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Ref: 10008:730
11 September 2017

Barro Group Pty Ltd
c/- John Taylor
Groundwork Plus

Dear John

Re: Burrum Quarry
Traffic Advice – Stopping Distance Assessment

We refer to your request to provide a response to Council's information request in relation to stopping distances for trucks at the school pedestrian crossing. The essence of the query relates to the ability for a truck driver see a pedestrian (eg. child) crossing or intending to cross Beerburrum Road from the Beerburrum State School and if necessary to stop in time.

In order to consider this, existing sight distances available for a truck driver to see someone intending to cross Beerburrum Road from the Beerburrum State School, and the stopping distances for trucks (laden quarry truck) are required to be known.

1. Site Location

The proposed Burrum Quarry is located on Beerburrum-Woodford Road.

Figure 1 – Locality Map illustrates the location of the site relative to Beerburrum-Woodford Road, Beerburrum Road, Steve Irwin Way and the Beerburrum State School (the school).

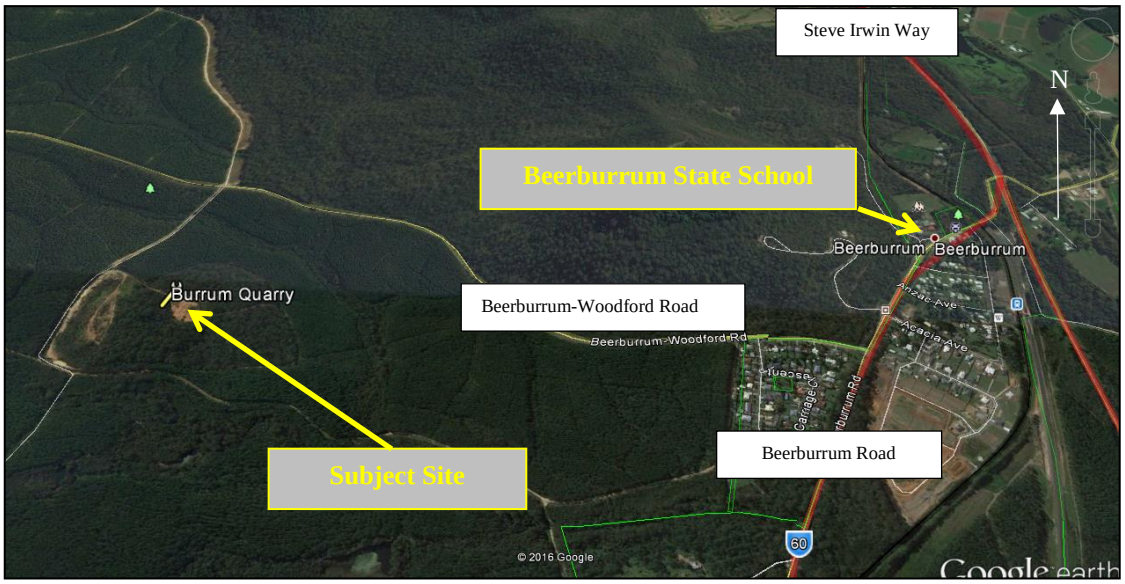

Figure 1 – Locality Map

2. Development Operational Characteristics

As discussed in the traffic report which accompanied the development application lodged for the Burrum Quarry (Ref. 1) and the response to Council's information request letter (Ref. 2), Beerburrum Road is part of the proposed haulage route of the site.

We have been advised that 13t payload tandem trucks (20%), 36t payload truck and dogs (75%) and 40t payload B-doubles (5%) would be used by the Burrum Quarry.

3. Sight Distance Assessment

A desktop sight distance study has been undertaken to estimate the sight distance available for truck drivers to see someone intending to cross Beerburrum Road from the school.

