouse gas accounting. The Protocol provides guidance on setting reporting boundaries, defining emission sources and dealing with issues such as data quality and materiality.

Scope 1 and 2 emissions were calculated based on the methodologies and emission factors contained in the National Greenhouse Accounts (NGA) Factors 2013 (DCCEE 2013).

Scope 3 emissions associated with product transport were calculated based on fuel efficiency factors contained in the National Greenhouse Gas Inventory: Analysis of Recent Trends and Greenhouse Gas Indicators (AGO 2007). Other Scope 3 emissions were calculated using methodologies and emission factors contained in the National Greenhouse Accounts (NGA) Factors 2013 (DCCEE 2013).

[1] The GHG Protocol 2004

All methodologies and calculations have been made assuming that all operations will continue as described in **Section 1.1**.

2.5 Data Sources

The calculations in this report are based on activity data projections developed by Holcim Australia during the quarry planning process.

Table 2.3 contains the source of activity data.

Table 2.3 - Source of Activity Data Used for the Assessment

Activity data	Source
On-site fuel consumption	Holcim Australia, - forecast diesel consumption Umwelt, – estimated diesel consumption of in-pit mill
Electricity consumption	Holcim Australia, - forecast electricity consumption
Product transport	Holcim Australia, - haulage distances
Materials transport	Umwelt estimates

A detailed description of activity data and calculations are provided in **Appendices A**.

2.6 Assessment Boundary

The GHGEA boundary was developed to include all significant scope 1, 2 and 3 emissions. **Figure 2.1** demonstrates how the assessment boundary interacts with the potential emission sources under Holcim Australia's operational control and other emission sources associated with the Project.

2.7 Data Exclusions

The GHG Protocol requires inventory data and methodologies to be relevant, consistent, complete, transparent and accurate. The relevance principle states that the greenhouse gas inventory should appropriately reflect greenhouse gas emissions and serve the decision-making needs of users – both internal and external to the Project (GHG Protocol, 2004).

A quarry has a number of potential emission sources, however, the dominant emission sources, often targeted by mitigation measures and stakeholders, can be summarised as:

- diesel use;
- electricity use; and
- product transport.

The completeness principle states that all relevant emission sources within the chosen inventory boundary need to be accounted for so that a comprehensive and meaningful inventory is compiled (GHG Protocol, 2004).

