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Mooloolaba Road: Buderim Hill Upgrade

Design Development Report

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Design Development Report

NCHD-2569

Prepared for

Department of Transport and Main Roads

Prepared by

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1.0 Introduction

AECOM Australia Pty Ltd (AECOM) has been commissioned by the Department of Transport and Main Roads (TMR) to undertake the detailed design for Mooloolaba Road, Buderim. The area of works extends from Ch.6,595.000 (west of Foote Avenue) to Ch.7,619.037 (east of Buderim Pines Drive).

Mooloolaba Road (134) is a State-controlled road located in the Sunshine Coast between Mooloolaba and Buderim and is identified as a Controlled Distributor on the Sunshine Coast Regional Council Maroochy Plan 2000. Mooloolaba Road provides a link between Mooloolaba and Buderim, and provides access to the Sunshine Coast Private Hospital. Mooloolaba Road also provides connections to the Sunshine Motorway in the east and the Bruce Highway in the west.

1.1 Background

The section of Mooloolaba Road in question has been subject to media interest following a number of recent crashes. As a result, AECOM were initially engaged by TMR to review the existing conditions and develop options to improve the section of road to an acceptable level. AECOM has worked closely with TMR through a number of design meetings in order to define both the design criteria objectives and the intended design approach for this section of road. Upon completion of the Option Development phase of the project a preferred solution was identified. TMR engaged AECOM to proceed into detail design (the current phase) of the upgrade to Mooloolaba Road. The following reports prepared by AECOM have formed a basis for the development of this design:

- Existing Conditions Report – April 2012 (Draft)
- Stage 6 (Existing Road) Road Safety Audit – April 2012
- Design Option Development Report – June 2012 (Draft)
- Stage 3 (Detailed Design) Road Safety Audit – November 2012
- Technical Note – Extended Design Domain and Design Exception – August 2012 (Draft).

1.2 Detail Design Submission Documents

1.2.1 Reporting

This report is part of the Detailed Design submission that comprises the following reports and information:

Table 1-1 Detailed Design Reports

Report Title	Location
Design Development Report	This Document
Geometry Report	Appendix A
Pavement Report	Appendix B
Geotechnical Factual Memorandum (TMR)	Appendix C
Geotechnical Technical Memorandum	Appendix D
Lighting Report	Appendix E
PUP Register	Appendix F
Safety in Design Meeting Minutes	Appendix G.1
Safety in Design Register	Appendix G.2
Risk Management Register	Appendix H
Road Safety Audit (Stage 3)	Appendix I
Cost Estimate and Constructability Report	Appendix J

1.2.2 Volume 1 – Contract Documents

The Contract Documents, based on the Road Performance Contract (RPC) documentation prepared in accordance with volume 2 of TMR's Standard Contract Provisions Roads, are outlined in **Table 1-2** below:

Table 1-2 Contract Documents

Volume 1	RPC
Part 1	Information for Tenderers
Part 2	Conditions for Tendering
Part 3	Tender Form and Tender Schedules
Part 4	General Conditions of Contract
Part 5	Supplementary Conditions of Contract
Part 6	Standard Documents
Part 7	Project Specific Documents
Part 8	Other Documents

1.2.3 Volume 2 – Engineering Drawings

The Engineering Drawings comprise of the following and will form the Contract Documents:

- Drawing Index and Locality Plan
- Drawing Index
- Typical Cross Sections
- Control Line Layout Plans
- Control Line Setout Tables
- General Arrangement Plans
- General Detail Plans
- Civil Design Notes
- Kerb, Median and Change of Formation Setout Plans
- Private Access Detail
- Drainage Layout Plans
- Drainage Long Sections
- Drainage Details
- Erosion and Sediment Control Layout Plan
- Pavement Layout Plans
- Pavement Detail Plans
- Signs and Pavement Marking Layout
- Rate 2 Roadway Lighting Legend and Notes
- Rate 2 Roadway Lighting Layout
- Rate 2 Roadway Lighting Schedule
- Rate 3 Roadway Lighting Legend and Notes
- Rate 3 Roadway Lighting Layout
- Rate 3 Roadway Lighting Layout Schematic

- Rate 3 Roadway Lighting Schedule
- Public Utility Layout
- Public Utility Conflicts Pothole Schedule
- Longitudinal Section Control Line MCA1
- Longitudinal Section Control Line MCB1
- Longitudinal Section Control Lines MCE1,MCC1,MCD1
- Annotated Cross Sections Control Line MCA1
- Annotated Cross Sections Control Line MCC1
- Annotated Cross Sections Control Line MCD1

2.0 Design Development

2.1 Current Situation

2.1.1 General Arrangement and Cross Section

This section of road is currently line marked such as to provide a single lane for eastbound and westbound traffic with an overall carriageway width ranging from 10m to 18m between kerb and channel. New line marking and signage was introduced in 2009 in a bid to reduce conflicts and lower the speed of vehicles along this section of road. Due to the generous carriageway width auxiliary turning lanes have been introduced at some intersections with the majority of these delineated by line marking as opposed to raised median. Line marking also provides for a slow vehicle turnout lane between Thomsen Terrace and Nyes Crescent (Chainage 7,175-7,280) where the longitudinal grade exceeds 12%.

Standard barrier kerb and channel is provided along the edge of the carriageway throughout the majority of this section of road with a variable shoulder width. There is a concrete pedestrian footpath located on the northern verge of Mooloolaba Road and there are no on road cycle facilities.

As part of earlier remedial works, a raised concrete median was introduced near the intersecting roads of Buderim Pines Drive and Thomsen Terrace. This median was introduced to separate eastbound and westbound traffic and to provide formal channelized right turn lanes from Mooloolaba Road into each intersecting street.

A summary of the existing auxiliary lanes within this section of road are outlined below:

- Mooloolaba Road / Foote Avenue – Channelized right turn lane from Mooloolaba Road into Foote Avenue
- Mooloolaba Road / Panorama Crescent – Auxiliary right turn lane from Mooloolaba Road into Panorama Crescent
- Mooloolaba Road / Nyes Crescent – Auxiliary left turn lane from Mooloolaba Road into Nyes Crescent
- Mooloolaba Road / Thomsen Crescent – Channelized right turn lane from Mooloolaba Road into Thomsen Terrace
- Mooloolaba Road / Buderim Pines Drive – Channelized right turn and left turn lanes from Mooloolaba Road into Buderim Pines Drive.

In addition to the auxiliary lanes listed above, it is noted that the right turn lane provided into Panorama Crescent in also utilised by motorists wishing to turn right into Nyes Crescent. This dual use of the right turn lane is a result of there being insufficient room between the intersections to provide standard line marking and lane arrangement which results in confusion for motorists. The right turn arrangement at this location creates a potential for head on crashes, for motorists turning right, as well as an increased potential for rear end collisions due to motorists unexpectedly slowing / stopping in the through lanes of Mooloolaba Road. There has been two recorded rear end crashes at this location (Type 303 – Right Rear) resulting from motorists travelling through on Mooloolaba Road, downhill, colliding with motorists turning right into Nyes Crescent.

2.2 Issue Identification

Prior to AECOM's involvement in this project it had been identified that there was an unacceptably high proportion of crashes occurring along this section of road. AECOM's subsequent analysis of the existing conditions of the road confirmed that 45 crashes had occurred since new asphalt overlay was introduced in early 2006 and that 80% of these crashes had taken place in wet weather. These crashes occurred in three separate crash clusters at the horizontal curves near Foote Avenue, Panorama Crescent and Thomsen Terrace. The crashes near Foote Avenue were mainly dry weather crashes whilst the majority of crashes near Panorama Crescent and Thomsen Terrace were wet weather crashes. AECOM's desktop stormwater analysis revealed that there is currently insufficient stormwater infrastructure with resultant excessive stormwater flow path lengths along this section of road.

Further investigation revealed that there are currently substandard combinations of curve radius and superelevation on some horizontal curves and that the cross fall and superelevation does not compliment drainage of stormwater from the road surface.

It was identified that the existing tight horizontal geometry results in a number of locations where the required Stopping Sight Distance (SSD) and Safe Intersections Sight Distance (SISD) is below the minimum requirements for the design speed.

2.3 Design Intent

At the onset of the project, TMR articulated that land resumption was highly undesirable and that where possible the design should remain within the extent of the existing kerb line. AECOM has therefore developed a design which remains within the existing corridor and hence does not require land resumption from adjacent properties. In the majority of locations the existing kerb alignment is retained with the exception of:

- Formation widening in the vicinity of Nyes Crescent to facilitate a formalised right turn lane into Panorama Crescent and provide improved SSD
- Widening at Buderim Pines Drive to facilitate u-turn movements
- Reconstruction of kerb at select areas where pavement levels have increased as a result of addressing cross-fall/superelevation deficiencies.

Primarily the design intent is to address the existing crash history by making improvements to the stormwater infrastructure and providing improved cross fall and superelevation which in turn will enhance both stormwater drainage and driveability. It was acknowledge that due to the constrained nature of the existing corridor the scope to improve sight distance is limited; however improvements have been achieved where possible.

As part of improving the existing stormwater drainage the design introduces strategically positioned raised medians (inclusive of stormwater inlets and grated drains) to reduce stormwater flow path lengths. Installation of a raised median provides additional advantages such as providing improvements to curve perception and lane discipline at the Foote Avenue curve and formalisation of the right turn lane into Panorama Crescent.

It is noted that accessibility to local roads and residences will be affected by the introduction of the raised central median and hence a u-turn facility has been designed at Buderim Pines Drive. This facility in combination with the existing round-about at Dixon Road provides for u-turning movements at the eastern and western extent of the project.

The Detail Design was undertaken with the aim of maximising the reuse of existing infrastructure and maintaining existing kerb lines where feasible.

TMR's North Coast Region was responsible for setting the overall design intent for the project. To assist in achieving this design intent, the Region sought technical advice and comment from TMR's Engineering and Technology Branch (E&T) including Pavements, Research and Innovation Section (PR&I) at regular intervals during the project.

Consultation was undertaken at the following stages:

- Review of existing conditions
- Development of project applied standards and intent
- 50% stage of the Detail Design
- 80% stage of the Detail Design
- 100% stage of the Detail Design.

3.0 Detail Design

3.1 Design Standards and References

The Detail Design has been undertaken in accordance with the requirements specified in relevant Australian and TMR standards current at July 2012, in particular:

- Interim Guide to Road Planning and Design, TMR (2010)
- Road Planning and Design Manual, TMR
- Austroads Guide to Road Design, Austroads (2010)
- Traffic and Road Use Management Manual (TRUM), TMR (2011)
- Manual of Uniform Traffic Control Devices, TMR (2011)
- Austroads – Guide to Traffic Engineering Practice series
- Austroads – Guide to Road Safety: Part 6 - Road Safety Audit (2009)
- Austroads – Guide to Pavement Technology series (including Parts 2 and 5)
- TMR Pavement Rehabilitation Manual (2012)
- TMR Pavement Design Manual (2009)
- Road Drainage Manual, TMR (2010)
- Preconstruction Processes Manual, TMR (2009)
- Project Cost Estimating Manual, TMR (2009)
- Standard Drawings Roads Manual, TMR.

3.2 Project Interfaces

The Detail Design ties back into the existing road conditions to the west of Foote Avenue at Ch.6,595.000 and to the east of Buderim Pines Drive at Ch.7,619.037.

3.3 Design Criteria

The Design Criteria adopted for the project are typically in accordance with the Road Planning and Design Manual (RPDM) and other relevant Austroads Guidelines or Australian Standards where referred to in the Interim Guide to Road Planning and Design Practice.

This project has adopted elements of Design Non-compliance and Design Exception. The project specific design criteria are summarised in **Section 6.0** of this report and presented and discussed in further detail within the Geometry Report which is contained within **Appendix A**.

4.0 Environmental Assessment

TMR has separately undertaken an Environmental Assessment via an Environmental Scoping Report. Requirements of this assessment have been included within the construction contract.

The Detail Design has also considered the environmental impacts of the project. As the upgrade is in an urban area and is largely confined to within the existing, disturbed, formation, including installation of drainage systems to better direct stormwater into existing downstream networks, it has been determined that there is a low risk of environmental impact.

The design has been cognisant of environmental impacts both during construction and subsequent operation, by considering overland flow impacts resulting from the steep grades encountered on the site as well as the need for erosion and sediment controls to be implemented.

The design has aimed to minimise clearing requirements to reduce environmental impacts.

Allowances have been made in the design and contract documents for:

- preparation and implementation of a Construction Environmental Management Plan (EMP(C))
- Water Quality Monitoring
- Noise monitoring during construction
- Condition surveys and vibration monitoring
- Air quality monitoring
- Fauna management
- Erosion and Sediment Control
- Selected vegetation clearing to assist construction and improve safety and operations.

5.0 Community Engagement

No community engagement has been undertaken by the design team as it was determined that the responsibility of community engagement lies with TMR.

At the time of preparing this report TMR were in the early stages of this process.

6.0 Geometric Design

Geometric design items are formally documented in the Geometry Report included in **Appendix A**. The following sections provide a summary of these items; however reference should be made to the Geometry Report for detailed documentation.

6.1 Posted Speed

The posted speed for the Detail Design is 60km/h with 50km/h advisory speeds posted at the horizontal curves in the vicinity of Foote Avenue, Panorama Crescent and Thomsen Terrace.

6.2 Design Speed

The methodology behind the development of the Design Speeds adopted for the Detail Design is included in the Geometry Report at **Appendix A**.

The Design Speeds relevant to the Detail Design are outlined below:

- MCA1 (Mooloolaba Road eastbound)
  - Cars = 65km/h [except R72.0m curve (Ch.6,720 to Ch.6,770) = 56km/h]
  - Trucks = 60kmh [except R72.0m curve (Ch.6,720 to Ch.6,770) = 52km/h]
- MCB1 (Mooloolaba Road westbound)
  - Cars = 65km/h [except R72.0m curve (Ch.6,720 to Ch.6,770) = 56km/h]
  - Trucks = 66km/h (Ch.7,100 to Ch.7,620)
    = 60km/h (Ch.6,595 to Ch.7,100) [except R72.0m curve (Ch.6,720 to Ch.6,770) = 52km/h].

6.3 Design Vehicle

The design vehicle(s) adopted for this design were approved by TMR and are outlined below:

- Mooloolaba Road - 12.5m rigid bus / truck
  - 19.0m semi-trailer (check vehicle)
- Side Roads - 8.80m refuse vehicle
  - 12.5m rigid bus / truck (check vehicle)
- Private Access - 5.2m car / van
- U-turn facilities - 6.4m small rigid vehicle (SRV).

It is noted that the design vehicle for Mooloolaba Road was initially set as a 19.0m semi-trailer, however upon review of the available traffic counts it was noted that articulated trucks (semi-trailers) only make up 0.5% of the total volume (commercial vehicles form 8% in the gazettal direction and 11% against gazettal).

Section 11.10.1 of the RPDM Chapter 11 gives provision to use a 12.5m rigid bus / truck as the design vehicle for curve widening where the incidence of prime mover and semi-trailer operation is less than 3% of AADT. A Semi-trailer would then be used as a check vehicle to ensure the appropriateness of the overall design.

This has therefore resulted in the 12.5m rigid bus / truck being adopted as the design vehicle.

6.4 Cross Section

The cross section of the Detail Design developed from the design intent which was to achieve the intended safety improvements within the constraints of the existing corridor and where possible within the existing kerb alignment. Driven by the need to provide improvements to the existing stormwater infrastructure, strategically positioned central medians are introduced at many locations; this has complimented the cross section by providing formal separation between eastbound and westbound traffic and facilitates the installation of new double outreach street lighting within the central median.

A single eastbound and westbound lane is provided with auxiliary turn lanes at the intersections of Panorama Crescent (right turn), Nyes Crescent (left turn), Thomsen Terrace (right turn) and Buderim Pines Drive (left turn and right turn). The existing slow vehicle turnout lane has been excluded from the design in a bid to discourage excessive speeds through this section.

The minimum lane width applied throughout the Detail Design is 3.3m with lane widths generally exceeding this minimum value due to the application of curve widening.

Generally 1.70m wide shoulders have been provided, narrowing to a minimum 1.10m at select locations. The design allows for the passing of broken down vehicles in accordance with Chapter 13 RPDM Clause 13.7.2.6. 5.5m clear width has been provided between median kerbs and roadside kerb with the exception of an isolated section of approximately 28m between Ch.7,405 to Ch.7,433 on MCA1. Throughout this section semi mountable kerbing has been provided clear of obstructions within the 5.5m envelope. Where generous carriageway width within the existing kerb alignment, a wider shoulder has been adopted.

6.5 Alignment

Due to the nature of this project the horizontal and vertical geometry remains largely unchanged from the existing conditions; this is due to the need to maintain existing property boundaries and accesses located along the length of this section of road.

6.5.1 Horizontal

There are three significant horizontal curves located within the extent of the Detail Design. These curves are located in the vicinity of Foote Avenue, Panorama Crescent and Thomsen Terrace. The kerb alignment along the curves at Foote Avenue and Thomsen Terrace will remain largely unchanged with minor changes to the travelled path curvature due to the realignment of the lanes within the existing kerb alignment to improve SSD/SISD.

The most notable change to the horizontal alignment occurs along the curve at Nyes Crescent where embankment widening is required to provide sufficient width for the raised central median and dedicated right turn lane into Panorama Crescent. Furthermore widening along this section improves sight distance from what is identified as a substandard level in the existing case.

6.5.2 Vertical

Due to the nature of the Detail Design the vertical geometry remains largely unchanged. Minor changes to levels are attributed to the introduction of pavement overlay and cross-fall correction applied along the length of the Detail Design.

Generally there is a 12% longitudinal grade from Thomsen Terrace through the intersections of Nyes Crescent and Panorama Crescent with a crest curve and sag curve located near the western and eastern extents respectively. The longitudinal grade at the western and eastern extent of the project is approximately 1%.

6.6 Extended Design Domain / Design Exception / Design Non Compliance

In the initial stages of the design development TMR articulated that land resumption was highly undesirable and that where possible the Detail Design should be formed within the existing kerb alignment. On this basis the AECOM design team and TMR have sought to achieve a balance between maximising the achieved safety improvements whilst acknowledging the existing constraints imposed by the corridor. In realising the constraints imposed on the design it is acknowledged that elements outside of the normal design domain exist within this design.

AECOM have liaised with TMR during the design development to notify of the Extended Design Domain and Design Exception Elements as they have been identified. These elements were formally documented and presented to TMR in a Technical Note in August 2012 and were subsequently agreed in principle by TMR on 31 October 2012.

It should be noted that at the time of compiling the Technical Note, the design had not yet reached the 30% completion milestone and elements relating to private accesses had not yet been fully investigated. On this basis additional elements have been identified within the Final Design.

It is noted that only Design Exception Elements and Design Non Compliances have been identified within the Detail Design. These items relate to the following:

- Safe Intersection Sight Distance (SISD) / Minimum Gap Sight Distance (MGSD)
- Stopping Sight Distance (SSD)
- Superelevation
- Flow path length.

All elements as summarised in **Table 6-1** and **Table 6-2**, have been formally documented in accordance with the TMR *Planners and Designers Instruction Number 6* (November 2010) within the Geometry Report included in **Appendix A**.

Table 6-1 Design Non-compliances

Non-compliance	Location	Description	Geometry Report Reference
1	Various	Maximum superelevation exceeds 5%	**3.2.1**
2	MCA1 Ch7,120	Flow path length exceeds 60m	**9.2.1**
3	MCB1 Ch7,120	Flow path length exceeds 60m	**9.2.2**

Table 6-2 Design Exceptions

DE Element	Location	Description	Geometry Report Reference
1	MCA1 Ch6,810 to Ch6,840	Compliant SSD cannot be achieved for trucks on the eastbound approach due to an existing cutting and retaining wall combined with a left hand horizontal curve.	**6.2.2.1**
2	MCA1 Ch7,180 to Ch7,290	Compliant SSD cannot be achieved for trucks on the eastbound approach due to the existing property boundaries on the northern verge of Mooloolaba Road.	**6.2.2.2**
3	Thomsen Terrace	There is substandard SISD and MGSD to the west due to the existing property boundaries on the northern verge of Mooloolaba Road	**7.5.3.1**
4	MCB1 Ch6,735	There is substandard SISD and MGSD at the access to Lot 1 RP 111424 due to the existing property boundaries on the southern verge of Mooloolaba Road.	**8.3.1**
5	MCB1 Ch6,700	There is substandard SISD and MGSD at the access to Lot 1 RP 109896 due to the existing property boundaries on the southern verge of Mooloolaba Road.	**8.3.2**
6	MCB1 Ch6,660	There is substandard SISD and MGSD at the access to Lot 2 RP 95390 due to the existing property boundaries on the southern verge of Mooloolaba Road.	**8.3.3**
7	MCB1 Ch6,740	There is substandard SISD and MGSD at the access to Lot 2 RP 101043 due to the existing property boundaries on the southern verge of Mooloolaba Road.	**8.3.4**
8	MCA1 Ch6,940	There is substandard SISD and MGSD at the access to Lot 2 RP 88513 due to the existing property boundaries on the northern verge of Mooloolaba Road.	**8.3.5**
9	MCA1 Ch7,295	There is substandard SISD and MGSD at the access to Lot 3 SP 185838 due to the existing property boundaries on the northern verge of Mooloolaba Road.	**8.3.6**

DE Element	Location	Description	Geometry Report Reference
10	MCA1 Ch7,315	There is substandard SISD and MGSD at the access to Lot 1 RP 134196 due to the existing property boundaries on the northern verge of Mooloolaba Road.	**8.3.7**
11	MCA1 Ch7,355	There is substandard SISD and MGSD at the access to Lot 3 RP 142911 due to the existing property boundaries on the northern verge of Mooloolaba Road.	**8.3.8**

7.0 Drainage Design

As noted within **Section 2.0** of this report, one of the key contributing factors to the current safety record of this section of Mooloolaba Road is the poor level of drainage infrastructure and resulting excessive flow paths that occur during and immediately after rain events. As a result, the improvement of the drainage network has formed the basis of the Detail Design.

The drainage design has been carried out in accordance with TMR Road Drainage Manual (RDM).

The minimum Average Recurrence Intervals (ARI) of the design storms for the drainage works are as listed in **Table 7-1** below.

Table 7-1 Design ARI for Urban Roads

Design Components	Design Storm (ARI)
Major Drainage System	
	50 years
Minor Drainage System	
Cross drainage - Mooloolaba Road - Other minor roads	 50 years 10 years
Longitudinal piped system	10 years
Channels and open drains	10 years

The design intent of the storm water drainage is to limit water levels to be 100mm below the pavement level for the design storm.

The design intent of pavement surface drainage, prior to entering the storm water network, is to limit flow widths along traffic lanes. The flow width is calculated for a storm of 10 years ARI and flow widths have been designed to be less than the values shown in **Table 7-2** below.

Table 7-2 Design Flow Width

Design Components	Flow Width
Mooloolaba Road	
2 lanes or more	- Leaving minimum 2.5m clear width for the lane closest to the kerb and channel
1 lane	- Keeping the traffic lane clear for lane less than 3.5m wide or - Leaving minimum clear width of 3.5m for lane wider than 3.5m
At median	- Leaving minimum clear width of 2.5m
Other minor roads	
	- Full pavement width with zero depth at crown or at high side of road for one way cross fall

Given the steep grades experienced within the project extents, the proximity of intersections and generally tight geometry, it is proposed that a maximum water film depth of 2.5mm (desirable) to 4.0mm (absolute) be achieved for control of aquaplaning with a desirable maximum flow length of 60m.

7.1 Existing Site Condition

West of Panorama Crescent

The existing terrain falls towards the south and to Mooloolaba Road. Runoff is intercepted by the eastbound carriageway. Where the cross-fall falls towards the outside kerb, runoff flows along the kerb and channel before it discharges into the gully pits or overflows to the eastbound carriageway when the runoff exceeds the capacity of the inlets. Where cross-fall falls to the median, runoff flows across the carriageway.

Mooloolaba Road crests at Foote Avenue where the longitudinal grade varies from 2 to 4%. The longitudinal grade increases to 12% approaching Panorama Crescent.