Whilst the majority of pedestrians crossing Beerburrum Road would utilise the provided crossing, it is acknowledged that at times some people may cross at other locations. Taking this into account it has been conservatively assumed that students / parents could cross Beerburrum Road near the northern school access (at or in the vicinity of the crossing) or at the southern school access. The locations are illustrated on **Figure 2 – Locations of the School Accesses**.

1 "Burrum Quarry – Traffic and Pavement Impact Assessment Report", MRCagney Pty Ltd, 17 November 2016.
2 "Burrum Quarry – Response to Council's Information Request", MRCagney Pty Ltd, 5 May 2017.

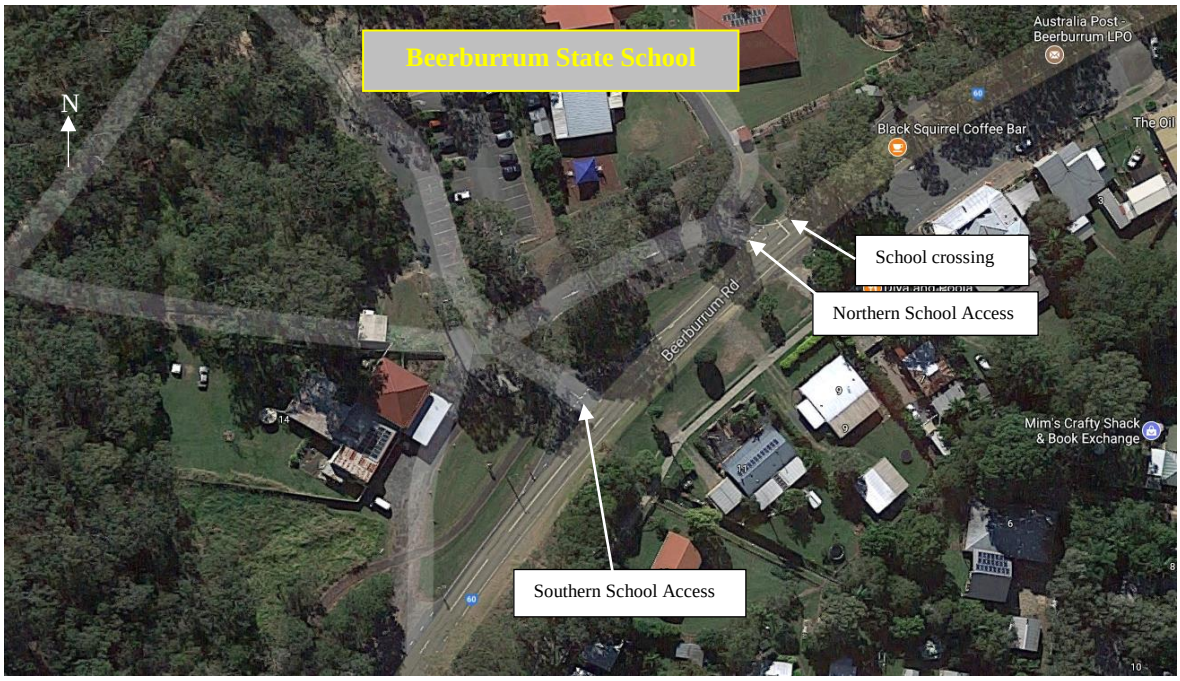

Figure 2 – Locations of the School Accesses

In this desktop sight distance study, the Googlemap street-view images have been used to inform the sight distance. The Googlemap street-view images are considered relevant, the reasons are listed below:

1. The height of a street-view camera installed in a street-view car is 2.5m (source: https://petapixel.com/2012/10/15/a-glimpse-of-googles-fleet-of-camera-equipped-street-view-cars/);
2. The suggested eye height of a truck driver is 2.33m. (source: https://comparativegeometrics.wordpress.com/2014/07/02/values-for-driver-eye-height/; the table of driver eye height (in metres) and vehicle type is duplicated below:

Table 2: Driver eye height (in metres) and vehicle type

vehicle type	suggested eye height	range of values	
		min	max
cars	1,08	1,00	1,20
trucks	2,33	1,80	3,00
buses	1,80	1,75	2,50
bicycles	1,50	1,00	2,20
pedestrians	1,55	0,90	2,00
equestrians	1,50	1,50	2,70

3. The height of a street-view camera is sufficiently comparable to the eye height of a truck driver to be considered a useful tool to identify the approximate sight distance available for a truck driver.