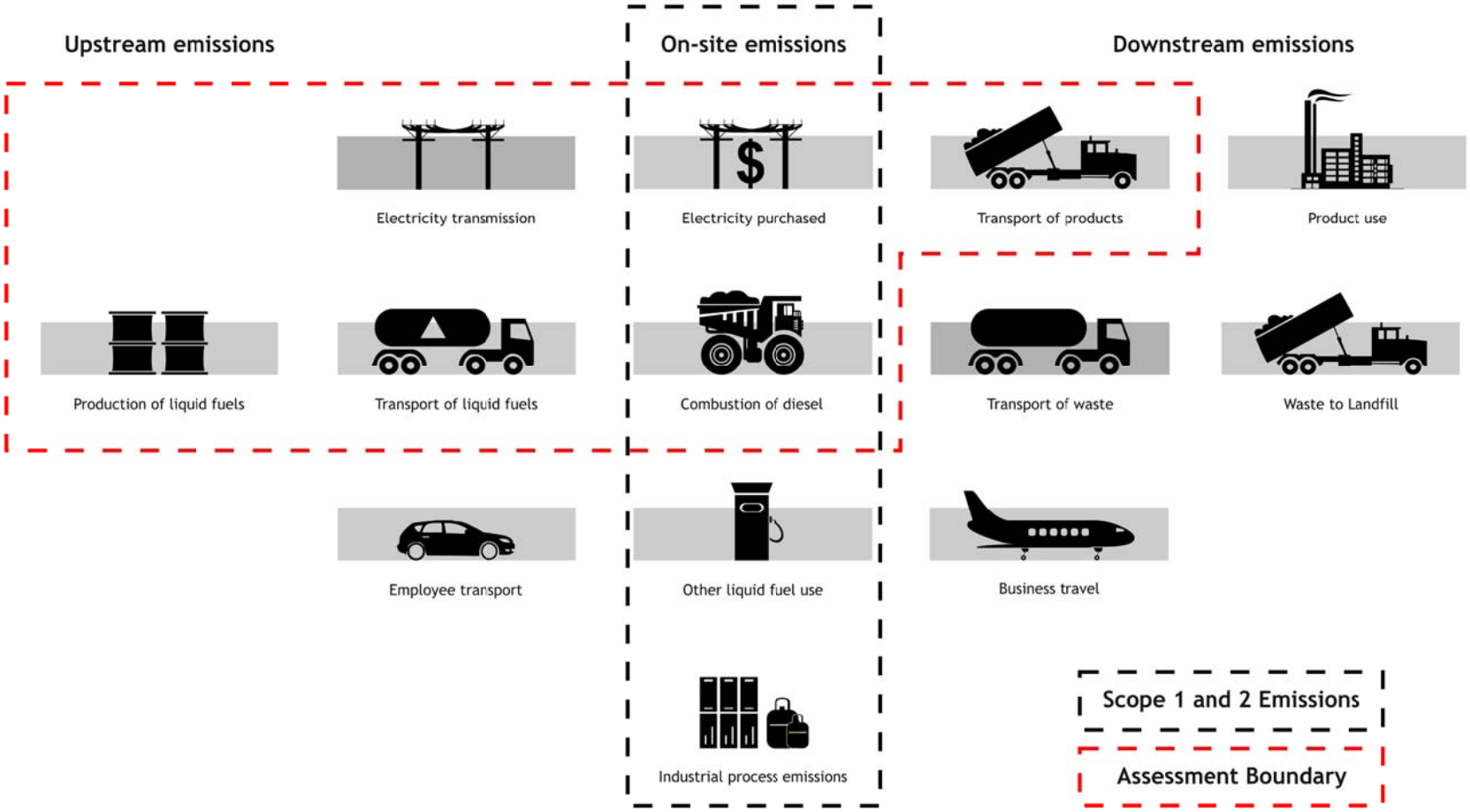

FIGURE 2.1

Teven Quarry Greenhouse Gas Assessment Boundary

The emission sources listed in **Table 2.4** have been excluded from the GHGEA as activity data is not readily available, and modelling activity data is unlikely to generate sufficient emissions to materially change impacts or influence the decision making outcomes of stakeholders.

Table 2.4 – Data Exclusions

Emissions source	Scope	Description
Combustion of fuel for energy	Scope 1	• Small quantities of fuels such as petrol and LPG.
Industrial processes	Scope 1	• Sulphur hexafluoride (high voltage switch gear). • Hydrofluorcarbon (commercial and industrial refrigeration).
Solid waste	Scope 3	• Solid waste to landfill.
Business travel	Scope 3	• Employees travelling for business purposes.
Employee travel	Scope 3	• Employees travelling between their place of residence and the Teven Quarry site.

3.0 Impact Assessment Results

The following assumptions were made to estimate the greenhouse gas emissions for the Project:

- the current incremental production limit would allow Holcim Australia to extract the remaining reserves (approximately 6.6 million tonnes) between 2014 and 2035;
- the proposed increased production limit would allow Holcim Australia to extract the remaining reserves (approximately 6.6 million tonnes) between 2014 and 2027;
- the quarry operates at its full production limit;
- the processing plant recycles 10,000 tonnes of surplus concrete per annum;
- the in-pit mill requires 0.55 l diesel / processed tonne;
- the pug mill processes 4,000 – 5,000 tonne per annum;
- the pug mill requires 1.08 l diesel / processed tonne;
- the Project requires an additional light vehicle;
- diesel is delivered to the quarry from Lismore; and
- the Project would result in the average delivery distance of quarry products increasing from 18 to 22 km.

3.1.1 Net Greenhouse Gas Emissions

The greenhouse gas emissions associated with the Project are best represented as the net difference between the existing operation (baseline case) and the proposed operation (the Project).

Table 3.1 outlines the net impact the Project will have on key activity data.

Table 3.1 – Forecast activity data for the baseline case and the Project

Activity Data	Baseline	Project	Net Impact
Production tonnes – Fixed crushing plant (t)	6,600,000	4,712,956	-1,887,044
Production tonnes – In-pit crushing plant (t)	0	1,887,044	1,887,044
Production tonnes – Recycled (t)	0	140,000	140,000
Production tonnes – Total (t)	6,600,000	6,740,000	140,000
Process tonnes – Pug mill (t)	0	62,345	62,345
Diesel use (kL)	7,856	9,253	1,397
Electricity use (kWh)	15,774,001	11,263,965	-4,510,036
3rd party diesel use (kL)	753.427	744.163	-9.264

The Project is forecast to have an important impact on a number of the processes that generate greenhouse gases. The Project is expected to reduce the tonnes of product processed by the fixed crushing plant over the life of the Project, which is expected to reduce electricity consumption. The Project is expected to increase the tonnes of product processed by the in-pit crushing plant, which is expected to increase diesel use. The total resource recovered from the quarry is not expected to increase as the total resource is fixed at 6.6 million tonnes, however, total production tonnes are expected to increase slightly due to the quantity of concrete recycled through the processing plant.

The Project's net greenhouse gas emissions are summarised in **Table 3.2**. Further detail regarding the calculation of net emissions is provided is **Appendix A**.

Table 3.2 – Net GHG Emission Summary for the Project

Scope	Source	Source Totals (t CO_2-e)	Scope Totals (t CO_2-e)
Scope 1	Diesel use	3,746	3,746
Scope 2	Electricity	-3,913	-3,913
Scope 3	Associated with energy extraction and distribution	-558	-587
	Product transport	-32	
	Materials transport – diesel	3	

The Project is forecast to increase Scope 1 greenhouse gas emissions by approximately 3,750 t CO_2-e. The additional Scope 1 emissions are generated by:

- the use of in-pit crushing plant (diesel powered rather than electricity); and
- the addition of a pug mill.