Foote Avenue falls towards Mooloolaba Road and there are no drainage structures along Foote Avenue. Runoff collected on Foote Avenue flows across Mooloolaba Road.

Existing drainage infrastructure in this area consists of pipes and pits which collect runoff and discharges to existing overland flow paths in the south between residential developments on the slopes.

East of Panorama Crescent

This section of Mooloolaba Road has been built along the ridge of the hill with the catchment mainly encompassing the road corridor. This section of road has a steep gradient of approximately 12% from Panorama Crescent to Thomsen Terrace and then is relatively flat (approximately 1% grade) to Buderim Pines Drive and the eastern extent of the project site.

There is minimal drainage provided east of Panorama Crescent, with some pits located such that they are not able to capture sufficient water. There are a number of very long flow paths that originate from the west of Panorama Crescent, bypassing the existing drainage at the intersection, and flowing towards Thomsen Terrace.

Some drainage pits are provided on the north-eastern side of Mooloolaba Road upstream of Thomsen Terrace, however site observation suggests that these pits cannot capture the large amount of water flowing down the road leading to stormwater bypassing the pits and continuing to flow further east. As a result the drainage networks between Panorama and Buderim Pines Drive do not operate to their design capacity.

Existing drainage infrastructure in this area consists of pipes and pits which collect runoff and discharges to existing overland flow paths in the south between residential developments on the slopes.

7.1.1 Existing Problem

The following problems have been identified by police incident reports, visual inspections undertaken by AECOM Road Safety Auditors and hydraulic assessment of the existing system.

- Excessive stormwater flowing across the carriageway
- Excessive stormwater flow path lengths
- Excessive stormwater flow widths
- Insufficient capacity of the pipe systems.

7.2 Design Intent

The design intent is to solve the identified problems by re-profiling the road and providing additional drainage infrastructure within constraints on the developed site.

7.2.1 Grated Drain

Grated drains have been proposed along the outside kerb of Mooloolaba Road eastbound carriageway from Foote Avenue to Panorama Crescent. The drains capture runoff from the catchment on the north and prevent excessive flow across the carriageway. As the drains are located on the high side of the carriageway, 300mm wide channel has been adopted to improve capture efficiency and to allow for potential blockage of the grates.

Grated drain across Foote Avenue is recommended to minimise runoff flowing across Mooloolaba Road. Geometric options to eliminate this flow path are not feasible without significant impacts to adjacent infrastructure, existing mature Camphor Laurel trees and nearby properties.

Grated drains are also proposed along a number of medians to control flow widths and help capture runoff on steep grades with discharge into the underground drainage system.

7.2.2 Flow Path

Long flow paths have been identified in the existing conditions. Geometric improvements and raised medians have been introduced to break these long flow paths. Following the implementation of this design there are two locations (eastbound and westbound of Mooloolaba Road at Ch.7,150) where the flow path lengths are 61m and 69m respectively, exceeding the requirements of the RDM which states that drainage path length should be limited to approximately 60m. Further reduction of these flow paths to less than 60m can only be achieved by significantly changing the road geometry.

Assuming that the method adopted by RDM Section 11.3.7.1 is still applicable for such a long drainage path, the water film depth is estimated to be less than the desirable maximum of 2.5mm (approximately 1.5mm and 1.7mm). The crash records show no incidents at these locations.

Water film depths are discussed in more detail, including figures identifying the flow paths, in the Geometry Report in **Appendix A**.

7.2.3 Drainage Network

Additional pipes and pits are proposed within the project to improve capture of stormwater runoff from the catchments that comprise the road carriageway as well as discharges from private properties within the defined catchment areas. The additional pits also assist with receiving runoff from the grated drains.

This increase in stormwater capture capability has been designed to provide improved compliance with flow width requirements.

To minimise deep excavation into rocky ground, facilitating construction, the proposed pipes follow the gradients of the roads. The road gradients in most sections are very steep and resultant pipe flow velocities are in excess of recommendations within the RDM.

7.3 Integration with Existing Drainage Networks

The design has been carried out to maintain the existing flow regime by maintaining the existing catchment boundaries and discharge points. Existing drainage systems are re-used as far as practicable. A section of existing PVC pipe of 300mm diameter remains as it has adequate hydraulic capacity.

With the introduction of grated drains and pits, the flows to the existing outlets have been increased. The existing and proposed discharges from the networks for a 10 years ARI design storm are listed in **Table 7-3**.

Table 7-3 Discharge

Drainage network	Existing Discharge (m^3/s)	Proposed Discharge (m^3/s)	Increase in Discharge (m^3/s)
A	0.40	0.44	0.04
B	0.65	0.91	0.26
C	0.23	0.50	0.28
D	0.29	0.31	0.02

Runoffs from the outlets flow on the slopes within the residential development via underground pipes and/or overland flow paths.

The slope varies from 12% to 50%. The increase in water level within the existing downstream overland flow paths has been assessed assuming that discharges flow within a trapezoidal channel of 1m base width. Based on this assumption, the maximum increase in water level is approximately 12mm.

7.4 Design Compliance

As noted in the previous section, it has not been possible to meet all requirements of the RDM at some locations due to site constraints. As a result a number of Design Non-compliances are proposed for the drainage design. In addition to those Design Non-compliances listed in **Table 6-1**, additional Drainage Design Non-compliances are proposed in **Table 7-4**.

Table 7-4 Drainage Design Non-compliances

Non-compliance	Location	Description
4	MCA1 Ch.6595 to Ch.6680 Ch.7500 toCh.7619	The network capacity remains unchanged where the upgraded road connects to the existing. In this area the proposed works mainly involve line marking and no drainage improvement works are proposed. These sections of road include the areas west of proposed pipe 4/A1 to 5/A1 and east of Buderim Pines Road. The incident records show that these two areas do not have a crash history.
5	Pipes 7/A1-8/A1-9/A1 9/B1-10/B1 10/C1-11/C1 6/D1-7/D1	The pipe flow velocity is higher than the recommended values in RDM. The RDM states that partially full and full flow velocity shall be less than 7.0m/s and 6.0 m/s respectively.
6	Pipes 2/B5-3/B5-4/B5 1/D2-3/D1-4/D1-5/D1-6/D1	Existing PVC pipes of 300mm diameter remains while RDM recommends that road drainage system shall consist of RCP of minimum 375mm diameter.
7	MCA1 Ch.6742-Ch.6777	A new 375mm RPC, installed between pits 1/B1-3/B1, has been designed with less than 600mm cover (minimum required) to the road surface. This has been done to avoid costly relocation of a Telstra Optic Fibre service. The risk to the storm water pipe is considered low as it is installed mostly under the kerb line and will experience minimal traffic loads.
8	MCA1 Ch.7020	A new 375mm RPC, installed between pits 1/C2-2/C1, has been design with less than 450mm cover (minimum required) to the verge surface. This has been done to avoid costly relocation of a Telstra Optic Fibre service. The risk to the storm water pipe is considered low as it is below a footpath.

8.0 Pavement Design

As noted in **Section 2.3**, the intent of the design has been to address the existing crash history by making improvements to the stormwater infrastructure and providing improved cross fall and superelevation which in turn will enhance both stormwater drainage and driveability. As a result the pavement design has been driven by the need to make geometric improvements rather than the pavement design, to achieve a certain design life, driving the geometric grade line and cross falls.

This intent for the pavement design was confirmed at the Value Management Workshop held on 4th October 2012, involving representatives from AECOM, TMR and RoadTek.

In general the pavement works incorporated into the Detail Design will be a varying thickness overlay, from a minimum 50mm to a maximum of approximately 500mm. New pavement has been designed, to achieve a 20 year design life, for areas where widening of the carriageway will occur or where the new road surface is below the existing and a reconstruction of the pavement is required.

As such, the approach of the pavement design of the overlay sections is to provide an estimation of the pavement design life using the available theoretical technique.

Refer to **Appendix B** for the complete Pavement Design Report and associated analysis.

8.1 Surfacing

The existing pavement surface / wearing course is an Open Graded Asphalt (OG14). This was applied to improve wet weather performance of the pavement by reducing water film thickness. The new pavement design has been designed based on a Dense Graded Asphalt (DG14) wearing course as pavement surface drainage has been improved through the introduction of increased drainage infrastructure, better pavement crossfall and superelevation as well as location of median islands to reduce flow path lengths.

As discussed in **Section 7.2.2** and in more detail in the Geometry Report contained within **Appendix A**, the implemented design features has made improvements to the surface drainage to achieve water film depths less than 2.5mm.

However, an allowance for the reinstatement of the OG14 wearing course has been made in this design.

8.2 Overlay Pavement

Prior to any asphalt overlay, all of the existing open grade asphalt (nominally 40 – 55mm thick based on testing) must be removed. It has been recommended that the underlying asphalt base be inspected for condition and if it is found to be unsound (eg. stripped, ravelled or cracked) after the milling, it should be completely removed and replaced with dense graded asphalt.

Table 8-1 below sets out the overlay design.

Table 8-1 Asphalt Overlay of Existing Pavement

Pavement Material	MRTS Reference	Min. Thickness (mm)
Dense graded asphalt surfacing layer with C320 binder, DG14 mix	MRTS30	50mm
PMB Seal, S4.5S binder with 10mm aggregate (Note 2)	MRTS11	(Note 1)
DG10 / DG14 (C320) / DG20 (C320 or C600) asphalt (Note 3)	MRTS30	Varies

Notes: 1. The ALD of a 10mm cover aggregate is approximately 6mm.

2. In areas where there is steep climbing gradient, a lower spray rate of 1.0 – 1.2 L/m^2 should be considered in accordance with the Pavement Design Manual Clause 3.5.

3. The choice of asphalt mix (DG10/DG14 or DG20) is dependent on the thickness lift requirements nominated in Clause 12.2.6.5 of MRTS30. CIRCLY analysis has been performed assuming DG14 (320) mix for all overlays which has a lower stiffness than the two DG20 mixes.

8.3 Pavement Design Life Estimation

While the design of the pavement overlay has not been driven by a requirement for a minimum design life, it is important to understand the calculated life of the new pavement to enable consideration of future maintenance requirements as well as managing pavement life with that of the wearing course.

The approach taken in this project has been to analyse a number of deflection bowls and apply the dense graded asphalt overlay thickness based on a DG14 (C320) overlay (after milling off the top 50mm of the existing open-graded asphalt) in CIRCLY to assess the design life expectation. Whilst it is acknowledged that this is a conservative approach, it reflects the uncertainty in the depth of OGA to be removed and the variable thicknesses of overlay across the pavement required to alter the vertical geometry. The CIRCLY models adopted in the calculation to provide 95% reliability and corresponding design life are summarised in **Table 8-2**.

Table 8-2 Summary of Design Life Estimation

Lane	Chainage (m)	New Overlay Thickness (E=1550MPa)	Modulus (MPa)				Design Life (ESA)	Design Life (years)
			E (#) (Layer 1)	E (^) (Layer 2)	E (^) (Layer 3)	E (^) (Layer 4)		
Lane 1 (EB)	Ch 6,824	100mm*	1,550	100	125	120	2.16e6	7–8
	Ch 6,875	50mm*	1,950	225	125	100	9.15e5	2–3
	Ch 7,025	90mm*	2,000	350	235	120	9.93e6	20
	Ch 7,074	100mm*	1,200	90	65	70	9.48e5	2–3
	Ch 7,125	150mm*	1,200	260	30	100	2.75e6	9–10
	Ch 7,224	50mm*	1,300	125	80	100	2.75e5	< 1
	Ch 7,275	50mm*	1,650	100	55	120	2.7e5	< 1
	Ch 7,425	200mm*	775	80	40	70	4.06e7	20
Lane 2 (WB)	Ch 6,750	100mm*	1,600	100	80	120	1.74e6	5–6
	Ch 6,949	150mm*	775	100	90	120	2.70e7	20
	Ch 7,150	200mm*	1,300	160	90	60	2.13e7	20
	Ch 7,400	100mm*	1,150	235	140	100	4.92e6	16–17
	Ch 7,500	50mm*	775	90	25	90	5.63e7	20
	Ch 7,599	50 mm*	1,950	350	250	120	3.03e6	10–11

Note:

(#) The back-calculated moduli presented above have been adjusted in accordance with Figure 5.8 of TMR Pavement Rehabilitation Manual (2012) and rounded to the nearest 50MPa.

(^) Values have been rounded off and maximum limit for the moduli for granular materials has been applied.

(*) The thickness is determined from isopach drawings showing the change in final surface levels.

Based on the calculation presented above, on average the estimated design life for the pavement in the Outer Wheel Path is in excess of 7 – 8 years with the exception of the following locations:

- Lane 1 (eastbound)
  - Ch. 6850 – 7000m
  - Ch. 7050 – 7100m
  - Ch. 7180 – 7320m
- Lane 2 (westbound)
  - Ch. 6700 – 6800m

where pavement life is defined by fatigue failure in the asphalt surfacing rather than subgrade deformation

For areas in which a lower design life is reported, as listed above, it is recommended that if funding allows, provision be made in the cost estimate for localised strengthening activities to be carried out. Alternatively if no funds are available then the sections should be monitored closely and the region is advised to carry out regular maintenance inspections and activities as required.

8.4 New Pavements

New pavements are required in areas where widening of the carriageway will occur or where the new road surface is below the existing and a reconstruction of the pavement is required. Overall this is a very small percentage by area of the total project.

An assessment was undertaken for an appropriate design life of the new pavements with consideration given to 10 year and 20 year design lives.

Examination of the estimated design life of the existing pavements, adjacent to the areas where new pavements are required reveals that, with one exception, these areas have an estimated design life remaining of 20 years. Only the area at Ch 6,750m on the westbound lane at the crest of the hill has a short estimated design life of some 5 – 6 years.

It is considered that a reduction on the design life for the areas of new pavement from 20 years back to 10 years has little merit due to the small savings that could be realised during construction. It is therefore recommended that the 20-year design life be adopted for all areas of new pavement.

Two new pavement widening designs based on subgrade CBR 5% and 7%, with a design subgrade swell of <2.5% have been provided, as shown in **Table 8-3.**

During construction, if the above design conditions cannot be met, subgrade treatment in accordance with PSTS101 will need to be followed.

Table 8-3 New Widening Pavement (20 Year Design Life)

Design Details	20 Year Design Life	
	CBR 5% Design	CBR 7% Design
Design Traffic (ESA)	5.87E+06	5.87E+06
Design HV Speed (kph)	30	30
DG14 (C320) Wearing Course	50mm	50mm
PMB Seal, S4.5S binder with 10mm aggregate(Note 1)	6mm	6mm
DG20 (C600) Base Course (Note 2)	220mm	200mm
AMC0 Prime and C170 seal with 10mm Aggregate	6mm	6mm
Working Platform (Cement Modified Type 2.3 Unbound Gravel, 7-days UCS 1.5 ± 0.5 MPa)	150mm	150mm
Subgrade	Note 3	

Notes: 1. In areas where there is steep climbing gradient, a reduced spray rate of 1.0 – 1.2L/m^2 should be considered in accordance with the Pavement Design Manual.

2. A 10mm construction tolerance has been added to the reported thickness.

3. Subgrade treatment shall be in accordance with PSTS101 and is to be confirmed during construction.

9.0 Geotechnical Assessment

AECOM undertook a Technical Study to investigate the slope stability of the embankment widening at approximate Ch.6,900 to Ch.7,075 and the cut widening at approximate Ch.7,480 to Ch.7,580 as proposed within the Detail Design. The stability assessment was carried out using the factual geotechnical data provided in the Geotechnical Branch Factual Memorandum (October 2012) contained within **Appendix C**.

9.1 Embankment Widening Assessment

The investigation revealed that satisfactory factors of safety were expected from the embankment widening with the assumption that at least one (1) metre thickness of existing ground be removed and the existing embankment slope benched prior to backfilling.

It is noted that any soft compressible soils encountered during construction will need to be removed and notice given to the designer for appropriate assessment.

9.2 Cut Slope Assessment

Available rock mapping was limited in the investigation of the widening of the cut slope, and therefore detailed analyses were not possible.

Preliminary analysis suggests the potential for a preferential slip plane, it is likely that the new cut face will indicate similar conditions, however this will not guarantee that the new face will be stable. It has therefore been recommended that an observational approach be adopted during construction.

An Engineering Geologist should inspect the cut face as it is cut back to identify any potential unstable situations and to provide advice on any stabilisation required. A detailed scanline and photogrammetry log of the final cut face should be undertaken to allow a kinematic analysis to consider long-term stability of the rock cut face.

If potential instability is identified, stabilisation methods such as rock bolts, wire mesh and shotcrete could be considered.

Full documentation of AECOM's assessment is provided in the Geotechnical Technical Memorandum contained within **Appendix D**.

10.0 Lighting Design

The current road section is lit with Rate 2 flag lighting to provide a low level of illumination at key locations, such as intersections, during night-time operation. It is proposed that all existing Rate 2 lighting be removed as part of the project.

As part of the detail design, Mooloolaba Road has been designed to have lighting in accordance with AS/NZS 1158.1 2005 Table 2.2, Category V3. The lighting design has been designed using the illuminance based parameters of AS/NZS 1158 using modelling software AGI 32 for the entire length of the upgrade. This method has been used to account for the occurrence of curves and bends in the alignment as well as changes in carriageway width, intersections and a centre median.

The lighting design has been undertaken to smoothly transition to the existing road lighting provided at either end of the project extents.

It is proposed that the lighting be Rate 3 tariff, in accordance with the Road Planning and Design Manual Cl17.7.

The design uses a combination of luminaires:

- Rexel Optispan 400W aeroscreen
- Rexel Optispan 250W aeroscreen
- Rexel Optispan 150W aeroscreen.

At the time of writing this report, the lighting design has been submitted to Energex for approval and to finalise points of supply. Once proof of acceptance of the lighting design has been obtained, it will be forwarded to TMR for their records.

Refer to **Appendix E** for the Lighting Certificate of Compliance document.

11.0 Resumptions and Property Access

11.1 Resumption Requirements

During the option development phase, options were considered that provided improved geometry with subsequent property impacts.

It was noted during the option development phase that there were to be no resumptions of privately held land. As a result the options that identified resumptions were discarded. The preferred option, which has been developed into the detail design, does not require resumption of any properties and all works are contained within the existing road reserve, with some accommodation works required to existing properties.

It is noted however, that the combination of road geometry and property boundaries does have an impact on available sight distance for some motorists entering or travelling along Mooloolaba Road. This has been noted as a constraint of the design due to the direction to have no property impacts and any resultant impacts on design compliance has been summarised in **Section 6.6** and covered in more detail within the Geometry Report contained in **Appendix A**.

11.2 Property Access

Existing property access locations were identified during the preliminary design, through survey and site inspections.

As a result of the design intent of the project, to correct cross fall and superelevation application to improve pavement water flow, the level of kerbs has been modified along the length of the project. This change in kerb height has resulted in the reconstruction of a number of property accesses (driveways).

The intent of these driveway reconstructions is to reinstate the existing facility. As a result, there is no single detail that has been developed rather driveway widths and materials have generally replicated the existing situation in the detail design.

In general, a type 17 ramped vehicular crossover, as defined in TMR standard drawing 1033, has been used with either a reinforced concrete or asphalt driveway. Where the driveway crosses a footpath, as a minimum, the section that crosses the verge has been defined with a concrete pavement to provide a consistent facility for users of the path.

As Mooloolaba Road traverses a mountainous terrain, a number of the driveways are on very steep grades. Due to the local geometric conditions of some driveways, special ramped vehicular crossovers have been required. All driveways have been checked to ensure clearance for a 5.2m car/van in accordance with *Austroads Design Vehicles 2006*.

Resulting from the reconstruction of some driveways, ensuring that grades are acceptable and the design vehicle can traverse the driveway, accommodation works are required within private property. The impact of these accommodation works has been identified as completely as possible within the detail design and associated contract documentation. Some survey was obtained within properties, however this may not be complete and there may be other impacts associated with making modifications to property accesses. As such it has been recommended that the final extents of works be confirmed on site and in consultation with the property owners prior to undertaking any reconstructions.

Table 11-1 lists all the affected properties and provides a brief description on the treatments required, including any accommodation works required.

It is noted that the combined property accesses at Ch.6,840 and Ch.7,580 are being treated with a type 22 channel, not a type 17 ramped vehicular crossover, with asphalt pavement to tie into the existing. The type 22 channel is being provided to maintain storm water drainage across the accesses.

Table 11-1 Property access impacts

Property	Drawing Number	Vehicular Crossover	Driveway Material	Accommodation Works
Lot 3 RP153972	611104	Type 17	Concrete	Nil
Lot 22 RP228644	611119	Type 17	Concrete	Driveway impact
Lot 1 RP111424	611120	Type 17	Concrete	Driveway impact
Lot 2 RP101043	611120	Type 17	Asphalt	Nil
Lot 1 RP109329	611121	Detailed	Concrete	Driveway impact and gates
Lot 10 RP132410	611121	Detailed	Asphalt	Driveway impact
Lot 11 RP132410	611122	Type 17	Concrete	Driveway impact
Lot 12 RP132410	611122	Type 17	Asphalt	Nil
Lot 4 RP88065	611122	Type 17	Asphalt	Nil
Lot 2 RP88513	611123	Type 17	Concrete	Nil
Lot 2 RP93588	611123	Type 17	Concrete (plus granular)	Driveway impact
Lot 1 CG3887	611124	Type 17	Asphalt	Nil
Lot 3 RP897856	611125	Type 17	Concrete	Driveway impact with grated drain requirement. Relocate letter box
Lot 4 RP80359	611125	Type 17	Concrete	Nil
Lot 5 RP80359	611126	Type 17	Concrete	Driveway impact with grated drain requirement. Modify gates
Lot 6 RP80359	611126	Type 17	Concrete	Nil
Lot 1 & 2 RP94674	611127	Type 17	Asphalt	Nil
Lot 565 CG3754	611128	Type 17	Concrete	Nil
Lot 5 RP115698	611129	Type 17	Asphalt	Nil
Lot 7 RP115698	611130	Type 17	Concrete	Nil
Lot 1 RP194342	611130	Type 17	Asphalt	Nil
Lot 1 RP91316	611131	Type 17	Concrete	Driveway impact
Lot 2 RP91316	611131	Type 17	Concrete	Driveway impact
Lot 3 RP91316	611132	Type 17	Asphalt	Nil
Lot 1 RP177458	611132	Type 17	Asphalt	Nil

12.0 Signage, Road Furniture and Fencing

12.1 Traffic Signs

The design of traffic signs and line marking has been undertaken in accordance with the Manual of Uniform Traffic Control Devices (MUTCD).

This section of road will be sign posted at 60km/h with 50km/h advisory signage provided at the three significant horizontal curves, namely in the vicinity of Foote Avenue, Panorama Crescent and Thomsen Terrace.

The introduction of the raised central median necessitates the installation of additional signage to prevent right turning vehicles at Foote Avenue and Nyes Crescent and 'Keep Left' signage to aid in lane discipline for vehicles travelling along the mainline. Due to the accessibility issues pertaining to the introduction of the raised median, signage has been introduced to reinforce the locations where u-turn movements are not permitted; at the intersection with Buderim Pines Drive where u-turns are permitted signage is provided to warn of the geometric constraints at this location.

Chevron Alignment Markers (CAMs) are currently provided along the horizontal curves in the vicinity of Panorama Crescent and Thomsen Terrace. CAMs have been reinstated at these curves with an emphasis placed on achieving optimum spacing within the constraints of existing road furniture and property accesses. The installation of CAMs at the horizontal curve adjacent to Foote Avenue was considered; however, the location of existing accesses and road furniture combined with the curve geometry prevented the appropriate placement. On this basis reflective fluorescent flexible bollards will be positioned along the median of the horizontal curve to improve driver perception through this section.

Formal give way line marking and signage will be provided at the intersections with local roads within the design extent with the exception of Thomsen Terrace where stop signage and linemarking will be provided due to the substandard intersection sight distance at this location.