3.1 Sight Distance Available on Beerburrum Road (Northbound)

Figure 3 – Street-view Image taken 120m South of the Southern School Access, Looking to the North is the Googlemap street-view image taken approximately 120m south of the southern school access, looking to the north. The red arrow represents the approximate location of the southern school access. A truck driver, located 120m south of the southern school access, could easily see someone intending to cross Beerburrum Road near the southern school access. It is noted that the images do not reflect the actual perception of a driver, but are intended to indicate the presence of the available sight line.

Figure 3 – Street-view Image taken 120m South of the Southern School Access, Looking to the North

Figure 4 – Street-view Image taken 120m South of the Northern School Access, Looking to the North is the Googlemap street-view image taken approximately 120m south of the northern school access, looking to the north. The red arrow represents the approximate location of the northern school access. A truck driver, located 120m south of the northern school access / crossing location, could easily see someone intending to cross Beerburrum Road (or crossing) at this location.

Figure 4 – Street-view Image taken 120m South of the Northern School Access, Looking to the North

Figure 5 – Street-view Image taken 120m North of the Southern School Access, Looking to the South is the Googlemap street-view image taken approximately 120m north of the southern school access, looking to the south. The red arrow represents the approximate location of the southern school access. A truck driver, located 120m north of the southern school access, could see someone intending to cross Beerburrum Road near the southern school access.

Figure 5 – Street-view Image taken 120m North of the Southern School Access, Looking to the South

Figure 6 – Street-view Image taken 120m North of the Northern School Access, Looking to the South is the Googlemap street-view image taken approximately 120m north of the northern school access, looking to the south. The red arrow represents the approximate location of the northern school access / crossing location. A truck driver, located 120m north of the northern school access, could easily see someone intending to cross Beerburrum Road near the northern school access.

Figure 6 – Street-view Image taken 120m North of the Northern School Access, Looking to the South

From the height of the Googlemap street-view camera (2.5m), at least 120m sight distance is available to see someone intending to cross Beerburrum Road near both the southern and northern school accesses (and crossing location) from either direction.

As the gradient of Beerburrum Road near the school is relatively flat, it is apparent that this same distance is available for a truck driver (eye level of 2.33m.) travelling on Beerburrum Road in both directions. As noted, the full available distance appears to be more than this determination.

3.2 Stopping Distance

Stopping distance = Reaction distance + Braking distance

Reaction Distance

In an emergency, the average driver takes 1.5 – 2.0 seconds to react. Based on the results of a speed survey undertaken on Beerburrum Road near Anzac Avenue (discussed in Ref. 2), the observed 85th%ile and the average speed (two-way) were approximately 70km/h and 62km/h.

Adopting the observed 85th%ile speed (70km/h), the reaction distance would be 29m (R_T = 1.5s) to 39m (R_T = 2.0s).

It is of course noted that the speed limit near the school is 40km/h during school zone times when students / parents would predominately be crossing Beerburrum Road.

Adopting the initial speed of 40km/h during the school zone times, the reaction distance would be 17m (R_T = 1.5s) to 22m (R_T = 2.0s).

Braking Distance

Braking distance depends on many factors, such as gradient of road, condition / type of road surface, type of truck, model of truck, model of braking system, travelling speed, etc.