The Project is forecast to reduce Scope 2 emissions by approximately 3,900 t CO_2-e. The use of the in-pit crushing plant reduces the proportion of product processed by the fixed crushing plant, which is powered by a combination of diesel and electricity. The use of the in-pit crushing plant effectively substitutes electricity use for diesel use, which reduces Scope 2 emissions while increasing Scope 1 emissions.

The Project is forecast to reduce Scope 3 emissions by approximately 600 t CO_2-e. Scope 3 emissions are generated by transport companies who consume diesel to transport quarry products on behalf of Holcim Australia. Scope 3 emissions are also generated by companies that supply diesel and electricity (through processes such as extraction, production, transport or transmission). Scope 3 emissions associated with the supply of electricity are forecast to decrease as a result of the Project, due to the reduction in electricity use. Scope 3 emissions associated with transporting quarry products are also forecast to decrease due to a predicted decrease in the proportion of products trucked directly to consumers by Holcim contractors, with a corresponding increase in ex-bin sales (i.e. deliveries over which Holcim has no operational control). Scope 3 emissions associated with the supply of diesel are forecast to increase as a result of the Project, due to the increase in diesel use associated with the mobile crusher.

Scope 2 and 3 emissions have been included in the GHGEA to demonstrate the potential upstream and downstream impacts of the Project. All Scope 2 and 3 emissions identified in the GHGEA are attributable to, and may be reported by, other sectors.

3.1.2 Energy Use

The Project is forecast to require approximately 38,000 GJ of energy from diesel and grid electricity over the life of the Project.

4.0 Impact Assessment Summary

The greenhouse gas emissions generated by the Project have the potential to impact the environment and the greenhouse gas reduction objectives of national and international governing bodies. The following sections distinguish between environmental impacts and policy impacts.

4.1 Environmental Impact

The Project's greenhouse gas emissions will have a disperse impact as they are highly mobile and are generated up and down the supply chain. The accumulation of greenhouse gases or carbon in "carbon sinks" is the primary impact of greenhouse gas emissions. Since the industrial revolution, anthropogenic greenhouse gas emissions have accumulated in three major carbon sinks - the ocean (30%), terrestrial plants (30%) and the atmosphere (40%) (BOM and CSIRO, 2014).

The accumulation of greenhouse gases in the atmosphere is an important driver of global warming, sea level rise and climate change (IPCC, 2013). Sea level rise and climate change may have many ramifications for the natural and built environment.

The accumulation of greenhouse gases in the ocean is an important driver of ocean acidification (IPCC, 2013).

The Project's direct emissions are forecast to be approximately 300 t CO_2 –e per annum.

To put the Project's emissions into perspective, global anthropogenic greenhouse gas emissions in 2013 were estimated at 38,800,000,000 t CO_2-e (BOM and CSIRO, 2014). During operation, the Project will contribute approximately 0.0000008 per cent to global anthropogenic emissions per annum (based on its projected Scope 1 emissions). The Scope 2 and 3 emissions associated with the Project should not be considered in a global context, as global projections only represent Scope 1 emissions (i.e. the sum of all individual emission sources).

4.1.1 Impact on Climate Change

The Intergovernmental Panel on Climate Change (IPCC) define climate change as a change in the state of the climate that can be identified by changes in the mean and/or variability of its properties, and persists for an extended period, typically decades or longer (IPCC, 2007).

Climate change is caused by changes in the energy balance of the climate system. The energy balance of the climate system is driven by atmospheric concentrations of greenhouse gases and aerosols, land cover and solar radiation (IPCC, 2007).

Climate change models forecast many different climate change impacts, which are influenced by future greenhouse gas emission scenarios. Climate change forecasts also vary significantly from region to region. Any increase in atmospheric greenhouse gas emissions can therefore generate many different climate change impacts, depending on future greenhouse gas scenarios and regional location.

4.2 Impact on National Policy Objectives

The Australian Government has committed to reduce Australia's greenhouse gas emissions by 5 per cent from 2000 levels by 2020 irrespective of what other countries do, and by up to 15 or 25 per cent depending on the scale of global action.

If Australia is able to meet the 5 per cent reduction target by 2020, the nation will be generating approximately 525,000,000 t CO_2-e per annum (National Greenhouse Gas Inventory 2011). The Project is forecast to generate approximately 300 t CO_2-e of Scope 1 emissions per annum, if emissions are not mitigated. The Project is unlikely to prevent the Federal Government achieving its national greenhouse gas objectives.

The Project's Scope 2 and 3 emissions should not be considered against national objectives, as national emissions only include Scope 1 emissions.

4.3 Impact on International Policy Objectives

At present there is no comprehensive global agreement on greenhouse gas reduction targets that includes comprehensive commitments from all major emitters such as China, India and the United States of America.