12.2 Road Furniture

In addition to traffic signs as discussed above, new road furniture will be introduced as part of the Detail Design, these additional items include:

- New fencing adjacent to the access road near Buderim Pines Drive (refer to **Section 12.4**)
- New street lighting including single outreach and dual outreach poles (refer to **Section 10.0**)
- Reinstatement of guardrail at three locations within the project extents (refer **Section 12.3**)
- Installation of plastic flexible bollards around the R72m curve at Foote Avenue to improve curve perception.

12.3 Safety Barriers

12.3.1 Barrier System

There are three locations where new guardrail is proposed. At each of these locations the new guardrail is being installed to replicate the provision of existing protection from roadside hazards. A summary of each of these locations is outlined below:

- *Guardrail 1* – (westbound) 170m of new guardrail replaces the existing guardrail along the southern verge of Mooloolaba Road to the west of Nyes Crescent. At this location embankment widening is proposed resulting in a new guardrail alignment.
- *Guardrail 2* - (westbound) 115m of new guardrail replaces existing guardrail along the southern verge of Mooloolaba Road to the east of Nyes Crescent. At this location the carriageway width has been reduced to limit the effective lane width and hence prevent vehicles from overtaking slow vehicles through this section.
- *Guardrail 3* - (westbound) 150m of new guardrail replacing existing along the southern verge of Mooloolaba Road to the west of Buderim Pines Drive. At this location there is minor narrowing of the carriageway and altered design levels necessitating the removal and reinstatement/replacement of guardrail.

All new barriers will be w-bean guardrail in accordance with TMR Standard Drawing 1474.

12.3.2 End Terminals

Of the eight end treatments within the Detail Design seven have been nominated as SKT, ET2000 (or equivalent approved product) approved for a 70km/h design speed. A Type 1 Melt (or equivalent) is nominated for the approach end treatment for *Guardrail 1* on the southern verge of Mooloolaba Road at the western corner of Nyes Crescent.

All end terminals are gating structures, hence requiring a hazard free zone of 6mx22m from the leading edge of the terminal. It is for this reason that a Type 1 Melt (or equivalent) has been nominated for the terminal adjacent to Nyes Crescent. At this location it is impracticable to increase the verge and flatten the batter further (to provide the required hazard free zone) as maintenance access is required at the toe of the batter. Introducing this type of terminal shall develop the guardrail outside the clear zone hence negating the need for a hazard free zone at the top of batter.

It should be noted that the hazard free zone has not be provided on the approach end to *Guardrail 3.* It was determined that providing a non-gating terminal would be high cost and impracticable. There are also numerous other hazards in the vicinity (stone pitched wall etc.) that prohibit relocating the terminal to provide a hazard free zone. The terminal location has been chosen as the most appropriate location to commence the barrier to provide the highest protection to the hazard; this barrier has been reinstated as per existing to minimise impacts.

12.3.3 Posts

The Detail Design nominates standard posts in accordance with TMR Standard Drawing 1474.

At some locations within the Detail Design guardrail is required to span kerbside gully pits. At these locations concrete footings for posts will be installed in accordance with Figure 8.16 Chapter 8 of the RPDM. This will facilitate 5.10m post spacing to span these structures.

12.4 Fencing

Due to the classification of this road fencing is not required to prevent persons from accessing the road. In general owners of private property fronting the road reserve provide fencing, if desired, at their own cost. All fences to property boundaries are being maintained as part of this project.

Where there are impacts associated with the road upgrade on privately owned fencing due to reconstruction of property accesses, the fencing is to be reinstated to the land owners' satisfaction as part of accommodation works covered under the contract.

It is noted that a galvanised welded mesh fence is provided along the southern edge of the access road near Buderim Pines Drive. This is to protect road users from the batter slope adjacent to Mooloolaba Road hence satisfying the requirements of Austroads Part 6A.

13.0 Pedestrian and Cyclist Facilities

As identified in the Sunshine Coast Council Existing and Future Cycle Network Plan there is an existing concrete footpath located on the northern verge of Mooloolaba Road. It is noted that there are no existing on road cycle facilities. The existing pedestrian footpath extends along the majority of the design extent and terminates at the intersection of Mooloolaba Road and Buderim Pines Drive. At this location pedestrians are required to traverse approximately 120m of access road in order to reconnect with the footpath to the east.

The Detail Design maintains the existing path connectivity along the northern extent of Mooloolaba Road. Due to changes in kerb levels, driveway levels and kerb alignments a new concrete footpath is required along much of the northern verge of Mooloolaba Road. All new footpaths will be 1.5m in width and match to existing at the interface with existing path. Minimum horizontal radius of footpath will be 10m.

14.0 Facilities for Public Transport

Translink service information indicates that there is one regular bus service that travels along the entire extent of Mooloolaba Road from Buderim Street through to King Street. This service (Route 616) travels from Maroochydore (Sunshine Plaza) to the University of Sunshine Coast via Buderim. This route provides a half hourly service from approximately 7:00am to 10:00pm on weekdays and an hourly service from approximately 7:30am-7:30pm on weekends and public holidays. A morning school service (Route 5707) also provides a weekday AM service along Mooloolaba Road from David Low Way at Bli Bli Castle to Musgrave Drive at Mountain Creek High School.

Eastbound and westbound bus stops are located to the west of Foote Avenue, both of which are within the extent of the Project area. Bus stops are also located to the east of Buderim Pines Drive, with the westbound bus stop located within the extent of the Project and the eastbound bus stop located outside the Project extent. There will be no change to the functionality of the bus stops located within the design extent nor does the Detail Design propose any changes to the facilities or signage provided at these bus stops.

15.0 Public Utility Plant

Information regarding the location of existing services within the area of works was requested from Dial Before You Dig (DBYD) in March 2012, which determined that PUP belonging to the following providers is present within the area of works:

- Optus (telecommunications)
- Telstra (telecommunications)
- Energex (electricity)
- Sunshine Coast Regional Council (stormwater)
- Unity Water (sewer and water).

To further supplement the DBYD data, a series of potholing activities were undertaken by TMR and Unity Water. Potholing was undertaken via physical location as well as electronic cable location methods. This information was incorporated into the Detail Design drawings to assist with confirming locations of service conflicts.

It is noted that some Unity Water services were not successfully located, particularly in the vicinity of Nyes Crescent.

All the service providers were contacted and discussions held with each of them to confirm service locations, identify potential conflicts and define the extents of the works to be relocated and locations for the relocated services.

Integration checks were carried out against the civil design to determine if there were any possible conflicts with the drainage and other aspects of the design. Integration checks were also carried out for conflicts within each of the individual service authority's designs to determine if they were conflicting with the other service relocations.

The three affected service authorities were requested to provide estimated costs for design and construction of relocations. At the time of writing this report, these estimates have not been finalised. As a result assumed relocation costs have been used for the P90 cost estimate. These are outlined in **Table 15-1** below for reference.

Table 15-1 Assumed PUP relocation costs

Activity	Assumed Cost	
Unity Water Relocations	$	200,000.00
Telstra Design and Relocation	$	170,000.00
Energex Design and Relocation	$	50,000.00
TMR Administration of Relocations	$	30,000.00
PUP Cost Subtotal	**$**	**450,000.00**

Timing of service relocations has yet to be finalised and is being co-ordinated between TMR and the service authorities. A list of current conflicts is contained within **Appendix F**. This provides details of current conflicts as identified on the design drawings and comments on conflict potential and/or protection/relocation requirements.

16.0 Safety in Design

16.1 Safety in Design

In Queensland, legislation and regulations exist which specify duties for designers, clients and main contractors within the construction industry (refer to the Queensland Work Health and Safety Act 2011, and in particular, Section 295 and 296 of the Queensland Work Health and Safety Regulations 2011).

To meet these requirements, the designer (or each designer if there is more than one) must provide a specific written report to the client (defined as the person for whose direct benefit all the work done at a construction site exists, upon its completion). This report must set out:

- The hazards identified by the designer which are associated with the construction work required to build the design (e.g. hazardous structural features, hazardous construction materials or hazardous procedures or practices)
- The designer's assessment of the risk of injury or harm to a person resulting from those hazards
- What actions the designer has taken to reduce those risks, (e.g. changes to the design or changes to construction methods or construction materials)
- Any parts of the design where hazards have been identified but not resolved.

The level of detail in the report must be appropriate for the client, the nature of the hazards and the degree of risk.

Clients also have duties under these regulations as follows:

- To consult with the designer for the purpose of ensuring, as far as practicable, that persons doing the construction work may do so without risk to their health and safety
- To ensure that, as far as practicable, any information they receive about identified hazards and related risk control measures, is passed on to the main contractor (if the client is not the main contractor) and to anyone who obtains the end product.

During the construction phase, clients should also bring information from the main contractor to the attention of the designer, should it become apparent that a change to the design could either eliminate or better control a risk to safety and health at the construction site.

16.1.1 Workshop

AECOM held a Safety in Design (SiD) review workshop in conjunction with TMR on 4 October 2012. The minutes of the workshop and register are provided in **Appendix G**.

A number of hazards were identified through discussion amongst workshop participants. They were added to the Risk Register, and their associated risks assessed and evaluated as part of the workshop. Many of the SiD items will need to be resolved at the Construction stage.

The risk matrix adopted is derived from the AECOM corporate matrix with an added criterion of Risk exposure. A copy of the risk matrix is provided in **Appendix G**.

16.1.2 Responsibilities

TMR must:

- Communicate this report including the SiD Matrix and the Risk Register to key stakeholders, Contractors and owners of mitigation actions
- Advise AECOM in a timely fashion of any issues or changes to the basis of design which might prompt reassessment of the design in order to reduce risks to health and safety during construction or at other times over the facility lifecycle.

16.1.3 Assumptions

The following assumptions were made during the SiD process:

- Scope is limited to hazards reasonably foreseeable at the time of the review and resulting from design aspects of the facility for which AECOM is responsible. Hazards arising due to normal site construction, installation, maintenance or operation as covered by WorkSafe Queensland, safe installation methods, Australian codes & standards, local codes and guidelines etc. are not part of this review
- The SiD process was completed based on current industry good practice and knowledge, and to the standard of skill, care and diligence as is reasonably expected of a consultant performing the same or similar services
- Any construction, operation, maintenance or demolition of the facilities will be carried out by organisations and/or personnel with appropriate knowledge, competence and skills to undertake such tasks
- Any organisation or person responsible for any of construction, operation, maintenance or demolition of the facilities will review and update/incorporate any new risks into the Risk Register as and when required.

16.2 Risk Management

A Risk Management Register has been prepared and is located in **Appendix H**. The Risk Management Register details the identified project related risks as well as mitigating risk factors and resulting impacts, both physical and financial.

Continual review of the risk register has occurred to assess any new risks that have been identified and any risks that have been mitigated during the development of the Detail Design.

17.0 Road Safety Audit

17.1 Existing Road (Stage 6)

A Stage 6 – Road Safety Audit was carried out by a team of TMR accredited road safety auditors who are AECOM employees. This audit was undertaken in April 2012 along Mooloolaba Road between Ch.6,500 and Ch.7,500.

This audit identified existing deficiencies within the road corridor relating to geometry, intersection layout, superelevation, signage, delineation, crash barriers, clear zones, stormwater infrastructure, and pedestrian and cycle facilities.

The findings of this audit, in combination with the interpretation of crash data, formed the basis for the development of this design.

This Road Safety Audit Report was previously issued to TMR during the option development phase of the project.

17.2 Detail Design (Stage 3)

A Stage 3 - Road Safety Audit was carried out by a team of TMR accredited road safety auditors who are AECOM employees. This audit was undertaken on the 80% detailed design submission drawings.

The design team acknowledged all the auditors' comments and an appropriate response was prepared and agreed with the auditors to close out the report. The auditor in closing the designers' response comment viewed the 100% submission drawings.

The Road Safety Audit Report is presented in **Appendix I**.

18.0 Cost Estimate

18.1 Cost Estimate

Aquenta was engaged as specialist cost estimators to prepare risk adjusted cost estimates for the Detail Design. The Cost Estimate Report is included in **Appendix J**.

The risk adjusted out-turn cost estimate is based on the following:

- The Detail Design drawings
- Material quantities that can be derived from the reference design
- Quantity and rate risk ranges applied to the estimate
- A Road Construction Contract (RCC) Schedule of Rates procurement method
- The base date for the estimate is September 2012
- Contract Award in March 2013
- Project Completion date of November 2013
- An allowance for unplanned risks.

An escalation allowance of 0% p.a. for the period June 2012 to February 2013 and 6% p.a. for the period March 2013 through to June 2014 was applied. The cost estimate has been analysed using @Risk software to provide out-turn cost estimates with a 50% probability of exceedance (P50) and 10% probability of exceedance (P90).

The risk adjusted cost estimate is summarised in **Table 18-1**.

Table 18-1 Cost Estimate Summary

Component	P50	P90
Construction Cost	$ 6,338,186.00	$ 6,338,186.00
Client Costs	$ 1,847,143.00	$ 1,847,143.00
Estimate Contingency	$ 55,169.00	$ 126,519.00
Client Cost contingency	$ 37,270.00	$ 100,243.00
Unplanned Risk	$ 634,607.00	$ 947,768.00
TOTAL PROJECT COSTS ($2012)	**$ 8,912,374.00**	**$ 9,359,860.00**
Escalation	$ 193,070.00	$ 200,819.00
TOTAL PROJECT COSTS $ (Forecast)	**$ 9,105,544.00**	**$ 9,560,679.00**

18.2 Construction Programme

A constructability workshop was held on 12 October 2012 and was attended by representatives of TMR (the client), AECOM (the designer), RoadTek (the constructor) and Aquenta (cost estimators). This workshop was undertaken to enable all relevant parties to consider the constructability of the design and propose alternative treatments and details to achieve the design intent.

The review was undertaken on the 50% Detail Design drawing package which enabled all valid improvements to be implemented into the design for 80% review and agreed for inclusion into the final Detail Design drawings.

At the constructability workshop it was agreed that the general construction staging methodology would follow the implementation of the drainage networks, working from the top of the hill to the bottom of the hill. This process was proposed as construction was proposed to commence during the wet season and improving the drainage from the high slopes first would realise the greater improvements in safety and drainage performance.

The project has been separated in to three (3) main stages, each with two (2) potential sub stages:

- Phase 1A: Ch.6,595 to Ch.6,950 – top section, uphill lane
- Phase 1B: Ch.6,595 to Ch.6,950 – top section, downhill lane
- Phase 2A: Ch.6,950 to Ch.7,400 – middle section, uphill lane
- Phase 2B: Ch.6,950 to Ch.7,400 – middle section, downhill lane
- Phase 3A: Ch.7,400 to Ch.7,619 – bottom section, uphill lane
- Phase 3B: Ch.7,400 to Ch.7,619 – bottom section, downhill lane

As an outcome of the constructability workshop, Aquenta developed a construction program with project duration of 36 weeks based on a five (5) day working week and three (3) day per month wet weather allowance.

Further detail of the construction program is contained within the Cost Estimate Report which included in **Appendix J**.

Department of Transport and Main Roads
20 February 2013
Document No. 60250500_TI_RP_008

Mooloolaba Road: Buderim Hill Upgrade

Geometry Report

Mooloolaba Road: Buderim Hill Upgrade

Geometry Report

NCHD-2596

Prepared for

Department of Transport and Main Roads

Prepared by

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AECOM in Australia and New Zealand is certified to the latest version of ISO9001 and ISO14001.

Quality Information

Document	Mooloolaba Road: Buderim Hill Upgrade
Ref	60250500
Date	20 February 2013
Prepared by	Matthew Gallagher, Tom Evans
Reviewed by	Alfred Chan

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
0	20-Feb-2013	Final Issue	Stephen Sewell Project Director	[redacted]

Client Acceptance

The Extended Design Domain Elements and Design Exceptions outlined in this report are accepted subject to the following conditions/clarifications:

Title	Name	Comments	Signature	Date
TMR Project Manager	Leah McKenzie	Accepted.	[redacted]	26/2/13
TMR Manager – ~~Road Engineering Standards~~ - Director (Special Projects Road Design)	Ricky Cox	Accepted		26/2/13
TMR Project Owner – Regional Director, North Coast	Dennis Tennant	Accepted		28/2/13

Table of Contents

1.0 Introduction

AECOM Australia Pty Ltd (AECOM) has been commissioned by the Department of Transport and Main Roads (TMR) to undertake the detailed design for Mooloolaba Road, Buderim. The area of works extends from Ch6595.000 (west of Foote Avenue) to Ch7619.037 (east of Buderim Pines Drive).

1.1 Project Background

The section of Mooloolaba Road in question has been subject to media interest following a number of recent crashes. As a result, AECOM were initially engaged by TMR to review the existing conditions and develop options to improve the section of road to an acceptable level responding to the availability of project funding.

AECOM has worked closely with TMR through a number of design meetings in order to select both the design criteria objectives and the intended design approach for this section of road. Upon completion of the Option Development phase of the project, a preferred solution was identified. TMR engaged AECOM to proceed into Detail Design (the current phase) of the upgrading of Mooloolaba Road, Buderim.

The following reports, prepared by AECOM, have formed a basis for the development of this design:

- Draft Existing Conditions Report – April 2012
- Stage 6 (Existing Road) Road Safety Audit – April 2012
- Draft Design Option Development Report – June 2012
- Technical Note – Extended Design Domain and Design Exceptions – August 2012
- Stage 3 (Detailed Design) Road Safety Audit – November 2012.

1.2 Purpose of the Report

This report supersedes the "*Technical Note – Extended Design Domain and Design Exceptions"* issued in August 2012. The Technical Note was issued to gain "in principle" approval from TMR of the design and associated elements of Extended Design Domain and Design Exceptions. With additional development of the Detail Design the geometric elements of this design have been finalised.

The purpose of this report is to confirm the geometric design of Mooloolaba Road Detail Design and review it against the project applied standards.

This report also assesses the design elements against the Design Domain and discusses the suitability of the incorporation of Extended Design Domain (EDD) and Design Exceptions (DE) for elements that are substandard. Each element of EDD or DE has been reported on and justified in accordance with the TMR Planners and Designers Instruction Number 6 (November 2010).

1.3 Design Standards

1.3.1 Overview

As part of the development of the geometric design the following activities were undertaken:

- Stage 6 Road Safety Audit to identify existing deficiencies within the road corridor that reduce the safety for all road users.
- Review of existing road alignment and associated infrastructure with respect to the current design standards and identification of specific deficiencies that impact on the road corridor requirements.
- Participated in workshops and meetings to discuss and confirm with TMR E&T representatives the selection of design standards, with particular application to this project.
- Identification and review of design standards to be adopted in the Detail Design and how they can be applied to the alignment whilst considering land constraints.
- Review of areas where desirable standards cannot be applied due to the existing corridor constraints and application of appropriate departures from the defined design criteria.
- Preparation of a 3-dimensional model (12D) and documentation for design drawings.

1.3.2 Design Standards and References

The Design Development for this project has been undertaken in accordance with the requirements specified in relevant Australian and TMR standards current at December 2012, in particular:

- Interim Guide to Road Planning and Design, TMR (2010)
- Road Planning and Design Manual, TMR
- Austroads Guide to Road Design, Austroads (2010)
- Traffic and Road Use Management Manual (TRUM), TMR (2011)
- Manual of Uniform Traffic Control Devices, TMR (2011)
- Austroads – Guide to Traffic Engineering Practice series
- Road Drainage Manual, TMR (2010)
- Preconstruction Processes Manual, TMR (2009)
- Project Cost Estimating Manual, TMR (2009)
- Standard Drawings Roads Manual, TMR.

Reference has also been made to previous work undertaken within this corridor during the design development:

- Draft Existing Conditions Report – April 2012
- Stage 6 (Existing Road) Road Safety Audit – April 2012
- Draft Design Option Development Report – June 2012
- Technical Note – Extended Design Domain and Design Exceptions – August 2012
- Stage 3 (Detailed Design) Road Safety Audit – November 2012.

1.4 Study Area

The area of works encompasses Mooloolaba Road Buderim extending from Ch6595.000 (west of Foote Avenue) to Ch7619.037 (east of Buderim Pines Drive). The approximate extent of the study area is illustrated in **Figure 1-1** below:

Figure 1-1 Study Area

The Study Area includes five priority controlled intersections connecting the following local roads:

- Foote Avenue
- Panorama Crescent
- Nyes Crescent
- Thomsen Terrace
- Buderim Pines Drive.

Mooloolaba Road (134) is a State-controlled road located in the Sunshine Coast between Mooloolaba and Buderim and is identified as a Controlled Distributor on the Sunshine Coast Regional Council Maroochy Plan 2000. Mooloolaba Road provides a link between Mooloolaba and Buderim, and provides access to the Sunshine Coast Private Hospital. Mooloolaba Road also provides connections to the Sunshine Motorway in the east and the Bruce Highway in the west.

2.0 Design Criteria

2.1 Design Intent

At the onset of the project, TMR articulated that land resumption with its resulting social impact was highly undesirable and that, where possible, the design should remain within the extent of the existing kerb lines. AECOM has developed a design in response to this direction which remains within the existing corridor and does not require land resumption from adjacent properties. In the majority of locations the existing kerb alignment is retained with the exception of:

- Formation widening in the vicinity of Nyes Crescent to facilitate a formalised right turn lane into Panorama Crescent and provide improved SSD
- Widening at Buderim Pines Drive to facilitate u-turn movements
- Reconstruction of kerb at select areas where pavement levels have increased as a result of addressing cross-fall/superelevation deficiencies.

The design intent is to address the existing crash history by making improvements to the stormwater infrastructure and providing improved cross fall and superelevation which in turn will enhance both stormwater drainage and driveability.

It was acknowledged that due to the constrained nature of the existing corridor the scope to improve sight distance is limited; however improvements have been achieved where possible. This results in the design not being able to fully address crashes that have sight distance as a contributing factor.

As part of improving the existing stormwater drainage the design introduces strategically positioned raised medians (inclusive of stormwater inlets and grated drains) to reduce stormwater flow path lengths. Installation of a raised median provides additional advantages such as providing improvements to curve perception and lane discipline at the Foote Avenue curve and formalisation of the right turn lane into Panorama Crescent.

It is noted that accessibility to local roads and residences will be affected by the introduction of the raised central median and hence a u-turn facility has been designed at Buderim Pines Drive. This facility in combination with the existing round-about at Dixon Road provides for u-turning movements at the eastern and western extent of the project.

The Detail Design was undertaken with the aim of maximising the reuse of existing infrastructure and maintaining existing kerb lines where feasible. AECOM has sought input from TMR's Engineering and Technology Division (E&T) at regular intervals during the project to ensure that the design intent is appropriate for the facility. Consultation was undertaken at the following stages:

- Review of existing conditions
- Development of project applied standards and intent
- 50% stage of the Detail Design
- 80% Stage of the Detail Design

2.2 Design Speed

The design speeds for this project have been derived from a speed survey undertaken by TMR between February and March 2012 at the following two locations:

- Site 1: Chainage 7,000 (between Panorama Crescent and Foote Avenue)
- Site 2: Chainage 7,300 (100m west of Thomsen Terrace).

Due to the nature of the speed surveys, separate design speeds were adopted for both cars and trucks. These were approved by TMR during the design development stage of the project and are outlined below:

- MCA1 (Mooloolaba Road eastbound)
  - Cars = 65km/h [except R72.0m curve (Ch6,720 to Ch6,770) = 56km/h]
  - Trucks = 60kmh [except R72.0m curve (Ch6,720 to Ch6,770) = 52km/h]
- MCB1 (Mooloolaba Road westbound)
  - Cars = 65km/h [except R72.0m curve (Ch6,720 to Ch6,770) = 56km/h]
  - Trucks = 66km/h (Ch7,100 to Ch7,620)
    = 60km/h (Ch6,595 to Ch7,100) [except R72.0m curve (Ch6,720 to Ch6,770) = 52km/h].

The design speed of cars for the R72.0m curve was obtained through the implementation of an OS Road assessment and applying the design philosophies outlined in Chapter 6 of the TMR Road Planning and Design Manual (RPDM). This approach was approved in principle by TMR and is documented in **Section 4.4** and **Appendix A**.

Truck design speed through the R72.0m curve is supported by VehSim analysis and Table 6.4.3 in Chapter 6 of the RPDM which indicates that drivers of trucks would likely be prepared to slow to a speed around 52 km/h on this bend.