After researching information in relation to braking distances of trucks, the most relevant information able to be sourced is "*Experiential Measurement of the Stopping Performance of a Tractor-Semitrailer From Multiple Speeds*" (Ref. 3). The braking distances (referred to as stopping distance in Ref. 3) of a fully loaded semi-trailer and a lightly loaded semi-trailer under different speed scenarios are duplicated on **Figure 7 – Braking Distances (referred to as Stopping Distance in Ref.3).** The units of mph and ft have been converted into kph and m for easy reference.

[3] "Experiential Measurement of the Stopping Performance of a Tractor-Semitrailer From Multiple Speeds", U.S. Department of Transportation, National Highway Traffic Safety Administration, June 2011.

Duplication from the U.S. document

Table 15: Stopping Distance Analysis of the MGVWR Test Data

Initial Speed (mph)	Maximum Permitted Stopping Distance (ft)	Average Measured Corrected Stopping Distance (ft)	Margin of Compliance (%)
60	250.0	250.7	-0.3 %
55	212.0	200.5	5.4 %
50	176.0	167.5	4.8 %
45	144.0	135.9	5.6 %
40	114.0	104.4	8.4 %
35	89.0	78.8	11.5 %
30	65.0	61.4	5.5 %
25	45.0	44.2	1.8 %
20	30.0	31.2	-4.0 %

Table 16: Stopping Distance Analysis of the LLVW Test Data

Initial Speed (mph)	Maximum Permitted Stopping Distance (ft)	Average Measured Corrected Stopping Distance (ft)	Margin of Compliance (%)
60	235.0	183.7	22.7 %
55	199.0	155.3	22.0 %
50	166.0	124.9	24.8 %
45	136.0	102.8	24.4 %
40	108.0	81.9	24.2 %
35	84.0	63.5	24.4 %
30	61.0	48.1	21.1 %
25	43.0	36.0	16.3 %
20	28.0	25.7	8.2 %

Convert to kph and m

Initial Speed (kph)	Max. Permitted Stopping Distance (m)	Average Measured Corrected Stopping Distance (m)
96.6	76.2	76.4
88.5	64.6	61.1
80.5	53.6	51.1
72.4	43.9	41.4
64.4	34.7	31.8
56.3	27.1	24
48.3	19.8	18.7
40.2	13.7	13.5
32.2	9.1	9.5

Initial Speed (kph)	Max. Permitted Stopping Distance (m)	Average Measured Corrected Stopping Distance (m)
96.6	71.6	56
88.5	60.7	47.3
80.5	50.6	38.1
72.4	41.5	31.3
64.4	32.9	25
56.3	25.9	19.4
48.3	18.6	14.7
40.2	13.1	11
32.2	8.5	7.8

Figure 7 – Braking Distances (referred to as Stopping Distance in Ref.3)

Note:
MGVWR – Modified Gross Vehicle Weight Rating (modified maximum operating weight / mass of a vehicle)
LLVW – Lightly Loaded Vehicle Weight

Based on the braking distances included on **Figure 7 – Braking Distances (referred to as Stopping Distance in Ref.3)**, the braking distance of a fully loaded semi-trailer would be ~14m with an initial speed of 40km/h; and ~41m with an initial speed of 70km/h.

Based on the above discussion, the stopping distance of a fully loaded semi-trailer (~26.5t payload) would be

- 31m (= 17 + 14) to 36m (22 + 14) with an initial speed of 40km/h; and
- 70m (= 29 + 41) to 80m (39 + 41) with an initial speed of 70km/h.

These distances are compared to the available sight distances later in this assessment.