The Seventeenth Conference of the Parties (COP17) climate change negotiations in Durban, however, provides some direction for international greenhouse gas objectives. Countries agreed in Durban to begin work on a new climate change agreement that will cover all countries. The intention is to develop an agreement, including emission reduction commitments, by 2015 to come into effect from 2020. Countries also agreed that there would be a second commitment period of the Kyoto Protocol from 1 January 2013 (DCCEE, 2012a).

The United Nations Framework Convention on Climate Change (UNFCCC) conference held in Cancún 2010 achieved important progress towards a comprehensive post-2012 international agreement to address climate change (DIICCSRTE, 2013). Under the Cancun Agreements, Australia has committed to reducing its 2020 national greenhouse gas inventory by 5 per cent (based on the 2000 inventory) (DCCEE, 2012b).

Australia's international objectives align with its national objectives. As discussed in **Section 4.2**, the Project is unlikely to prevent the Federal Government achieving its national/international 5 per cent greenhouse gas reduction target.

5.0 Evaluation of Greenhouse Gas Mitigation Measures

The GHGEA is required to assess reasonable and feasible measures to minimise the Project's greenhouse gas emissions.

The term reasonable incorporates notions of costs and benefits, whereas the term feasible focuses on the more fundamental practicalities of the mitigation measures, such as engineering considerations and what is practical to build or operate (Hunter Environment Lobby Inc v Minister for Planning, 2011).

5.1 Current Management Measures

Holcim Australia's environmental performance is driven by its Environmental Policy (Holcim (Australia) Pty Limited, 2010), which states that protecting the environment is integral to sustainable development. The Environmental Policy (Holcim (Australia) Pty Ltd, 2010) includes specific commitments which address greenhouse gas emissions. The commitments are:

- ensure energy efficiency, optimum use of raw materials and the reduction of waste in all operations; and
- respond to the challenges presented by climate change by identifying opportunities to reduce its carbon footprint.

Holcim Australia designs and manages its operations to achieve these commitments.

5.1.1 Energy Efficiency

The energy efficiency of quarry operations is driven by energy use and productivity. Energy efficiency is maximised when highly efficient equipment is operated at optimal capacity. Holcim Australia's quarry planning process optimises operational productivity through scheduling and equipment selection.

Holcim Australia is currently preparing energy efficiency opportunity plans on a national basis and per business unit. Teven Quarry will be required to review these plans and implement initiatives where applicable.

Holcim Australia will continue to mitigate Scope 1 emissions through diesel use efficiency initiatives. Holcim Australia is unable to directly manage Scope 3 emissions as Holcim Australia does not have operational control of transport contractors and/or facilities that extract and supply energy.

The Project will continue to monitor diesel usage and seek opportunities for further efficiency. All Holcim Australia sites are required to complete an annual self-assessment report against Holcim Australia standards, which include fuel efficiency. The self-assessment process drives sites to review current practices and implement fuel efficiency initiatives.

5.2 Assessment of Potential Management Measures

The following sections assess the Project's planned greenhouse gas mitigation measures against best practice greenhouse gas management.

5.2.1 Improving On-site Diesel Use Efficiency

Table 5.1 includes the mitigation measures assessed for minimising greenhouse gas emissions from on-site diesel use.

Table 5.1 – Options Assessed for On-site Diesel Use

Energy Use During Extraction		
Potential Mitigation Measure	**Planned for Project**	**Reason for Inclusion/Exclusion**
1. Scheduling activities so that equipment and vehicle operation is optimised	Yes	Holcim is committed to optimising site schedules to reduce energy use.
2. Alternative fuels	Yes	Fuel additives and new diesels are being trialled by Holcim.
3. Fuel efficient equipment	Yes	New, larger equipment purchased is assessed for fuel burn efficiency.
4. Blasting strategies to improve extraction efficiency	Continuous	Holcim blast design is focused around fragmentation efficiency and continuously updated from results of previous blasts.
5. Maximising resource recovery efficiency	Continuous	Efficient recovery plans are detailed in the quarry development plan
6. Working machines to their upper design performance	Yes	National fleet optimisation project continuously monitors and transfers machines to provide optimum utilisation.
7. Electric drills	No	Option has not yet been investigated.

Table 5.2 includes the mitigation measures assessed for minimising greenhouse gas emissions from haul trucks.

Table 5.2 – Options Assessed for Haul Trucks

Energy Use During Extraction		
Potential Mitigation Measure	**Planned for Project**	**Reason for Inclusion/Exclusion**
8. Limiting the length of material haulage routes	Yes	Quarry development plan is designed to minimise the length of haul roads.
9. Replacing trucks with conveyors	No	Option has not yet been investigated. Due to scale of operations is highly unlikely to be economically viable.
10. Optimising ramp gradients	Yes	Ramp gradients are designed to minimise fuel burn of haul trucks.
11. Fuel efficient haul trucks	Continuous	Haul trucks fuel burn is monitored to determine efficiency against national benchmarks.
12. Maximising payload	Yes	Holcim is committed to maximising haul truck payload to maximise productivity efficiency.
13. Increasing haul truck payload	Continuous	Holcim is committed to maximising haul truck payload to maximise productivity efficiency.