2.3 Design Vehicle

The design vehicle(s) adopted for this design were approved by TMR and are outlined below:

- Mooloolaba Road - 12.5m rigid bus / truck
  - 19.0m semi-trailer (check vehicle)
- Side Roads - 8.80m refuse vehicle
  - 12.5m rigid bus / truck (check vehicle)
- Private Access - 5.2m car / van
- U-turn facilities - 6.4m small rigid vehicle (SRV).

It is noted that the design vehicle for Mooloolaba Road was initially set as a 19.0m semi-trailer, however upon review of the available traffic counts it was noted that articulated trucks (semi-trailers) only make up 0.5% of the total volume (commercial vehicles form 8% in the gazettal direction and 11% against gazettal).

Section 11.10.1 of the RPDM Chapter 11 gives provision to use a 12.5m rigid bus / truck as the design vehicle for curve widening where the incidence of prime mover and semi-trailer operation is less than 3% of AADT. A Semi-trailer would then be used as a check vehicle to ensure the appropriateness of the overall design.

This has therefore resulted in the 12.5m rigid bus / truck being adopted as the design vehicle.

3.0 Cross Section

The cross section of the Detail Design has been driven by the intent to achieve the desirable safety improvements within the constraints of the existing corridor and, where possible, within the existing kerb alignment. Due to the need to provide improvements to the existing stormwater infrastructure, strategically positioned central medians have been introduced. The implementation of medians has complimented the cross section by providing formal separation between eastbound and westbound traffic, facilitates the installation of double outreach street lighting within the central median and improves curve perception at the Foote Avenue curve.

A single eastbound and westbound lane is provided with auxiliary turn lanes at the intersections of Panorama Crescent (right turn), Nyes Crescent (left turn), Thomsen Terrace (right turn) and Buderim Pines Drive (left turn and right turn). The existing slow vehicle turnout lane has been excluded from the design in a bid to discourage excessive speeds through this section.

3.1 General

Table 3-1 below identifies the cross sectional design criteria referenced for this design.

Table 3-1 Typical Cross Section Criteria

Mooloolaba Road	Design Criteria
Typical Cross Section Criteria	
Minimum Lane Width	3.3m
Minimum Radius without Curve Widening	350m
Minimum Median Width	0.60m

3.1.1 Lanes

A 3.3m minimum lane width currently exists at the eastern and western extent of the project where the Detail Design ties into the existing carriageway. It is noted that this is consistent with the minimum lane width requirements outlined in Austroads Part 3. On this basis 3.3m is the minimum lane width applied within the Detail Design for through lanes and auxiliary turn lanes. Generally lane widths exceed the minimum requirements due to the application of curve widening and the existing generous carriageway width.

3.1.2 Shoulders

In the initial stage of the design development the design intent was to provide 1.70m wide cycle lanes adjacent to both the eastbound and westbound lanes thus providing a minimum 1.25m effective pavement surface measured from 450mm lip of channel. As the design progressed, TMR advised that formalised cycle lanes be excluded from the design. The design progressed with the philosophy of providing a 1.70m wide shoulder width where possible. However, in the interests of retaining existing kerb alignments and therefore minimising impacts outside the current kerb line, the shoulder width has been reduced to an approximate minimum value of 1.1m at constrained locations.

It is noted that the Detail Design provides improved road lighting to Category V3; therefore there is no requirement to provide an offset between the edge of lane and the kerb. On this basis the edge of lane is in some instances positioned flush with the central median kerb face, channel lip or grated drain.

Consideration has been given to allow for passing of broken down vehicles in accordance with Clause 13.7.2.6 Chapter 13 RPDM. A 5.5m clear width has been provided between median kerbs and roadside kerb with the exception of an isolated section of approximately 28m between Ch7405 to Ch7433 on MCA1. Throughout this section semi mountable kerbing has been provided clear of obstructions within the 5.5m envelope.

3.2 Superelevation

The horizontal geometry of the Detail Design dictates the application of superelevation through the horizontal curves. During the design development it was noted that there is currently insufficient superelevation and abrupt changes of superelevation in transitions and throughout the horizontal curves. Through the introduction of new pavement and the application of pavement overlay, a more consistent application of superelevation has been achieved.

Table 11.2 of the RPDM suggests that the maximum value of superelevation for an urban road with design speed less than or equal to 70km/h is 5%. The existing geometry included instances of superelevation over 7% and many curves with 6%.

3.2.1 Design Non-Compliance 1: Maximum Superelevation

Due to the existing geometry and desire to minimise additional overlay as well as verge and property impacts, a maximum application of 6% was set as the design criteria. This is noted as a design non-compliance.

A maximum superelevation value of 7% has not been exceeded at any location within the Detail Design. Generally 6% superelevation has been applied at the three major horizontal curves with the development of superelevation not exceeding the maximum allowable value of 0.035 rad/sec within the travelled lane as per the maximum requirements outlined in the Chapter 11 RPDM.

3.3 Curve Widening

3.3.1 Application

Curve widening has been applied to the horizontal curves, as required by Section 7.9 of Austroads Part 3, within the Detail Design for the design vehicle of a 12.5m rigid bus / truck. The extent of curve widening has been maximised where possible within the constraints the corridor and existing kerb alignment.

4.0 Horizontal Geometry

4.1 Project Applied Standards

Table 4-1 below identifies the horizontal design criteria referenced for the Detail Design. These values have been based on the criteria outlined in Austroads and the RPDM. A summary of the relevant reference documents is contained in **Section 1.3.2**.

Table 4-1 Horizontal Alignment Parameters

Mooloolaba Road	Design Criteria
Horizontal Alignment Criteria	
Absolute Maximum Side Friction Factor (Car)	0.33
Absolute Maximum Side Friction Factor (Truck)	0.24
Rate of Rotation (max)	0.035rad/s
Maximum Superelevation	7%
Superelevation rotation length -3% to +7%	51m

The method for determining the minimum horizontal radius applies to longitudinal grades up to 3%; however Austroads suggests that the radius should be increased by 10% for each 1% increase in longitudinal grade thereafter.

TMR has accepted that whilst a grade correction factor is desirable, the constraints of the existing corridor and funding requirements are considerable factors governing the decision process and therefore grade correction has not been applied to the Detail Design. This has enabled the horizontal geometry to largely remain within the existing kerb lines.

4.2 Eastbound Carriageway MCA1

Table 4-2 below presents the horizontal geometry for the eastbound carriageway, MCA1.

Table 4-2 Horizontal Curves, MCA1

Chainage (m)		Length (m)	Radius (m)		Super-elevation	Cars – Design Speed (km/h)	Cars – Design Speed Achieved*	Trucks – Design Speed (km/h)	Trucks – Design Speed Achieved#
Start	End								
6570	6618	48	210	R	2.5%	65	Yes	60	Yes
6718	6766	48	72	R	6.0%	56	Yes	52	Yes
6835	6884	49	180	L	-3.8%	65	Yes	60	Yes
7010	7106	96	128	R	6.0%	65	Yes	60	Yes
7186	7365	179	129	L	-6.0%	65	Yes	60	Yes
7463	7516	53	350	R	-3.0%	65	Yes	60	Yes
7516	7561	45	450	L	-3.0%	65	Yes	60	Yes

** Maximum allowable side friction factor = 0.33*

 # Maximum allowable side friction factor = 0.24

4.3 Westbound Carriageway MCB1

Table 4-3 below presents the horizontal geometry for the westbound carriageway, MCB1.

Table 4-3 Horizontal Curves, MCB1

Chainage (m)		Length (m)	Radius (m)		Super-elevation	Cars – Design Speed (km/h)	Cars – Design Speed Achieved*	Trucks – Design Speed (km/h)	Trucks – Design Speed Achieved#
Start	End								
6651	6573	78	210	L	-3.6%	65	Yes	60	Yes
6770	6725	45	72	L	-6.0%	56	Yes	52	Yes
6879	6836	43	160	R	3.0%	65	Yes	60	Yes
7111	6990	121	145	L	-5.8%	65	Yes	60	Yes
7364	7191	173	129	R	4.7%	65	Yes	66	Yes

** Maximum allowable side friction factor = 0.33*

 # Maximum allowable side friction factor = 0.24

4.4 R72.0m Curve Design Capability

During the investigation of the existing conditions it was identified that there is a number of geometric deficiencies on the westbound approach to the curve at Foote Avenue based on applying a design speed of 70km/h (posted +10km/h). Due to the constrained corridor it was determined that in order to improve the radius for 70km/h considerable land resumption would be required. AECOM therefore undertook separate assessments to determine the Section Operating Speed (SOS) and the adequacy of curve perception on the westbound approach to the curve. The details of these assessments are summarised in **Section 4.4.1** and **Section 4.4.2**; the complete documentation is included in **Appendix A**.

It is noted that analysis of SOS and curve perception form the basis for confirming a design speed of 56km/h between Ch6720 and Ch6770.

4.4.1 OS Road Assessment

AECOM has undertaken an OS Road Assessment to determine the SOS of the horizontal curve in the vicinity of Foote Avenue. Based on an R.72m curve with 6% superelevation the SOS equates to 56km/h. This therefore indicates that 56km/h represents the speed which it can reasonably be expected that drivers will be prepared to slow to for the curve.

4.4.2 Curve Perception

To supplement the OS Road assessment, AECOM has analysed the horizontal curve perception sight distance for the westbound approach to the curve at Foote Avenue. This analysis was undertaken to ensure that adequate visibility was available to allow for driver reaction and deceleration from the approach design speed (65km/h) to the SOS of the curve (56km/h).

Reference is made to Austroads Part 3 Section 5.10 which indicates that deceleration to the SOS will be complete once the vehicle arrives at the mid-section of the approach transition and that a minimum of 80% of the transition needs to be seen by the driver from the point of perception.

It was the opinion of the design team that requirements outlined in Section 5.10 were not suitable for this road environment (low speed, short curve with small radius and short transition) and therefore the design team adopted an alternative approach in agreement with TMR and outlined below:

- Vehicle completes deceleration process (from design speed to SOS) at the commencement of the curve radius (Ch6,770)
- Prior to deceleration there is a period where the driver perceives the curvature of the road, this process occurs over the duration of the driver reaction time and the 'perception point' occurs at the commencement of this process.

- The available sight distance at the perception point (projected from driver eye height of 1.1m to pavement level) is assessed to determine how much of the curve is seen at this point. Engineering judgement is thus applied to the adequacy of this distance based on the road environment and the additional visual cues proposed within the design.

The analysis revealed that there is sufficient sight distance to allow for a driver's perception of the approaching curve and deceleration from the approach design speed to the SOS of the curve and also that there is sufficient SSD on the westbound approach based on the SOS profile calculated within the analysis.

5.0 Vertical Geometry

5.1 Project Applied Standards

Table 5-1 below identifies the vertical design criteria referenced for the Detail Design. These values have been based on the criteria outlined in Austroads and the RPDM. A summary of the relevant reference documents is contained in **Section 1.3.2**.

Table 5-1 Vertical Curve Requirements

Element	Minimum Curve Radius (m)
Crest Curve	890
Sag Curve	685^

^ *Based on Comfort Criterion*

5.2 Vertical Elements

Due to the nature of the Detail Design the vertical geometry remains largely unchanged. Minor changes to levels are attributed to the introduction of pavement overlay and cross-fall correction applied along the length of the Detail Design.

Generally there is a 12% longitudinal grade from Thomsen Terrace through the intersections of Nyes Crescent and Panorama Crescent to the crest curve located to the west of Foote Avenue. Along this extent the long section comprises of a number of large radius curves separated by straight sections.

5.2.1 MCA1

This longitudinal grade on MCA1, eastbound carriageway, starts at an approximate 1% upgrade. In the vicinity of Foote Avenue via this grade is connected to a R1230m crest curve which transitions to the afore mentioned 12% downgrade

Via a combination of successive R1700m, R1355 and R1200m sag curves the vertical alignment continues to the eastern extents of the project at an approximate 1% downgrade in the vicinity of Thomsen Terrace.

5.2.2 MCB1

The westbound carriageway, MCB1, is very similar to the eastbound carriageway, though utilising slightly modified crest and sag curves.

The crest curve near Foote Avenue is an R1200m. While in the vicinity of Thomsen Terrace a single R1400m sag curve is used to transition from the 12% downgrade to the 1% downgrade

6.0 Stopping Sight Distance

One of the most critical elements of road design is the provision of sight distance to allow all vehicle types and driver abilities to interact safely with other vehicles, travel at speeds that are suitable for the environment and to identify then stop before, or manoeuvre around, hazards on the road.

It is acknowledged that due to the constrained nature of the existing corridor where there are currently substandard Sight Distance Elements the scope to improve sight distance is limited; however improvements have been achieved where possible. Design Exceptions are proposed to be adopted in some locations.

6.1 Project Applied Standards

The required Stopping Sight Distance (SSD) has been determined in accordance with Section 5.3 of Austroads Guide to Road Design (Austroads) Part 3. SSD is derived from two components, namely the distance travelled during the total reaction time and the distance travelled during the braking time.

Table 6-1 and **Table 6-2** below list the critical sight distance and geometric values for cars and trucks respectively. It is noted that these values are for reference only as grade corrections will need to be applied.

Table 6-1 Mooloolaba Road Sight Distance and Geometric Design Values - Cars

Mooloolaba Road	Design Criteria	
Stopping Sight Distance – Cars	**56km/h**	**65km/h**
Reaction Time (Cars)	1.5s	
Eye / Target Height – Cars	1.1m / 0.2m	
Stopping Sight Distance – Cars (not grade corrected)	50m	63m
Coefficient of Deceleration – Cars	0.46[1]	

[1] *Mountainous Terrain*
Object Position – Centre of Lane
Eye Position (Car) – Centre of Lane

Table 6-2 Mooloolaba Road Sight Distance and Geometric Design Values - Trucks

Mooloolaba Road	Design Criteria	
Stopping Sight Distance – Trucks	**60km/h**	**66km/h**
Reaction Time (Trucks)	1.5s	
Eye / Target Height – Trucks	2.4m / 0.2m	
Stopping Sight Distance – Trucks (not grade corrected)	74m	87m
Coefficient of Deceleration – Trucks	0.29	

6.2 Stopping Sight Distance

Sight distance has been assessed for both cars and trucks in the eastbound and westbound direction. Graphical analysis for this output is contained in **Appendix C**.

6.2.1 Eastbound – Cars

There is sufficient SSD for cars travelling eastbound within the project extent.

6.2.2 Eastbound – Trucks

There is insufficient SSD at two locations for trucks travelling eastbound within the project extent. These two deficiencies occur at the following locations:

6.2.2.1 Design Exception Element 1 – Ch6810 to Ch6840

Location

Mooloolaba Road. Eastbound at the east of the shared access (Ch6810 to Ch6840).

Existing Situation

SSD is below the guidance levels in the current design manuals at this location for eastbound trucks. This is due to a cutting and retaining wall on the northern side of the road combined with an R180m left hand horizontal curve.

Capability provided by Detail Design

The Detail Design provides an improvement in SSD of approximately 10m when compared with the existing alignment; this has been achieved by realigning the lanes within the existing kerb alignment.

The achieved and required SSD at this location is outlined in **Table 6-3.**

Table 6-3 Stopping Sight Distance - Design Exception 1

Chainage	Minimum Achieved SSD (m)	Required SSD at Location of Minimum Achieved (m)
6810-6840	89	92

It is noted that whilst SSD below the guidance levels in the current design manuals, the maximum deficit between the achieved and required SSD is 3m. The location where SSD below the guidance levels in the current design manuals occurs over an approximate 30m distance, this equates to 1.8s of travel time.

Implications on Detail Design of Providing NDD

In order to provide sufficient SSD it would be necessary to cut back the existing rock cutting. Due to the narrow verge width and substantial batter slope the required earthworks and reconstruction works would be substantial.

It is noted that the Extended Design Domain only provides scope to increase the object height and hence does not provide benefit in this instance where the horizontal geometry and cut rock batter ((higher than the EDD maximum object height of 1.25m) restricts SSD.

Mitigation Measures

The following mitigation measure will be included as part of the Preferred Design Option:

- Raised median to improve driver perception of curve
- Improved road lighting
- Curve warning speed signage as well as steep grade warning and "Trucks and Buses Must use Low Gear" signage.

The following advice was supplied by TMR E&T (Design Review Comments, 5 Feb 2013) to provide additional mitigation. Some information is based on recent research not incorporated into the current design guidance.

> *It would be unlikely that large heavy vehicles i.e. semi-trailers (for which the 0.29 braking co-efficient is applicable) would have an operating speed approaching 60km/h along this section due to the combination of horizontal and vertical alignment. The 89m achieved provides capability for 54km/h which is likely to more reflect a realistic operating speed for this type of vehicle at this location.*
>
> *For smaller single unit trucks which are more likely to have an operating speed of 60km/h there is research to show that they exhibit better braking characteristics than represented by the 0.29 co-efficient. Something more like 0.36 is realistic. Based on this co-efficient and a down grade of 12% the required SSD would be 84m which has been achieved.*

It is further noted that some of the speeds noted in the above advice are different to the applied design speeds defined in **Section 2.2**. The speeds noted above are for specific vehicle types whereas the design speed considers all Commercial Vehicle types.

Suitability of Element

This is an existing Design Exception that is to be retained.

Given consideration of the factors associated with implementing this Design Exception, the current situation as well as the implications of achieving NDD, it is considered that this element is suitable for application at this location.

6.2.2.2 Design Exception Element 2 – Ch7180 to Ch7290

Location

Mooloolaba Road. Eastbound to the west of Thomsen Terrace (Ch7180 to Ch7290).

Existing Situation

SSD is below the guidance levels in the current design manuals at this location for eastbound trucks. This is due to the existing property boundaries on the northern side of Mooloolaba Road. At this location there is a curve in the road alignment which causes driver's sight line to project along the northern verge of Mooloolaba Road.

It should be noted that there is currently vegetation extending from the property boundary into the verge at this location which further reduces the existing SSD. It is a recommendation of the Detail Design that vegetation is cut back to the property line at this location.

Recent crash data indicates that there is a crash cluster consisting of 20 crashes along this horizontal curve since January 2006. One of these crashes involved an eastbound vehicle colliding into the rear of a vehicle entering a private property.

Capability provided by Detail Design

SSD at this location remains unchanged through the implementation of this design; however it is noted that the removal of vegetation will provide improvements to SSD when compared with the existing capabilities.

Table 6-4 Stopping Sight Distance - Design Exception 2

Chainage	Minimum Achieved SSD (m)	Required SSD at Location of Minimum Achieved (m)
7180-7290	90	109

Table 6-4 indicates that the maximum deficit between achieve and required SSD at this location is 19m. Substandard SSD occurs over a length of approximately 110m, this equates to 6.6s of travel time.

Implications on Detail Design of Providing NDD

The horizontal curve at this location would need to be increased considerably to achieve NDD. It is noted that there is a vertical drop in excess of 15m on the southern side of Mooloolaba Road at chainage 7,350. Increasing the curve radius at this location would result in significant constructability issues; considerable property resumption and anticipated relocation of adjacent services; this possibility was deemed unacceptable by TMR during the design development.

It is noted that the Extended Design Domain only provides scope to increase the object height and hence does not provide benefit in this instance where the horizontal geometry and fixed property boundaries (higher than the EDD maximum object height of 1.25m) restricts SSD.

Mitigation Measures

The following mitigation measure will be included as part of the Preferred Design Option:

- Raised median to improve driver perception of curve
- Improved road lighting
- Curve warning speed signage

The following advice was supplied by TMR E&T (Design Review Comments, 5 Feb 2013) to provide additional mitigation. Some information is based on recent research not incorporated into the current design guidance.

> *It would be unlikely that large heavy vehicles i.e. semi-trailers (for which the 0.29 braking co-efficient is applicable) would have an operating speed approaching 60km/h along this section due to the combination of horizontal and vertical alignment (VehSim indicates <50km/h). The 90m achieved provides capability for 54km/h which is likely to more reflect a realistic operating speed for this type of vehicle at this location.*
>
> *For smaller single unit trucks which are more likely to have an operating speed of 60km/h there is research to show that they exhibit better braking characteristics than represented by the 0.29 co-efficient. Something more like 0.36 is realistic. Based on this co-efficient and a down grade of 12% the required SSD would be 84m which has been achieved.*

It is further noted that some of the speeds noted in the above advice are different to the applied design speeds defined in **Section 2.2**. The speeds noted above are for specific vehicle types whereas the design speed considers all Commercial Vehicle types.

However, based on the VehSim values for semi-trailers at this location, it could be considered that the design speed for semi-trailers (as opposed to trucks overall) should be in line with the VehSim value. As such the proposed Design Exception should not apply for semi-trailers.

Suitability of Element

This is an existing Design Exception that is to be retained.

Given consideration of the factors associated with implementing this Design Exception, the current situation as well as the implications of achieving NDD, it is considered that this element is suitable for application at this location.

6.2.3 Westbound – Cars

There is sufficient SSD for cars travelling westbound within the project extent.

6.2.4 Westbound – Trucks

There is sufficient SSD for trucks travelling westbound within the project extent

7.0 Intersections

7.1 Design Requirements

7.1.1 Sight Distance

As a requirement the following sight distance requirements must be adhered to:

- Approach Sight Distance (ASD)
- Safe Intersection Sight Distance (SISD)
- Minimum Gap Sight Distance (MGSD).

Austroads states that intersections should be designed to provide the more conservative value of SISD and MGSD for all vehicle movements that may be required to give way to other vehicles at the intersection.

The SISD criteria for the project has been determined in accordance with Section 3.2 of Austroads Part 4A.

Table 7-1 below lists the critical values relating to SISD.

Table 7-1 SISD Parameters

Mooloolaba Road	Design Criteria	
Safe Intersection Sight Distance Parameters	**NDD**	**EDD**
R_T – Reaction Time	1.5s	1.5s
Observation Time	3.0s	1.5s
D_T - Decision Time	4.5s	3.0s
V – Operating Speed Cars	56km/h / 65km/h	
V – Operating Speed Trucks	52km/h / 60km/h / 66km/h	
d – Coefficient of Deceleration Cars	0.46[1]	0.46[1]
d – Coefficient of Deceleration Trucks	0.29	0.29
Eye Height – Cars	1.10m	1.10m
Eye Height – Trucks	2.40m	2.40m
Target Height	1.25m	1.25m
SISD Cars^	97m / 117m	74m / 90m
SISD Trucks^	102m / 124m / 142m	90m / 99m / 114m

[1] *Mountainous terrain*

^ Grade correction not applied

MGSD has also been checked for intersections with driver eye height and object height set as 1.10m and 0.65m respectively in accordance with 3.2.3 of Austroads Part 4A. The critical acceptance gaps and follow-up headways have been determined in accordance with Table 3.4 with resultant distances being obtained from Table 3.5 of Austroads Part 4A.

7.2 Foote Avenue

7.2.1 Layout

Existing

In its existing configuration this intersection is a three legged priority controlled (give–way) intersection located on the outside of a horizontal curve in the Mooloolaba Road alignment. At this location Mooloolaba Road has one eastbound lane and one westbound lane with basic left turn provisions and a channelized right turn lane from Mooloolaba Road into Foote Avenue. This right turn lane is delineated by linemarking and is approximately 4.2m in width and 80m in length (excluding taper length).

Detail Design

The Detail Design introduces a raised central median on Mooloolaba Road. At this location there is insufficient width to provide for curve widening and central median whilst maintaining a right turn lane from Mooloolaba Road into Foote Avenue, hence provision for a right turn lane has been excluded from the Detail Design. The existing carriageway width of both Foote Avenue and Mooloolaba Road is maintained with curve widening applied to the through lanes on Mooloolaba Road.

The design vehicles applied to the Detail Design of this intersection is included in **Section 2.3** and the design vehicle swept paths are illustrated in **Appendix B**.

7.2.2 Alignment

The superelevation along Mooloolaba Road at this location has been increased as part of the Detail Design. This results in increased pavement level at the interface between Mooloolaba Road and Foote Avenue. Minor adjustments have therefore been applied to the Foote Avenue longitudinal grade to connect with the Mooloolaba Road design levels.