No data could be found in relation to the stopping distance of a fully loaded truck in wet conditions. Reference has been made the stopping distance of an average family car (source: https://www.qld.gov.au/transport/safety/road-safety/driving-safely/stopping-distances), which shows the stopping distances of an average family car in both dry and wet conditions. The figure is duplicated on **Figure 8 – Stopping Distance of an Average Family Car.**

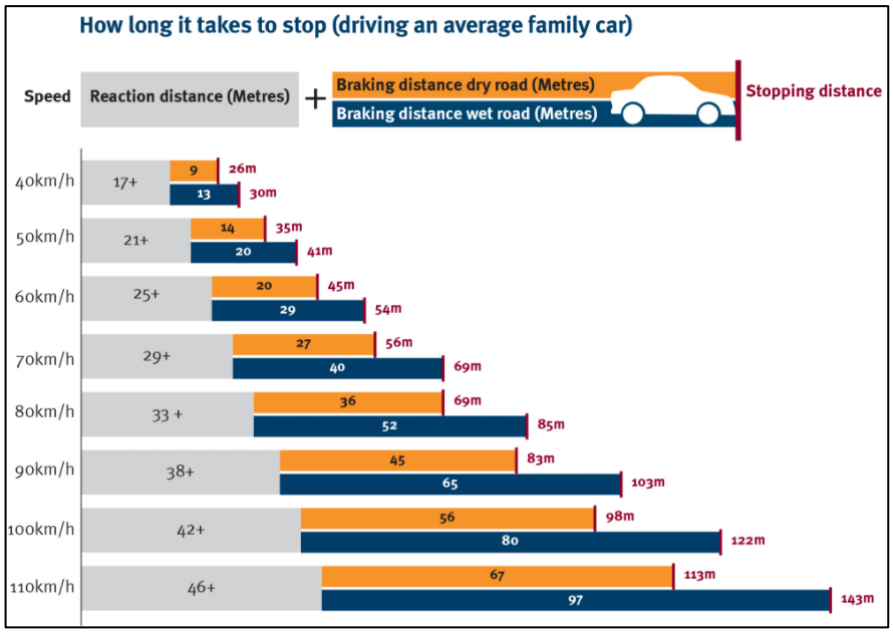

Figure 8 – Stopping Distance of an Average Family Car

Based on data included on **Figure 8 – Stopping Distance of an Average Family Car**, the stopping distance of an average family car would increase by 23% (= (69 – 56) / 56 x 100%) when the road is wet.

Applying the same increase percentage (+23%) the stopping distance of a fully loaded semi-trailer (~26.5t payload) when the road is wet, would be in the order of:

- 38m (= 31 x 1.23) to 44m (= 36 x 1.23) with an initial speed of 40km/h; and
- 86m (= 70 x 1.23) to 98m (= 80 x 1.23) with an initial speed of 70km/h.

Notwithstanding the above calculations, it is noted that heavy vehicles are unlikely to be on the road during wet weather, and in any event, tend to travel slower when the road is wet.

In addition, the actual braking distances from the north would be less as trucks would be empty.

3.3 Sight Distance Available vs Stopping Distance

Based on the results of the desktop study outlined herein:

- It is apparent that at least 120m sight distance is available for a truck driver travelling on Beerburrum Road in both directions in the vicinity of the school;
- If the initial speed is 40km/h, it is estimated that the stopping distance of a fully loaded semi-trailer (~26.5t payload) would be would be 31m to 36m when the road is dry; and 38m to 44m when the road is wet;
- If the initial speed is 70km/h, it is estimated that the stopping distance of a fully loaded semi-trailer (~26.5t payload) would be would be 70m to 80m when the road is dry; and 86m to 98m when the road is wet; and
- A driver of a fully loaded semi-trailer could see someone intending to cross Beerburrum Road from the Beerburrum State School in any of the investigated locations and if necessary, to stop in time.

As previously discussed, we have been advised that 13t payload tandem trucks (20%), 36t payload truck and dogs (75%) and 40t payload B-doubles (5%) would be used by the Burrum Quarry. It is likely that the actual stopping distance of a truck and dog and a B-double would be only slightly longer than that of a semi-trailer as outlined herein.

Accordingly, the available sight distance is more than sufficient.

I trust that this information is of assistance. If you require any additional assistance in relation to this matter, please do not hesitate to contact me.

Yours faithfully

Bryce Trevilyan – RPEQ #7745
Traffic and Transport Plus