14. Improving rolling resistance of haul roads	Yes	Roads to be maintained to Holcim policy and consistently graded.
15. Reducing idling times	Continuous	Idle times are continuously monitored to determine best suited assets for sites that reduce idle time.
16. Alternative fuels	Yes	Fuel additives and new diesels are being trialled by Holcim.

5.2.2 Improving electricity efficiency of processing equipment

Table 5.3 includes the mitigation measures assessed for minimising greenhouse gas emissions from consuming electricity.

Table 5.3 – Options Assessed for Electricity Use

Energy Use During Processing		
Potential Mitigation Measure	**Planned for Project**	**Reason for Inclusion/Exclusion**
17. Automatically shutting down the processing plant when not in use	No	Option has not been investigated.
18. High efficiency motors	Yes	Holcim is committed to implementing all Energy Efficiency Opportunities possible
19. Variable Speed Drives	Yes	Holcim is committed to implementing all Energy Efficiency Opportunities possible
20. Optimising motor size to load	Yes	Holcim is committed to implementing all Energy Efficiency Opportunities possible
21. Optimising basalt throughput	Continuous	The quarry development plan provides areas to progress which maximize basalt extraction.
22. On-site renewable energy (solar)	No	A Solar study was completed in March 2014 that defined Teven as not financially viable for on-site solar.

The Project is planning to utilise many of the common greenhouse gas mitigation measures available for a hard rock quarry.

5.3 On-going Greenhouse Gas and Energy Measures

Holcim Australia will generate and evaluate many greenhouse gas management measures during a normal annual planning cycle. It is not reasonable or feasible to implement all management measures identified through the annual planning process, therefore, measures will be prioritised to ensure the implementation of the most cost effective measures. To prioritise the implementation of greenhouse gas management measures, Holcim Australia will use technical review and marginal cost of abatement considerations to evaluate and prioritise all operational measures.

Holcim Australia will prioritise greenhouse gas management options annually. The annual prioritisation process will assist operational planning and support a transparent process for demonstrating Holcim Australia's commitment to implementing all reasonable and feasible greenhouse gas management controls.

6.0 Conclusion

The proposed increase in annual production limits will have a limited impact on the net greenhouse gas emissions of Teven Quarry, as the increase in annual production limits will not increase the total tonnes of product extracted over the life of the quarry.

The combined impacts of the Project are expected to increase Scope 1 emissions by approximately 3,750 t CO_2-e and reduce Scope 2 emissions by 3,900 t CO_2-e over the life of the quarry. From a greenhouse gas perspective, the primary impact of the Project is not an increase in emissions, but a shift in source of greenhouse gas emissions. The Project is expected to shift a significant proportion of emissions from the electricity sector to on-site consumption of diesel.

The Project is unlikely to impact national greenhouse gas policy objectives, given the Project's direct emissions are forecast to generate an additional 3,750 t CO_2-e over the life of the Project.

The Project will mitigate greenhouse gas emissions through ongoing energy efficiency initiatives and optimising productivity.

7.0 References

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APPENDIX A

Life of Project Calculations

Appendix A – Life of Project Calculations

Stationary Diesel Use

Activity Data			Energy Use		Emission Factors		
Baseline	**Project**	**Net Use**			**CO_2**	**CH_4**	**N_20**
kL	kL	kL	GJ/kL	GJ	kg CO_2-e/GJ	kg CO_2-e/GJ	kg CO_2-e/GJ
7,856.2	9,252.7	1,396.5	38.6	53,905	69.2	0.1	0.2
					t CO_2-e	t CO_2-e	t CO_2-e
Breakdown of individual GHG emissions (t CO_2-e)					3,730	5	11
Total GHG Emissions (t CO_2-e)							**3,746**

Electricity Use

Activity Data			Energy Use	Emission Factors		
Baseline	**Project**	**Net Use**		**CO_2**	**CH_4**	**N_20**
kWh	kWh	kWh	GJ	kg CO_2-e / GJ	kg CO_2-e / GJ	kg CO_2-e / GJ
15,774,001	11,263,965	-4,510,036	-16,236	241	N/A	N/A
				t CO_2-e	t CO_2-e	t CO_2-e
Breakdown of individual GHG emissions (t CO_2-e)				-3,913	N/A	N/A
Total GHG Emissions (t CO_2-e)						**-3,913**

Extraction, Production and Distribution of Energy Purchased

Activity Data		Emission Factors	GHG Emissions
Purchased energy	GJ	kg CO_2-e/GJ	t CO2-e
Net Diesel Use	53,905	5.3	286
Net Electricity Use	-16,236	52	-844
Total GHG emissions (t CO_2-e)			-558