No changes to the cross section of Foote Avenue have been proposed as part of the Detail Design. Two Camphor Laurel trees positioned on either side of the throat of Foote Avenue, along with associated retaining walls, were identified as needing to remain and were confirmed as a constraint to the project. As a result no improvements to the Foote Avenue approach could be made.

The cross fall of Foote Avenue has been modified in an attempt to better direct surface water to the kerbs and so it does not run across Mooloolaba Road.

It is noted there are existing sight distance deficiencies for traffic travelling along Foote Avenue, improving these deficiencies is outside the scope of this project.

7.2.3 Sight Distance

As the Foote Avenue intersection is being changed to left-in left-out, SISD and MGSD is only requires for the eastbound approach.

Intersection sight distance checks are illustrated on sketch SK-60250500-00141 in **Appendix D**. The achieved SISD values were determined and compared with the requirements (with grade correction applied) as outlined in **Table 7-2**.

Table 7-2 Foote Avenue – SISD (NDD)

Direction	SISD Required – Cars (m)^	SISD Compliant - Cars	SISD Required – Trucks (m)	SISD Compliant - Trucks
Eastbound	117	Yes	122	Yes

^ An approach speed of 65km/h conservatively adopted

Similarly, the achieved MGSD values were determined and compared with the requirements as outlined in **Table 7-3**.

Table 7-3 Foote Avenue – MGSD (NDD)

Direction	MGSD Required^	MGSD Compliant
LT out of Foote	90m	Yes

^ An approach speed of 65km/h conservatively adopted

It is noted that there is sufficient SISD and MGSD to satisfy NDD conditions for all cases.

7.3 Panorama Crescent

7.3.1 Layout

Existing

In its existing configuration this intersection is a three legged priority controlled (give way) intersection located on the outside of a horizontal curve in the Mooloolaba Road alignment where the longitudinal grade is 12%. At this location Mooloolaba Road has one eastbound and one westbound lane with basic left turn provisions and provision for limited right turn queuing from Mooloolaba Road into Panorama Crescent. Panorama Crescent is a no-through road serving a small number of residential developments.

Detail Design

The general functionality of this intersection remains unchanged with the implementation of the Detail Design. A central median is introduced which formalises the existing right turn lane from Mooloolaba Road into Panorama Crescent. A pedestrian refuge island is introduced on Panorama Crescent due to the notable required width of crossing.

The design vehicles applied to the Detail Design of this intersection is included in **Section 2.3** and the design vehicle swept paths are illustrated in **Appendix B**.

7.3.2 Alignment

At this location the superelevation along Mooloolaba Road has been increased in the Detail Design. This results in an increased pavement level at the interface of Mooloolaba Road and Panorama Crescent. An R.350m crest curve has been applied to the Panorama Crescent approach with works connecting to the existing pavement at approximate Ch50.0m.

7.3.3 Sight Distance

SISD and MGSD has been checked for both approaches to Panorama Crescent with the plan sight distance alignments shown on sketch SK-60250500-00142 in **Appendix D**.

Intersection sight distance checks are illustrated on sketch SK-60250500-00143 in **Appendix D**. The achieved SISD values were determined and compared with the requirements (with grade correction applied) as outlined in **Table 7-4**.

Table 7-4 Panorama Crescent – SISD (NDD)

Direction	SISD Required – Cars (m)	SISD Compliant - Cars	SISD Required – Trucks (m)	SISD Compliant - Trucks
Eastbound	130	Yes	158	Yes
Westbound	110	Yes	110	Yes

Similarly, the achieved MGSD values were determined and compared with the requirements as outlined in **Table 7-5**.

Table 7-5 Panorama Crescent – MGSD (NDD)

Direction	MGSD Required	MGSD Compliant
LT out of Panorama	90m	Yes
RT into Panorama	73m	Yes
RT out of Panorama	126m	Yes

It is noted that there is sufficient SISD and MGSD to satisfy NDD conditions for all cases.

7.4 Nyes Crescent

7.4.1 Layout

Existing

In its existing configuration this intersection is a three legged priority controlled (give way) intersection located on the inside of a horizontal curve in the Mooloolaba Road alignment where the longitudinal grade is 12%. At this location Mooloolaba Road offers a single eastbound and westbound lane with an auxiliary left turn lane provided from Mooloolaba Road into Nyes Crescent, this lane is delineated by linemarking and is approximately 3.1m in width and 40m in length (excluding taper length). Nyes Crescent services a moderate number of residential developments and connects a number of local roads to both Mooloolaba Road and Dixon Road.

Detail Design

The Detail Design introduces a raised central median on Mooloolaba Road. The right turn movement from Nyes Crescent is prevented and line marking and central median on Nyes Crescent is provided in combination with appropriate signage to clearly signify the turning restriction. A dedicated left turn lane from Mooloolaba Road into Nyes Crescent will be maintained.

The design vehicles applied to the Detail Design of this intersection is included in **Section 2.3** and the design vehicle swept paths are illustrated in **Appendix B**.

7.4.2 Alignment

The horizontal curve of Mooloolaba Road has been widened in the vicinity of the intersection with Nyes Crescent. This combined with the application of new pavement has resulted in minor changes to the pavement levels at the interface of Nyes Crescent. On this basis minor adjustments have been made to the longitudinal grade of Nyes Crescent. An R.280m crest curve is applied on the approach with works connecting into the existing pavement at approximate Ch38.0m

7.4.3 Sight Distance

As the Nyes Crescent intersection is left-in left-out, SISD and MGSD is only required for the westbound approach.

Intersection sight distance checks are illustrated on sketches SK-60250500-00142 and SK-60250500-00143 in **Appendix D**. The achieved SISD values were determined and compared with the requirements (with grade correction applied) as outlined in **Table 7-6**.

Table 7-6 Nyes Crescent – SISD (NDD)

Direction	SISD Required – Cars (m)	SISD Compliant - Cars	SISD Required – Trucks (m)	SISD Compliant - Trucks
Westbound	110	Yes	124	Yes

Similarly, the achieved MGSD values were determined and compared with the requirements as outlined in **Table 7-7**.

Table 7-7 Nyes Crescent – MGSD (NDD)

Direction	MGSD Required	MGSD Compliant
LT out of Nyes	90m	Yes

It is noted that there is sufficient SISD and MGSD to satisfy NDD conditions for all cases.

7.5 Thomsen Terrace

7.5.1 Layout

Existing

In its existing configuration this intersection is a three legged priority controlled (stop) intersection located at the end of a horizontal curve in the Mooloolaba Road alignment with a notable longitudinal grade. At this location Mooloolaba Road offers a single through lane in each direction with a raised mountable kerbed median separating eastbound and westbound traffic. There is a channelized right turn lane from Mooloolaba Road into Thomsen Terrace with basic turning provisions for all other movements. Thomsen Terrace provides access for residential developments on Plantation Parade and Bunyarra Circuit; however, does not act as a thoroughfare by providing through connection.

Detail Design

The existing raised central median will be reconfigured with provision for a dedicated right turn lane from Mooloolaba Road into Panorama Crescent to be maintained. The right turn movement from Thomsen Terrace has been banned. This is considered preferential from the point of view that there is insufficient SISD, MGSD and SSD on the eastbound approach to this intersection. The banning of this movement has been achieved by the introduction of relevant signage, chevron line marking and the extension of the central median.

The design vehicles applied to the Detail Design of this intersection is included in **Section 2.3** and the design vehicle swept paths are illustrated in **Appendix B**.

7.5.2 Alignment

The alignment of Thomsen Terrace remains unchanged. The Detail Design will join smoothly to existing pavement levels at this location.

7.5.3 Sight Distance

Table 7-8 outlines a summary of NDD and EDD requirements (with grade correction applied) for SISD at Thomsen Terrace. These were then checked against the sight distance achieved, as shown in sketches SK-60250500-00143 and SK-60250500-00144 in **Appendix D**. These sketches note that there is insufficient sight distance for both the NDD and EDD cases.

Sight line MCAC05 on sketch SK-60250500-00144 shows the sight triangle required to provide NDD sight distance for Thomsen Terrace. This would require the resumption of four properties and is not considered feasible under this project. As such a Design Exception is proposed at this location.

Table 7-8 Thomsen Terrace – SISD (NDD/EDD)

Direction	SISD Required – Cars (m) NDD	SISD Required – Cars (m) EDD	SISD Compliant NDD/EDD-Cars	SISD Required – Trucks (m) NDD	SISD Required – Trucks (m) EDD	SISD Compliant NDD/EDD-Trucks
Eastbound	130	112	No/No	158	142	No/No

Similarly, the achieved MGSD values were determined and compared with the requirements as outlined in **Table 7-9**.

Table 7-9 Thomsen Terrace – MGSD (NDD)

Direction	MGSD Required	MGSD Compliant
LT out of Thomsen	90m	No (76m/4.6sec)

As with SISD, there is insufficient MGSD due to the property boundaries and associated fences blocking sight lines. This would require the resumption of properties and is not considered feasible under this project. As such a Design Exception is proposed at this location.

7.5.3.1 Design Exception Element 3 – SISD and MGSD Thomsen Terrace

Location

Intersection of Thomsen Terrace with Mooloolaba Road.

Existing Situation

Refer description of the existing in **Section 7.5.1**.

There have been two (2) recorded crashes at this intersection since January 2006 with both being type 201 crashes involving vehicles exiting Thomsen Terrace colliding with eastbound traffic on Mooloolaba Road. Both crashes were hospitalisation crashes with one occurring in dry conditions and the other in wet conditions.

Capability provided by Detail Design

Refer description of the existing in **Section 7.5.1**. The banning of right turns out of Thomsen Terrace is aimed at addressing the crash history and minimising driver load by allowing only left turn movement where motorists only have to look for a gap in one direction.

Implications on Detail Design of Providing NDD

As noted in **Section 7.5.3** above, the resumption of four properties would be required to achieve NDD SISD and MGSD for the eastbound approach. It is not considered socially acceptable to resume these properties.

Mitigation Measures

The following mitigation measure will be included as part of the Preferred Design Option:

- Right turns out of Thomsen Terrace have been banned
- Raised median to improve driver perception of curve
- Improved road lighting
- Curve warning speed signage
- Side road junction signage
- Convex mirror is retained to improve visibility for vehicles on Thomsen Terrance looking to the west.

Suitability of Element

This is an existing Design Exception that is to be retained. It is noted that the situation is improved at this location through the banning of the right turn out of Thomsen Terrace to minimise potential driver conflicts.

Given consideration of the factors associated with implementing this Design Exception, the current situation as well as the implications of achieving NDD, it is considered that this element is suitable for application at this location.

7.6 Buderim Pines Drive

7.6.1 Layout

Existing

In its existing configuration this intersection is a three legged priority controlled (give way) intersection. At this location Mooloolaba Road offers a single through lane in each direction with a raised mountable kerbed median separating eastbound and westbound traffic. There are channelized turn lanes provided for both left turn and right turn movements from Mooloolaba Road into Buderim Pines Road. Buderim Pines Road provides through connection to Golf Links Road and Karawatha Street ultimately connecting to the Sunshine Motorway.

Detail Design

The functionality of the intersection remains unchanged with the implementation of the detail design.

It is noted that minor kerb widening has been applied to the existing kerb alignment on the western side of Buderim Pines Drive, and northern side of Mooloolaba Road, in order to facilitate u-turn movements from the eastbound approach of Mooloolaba Road.

The design vehicles applied to the Detail Design of this intersection is included in **Section 2.3** and the design vehicle swept paths are illustrated in **Appendix B**.

7.6.2 Alignment

The alignment of Buderim Pines Drive remains unchanged. The Detail Design will join smoothly to existing pavement levels at this location.

7.6.3 Sight Distance

The alignment of Buderim Pines Drive remains unchanged. At this location there is sufficient SISD (with grade correction applied) to satisfy the requirements for NDD for both eastbound and westbound directions as outlined in **Table 7-10**.

Table 7-10 Buderim Pines Drive – SISD (NDD)

Direction	SISD Required – Cars (m)	SISD Compliant - Cars	SISD Required – Trucks (m)	SISD Compliant - Trucks
Eastbound	123	Yes	136	Yes
Westbound	117	Yes	141	Yes

Similarly, the achieved MGSD values were determined and compared with the requirements as outlined in **Table 7-5**.

Table 7-11 Buderim Pines Drive – MGSD (NDD)

Direction	MGSD Required	MGSD Compliant
LT out of Buderim Pines	90m	Yes
RT into Buderim Pines	73m	Yes
RT out of Buderim Pines	126m	Yes

It is noted that there is sufficient SISD and MGSD to satisfy NDD conditions for all cases.

8.0 Private Property Access

8.1 Project Applied Standards

As defined in Section 3.4 of Austroads Part 4A, sight distances at accesses should comply with the sight distance requirements for intersections. It is noted, however, that these criteria cannot be fully achieved on roadways with tighter horizontal or vertical alignment, as is the case for this section of Mooloolaba Road.

It is recommended that the minimum sight distance for accesses should be SISD using values given under the EDD criteria for sight distance as defined in Section A.3 and Tables A9 to A14 of Austroads Part 4A.

As noted in Section A.3 of Austroads Part 4A, the EDD value of SISD is based on using an Observation Time (O_T) of 0.5s less than the value given in Table A8. In this instance, Table A8 suggests that an O_T equal to 2.0s would be the applied for intersections associated with this project. As such an O_T of 1.5s (2.0s - 0.5s) has been applied as shown in **Table 8-1** below, which also lists the critical values adopted for SISD for property accesses within the project extents.

Table 8-1 SISD parameters for property accesses

Mooloolaba Road	Design Criteria	
Safe Intersection Sight Distance Parameters	NDD	EDD
R_T – Reaction Time	1.5s	1.5s
O_T – Observation Time	3.0s	1.5s
D_T - Decision Time	4.5s	3.0s
V – Operating Speed	56km/h / 65km/h	
d – Coefficient of Deceleration	0.46[1]	
Eye / Target Height	1.1 / 1.25	
SISD^	97m / 117m	74m / 90m

[1] *Mountainous Terrain*

^ *Grade correction not applied*

Similar to intersections, Section 3.4 of Austroads Part 4A requires that MGSD is to be checked for all vehicle movements that may be required to give way to other vehicles at the intersection.

MGSD has also been checked for intersections with driver eye height and object height set as 1.10m and 0.65m respectively in accordance with 3.2.3 of Austroads Part 4A. The critical acceptance gaps and follow-up headways have been determined in accordance with Table 3.4 with resultant distances being obtained from Table 3.5 of Austroads Part 4A.

8.2 Private Property Sight Distance

SISD and MGSD checks have been undertaken for all property accesses within the project extents. **Table 8-2** provides a summary of the sight distance achieved at all property accesses.

It is noted that the standard NDD case of SISD has been checked first with the EDD case then being checked. This has been done to provide a better indication of SISD compliance for the property accesses.

Table 8-2 Property access sight distance checks for Cars

Property Description	Drawing No.	SISD NDD Calculated	Achieved (Yes / No)	Comments	Domestic Accesses SISD (Table 13.17)	Achieved (Yes / No)	Design exception		Conclusion	MGSD NDD Calculated	Achieved (Yes / No)	Actual achieved
							Existing case achieved (m)	Design case achieved (m)				
Lot 22 RP 228644	611119	153m	No	Sightline crosses existing property boundary and fences	90m	Yes		118m	Domestic access criteria achieved	90m	Yes	
Lot 20 RP 228644	611104	153m	No	Sightline crosses existing property boundary and fences	90m	Yes		104m	Domestic access criteria achieved	90m	Yes	
Lot 1 RP 111424	611120	119m	No	Sightline crosses existing property boundary and fences.	68m	No	25m	27m	**Design Exception 4**	90m	No	27m
Lot 1 RP 109896	611104	127m	No	Sightline crosses existing property boundary and fences.	74m	No	34m	35m	**Design Exception 5**	90m	No	35m
Lot 2 RP 95390	611103	127m	No	Sightline crosses existing property boundary and fences.	74m	No	63m	65m	**Design Exception 6**	90m	No	39m
Lot 2 RP 101043	611120	143m	No	Sightline crosses existing property boundary and fences.	83m	No	54m	54m	**Design Exception 7**	90m	No	54m
Lot 1 RP 109329	611121	143m	No	Sightline crosses existing property boundary and fences.	83m	Yes	110m	97m	Domestic access criteria achieved	90m	Yes	
Lot 10 RP 132410	611121	143m	No	Sightline crosses existing property boundary and fences.	83m	Yes		117m	Domestic access criteria achieved	90m	Yes	
Lot 11 RP 132410	611122	143m	Yes						NDD Achieved	90m	Yes	
Lot 12 RP 132410	611122	143m	Yes						NDD Achieved	90m	Yes	
Lot 4 RP 88065	611122	143m	No	Sightline over new guardrail	83m	Yes		116m	Domestic access criteria achieved	90m	Yes	
Lot 2 RP 88513	611123	177m	No	Sightline obstructed by existing rock face (LHS) downhill	103m	No	68m	75m	**Design Exception 8**	90m	No	75m
Lot 2 RP 93588	611123	177m	No	Sightline obstructed by existing rock face (LHS) downhill	103m	Yes		120m	Domestic access criteria achieved	90m	Yes	
Lot CG 3887	611124			Sightline achieved to Intersection with Mooloolaba Rd								
Lot 3 RP 897856	611125	113m			65m	Yes		92m	Domestic access criteria achieved	90m	Yes	
Lot 4 RP 80356	611125	177m	Yes						NDD Achieved	90m	Yes	
Lot 5 RP 80359	611126	177m	Yes	Sightline over new guardrail, likely that existing vegetation will obstruct sightline	103m	Yes		150m	Domestic access criteria achieved	90m	Yes	
Lot 6 RP 80359	611126	177m	No	Sightline over new guardrail, crosses existing property boundary fence to Lot 571 CG3807	103m	Yes		150m	Domestic access criteria achieved	90m	Yes	
Lot 1 and 2 RP 94674	611127	177m	No	Sightline over new guardrail, crosses existing property boundary fence to Lot 571 CG3807	103m	Yes		150m	Domestic access criteria achieved	90m	Yes	
Lot 1 RP 128606 (Existing access to remain ie. No new cross over proposed)		177m	Yes	Sightline crosses through existing vegetation.	103m	Yes			NDD Achieved	90m	Yes	
Lot 3 SP 185838 (Existing access to remain i.e. No new cross over proposed)		177m	No	Sightline crosses existing property boundary, high block fence.	103m	No	54m	54m	**Design Exception 9**	90m	No	54m
Property Description	Drawing No.	SISD NDD Calculated	Achieved (Yes / No)	Comments	Domestic Accesses SISD (Table 13.17)	Achieved (Yes / No)	Design exception Existing case	Design case	Conclusion	MGSD NDD Calculated	Achieved (Yes / No)	Actual achieved

							achieved (m)	achieved (m)				
Lot 1 RP 134195 (Existing access to remain i.e. No new cross over proposed)		177m	No	Sightline crosses existing property boundary, high block fence.	103m	No	68m	68m	**Design Exception 10**	90m	No	54m
Lot 3 RP 142911 (Existing access to remain i.e. No new cross over proposed)		177m	No	Sightline crosses existing property boundary, high block fence.	103m	No	62m	62m	**Design Exception 11**	90m	No	62m
Lot 565 CG 3754	611128	153m	Yes						NDD Achieved	90m	Yes	
Lot 5 RP 115698	611129	153m	Yes						NDD Achieved	90m	Yes	
Lot 7 RP 208966	611130	153m	Yes						NDD Achieved	90m	Yes	
Lot 1 RP 194342	611130	153m	Yes						NDD Achieved	90m	Yes	
Lot 1 RP 91316	611131	177m	No	Sightline obstructed by existing property boundary	103m	Yes, note sightline across existing guardrail and ped fence	103m	103m	Domestic access criteria achieved	90m	Yes	
Lot 2 RP 91316	611131	177m	No	Sightline obstructed by existing property boundary	103m	Yes, note sightline across existing guardrail and ped fence	103m	103m	Domestic access criteria achieved	90m	Yes	
Lot 3 RP 91316	611132	177m	No	Sightline obstructed by existing property boundary	103m	Yes, note sightline across existing guardrail and ped fence			Domestic access criteria achieved	90m	Yes	
Lot 1 RP 177458	611132	177m	No	Sightline obstructed by existing property boundary	103m	Yes, note sightline across existing guardrail and ped fence		130m	Domestic access criteria achieved	90m	Yes	
Lot 8 RP 91316, CRP 901058, Lot 4 RP 901058		177m	No	Sightline obstructed by existing embankment	103m	Yes		130m	Domestic access criteria achieved	90m	Yes	

8.3 Property Access Design Exception Elements

As noted in **Table 8-2**, there are a number of property accesses that do not achieve the Safe Intersection Sight Distance Requirements as set out within Section 3.4 of Austroads Part 4A.

The following sections provide justification for each Design Exception (DE) element. It is noted that where SISD and MGSD is deficient for both cars and trucks at a property, they are discussed as a single DE for that property.

8.3.1 Design Exception Element 4 – Lot 1 RP 111424

Location

Driveway located on the southern side of Mooloolaba Road at approximate Chainage 6,735 on MCB1.

Existing Situation

The driveway is located on the inside of a small radius curve (approximately R71m) with the verge varying in width from approximately 2m to 4m. Properties along this section of Mooloolaba Road are generally fenced with high fences that block visibility.

Drivers can currently perform all movements into and out of their property.

SISD and MGSD is restricted from Mooloolaba Road westbound approach.

Recent crash data indicates that there have been six crashes at this location since January 2006; none of which have included vehicles entering properties on the southern side of Mooloolaba Road.

Capability Provided by Preferred Design Option

The lanes are realigned within the existing kerb alignment at this location; whilst improving sight distance values the achieved visibility remains substandard. Little improvement can be made due to the narrow verge and location of high boundary fences.

Implications on Preferred Design Option of Providing NDD

In order to achieve NDD, land resumption would be required from the private properties on the southern side of Mooloolaba Road.

Similarly, improving the horizontal geometry of Mooloolaba Road would likely necessitate resumptions from private properties from both the southern and northern sides of the road.

Mitigation Measures

The following mitigation measure will be included as part of the Preferred Design Option:

- Driveway access will be limited to left in, left out
- Raised median to improve driver perception of curve
- Improved road lighting
- Curve warning speed signage.

It is observed that vehicles at this property have the opportunity to turn around within the property to enable them to re-enter Mooloolaba Road in a forwards direction. SSD, as noted in **Section 6.0**, is achieved through this area.

Suitability of Element

This is an existing Design Exception that is to be retained.

Given consideration of the factors associated with implementing this Design Exception, the current situation as well as the implications of achieving NDD, it is considered that this element is suitable for application at this location.

8.3.2 Design Exception Element 5 – Lot 1 RP 109896

Location

Driveway located on the southern side of Mooloolaba Road at approximate Chainage 6,700 on MCB1.

Existing Situation

The driveway is located downstream of a small radius curve (approximately R71m) with the verge varying in width from approximately 2m to 4m. Properties along this section of Mooloolaba Road are generally fenced with high fences that block visibility.

Drivers can currently perform all movements into and out of their property.

SISD and MGSD is restricted from Mooloolaba Road westbound approach.

Recent crash data indicates that there have been six crashes at this location since January 2006; none of which have included vehicles entering properties on the southern side of Mooloolaba Road.

Capability Provided by Preferred Design Option

The lanes are realigned within the existing kerb alignment at this location; whilst improving sight distance values the achieved visibility remains substandard. Little improvement can be made due to the narrow verge and location of high boundary fences.

Implications on Preferred Design Option of Providing NDD

In order to achieve NDD, land resumption would be required from the private properties on the southern side of Mooloolaba Road.

Similarly, improving the horizontal geometry of Mooloolaba Road would likely necessitate resumptions from private properties from both the southern and northern sides of the road.

Mitigation Measures

The following mitigation measure will be included as part of the Preferred Design Option:

- Driveway access will be limited to left in, left out
- Raised median to improve driver perception of curve
- Improved road lighting
- Curve warning speed signage.

It is observed that vehicles at this property have the opportunity to turn around within the property to enable them to re-enter Mooloolaba Road in a forwards direction. SSD, as noted in **Section 6.0**, is achieved through this area.