Product Transported by 3rd Parties

Activity Data							Emission Factors
							Scope 3 - Full Life Cycle
Scenario	Product Delivered (Tonnes)	Deliveries (No.)	Total Distance (Km)	Diesel use (l/Km)	Diesel use (kL)	Diesel use (GJ)	kg CO_2-e/GJ
Baseline	2,508,000	76,000	18	0.546	746.928	NA	NA
Project	2,022,000	61,273	22	0.546	736.011	NA	NA
Net	-486,000	-14,727	4	NA	-10.917	-421	75.2
							t CO_2-e
Total GHG emissions (t CO_2-e)							**-32**

Materials Transported by 3rd Parties

Activity Data							Emission Factors
							Scope 3 - Full Life Cycle
Scenario	Diesel Delivered (Tonnes)	Deliveries (No.)	Total Distance (Km)	Diesel use (l/Km)	Diesel use (kL)	Diesel use (GJ)	kg CO_2-e/GJ
Baseline	7,856	239	50	0.546	6.525	NA	NA
Project	9,253	281	50	0.546	7.671	NA	NA
Net	1,397	60	0		1.146	44	75.2
					NA		t CO_2-e
Total GHG emissions (t CO_2-e)							**3**

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APPENDIX 10

Ecological Assessment Supporting Documentation

Appendix 10 - Seven Part Tests under the *Environmental Planning and Assessment Act 1979*

Seven part tests are provided below for those threatened species, endangered populations (EPs) and threatened ecological communities (TECs) considered (refer to **Table 1.1** of the main document) to have the potential to be indirectly impacted by the Project.

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;

The Project will not involve any additional direct impact on the ecological values of the Project area as no additional ground disturbance or vegetation clearing (above that already approved) is required. The potential indirect impacts identified are considered unlikely to substantially impact upon TSC Act listed threatened species. As such, the Project is unlikely to have an adverse effect on the lifecycle of any occurring or potentially occurring threatened species such that a viable local population is likely to be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; and

The Project will not involve any additional direct impact on the ecological values of the Project area as no additional ground disturbance or vegetation clearing (above that already approved) is required. The potential indirect impacts identified are considered unlikely to substantially impact upon TSC Act listed EECs or CEECs. As such, the Project is not likely to have an adverse effect on the extent of any potentially occurring EEC or CEEC such that its local occurrence would be placed at the risk of extinction.

ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;

The Project will not involve any additional direct impact on the ecological values of the Project area as no additional ground disturbance or vegetation clearing (above that already approved) is required. The potential indirect impacts identified are considered unlikely to substantially impact upon TSC Act listed EECs or CEECs. As such, the Project is unlikely to result in the loss of species diversity that would adversely modify the composition of the community such that its local occurrence may place it at risk of extinction.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

The Project will not involve any additional direct impact on the ecological values of the Project area as no additional ground disturbance or vegetation clearing (above that already approved) is required. Therefore, no habitat will be removed or modified as a result of the Project.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will not involve any additional direct impact on the ecological values of the Project area as no additional ground disturbance or vegetation clearing (above that already approved) is required. Therefore, no area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the Project.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

No habitat will be removed, modified, fragmented or isolated (above that already approved) as a result of the Project.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

The Project area is not located in proximity to any areas of declared or recommended critical habitat. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

Of the TSC Act listed species considered to have the potential to occur within the Project area, recovery plans exist for the following:

- Bush stone-curlew (*Burhinus grallarius);*
- Davidson's Plum (*Davidsonia jerseyana*);
- Smooth Davidson's Plum (*Davidsonia johnsonii*);
- Small-leaved tamarind (*Diploglottis campbellii*);
- Green-leaved Rose Walnut (*Endiandra muelleri* subsp*. bracteata*);
- Long-nosed potoroo (*Potorous tridactylus*) ;
- Red goshawk (*Erythrotriorchis radiatus*); and
- Koala (*Phascolarctos cinereus*).

The Project will not involve any additional direct impact on the ecological values of the Project area as no additional ground disturbance or vegetation clearing (above that already

approved) is required. As such, the project is consistent with the objective or actions of the above listed recovery plans.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The Project will not involve any additional direct impact on the ecological values of the Project area as no additional ground disturbance or vegetation clearing (above that already approved) is required. As such, it is considered that the Project is not part of, result in the operation of, or increase the impact of a key threatening process.

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on any TSC Act listed threatened species or TEC.

Appendix 10 - Assessment of Significance under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires an Assessment of Significance relating to the potential impacts of a Project on listed matters of national environmental significance (MNES).

Under the EPBC Act, the approval of the Commonwealth Minister for the Environment is required for any action that may have a significant impact on MNES. These matters are:

- listed threatened species and communities;
- migratory species protected under international agreements;
- Ramsar wetlands of international importance;
- the Commonwealth marine environment;
- the Great Barrier Reef Marine Park;
- World Heritage properties;
- National Heritage places;
- nuclear actions; and
- a water resource, in relation to coal seam gas development and large coal mining development.