Suitability of Element

This is an existing Design Exception that is to be retained.

Given consideration of the factors associated with implementing this Design Exception, the current situation as well as the implications of achieving NDD, it is considered that this element is suitable for application at this location.

8.3.3 Design Exception Element 6 – Lot 2 RP 95390

Location

Driveway located on the southern side of Mooloolaba Road at approximate Chainage 6,660 on MCB1.

Existing Situation

The driveway is located downstream of a small radius curve (approximately R71m) with the verge varying in width from approximately 2m to 4m. Properties along this section of Mooloolaba Road are generally fenced with high fences that block visibility.

Drivers can currently perform all movements into and out of their property.

SISD and MGSD is restricted from Mooloolaba Road westbound approach.

Recent crash data indicates that there have been six crashes at this location since January 2006; none of which have included vehicles entering properties on the southern side of Mooloolaba Road.

Capability Provided by Preferred Design Option

The lanes are realigned within the existing kerb alignment at this location; whilst improving sight distance values the achieved visibility remains substandard. Little improvement can be made due to the narrow verge and location of high boundary fences.

Implications on Preferred Design Option of Providing NDD

In order to achieve NDD, land resumption would be required from the private properties on the southern side of Mooloolaba Road.

Similarly, improving the horizontal geometry of Mooloolaba Road would likely necessitate resumptions from private properties from both the southern and northern sides of the road.

Mitigation Measures

The following mitigation measure will be included as part of the Preferred Design Option:

- Driveway access will be limited to left in, left out
- Raised median to improve driver perception of curve
- Improved road lighting
- Curve warning speed signage

It is observed that vehicles at this property <u>do not</u> have the opportunity to turn around within the property as such they must re-enter Mooloolaba Road in a reverse direction. To mitigate this, the shoulder is 4.0m wide at this location and motorists can reverse into the shoulder and then enter the traffic lane from a parallel position. This manoeuvre is shown in **Figure 8-1** below.

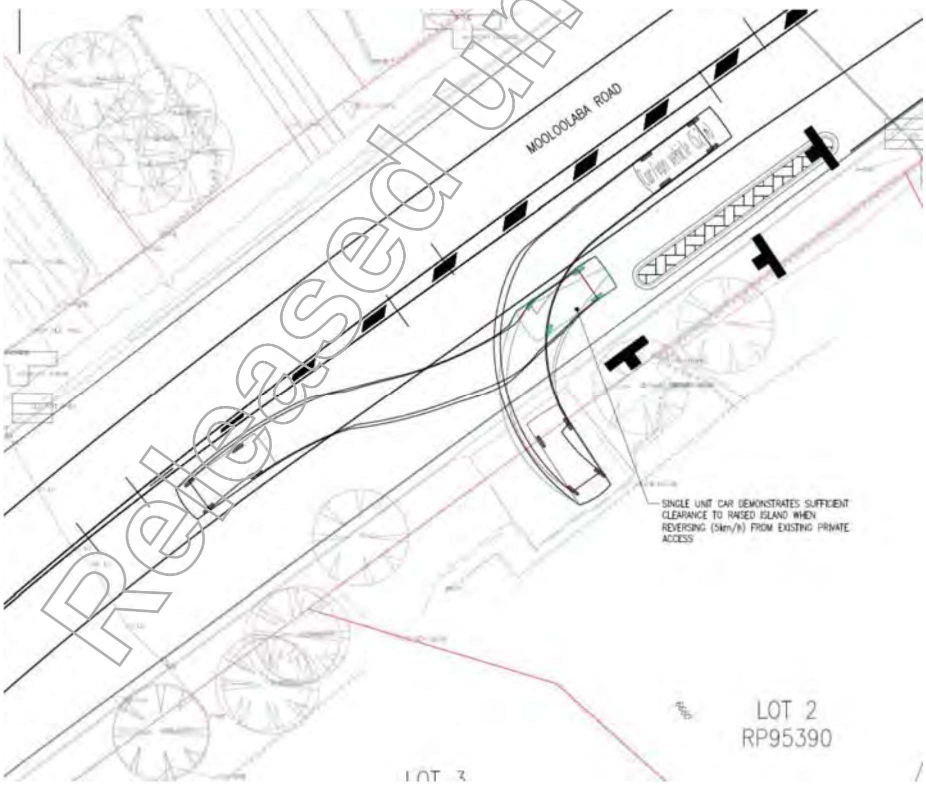

Figure 8-1 Turning path for car reversing out of Lot 2 on RP95390

SSD, as noted in **Section 6.0**, is achieved through this area.

Suitability of Element

This is an existing Design Exception that is to be retained.

Given consideration of the factors associated with implementing this Design Exception, the current situation as well as the implications of achieving NDD, it is considered that this element is suitable for application at this location.

8.3.4 Design Exception Element 7 – Lot 2 RP 101043

Location

Driveway located on the southern side of Mooloolaba Road at approximate Chainage 6,740 on MCB1.

Existing Situation

The driveway is located on the inside of a small radius curve (approximately R71m) with the verge varying in width from approximately 2m to 4m. Properties along this section of Mooloolaba Road are generally fenced with high fences that block visibility.

Drivers can currently perform all movements into and out of their property.

SISD and MGSD is restricted from Mooloolaba Road westbound and eastbound approaches.

Recent crash data indicates that there have been six crashes at this location since January 2006; none of which have included vehicles entering properties on the southern side of Mooloolaba Road.

Capability Provided by Preferred Design Option

The lanes are realigned within the existing kerb alignment at this location; whilst improving sight distance values the achieved visibility remains substandard. Little improvement can be made due to the narrow verge and location of high boundary fences.

Implications on Preferred Design Option of Providing NDD

In order to achieve NDD land resumption would be required from the private properties on the southern side of Mooloolaba Road.

Similarly, improving the horizontal geometry of Mooloolaba Road would likely necessitate resumptions from private properties from both the southern and northern sides of the road.

Mitigation Measures

The following mitigation measure will be included as part of the Preferred Design Option:

- Driveway access will be limited to left in, left out
- Raised median to improve driver perception of curve
- Improved road lighting
- Curve warning speed signage.

It is observed that vehicles at this property have the opportunity to turn around within the property to enable them to re-enter Mooloolaba Road in a forwards direction. SSD, as noted in **Section 6.0**, is achieved through this area.

Suitability of Element

This is an existing Design Exception that is to be retained.

Given consideration of the factors associated with implementing this Design Exception, the current situation as well as the implications of achieving NDD, it is considered that this element is suitable for application at this location.

8.3.5 Design Exception Element 8 – Lot 2 RP 88513

Location

Driveway located on the northern side of Mooloolaba Road at approximate Chainage 6,940 on MCA1.

Existing Situation

The driveway is located to the east of a cutting on the northern side of the road that is approximately 80m long. Also there is an R180 left hand horizontal curve that is located between 25m and 105m west of the access.

Drivers can currently perform all movements into and out of their property.

SISD and MGSD is restricted from Mooloolaba Road eastbound due to the combination of the horizontal curve and cutting on the northern side of the road. SISD and MGSD to the east is compliant for this property access.

Recent crash data indicates that there have been no crashes in this section of road related to vehicles entering properties on the northern side of Mooloolaba Road.

Capability Provided by Preferred Design Option

To the west of the property access, the lanes have been moved to the south, within the existing kerb alignment, at this location so as to introduce a minimum 1.1m shoulder and improve the horizontal geometry.

Whilst these changes improve SISD at the access, the achieved value remains substandard. Little improvement can be made due to the cut slope on the northern side of the road which would be costly to cut back further.

Implications on Preferred Design Option of Providing NDD

In order to achieve NDD extensive cutting back of the rock slope would be required. It is understood that the rock encountered at this location would be very difficult and costly to further cut back to provide increased sight distance to a single property access.

Similarly, improving the horizontal geometry of Mooloolaba Road would likely necessitate resumptions from private properties from both the southern and northern sides of the road.

Mitigation Measures

The following mitigation measure will be included as part of the Preferred Design Option:

- A shoulder has been introduced to move the through lanes away from the property access.
- Improved road lighting
- Curve warning speed signage
- Concealed Driveway advance signage to be retained.

It is observed that vehicles at this property have the opportunity to turn around within the property to enable them to re-enter Mooloolaba Road in a forwards direction.

As noted in **Section 6.2.2.1** (Design Exception 1), there is insufficient SSD for trucks (travelling eastbound) to the west of this property access.

Suitability of Element

This is an existing Design Exception that is to be retained.

Given consideration of the factors associated with implementing this Design Exception, the current situation as well as the implications of achieving NDD, it is considered that this element is suitable for application at this location.

8.3.6 Design Exception Element 9 – Lot 3 SP 185838

Location

Driveway located on the northern side of Mooloolaba Road at approximate Chainage 7,295 on MCA1.

Existing Situation

The driveway is located on the inside of a small radius curve (approximately R129m) with the verge narrowing to a pinch point of approximately 3.5m located 20m west of the property access. Properties along this section of Mooloolaba Road are generally fenced with high fences that block visibility.

Drivers can currently perform all movements into and out of their property.

SISD and MGSD is restricted from Mooloolaba Road westbound approach.

Recent crash data indicates that there have been 20 crashes in the vicinity of this property access since January 2006; of which there was one crash (type 302) that involved a vehicle entering a property on Mooloolaba Road. This crash occurred at a property further east and involved a rear end crash caused by a motorists running into the rear of someone turning left into a property. The crash occurred during wet conditions and resulted in a minor injury.

Capability Provided by Preferred Design Option

There is no change to the road (or lane) alignment at this location and as such there is no improvement to available visibility.

Implications on Preferred Design Option of Providing NDD

In order to achieve NDD land resumption would be required from the private property to which the driveway accesses, and could result in the building being affected leading to a full resumption, thus rendering the benefit obtained from improving sight distance invalid.

Similarly, improving the horizontal geometry of Mooloolaba Road would likely necessitate resumptions from private properties from both the southern and northern sides of the road.

Mitigation Measures

The following mitigation measure will be included as part of the Preferred Design Option:

- Driveway access will be limited to left in, left out
- Raised median to improve driver perception of curve
- Improved road lighting
- Curve warning speed signage
- Concealed Driveway advance signage installed.

It is observed that vehicles at this property have the opportunity to turn around within the property to enable them to re-enter Mooloolaba Road in a forwards direction.

As noted in **Section 6.2.2.2** (Design Exception 2), there is insufficient SSD for trucks (travelling eastbound) to the west of this property access.

Suitability of Element

This is an existing Design Exception that is to be retained.

Given consideration of the factors associated with implementing this Design Exception, the current situation as well as the implications of achieving NDD, it is considered that this element is suitable for application at this location.

8.3.7 Design Exception Element 10 – Lot 1 RP 134196

Location

Driveway located on the northern side of Mooloolaba Road at approximate Chainage 7,315 on MCA1.

Existing Situation

The driveway is located on the inside of a small radius curve (approximately R129m) with the verge narrowing to a pinch point of approximately 3.5m located 40m west of the property access. Properties along this section of Mooloolaba Road are generally fenced with high fences that block visibility.

Drivers can currently perform all movements into and out of their property.

SISD and MGSD is restricted from Mooloolaba Road westbound approach.

Recent crash data indicates that there have been eighteen crashes in the vicinity of this property access since January 2006; of which there was one crash (type 302) that involved a vehicle entering a property on Mooloolaba Road. This crash occurred at a property further east and involved a rear end crash caused by a motorists running into the rear of someone turning left into a property. The crash occurred during wet conditions and resulted in a minor injury.

Capability Provided by Preferred Design Option

There is no change to the road (or lane) alignment at this location and as such there is no improvement to available visibility.

Implications on Preferred Design Option of Providing NDD

In order to achieve NDD land resumption would be required from the private property to which the driveway accesses, and could result in the building being affected leading to a full resumption, thus rendering the benefit obtained from improving sight distance invalid.

Similarly, improving the horizontal geometry of Mooloolaba Road would likely necessitate resumptions from private properties from both the southern and northern sides of the road.

Mitigation Measures

The following mitigation measure will be included as part of the Preferred Design Option:

- Driveway access will be limited to left in, left out
- Raised median to improve driver perception of curve
- Improved road lighting
- Curve warning speed signage
- Concealed Driveway advance signage installed.

It is observed that vehicles at this property have the opportunity to turn around within the property to enable them to re-enter Mooloolaba Road in a forwards direction.

As noted in **Section 6.0**, there is insufficient SSD for trucks (travelling eastbound) to the west of this property access.

Suitability of Element

This is an existing Design Exception that is to be retained.

Given consideration of the factors associated with implementing this Design Exception, the current situation as well as the implications of achieving NDD, it is considered that this element is suitable for application at this location.

8.3.8 Design Exception Element 11 – Lot 3 RP 142911

Location

Driveway located on the northern side of Mooloolaba Road at approximate Chainage 7,355 on MCA1.

Existing Situation

The driveway is located on the inside of a small radius curve (approximately R129m) with the verge narrowing to a pinch point of approximately 3.5m located 20m west of the property access. Properties along this section of Mooloolaba Road are generally fenced with high fences that block visibility.

Drivers can currently perform all movements into and out of their property.

SISD and MGSD is restricted from Mooloolaba Road westbound approach.

Recent crash data indicates that there have been eighteen crashes in the vicinity of this property access since January 2006; of which there was one crash (type 302) that involved a vehicle entering a property on Mooloolaba Road. This crash occurred at a property further east and involved a rear end crash caused by a motorists running into the rear of someone turning left into a property. The crash occurred during wet conditions and resulted in a minor injury.

Capability Provided by Preferred Design Option

There is no change to the road (or lane) alignment at this location and as such there is no improvement to available visibility.

Implications on Preferred Design Option of Providing NDD

In order to achieve NDD land resumption would be required from the private property to which the driveway accesses, and could result in the building being affected leading to a full resumption, thus rendering the benefit obtained from improving sight distance invalid.

Similarly, improving the horizontal geometry of Mooloolaba Road would likely necessitate resumptions from private properties from both the southern and northern sides of the road.

Mitigation Measures

The following mitigation measure will be included as part of the Preferred Design Option:

- Driveway access will be limited to left in, left out
- Raised median to improve driver perception of curve
- Improved road lighting
- Curve warning speed signage
- Concealed Driveway advance signage installed.

It is observed that vehicles at this property have the opportunity to turn around within the property to enable them to re-enter Mooloolaba Road in a forwards direction.

As noted in **Section 6.0**, there is insufficient SSD for trucks (travelling eastbound) to the west of this property access.

Suitability of Element

This is an existing Design Exception that is to be retained.

Given consideration of the factors associated with implementing this Design Exception, the current situation as well as the implications of achieving NDD, it is considered that this element is suitable for application at this location.

9.0 Water Film Depths

9.1 Design Standards

The design standards used to determine the absolute maximum and desirable maximum water film depth (4.0mm and 2.5mm respectively) are from TMR Road Drainage Manual (Ch. 11, Section 11.3.8.1).

It should be noted that at the time of preparing this report the TMR Road Drainage Manual was under review.

A risk has been associated with each level of water film depth, see **Table 9-1** below:

Table 9-1 Water Film Depths

WATER FILM DEPTH RISKS (project specific)	
UNACCEPTABLE RISK:	>= 4.0 mm
HIGH (ACCEPTABLE) RISK:	3.2 – <4.0 mm
MODERATE (ACCEPTABLE) RISK:	2.5 – <3.2 mm
LOW (DESIRABLE) RISK:	0.0 - <2.5 mm

The design has focused on reducing flow path lengths and water film depths; this is of particular importance given the notable crash history recorded along this section of road during wet weather. Whilst film depths of 4.0mm and 2.5mm represent the absolute maximum and the desirable maximum values an attempt has been made to restrict film depths to a low risk classification (<2.5mm).

The Detail Design proposes a dense graded asphalt (DGA) surfacing which equates to a texture depth of 0.4mm. This is the basis upon which the water film depths have been check and are reported on in this document.

However, an allowance has been made to apply an open graded asphalt (OGA) wearing surface to reinstate the existing surfacing. If the OGA was to be installed, it would provide a texture depth of 0.9mm leading to improved water film depths above those reported in this document.

However, as a conservative approach, film depth analysis should consider a pavement texture depth of 0.4mm (consistent with a dense graded wearing surface). This approach aims to more accurately model the inevitable wearing of the OGA surface.

As such the analysed surfacing provides a conservative approach for whatever final surfacing is applied.

9.2 Analysis

Each of the superelevation transitions have been analysed and the results are summarised below in **Table 9-2**. Aquaplaning Plots can be found in **Appendix E**.

Table 9-2 Aquaplaning Results

FLOW PATH ID	Total Flow LENGTH (m)	Maximum DEPTH (mm)	DEPTH RISK
6810R6	49.427	2.18	LOW
6810R1	47.524	1.93	LOW
7150L0	**60.161**	1.50	LOW
7150R10	**68.366**	1.71	LOW

As can be seen in **Table 9-2**, there are two locations (7150L0 and 7150L10) that have a total flow length that is in excess of 60m. It is noted that the 60m flow length is a guide and should be achieved as a maximum. As a result having flow lengths greater than 60m can be accepted, though they have been noted here for completeness and have been documented in **Section 9.2.1** and **9.2.2** as a Design Non Compliance. These Design Non Compliances could only be rectified by significantly changing the road geometry.

Assuming that the method adopted by RDM Section 11.3.7.1 is still applicable for such a long drainage path, the water film depth is estimated to be less than the desirable maximum of 2.5mm. The accidents records show no accidents at these locations. As such the aquaplaning risk is not significant and the solution is considered acceptable although it does not totally comply with the proposed design criteria and the requirements of RDM. On this basis the following non-compliances are noted.

9.2.1 Design Non-Compliance 2: Location 7150L0

Clause 11.3.8.1 of the Road Drainage Manual suggests that drainage path lengths should be limited to 60m. This flow path has been calculated to be 60m in length.

9.2.2 Design Non-Compliance 3: Location 7150L10

Clause 11.3.8.1 of the Road Drainage Manual suggests that drainage path lengths should be limited to 60m. This flow path has been calculated to be 68m in length.

10.0 Design Non-compliance / EDD / DE Elements

The design intent for the project was defined in **Section 2.1** where it was noted that the application of design non-compliances as well as EDD/DE was expected due to the constraints of the existing corridor and desire for asset preservation and minimisation of redundancy. This report has sought to define the geometry applied to the Detail Design and highlight specific elements that do not achieve the NDD.

Table 10-1 and **Table 10-2** below list out the Design Non-compliances and Design Exception elements retained in the project Detail Design.

Table 10-1 Design Non-compliances

Non-compliance	Location	Description	Report Reference
1	Various	Maximum superelevation exceeds 5%	3.2.1
2	MCA1 Ch7,120	Flow path length exceeds 60m	9.2.1
3	MCB1 Ch7,120	Flow path length exceeds 60m	9.2.2

Table 10-2 Design Exceptions

DE Element	Location	Description	Report Reference
1	MCA1 Ch6,810 to Ch6,840	Compliant SSD cannot be achieved for trucks on the eastbound approach due to an existing cutting and retaining wall combined with a left hand horizontal curve.	6.2.2.1
2	MCA1 Ch7,180 to Ch7,290	Compliant SSD cannot be achieved for trucks on the eastbound approach due to the existing property boundaries on the northern verge of Mooloolaba Road.	6.2.2.2
3	Thomsen Terrace	There is substandard SISD and MGSD to the west due to the existing property boundaries on the northern verge of Mooloolaba Road	7.5.3.1
4	MCB1 Ch6,735	There is substandard SISD and MGSD at the access to Lot 1 RP 111424 due to the existing property boundaries on the southern verge of Mooloolaba Road.	8.3.1
5	MCB1 Ch6,700	There is substandard SISD and MGSD at the access to Lot 1 RP 109896 due to the existing property boundaries on the southern verge of Mooloolaba Road.	8.3.2
6	MCB1 Ch6,660	There is substandard SISD and MGSD at the access to Lot 2 RP 95390 due to the existing property boundaries on the southern verge of Mooloolaba Road.	8.3.3
7	MCB1 Ch6,740	There is substandard SISD and MGSD at the access to Lot 2 RP 101043 due to the existing property boundaries on the southern verge of Mooloolaba Road.	8.3.4
8	MCA1 Ch6,940	There is substandard SISD and MGSD at the access to Lot 2 RP 88513 due to the existing property boundaries on the northern verge of Mooloolaba Road.	8.3.5
9	MCA1 Ch7,295	There is substandard SISD and MGSD at the access to Lot 3 SP 185838 due to the existing property boundaries on the northern verge of Mooloolaba Road.	8.3.6
10	MCA1 Ch7,315	There is substandard SISD and MGSD at the access to Lot 1 RP 134196 due to the existing property boundaries on the northern verge of Mooloolaba Road.	8.3.7

DE Element	Location	Description	Report Reference
11	MCA1 Ch7,355	There is substandard SISD and MGSD at the access to Lot 3 RP 142911 due to the existing property boundaries on the northern verge of Mooloolaba Road.	8.3.8

A continual process of review and consultation has been undertaken to assess the overall design intent and application of design standards for the upgrade of Mooloolaba Road. Of particular importance has been the retaining of Design Non-compliances and Design Exception elements.

Overall, it is considered that the defined Design Exceptions are considered appropriate given the TMR defined project constraints.

Appendix A

R72.0 Operating Speed and Curve Perception Tech Notes

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Memorandum

To	Nathan Guild, Stephen Sewell	Page	1
CC	Matthew Gallagher, Mark Westaway		
Subject	Mooloolaba Road, Buderim Hill Foote Avenue Curve Design Capability		
From	Michael Bannah		
File/Ref No.	60250500_TI_MEM_003_B	Date	10-Dec-2012

Background

The existing horizontal curve on Mooloolaba Road at Foote Ave is approximately R.71m with 6% superelevation. The through lane is laterally positioned close to the existing kerb and channel with limited shoulder. An existing dedicated right turn lane is provided for westbound vehicles turning right into Foote Ave.

TMR have provided advice to date that the following design speeds are to be applied to this curve. These speeds have been derived from a review by TMR of actual speed survey results.

- Car Design speed of 65km/h
- Truck Design speed of 60km/h

At this location and with these existing geometric parameters and operating speeds, deficiencies exist in car and truck stopping sight distance, safe intersection sight distance to driveways and curve side friction demands for cars and trucks.

Proposed Geometric Solution

The Preferred Design Option attempts to maximise the available stopping sight distance for the design speeds identified above. To achieve this we propose the following actions:

- Removing the right turn lane and realigning the through lane to be located adjacent a newly formed raised concrete kerbed median.
- The horizontal radius has been increased to R.72m with 6% superelevation
- This horizontal curve is positioned at the top of the crest with a vertical grade of about 1% and the approaching grade of 12% in the uphill direction. No grade correction is required to be applied to the SSD parameters at this location.
- Adoption of a coefficient of deceleration of 0.41 for car SSD, a reduction of 0.05 due to side friction demands being greater than the desirable maximum (Austroads Guide to Road Design, Part 3, Section 5.2.3).

The stopping sight distance (SSD) achieved is improved over the existing condition however it still does not meet the 65km/h design speed for cars (Note: Trucks will require a Design Exception).

Initial analysis of the R.72m curve for a 65km/h Design Speed show that the absolute maximum side friction demands are exceeded for cars and trucks. This would require a Design Exception application.

Advice from TMR's Engineering and Technology Division (Ricky Cox and Mike Whitehead) has suggested that application of the principles contained within the Road Planning and Design Manual (RPDM), Chapter 6, Speed Parameters would result in identification of the proposed R.72m curve being acceptable and therefore remove the need for a Design Exception application.

The AECOM design team (Matthew Gallagher, Tom Evans, Michael Bannah and Mark Westaway) have analysed the proposed geometric solution following the processes outlined within the Road Planning and Design Manual (RPDM), Chapter 6, Speed Parameters.

It is noted that larger radii curves were considered (including an R77m) however larger curves resulted in the reconstruction of a low block retaining wall on the north east side of the curve. TMR advised that reconstruction of this wall would be unacceptable and as a result the minimum improvement possible was investigated to fit within the constraints of the existing roadway. The curve that best achieved the constraints was the proposed R72m horizontal curve.