The EPBC Act assessment process varies based on the listing status of the species or community being assessed. For the purposes of this assessment, all four assessment types have been undertaken.

Critically Endangered and Endangered Ecological Communities

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- **Reduce the extent of an ecological community**

The Project will not involve any additional direct impact on the ecological values of the Project area as no additional ground disturbance or vegetation clearing (above that already approved) is required. As such, there will be no reduction on the extent of any potentially occurring CEEC or EEC.

- **Fragment or increase fragmentation of an ecological community**

The Project will not involve any additional direct impact on the ecological values of the Project area as no additional ground disturbance or vegetation clearing (above that already approved) is required. As such, there will be no increase in fragmentation of any potentially occurring CEEC or EEC.

Adversely affect habitat critical to the survival of an ecological community

The Project will not involve any additional direct impact on the ecological values of the Project area as no additional ground disturbance or vegetation clearing (above that already approved) is required. The potential indirect impacts associated with the project are considered unlikely to adversely affect habitat critical to the survival of any ecological community.

Therefore the Project would be unlikely to adversely affect habitat critical to the survival of any potentially occurring CEEC or EEC.

- **Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alternation of surface water drainage patterns**

The Project will not involve any additional direct impact on the ecological values of the Project area as no additional ground disturbance or vegetation clearing (above that already approved) is required. The potential indirect impacts associated with the project are considered unlikely to adversely modify or destroy abiotic factors necessary for the survival of any potentially occurring CEEC or EEC.

- **Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting**

The Project will not involve any additional direct impact on the ecological values of the Project area as no additional ground disturbance or vegetation clearing (above that already approved) is required. Therefore, the Project is unlikely to impact on the species composition (including causing a decline or loss of functionally important species) of any potentially occurring CEEC or EEC in the local area.

- **Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:**
    - **Assisting invasive species, that are harmful to the listed ecological community, to become established, or**
    - **Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or**

The Project will not involve any additional direct impact on the ecological values of the Project area as no additional ground disturbance or vegetation clearing (above that already approved) is required. The potential indirect impacts associated with the project are unlikely to cause a substantial reduction in the quality or integrity of any potentially occurring CEEC or EEC in the local area.

- **Interfere with the recovery of an ecological community.**

The Project will not involve any additional direct impact on the ecological values of the Project area as no additional ground disturbance or vegetation clearing (above that already

approved) is required. The potential indirect impacts associated with the project are unlikely interfere with the recovery of any potentially occurring CEEC or EEC.

Conclusion

The Project is unlikely to have a significant impact on any of the potentially occurring CEECs or EECs listed under the EPBC Act.

Critically Endangered and Endangered Species

In this case, a *population* means:

- a geographically distinct regional population, or collection of local populations; or
- a regional population, or collection of local populations, that occurs within a particular bioregion.

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- **lead to a long-term decrease in the size of a population; or**

The Project will not involve any additional direct impact on the ecological values of the Project area as no additional ground disturbance or vegetation clearing (above that already approved) is required. The potential indirect impacts identified are considered unlikely to substantially impact upon any critically endangered or endangered species. It is considered that the Project is unlikely to lead to a long-term decease in the size of any potentially occurring populations.

- **reduce the area of occupancy of the species; or**

The Project will not involve any additional direct impact on the ecological values of the Project area as no additional ground disturbance or vegetation clearing (above that already approved) is required. The potential indirect impacts identified are considered unlikely to substantially impact upon any critically endangered or endangered species. It is considered that the Project is unlikely to reduce the area of occupancy of any potentially occurring critically endangered or endangered species.

- **fragment an existing *population* into two or more populations; or**

No population of critically endangered or endangered species are known to occur in the Project area. The Project will not involve any additional direct impact on the ecological values of the Project area as no additional ground disturbance or vegetation clearing (above that already approved) is required. The potential indirect impacts identified are considered unlikely to substantially impact upon any critically endangered or endangered species. It is

considered that the Project is unlikely to result in the fragmentation of an existing *population* into two or more *populations*.

- **adversely affect habitat critical to the survival of a species; or**

The Project will not involve any additional direct impact on the ecological values of the Project area as no additional ground disturbance or vegetation clearing (above that already approved) is required. The potential indirect impacts identified are considered unlikely to substantially impact upon any habitat for critically endangered or endangered species. It is considered that the Project is unlikely to adversely affect habitat critical to the survival of a species.

- **disrupt the breeding cycle of a population; or**

The Project will not involve any additional direct impact on the ecological values of the Project area as no additional ground disturbance or vegetation clearing (above that already approved) is required. The potential indirect impacts identified are considered unlikely to substantially impact upon any potentially occurring critically endangered or endangered species. It is considered that the Project is unlikely to disrupt the breeding cycle of any potentially occurring population of critically endangered or endangered species.

- **modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline; or**

The Project will not involve any additional direct impact on the ecological values of the Project area as no additional ground disturbance or vegetation clearing (above that already approved) is required. The potential indirect impacts identified are considered unlikely to substantially impact upon any potentially occurring critically endangered or endangered species. It is considered unlikely that the Project will modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that any potentially occurring critically endangered or endangered species is likely to decline.

- **result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;**

The Project is not expected to result in invasive species that are harmful to any potentially occurring critically endangered or endangered species becoming established in the species' habitat.

- **introduce disease that may cause the species to decline; or**

It is considered unlikely that the Project will introduce any disease that may cause any potentially occurring critically endangered or endangered species to decline.

- **interfere with the recovery of the species.**

It is considered unlikely that the Project will interfere with the recovery of any potentially occurring critically endangered or endangered species throughout Australia.

- **Conclusion**

The Project is unlikely to result in a significant impact on any potentially occurring critically endangered or endangered species.

Vulnerable Species

In this case, an *important population* is a population that is necessary for a species' long-term survival and recovery. This may include populations that are:

- key source populations either for breeding or dispersal; or
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

An action has, will have, or is likely to have a significant impact on threatened species if it does, will, or is likely to:

- **lead to a long-term decrease in the size of an important population of a species;**

No important population of any potential occurring vulnerable species is known to occur in the Project area.

The Project will not involve any additional direct impact on the ecological values of the Project area as no additional ground disturbance or vegetation clearing (above that already approved) is required. The potential indirect impacts identified are considered unlikely to substantially impact upon any potentially occurring vulnerable species. It is considered that the Project is unlikely to lead to a long-term decrease in the size of an important population of a vulnerable species.

- **reduce the area of occupancy of an important population, or;**

No important population of any potential occurring vulnerable species is known to occur in the Project area.

The Project will not involve any additional direct impact on the ecological values of the Project area as no additional ground disturbance or vegetation clearing (above that already approved) is required. The potential indirect impacts identified are considered unlikely to substantially impact upon any potentially occurring vulnerable species. It is considered that the Project is unlikely to result in a reduction in the potential area of occupancy of an important population of a potentially occurring vulnerable species.

- **fragment an existing important population into two or more populations, or;**

No important population of any potential occurring vulnerable species is known to occur in the Project area. The Project will not involve any additional direct impact on the ecological values of the Project area as no additional ground disturbance or vegetation clearing (above that already approved) is required. It is considered that the Project is unlikely to fragment an existing important population into two or more populations.

- **adversely affect habitat critical to the survival of a species, or;**

The Project will not involve any additional direct impact on the ecological values of the Project area as no additional ground disturbance or vegetation clearing (above that already approved) is required. The potential indirect impacts identified are considered unlikely to substantially impact upon any potentially occurring vulnerable species. It is considered that the Project is unlikely to adversely affect habitat critical to the survival of any potentially occurring vulnerable species.

- **disrupt the breeding cycle of an important population, or;**

The Project will not involve any additional direct impact on the ecological values of the Project area as no additional ground disturbance or vegetation clearing (above that already approved) is required. The potential indirect impacts identified are considered unlikely to substantially impact upon any potentially occurring vulnerable species. It is considered that the Project is unlikely to disrupt the breeding cycle of an important population of any potentially occurring vulnerable species.

- **modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or;**

The Project will not involve any additional direct impact on the ecological values of the Project area as no additional ground disturbance or vegetation clearing (above that already approved) is required. The potential indirect impacts identified are considered unlikely to substantially impact upon habitat for any potentially occurring vulnerable species. It is considered that the Project is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that any potentially occurring vulnerable species is likely to decline

- **result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;**

The Project is not expected to result in invasive species that are harmful to any potentially occurring vulnerable species becoming established in their habitat.

- **introduce disease that may cause the species to decline; or**

It is considered unlikely that the Project will introduce any disease that may cause any potentially occurring vulnerable species to decline.

- **interfere substantially with the recovery of the species.**

It is considered unlikely that the Project will interfere with the recovery of any potentially occurring vulnerable species throughout their range.

Conclusion

The Project is unlikely to result in a significant impact on any potentially occurring vulnerable species.

Migratory Species

An area of *important habitat* is:

- habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; or

- habitat utilised by a migratory species which is at the limit of the species range; or

- habitat within an area where the species is declining.

The habitats within the Project area for migratory species listed under international conventions is not considered to meet the criteria listed above, and important habitat is not likely to occur. The EPBC Act lists additional criteria that are used to determine whether an action is likely to have a significant impact on migratory species. The proposed Project is considered likely to result in a significant impact on migratory species if there is a real chance or possibility that it will:

- substantially modify and/or destroy an area of important habitat for a migratory species;

- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species; and/or

- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.

The Project Area is not considered to comprise *important habitat* for any of the potentially occurring migratory species, and therefore the Project is not likely to substantially modify or destroy important migratory species habitat. Similarly, the Project will not seriously disrupt the lifecycle of an ecologically significant proportion of the population of a migratory species; or result in an invasive species that is harmful to migratory species becoming established within the Project area.

Conclusion

The Project is unlikely to result in a significant impact on any migratory species listed under the EPBC Act or international conventions.