Analysis

We have reviewed the Preferred Design Option against the principles discussed in RPDM Chapter 6. Specifically we have undertaken a review of the alignment using TMR's OSroad program and confirmed the results through tables, figures and charts in Chapter 6. The following commentary outlines the process we have adopted.

The alignment has been analysed as a series of sections with each having a Section Operating Speed (SOS). The Foote Avenue curve is Section 5. **Figure 1** below depicts the analysed alignment.

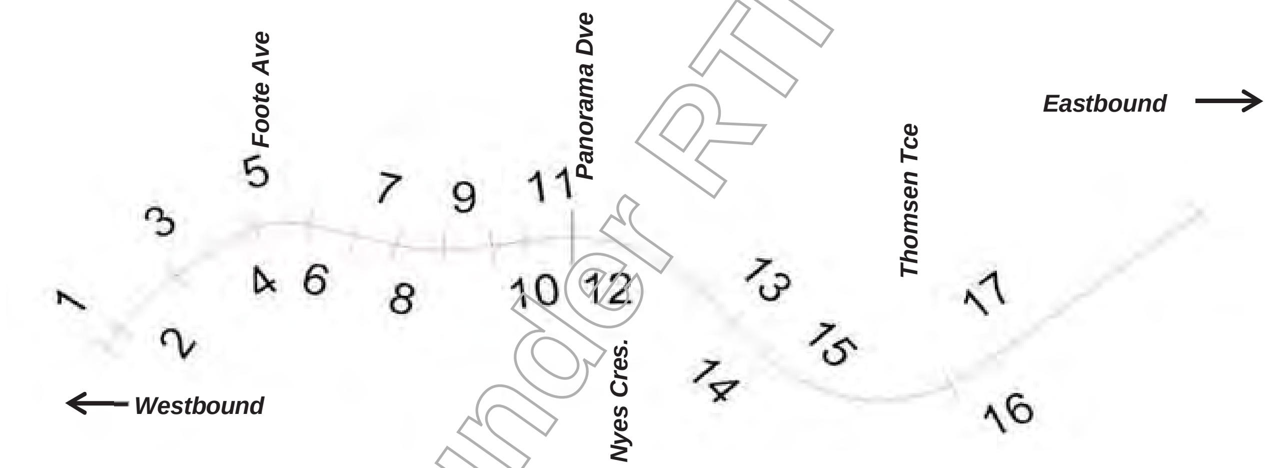

Figure 1 Alignment Sections

Figures 2 – 5 below provide the output details from the OSroad runs for the existing and proposed alignments.

Operating Speed Model

Alignment Name: MCB1 - Existing Mooloolaba Road West

Direction: B to A Start Chainage: 6550.615 m Approach Speed: 65 km/h LCS Margin: 5 km/h

Element ID	Element Code	Start Chainage (m)	End Chainage (m)	Length (m)	Super Elevation (%)	Desired Speed (km/h)	Sect/SOS (No/km/h)	V85 (km/h)	Delta V85 (km/h)	Side Friction	LCS	Applied Rules	Design Checks
19	Straight	7509	7433	76		65	1 / 65	65	0			[02][19][30]	
18	Transition	7433	7372	61									
17	R129	7372	7207	164	5.0	65	1 / 65	65	0	0.21	75	[01][02][13][19][43]	
16	Transition	7207	7147	60									
15	Straight	7147	7133	15		65	1 / 65	65	0			[01][02][19][30]	
14	Transition	7133	7073	60									
13	R111	7073	7016	57	6.0	65	1 / 65	65	0	0.24	72	[01][02][13][19][43]	
12	Transition	7016	6956	60									
11	Straight	6956	6934	22		65	2 / 65	65	0			[01][02][19][21][30]	
10	Transition	6934	6894	40									
9	R205	6894	6840	53	-3.0	65	2 / 65	65	0	0.19	78	[01][02][19][43]	
8	Transition	6840	6800	40									
7	Straight	6800	6793	8		65	3 / 56	65	0			[01][02][19][20][30]	
6	Transition	6793	6763	30									
5	R71	6763	6718	44	6.0	65	3 / 56	56	-9	0.29	59	[01][02][43]	
4	Transition	6718	6688	30									
3	Transition	6688	6641	47									
2	R200	6641	6569	72	3.0	65	4 / 65	60	4	0.11	83	[01][19][42][33]	
1	Straight	6569	6551	18		65	4 / 65	60	0			[19][33]	

Foote Ave Curve

Figure 2 OSroad output for Existing Alignment (Westbound)

Operating Speed Model

Alignment Name: MCA1 - Existing Mooloolaba Road East

Direction: A to B Start Chainage: 6544.219 m Approach Speed: 65 km/h LCS Margin: 5 km/h

Element ID	Element Code	Start Chainage (m)	End Chainage (m)	Length (m)	Super Elevation (%)	Desired Speed (km/h)	Sect/SOS (No/km/h)	V85 (km/h)	Delta V85 (km/h)	Side Friction	LCS	Applied Rules	Design Checks
1	Straight	6544	6563	19		65	1 / 65	65	0			[19][30]	
2	R230	6563	6624	61	-3.0	65	1 / 65	65	0	0.17	80	[02][19][43]	
3	Transition	6624	6664	40									
4	Straight	6664	6690	26		65	2 / 56	65	0			[01][19][20][30]	
5	R70	6690	6763	74	6.0	65	2 / 56	56	-9	0.30	59	[02][43]	
6	Transition	6763	6783	20									
7	Transition	6783	6817	34									
8	R214	6817	6913	96	2.0	65	3 / 65	60	4	0.11	83	[01][19][42][33]	
9	Straight	6913	6954	41		65	4 / 65	63	3			[02][19][21][33]	
10	Transition	6954	7014	60									
11	R110	7014	7089	75	5.0	65	4 / 65	65	2	0.25	71	[01][19][42][33]	
12	R300	7089	7121	32	-3.0	65	5 / 65	65	0	0.14	85	[02][19][43]	
13	Transition	7121	7183	62									
14	R121	7183	7333	150	5.0	65	6 / 65	65	0	0.22	73	[01][02][19][43]	
15	Transition	7333	7412	79									
16	Straight	7412	7535	123		65	6 / 65	65	0			[01][19][30]	

Foote Ave Curve

Figure 3 OSroad output for Existing Alignment (Eastbound)

Operating Speed Model

Alignment Name: MCB1

Direction: B to A   Start Chainage: 6551.662 m   Approach Speed: 65 km/h   LCS Margin: 5 km/h

Element ID	Element Code	Start Chainage (m)	End Chainage (m)	Length (m)	Super Elevation (%)	Desired Speed (km/h)	Sect/SOS (No/km/h)	V85 (km/h)	Delta V85 (km/h)	Side Friction	LCS (km/h)	Applied Rules	Design Checks	Remarks
15	Straight	7624	7404	220		65	1 / -	65	0			[02][35][33][49]		
14	Transition	7404	7364	40										
13	R129	7364	7191	173	5.0	65	2 / 65	65	0	0.21	75	[01][02][13][19][43]		
12	Transition	7191	7111	80										
11	R145	7111	6990	121	6.0	65	2 / 65	65	0	0.17	78	[01][02][13][19][43]		
10	Transition	6990	6950	40										
9	Straight	6950	6919	32		65	2 / 65	65	0			[01][02][19][30]		
8	Transition	6919	6879	40										
7	R160	6879	6836	42	3.0	65	2 / 65	65	0	0.18	78	[01][02][13][19][43]		
6	Transition	6836	6770	66										
5	R72	6770	6725	45	6.0	65	3 / 56	57	-8	0.29	60	[01][02][43]		Foote Ave Curve
4	Transition	6725	6688	37										
3	Straight	6688	6651	37		65	4 / 65	58	1			[01][21][33]		
2	R210	6651	6573	78	3.0	65	4 / 65	61	3	0.11	84	[19][42][33]		
1	Straight	6573	6552	22		65	4 / 65	62	1			[19][33]		

Figure 4 OSroad output for Proposed Alignment (Westbound)

Operating Speed Model

Alignment Name: MCA1

Direction: A to B   Start Chainage: 6548.129 m   Approach Speed: 65 km/h   LCS Margin: 5 km/h

Element ID	Element Code	Start Chainage (m)	End Chainage (m)	Length (m)	Super Elevation (%)	Desired Speed (km/h)	Sect/SOS (No/km/h)	V85 (km/h)	Delta V85 (km/h)	Side Friction	LCS (km/h)	Applied Rules	Design Checks	Remarks
1	Straight	6548	6570	22		65	1 / 65	65	0			[19][30]	[20]	
2	R210	6570	6618	48	3.0	65	1 / 65	65	0	0.13	84	[02][19][43]		
3	Transition	6618	6678	60										
4	Straight	6678	6689	11		65	2 / 56	65	0			[01][02][19][20][30]	[20]	
5	Transition	6689	6718	29										
6	R72	6718	6766	48	6.0	65	2 / 56	57	-8	0.29	60	[01][02][43]		Foote Ave Curve
7	Transition	6766	6835	69										
8	R180	6835	6884	50	3.0	65	3 / 65	60	3	0.13	80	[01][02][12][19][42][33]		
9	Transition	6884	6924	40										
10	Straight	6924	6950	26		65	3 / 65	63	3			[01][02][19][33]		
11	Transition	6950	7010	60										
12	R128	7010	7106	95	6.0	65	3 / 65	65	2	0.20	75	[01][02][12][19][42][33]		
13	Transition	7106	7186	80										
14	R129	7186	7365	179	6.0	65	3 / 65	65	0	0.20	75	[01][02][12][19][43]		
15	Transition	7365	7405	40										
16	Straight	7405	7463	59		65	4 / 65	65	0			[01][19][21][30]		
17	R350	7463	7516	53	-2.0	65	4 / 65	65	0	0.12	89	[12][19][43]		
18	R450	7516	7561	45	3.0	65	4 / 65	65	0	0.04	102	[12][19][43]		
19	Straight	7561	7619	58		65	4 / 65	65	0			[19][30]		

Applied Design Checks

[20] GEOMETRICS – Insufficient length to develop required superelevation.   Elements: 1, 4

Figure 5 OSroad output for Proposed Alignment (Eastbound)

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Section Operating Speed SOS

The SOS is the speed at which drivers will potentially drive that section.

OSroad calculates that the R.72m curve has a SOS of 56km/h. This is consistent with the values shown in Table 6.9.2 of the RPDM which show a SOS of 58km/h for radii ranging from R.70-90m.

Using Figure 6.9.2(b) of the RPDM, we can interpolate that for an approach design speed of 65km/h to an R.72m curve, a resultant SOS of approximately 58km/h is achieved. This value sits within the "Desirable Design Limits" range and shows that the horizontal curve radius is above the desirable minimum radius.

The reduction in speed of 8km/h falls within the values shown in Table 6.7.2 of the RPDM for maximum decrease in design speeds between successive horizontal elements of roadways.

Limiting Curve Speed (LCS)

The LCS is *"the speed at which a vehicle travelling on a curve of given radius and superelevation, will have a side friction demand equal to the absolute maximum recommended value given in Chapter 11",* (RPDM, Ch.6, page 6-4). Additionally, it's important to note that "*The operating speed on a particular horizontal curve should not exceed the limiting curve speed for that curve",* (RPDM, Ch.6, page 6-4).

OSroad calculates that the R.72m curve has a LCS of 60km/h.

Based on the speed survey results the operating speed of 65km/h does exceed the limiting curve speed of 60km/h. However, the SOS suggests that vehicles will reduce their operating speed to 56km/h on this curve.

Crash History

It is important to note that the analysis of the existing alignment shows a LCS of 59km/h and a SOS of 56km/h. It must also be recognised that this curve has a crash history, with crashes predominately occurring in dry weather. This suggests a tendency for drivers to not perceive the curve adequately and "over-drive" the curve. The LCS of 59km/h represents a need for drivers to reduce their approach speed by 6km/h upon entry to the curve.

To provide drivers with increased awareness and perception of the proposed curve, the design team is proposing the following visual cues:

- Introducing a raised concrete median
- Providing improved lighting
- Installing curve advisory speed signs (50km/h)

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Conclusion

Analysis of the proposed R.72m curve at Foote Avenue for a 65km/h Design Speed identifies that the maximum curve side friction demands for cars is exceeded. This would result in a Design Exception application being required.

Through application of the OSroad program and the principles outlined in Chapter 6 of the RPDM, the Proposed Design Option provides (for cars):

- An approach design speed of 65km/h
- A Limiting Curve Speed (LCS) of 60km/h (improved from 59km/h for the existing curve geometry)
- A Section Operating Speed (SOS) of 56km/h (maintaining 56km/h for the existing curve geometry)

Acceptance and adoption of the above parameters for this curve must be undertaken with an awareness of the existing crash history at this location. An application for a Design Exception (for cars only) at this location may not be required should TMR accept:

a) That the methodology, process and results outlined in this memo are correct;

b) That suitable curve perception is available to allow motorists to observe and appreciate the curve to enable them to safely reduce speeds from 65km/h to 57km/h through the curve;

c) That a combination of improved LCS/SOS over the existing condition and the proposed measures identified to improve driver perception of the curve, will likely result in drivers negotiating the curve at the proposed SOS thereby mitigating against the previous crash history; and

d) That a residual risk remains with this curve requiring greater than maximum side friction demands for vehicles traveling above 62km/h

It is noted that a Design Exception for trucks is still required for the side friction demand being exceeded through this curve.

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Memorandum

To	Leah McKenzie	Page	1
CC	Ricky Cox		
Subject	Horizontal Curve Perception Sight Distance - Mooloolaba Road		
From	Matthew Gallagher		
File/Ref No.	TI_RP_006	Date	20-Sep-2012

1.0 Background

As part of the development of the Mooloolaba Road Preliminary Design, AECOM prepared a Technical Note (TI_RP_004, August 2012) which sought to document potential Extended Design Domain and Design Exceptions to be adopted as part of the project for in-principal approval from TMR.

Design Exception 1 was documented as being insufficient side friction for cars at the horizontal curve located on Mooloolaba Road at Ch6,740 (adjacent to Foote Avenue). An assessment of the curve was undertaken in accordance with Chapter 6 of the Road Planning and Design Manual to assess the curve operating speed. This was done using TMR's OSroad program to assess the westbound carriageway for both the existing geometry and AECOM's proposed design; the results were contained within Appendix A of the aforementioned Technical Note.

The design proposed to increase the curve radius from R.71m to R.77m; however this resulted in the need to realign approximately 55m of an existing retaining wall on the northern verge of Mooloolaba Road.

In an attempt to minimise impacts to the retaining wall and associated issues, it was agreed that AECOM review the design of the curve. AECOM has therefore prepared an alternative design comprising of the following:

- radius = 72m
- superelevation = 6%
- arc length of curve = 45m
- westbound approach transition length = 30m
- eastbound approach transition length = 37m

An OSroad analysis was undertaken for the amended design (westbound) and the results are outlined below:

- section operating speed (SOS) = 56km/h
- limiting curve speed (LCS) = 60km/h
- side friction demand at SOS = 0.29

This revised design was presented to, and discussed with, TMR's Engineering and Technology Division (Ricky Cox and Mike Whitehead) on 6 September 2012. Refer attached minutes for a record of the meeting

This alternate alignment was generally accepted as being appropriate for the conditions.

It was recommended that, to ensure the proposed SOS could be achieved, the horizontal curve perception be assessed.

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2.0 Horizontal Curve Perception

AECOM have undertaken an analysis of the horizontal curve perception sight distance for the westbound approach to the curve, this is to ensure that there is adequate visibility to allow for driver reaction and deceleration from the design speed (65km/h) to the SOS of the curve (56km/h). Reference was initially made to Austroads Guide to Road Design, Part 3, Section 5.10.

Section 5.10 indicates that deceleration to the SOS will have been completed when the vehicle arrives at the mid-section of the approach transition and that a minimum of 80% of the transition needs to be seen by the driver from the point of perception.

It was the opinion of the design team that requirements outlined in Section 5.10 were not suitable for this road environment (low speed, short curve with small radius and short transition) and therefore the design team adopted the approach proposed by Ricky Cox at the meeting on 6 September 2012 as noted in the meeting minutes.

The approach adopted in this analysis therefore consists of the following:

- Vehicle completes deceleration process (from design speed to SOS) at the commencement of the curve radius (Ch6,770)
- Prior to deceleration there is a period where the driver perceives the curvature of the road, this process occurs over the duration of the driver reaction time and the 'perception point' occurs at the commencement of this process.
- The available sight distance at the perception point (projected from driver eye height of 1.1m to pavement level) is assessed to determine how much of the curve is seen at this point. Engineering judgement is thus applied to the adequacy of this distance based on the road environment and the additional visual cues proposed within the design.

Perception Point

Working back from the start of the curve at Ch6,770, the driver decelerates from the design speed (65km/h) to the SOS (56km/h), this distance equates to approximately 21m based on a 2.0m/s/s deceleration rate. Deceleration commences at Ch6,791.

Prior to the deceleration commencing, the distance travelled during the reaction period equates to approximately 27m based on a 1.5s reaction time. This reaction time is consistent with the value adopted for determining sight distance requirements during the design development of the project. This suggests that the reaction process occurs between Ch6818 and 6791.

Therefore Ch6818 is the Perception Point at which point the horizontal curve must be able to be perceived to enable motorists to observe then react and decelerate in advance of the curve.

The assumed speed profile is indicated below in **Figure 1**.

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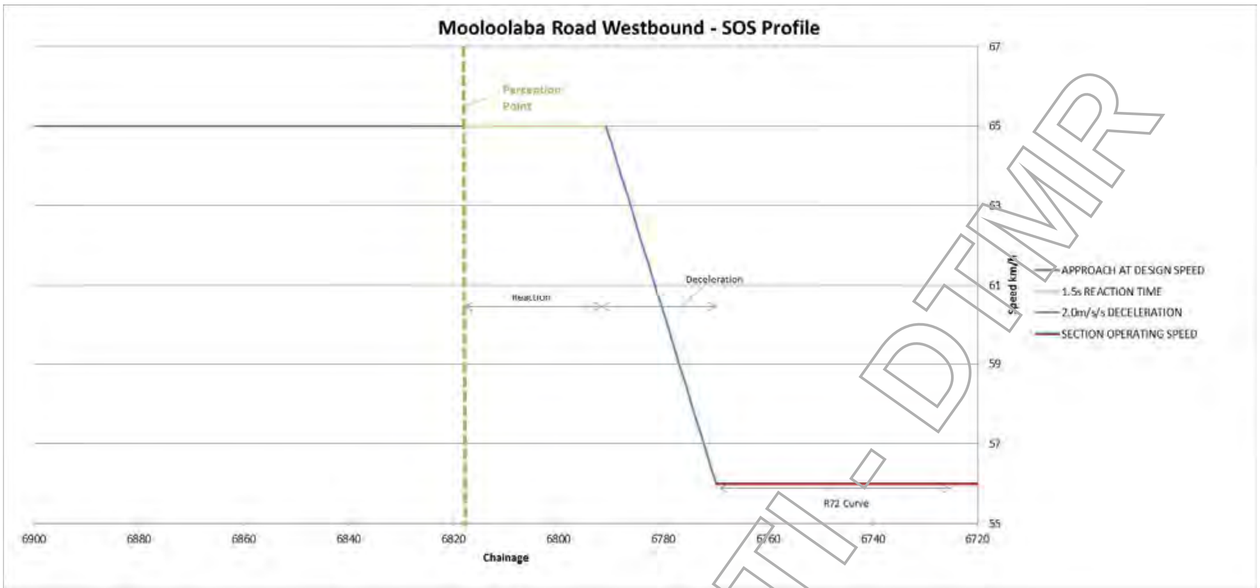

Figure 1 Mooloolaba Road Westbound – SOS Profile

Sighting the Arc

Figure 2 illustrates the achieved sight distance profile (projected to pavement level in the centre of the lane) throughout this section of road; this illustrates that there is 74m of sight distance available at the commencement of the reaction process (Ch6818). This indicates that the approaching driver is able to view 26m into the arc of the curve from the point of perception, therefore providing in excess of half the total length of the arc (45m).

In addition to being able to sight more than half of the pavement surface through the arc at the perception point, the curve is on 6% superelevation and is defined by median kerb. These factors will greatly aid motorists in being able to identify and appreciate the approaching geometry of the arc.

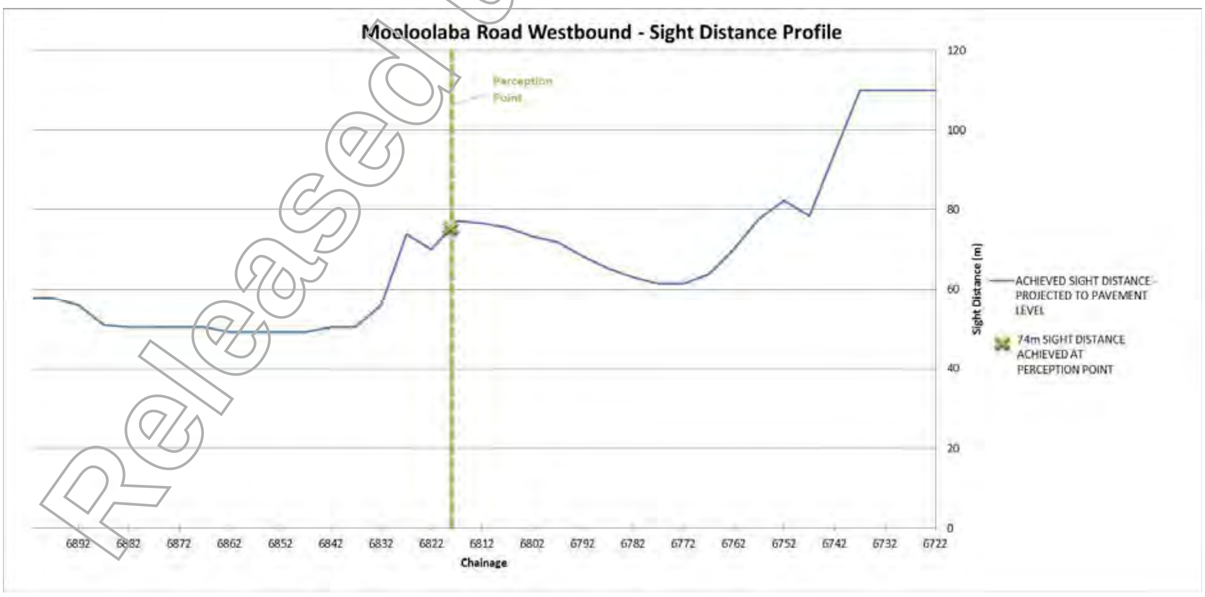

Figure 2 Mooloolaba Road Westbound - Sight Distance Profile

3.0 Contributing Factors

Whilst it is considered that there is adequate approach sight distance to the curve, the design team propose to improve the visual cues on the approach to the curve to increase awareness and perception of the curve; such features include:

- introducing a raised concrete median
- providing improved lighting
- installing curve advisory speed signs (50km/h)
- installation of reflective (frangible) bollards in the median to aid delineation (to be determined through further design development)
- potential introduction of Chevron Alignment Markers (to be determined through further design development)

4.0 Stopping Sight Distance

A Stopping Sight Distance (SSD) analysis was also undertaken for this approach and is based on a driver's eye height of 1.1m and an object height of 0.2m. The achieved SSD assumes the operating speed profile outlined in **Figure 1** and also accounts for grade correction. This graph indicates that the achieved SSD exceeds the requirements throughout the westbound approach to the curve. It is noted that a reaction time of 1.5s and a coefficient of deceleration of 0.41 has been adopted for the SSD analysis.

Figure 3 Mooloolaba Road Westbound – SSD

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5.0 Conclusion

This analysis has investigated the curve perception of the horizontal curve on the westbound approach of Mooloolaba Road at Ch6,740.

Based on the assumptions and parameters outlined in this document, there is sufficient sight distance to allow for a driver's perception of the approaching curve and deceleration from the design speed to the SOS of the curve. Furthermore there is also sufficient SSD on the westbound approach based on the SOS profile outlined in this document.

As a result it is recommended that the R72m curve be adopted in the detail design.

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Minutes of Meeting

Mooloolaba Road - Buderim Hill

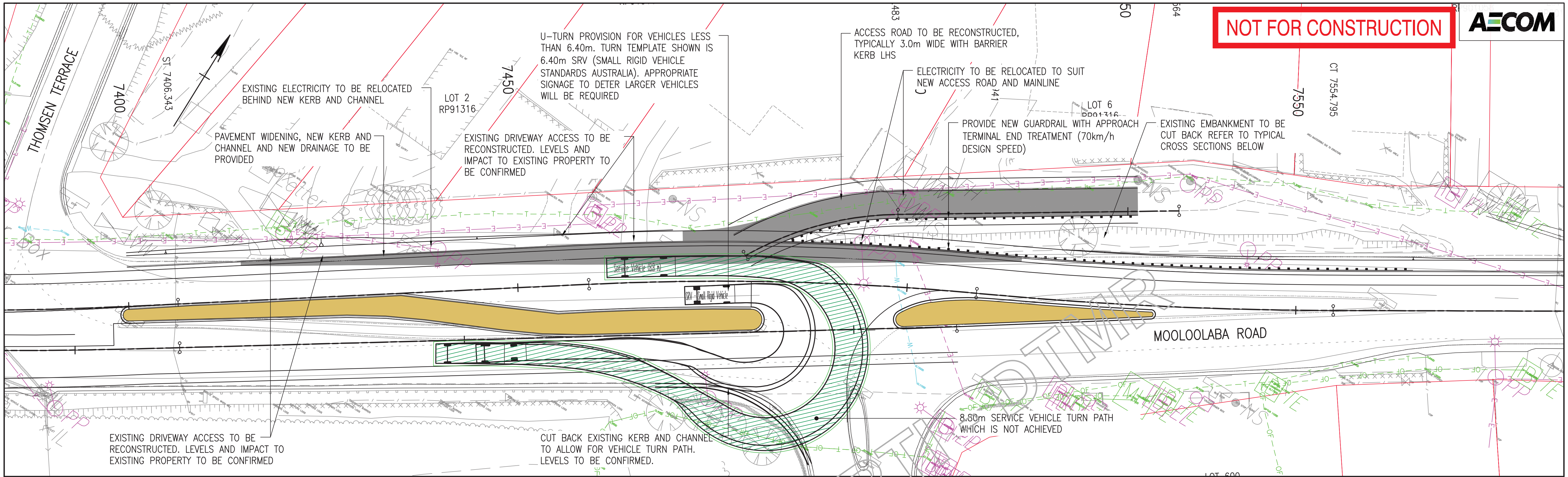
Subject	Foote Avenue Curve - Design Capability	Page	1
Venue	TMR Offices, Level 6, Boundary Street, Spring Hill	Time	11.30am
Participants	Ricky Cox (RC) (TMR) Mike Whitehead (MW) (TMR) Michael Bannah (MB) (AECOM) Matthew Gallagher (MG) (AECOM) Mark Westaway (MLW) (AECOM)		
Apologies			
File/Ref No.	60250500/MIN	Date	06-Sep-2012
Distribution	As above		

No	Item	Action	Date
1.0	**Introduction** AECOM outlined desire of meeting was to discuss the current options for the Foote Ave curve, their capability and intended drainage solutions in the area		
2.0	**Foote Avenue Curve** AECOM presented 2 option for the Foote Avenue Curve - Option 1 comprises R77 radius - Option 2 comprises R72 radius Option 1 has been amended since 30% Design Review issue to further reduce impact to wall. This has occurred through design development (reduction in median width through amended drainage solution, reduction in shoulder width and modifying spiral transition lengths through use of 0.035 radian superelevation transition) Option 1 now has approximately 35m impact to existing retaining wall on northern side Option 2 has no impact to existing retaining wall on northern side *(See attached spread sheet for Option capabilities)* **Documenting Curve Capability** Option 2 provides an approximate 20m length of SSD below 65km/h (desired speed) on the approach to the curve. RC suggested adopting the following methodology to document the capability of the curve for Option 2	NOTE	

No	Item	Action	Date
	1) Identify the point at which the curve can be perceived (Perception Point) for vehicles approaching the element at the desired speed (65km/h). This is defined as point at which the motorist has sufficient sight distance (from Eye to Pavement) to be able to appreciate the curve. This needs to consider preceding crest VC. 2) From Perception Point, calculate the distance available to react (Reaction Time) and Decelerate (at 2.5m/s/s) to 57km/h. It is desirable that this occurs before motorists enter the curve. This will create a speed profile leading into and through the curve 3) Based on the speed profile calculated in step 2, calculate the SSD required and test against SSD available *(Note – AECOM have since reviewed AustRoads Part 3, Section 5.10, Horizontal Curve Perception Sight Distance, and will ensure that the criteria described within this section are addressed)* MW questioned if the SSD achieved was below the SSD required for the speed profile, whether the curve should then be increased slightly and retested to ensure SSD was achieved. RC confirmed this was a suitable approach. AECOM are to test the curve capability and document using the above methodology RC and MW suggested possible further mitigation of the curve could be achieved through the installation of guide posts (preferably short and flexible base)	AECOM	
3.0	**Drainage** AECOM outlined recent discussions with ACO regarding use of ACO products. Further review of 30% design has identified possibly locations where use of lengths of ACO drain may be required. AECOM presented ACO information regarding use of transverse drain on Mountain Creek Road MW noted Ross Pritchard is likely to define performance based specifications for these products instead of identifying a specific manufacturer product MW suggested possibility of raising crown of Foote Avenue to better channel water towards existing kerb and channel, potentially negating the need for a transverse cutoff drain. AECOM to investigate	AECOM	

Appendix B

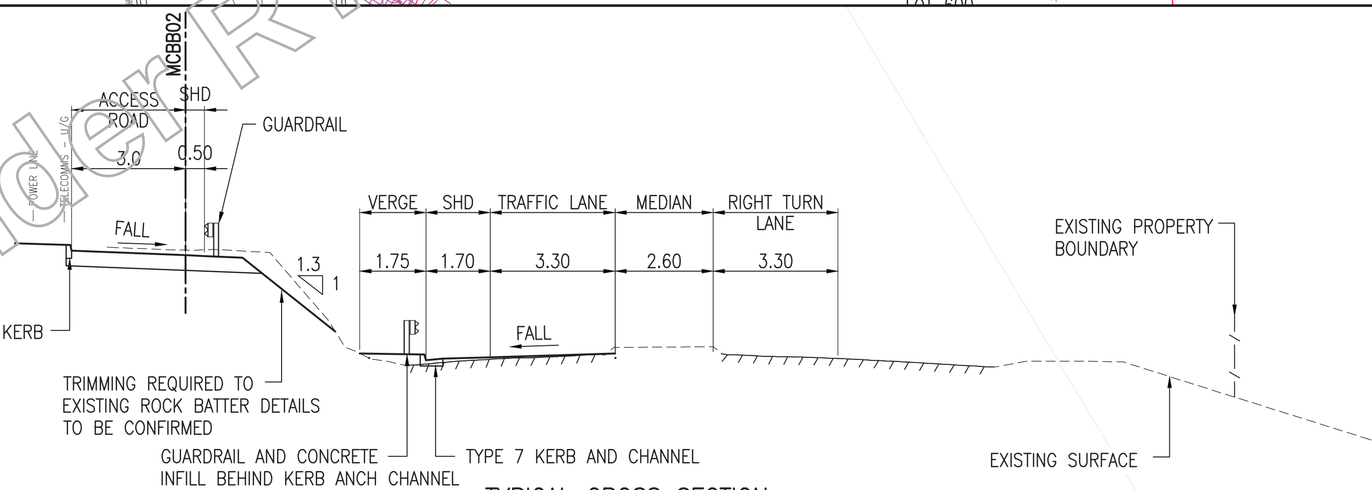
Intersection Swept Path Sketches



NOTES:

1. THIS IS A CONCPET DESIGN WHICH WILL REQUIRE FURTHER REFINEMENT TO CONFIRM LEVELS, STOPPING SIGHT DISTANCES AND IMPACTS TO EXISTING DRIVEWAY ACCESSES.

2. PROVISION FOR TRAFFIC SIGNALS TO BE CONSIDERED AT UPGRADED INTERSECTION.



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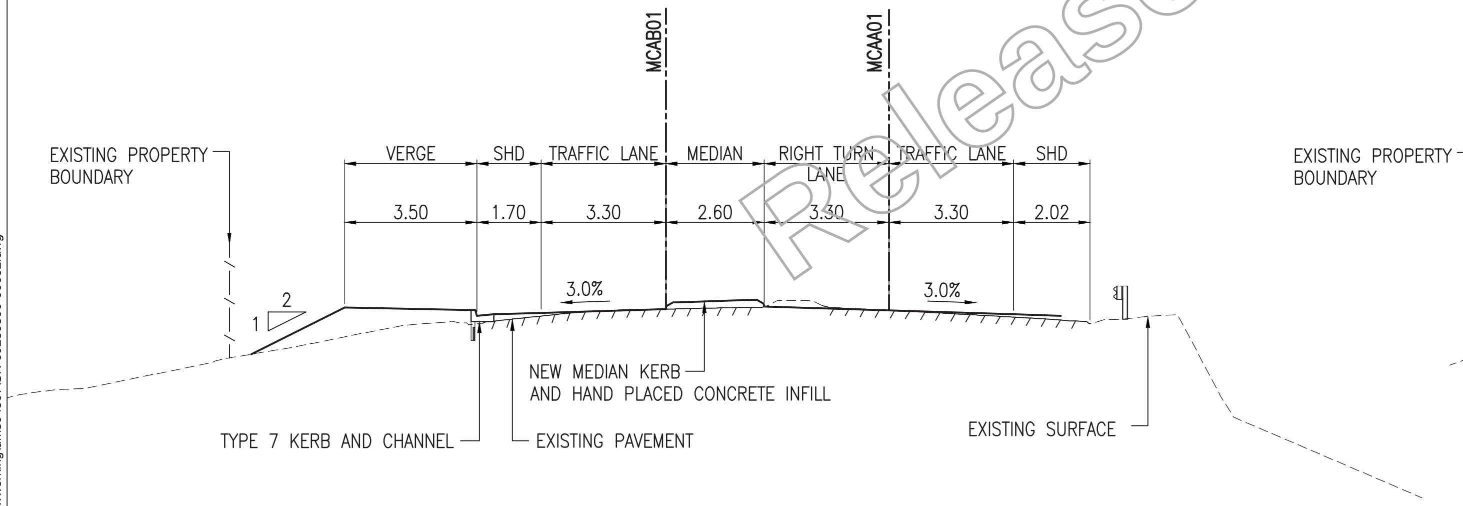
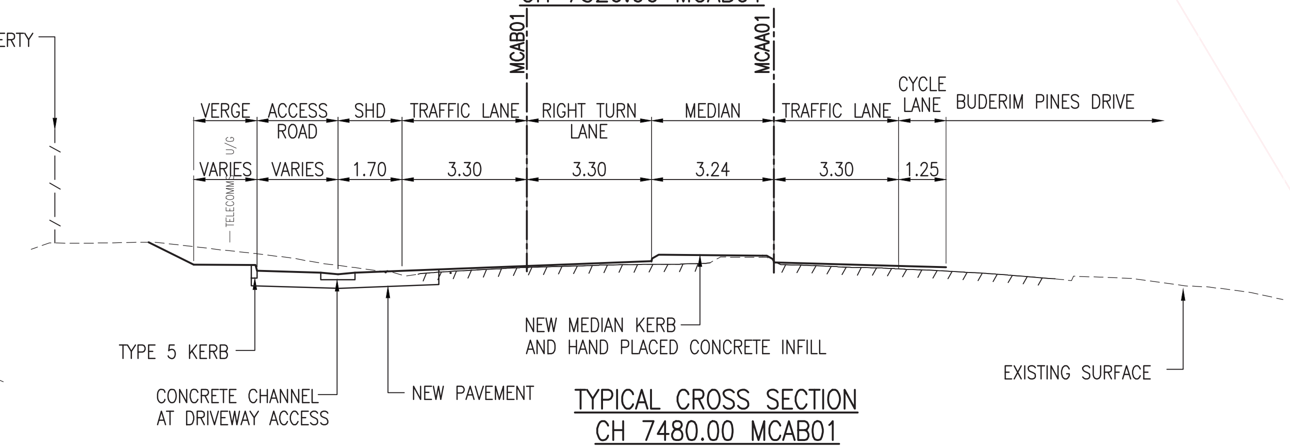
CH 7520.00 MCAB01



TYPICAL CROSS SECTION
CH 7420.00 MCAB01



TYPICAL CROSS SECTION
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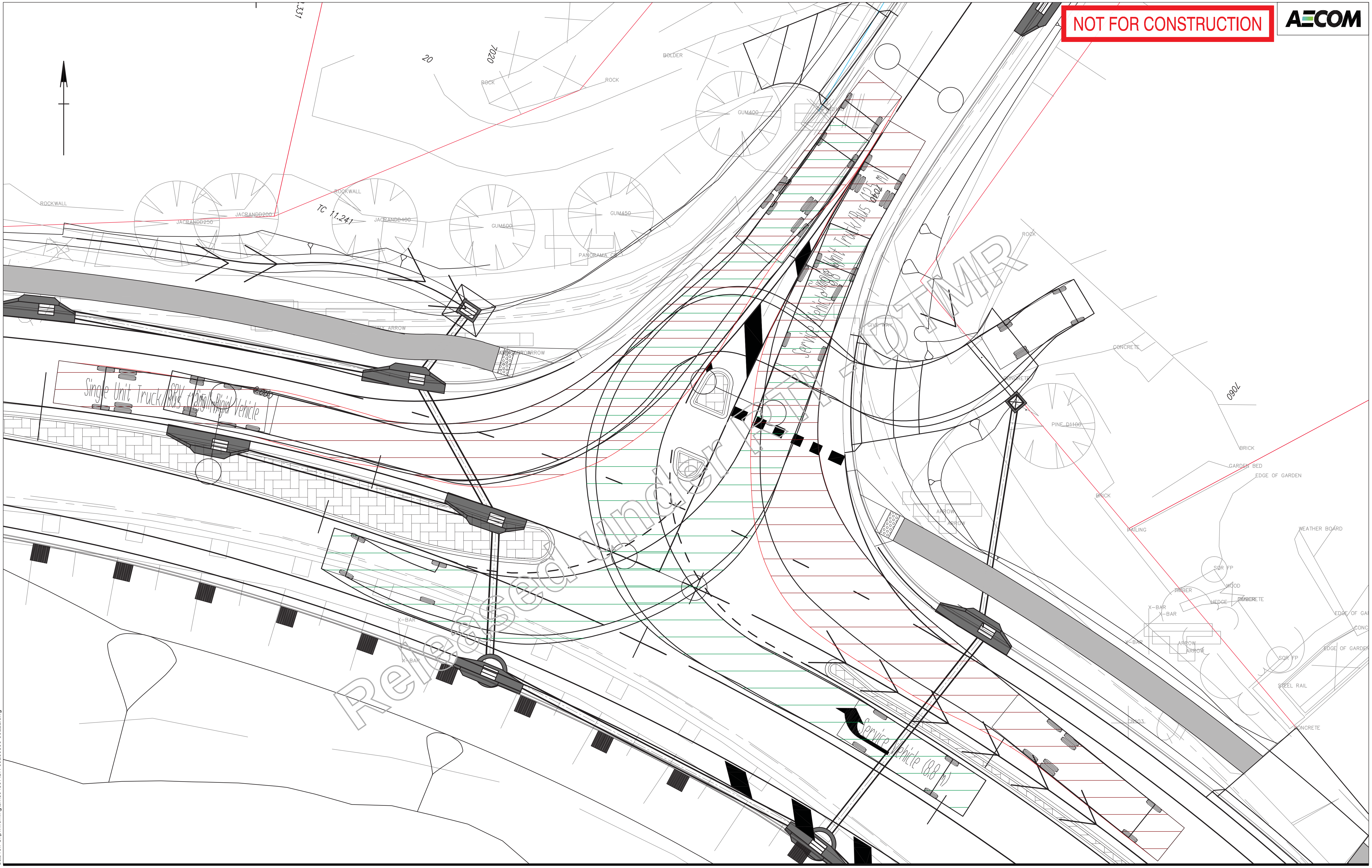
0 2 4 6 8 10m

MOOLOOLABA ROAD - BUDERIM
PROPOSED U-TURN AT BUDERIM PINES DRIVE

SK-60250500-00062



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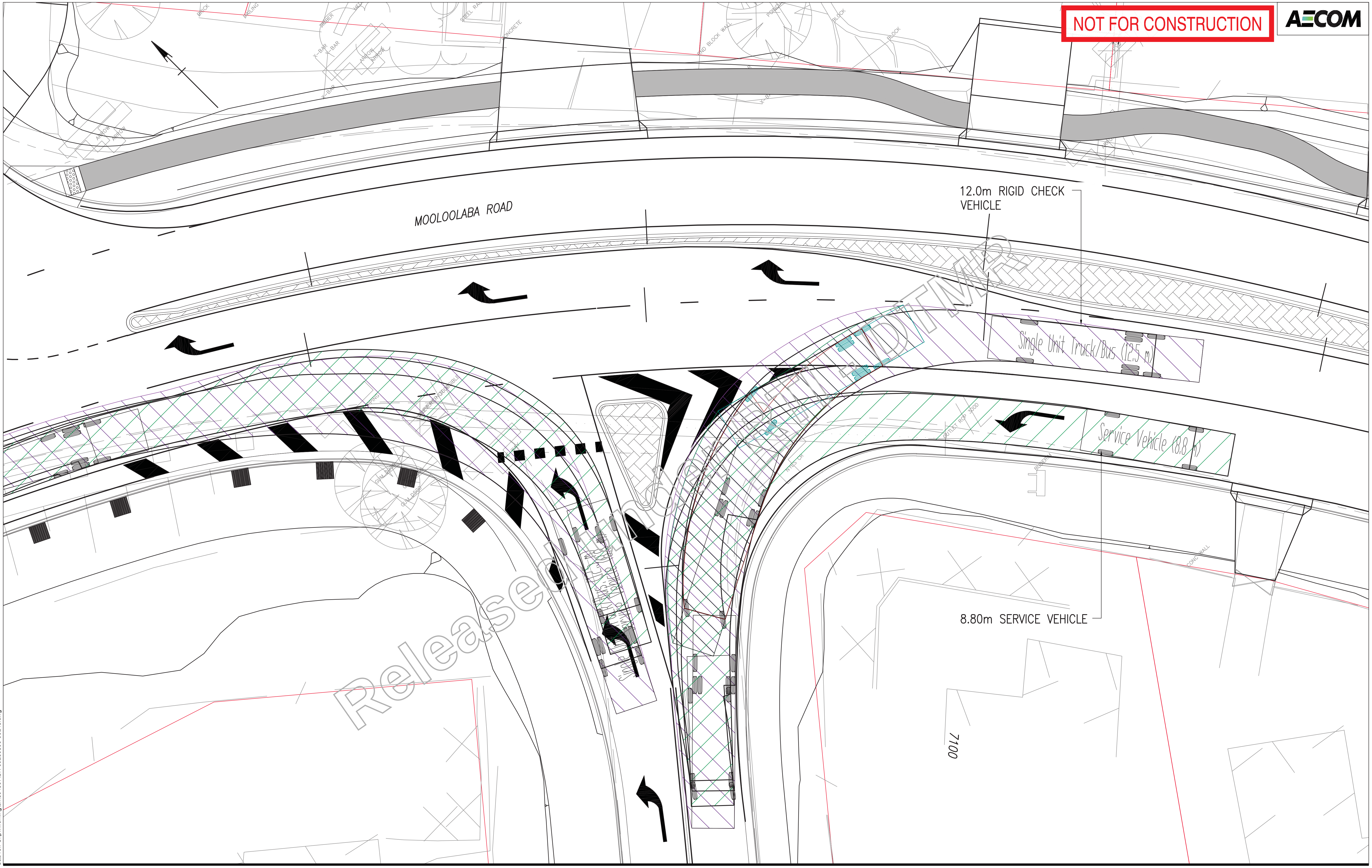
PANORAMA CRESCENT INTERSECTION
PROVISION FOR PEDESTRIAN REFUGE

SK-60250500-00121



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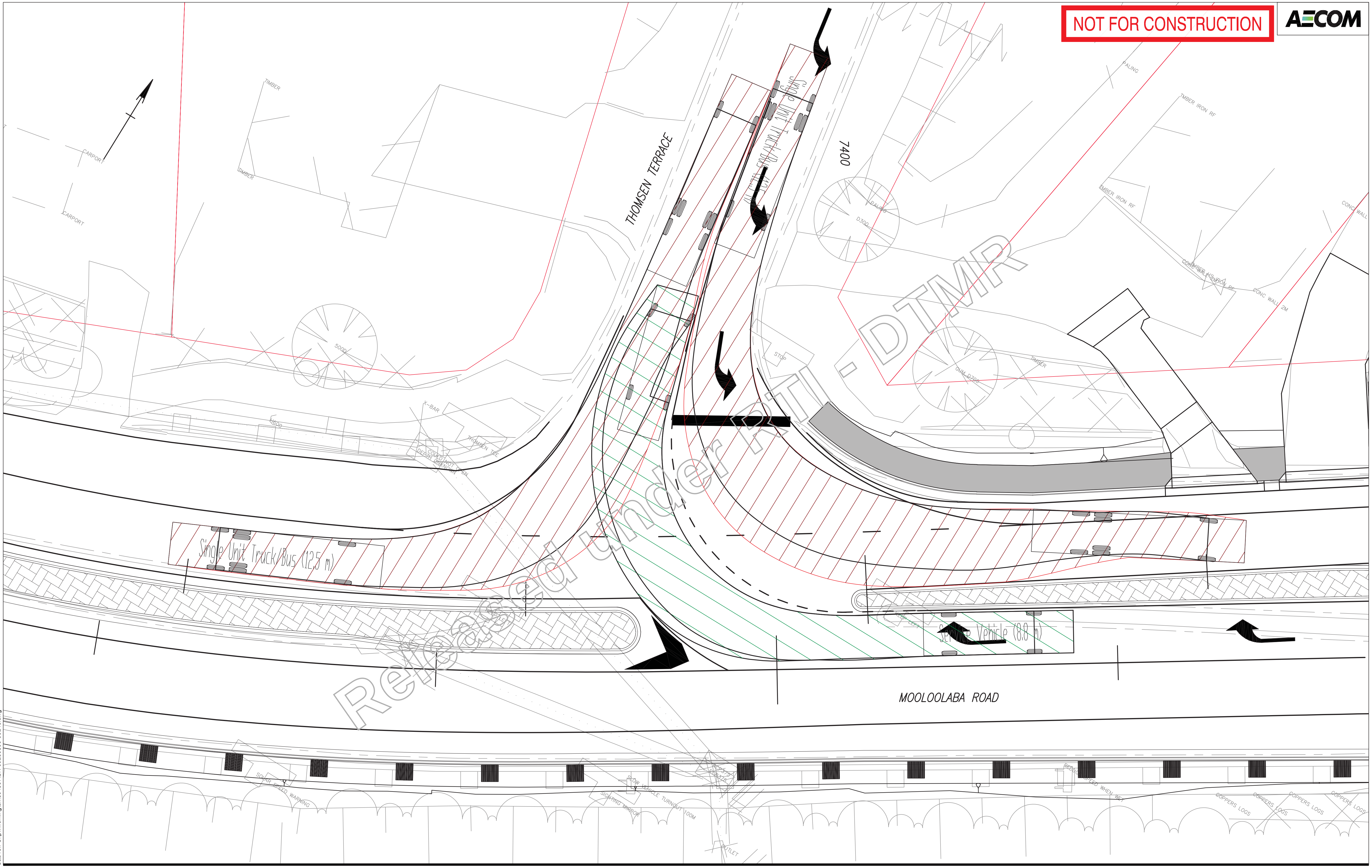
MOOLOOLABA ROAD - BUDERIM
NYES CRESCENT VEHICLE TURNPATHS

SK-60250500-00145



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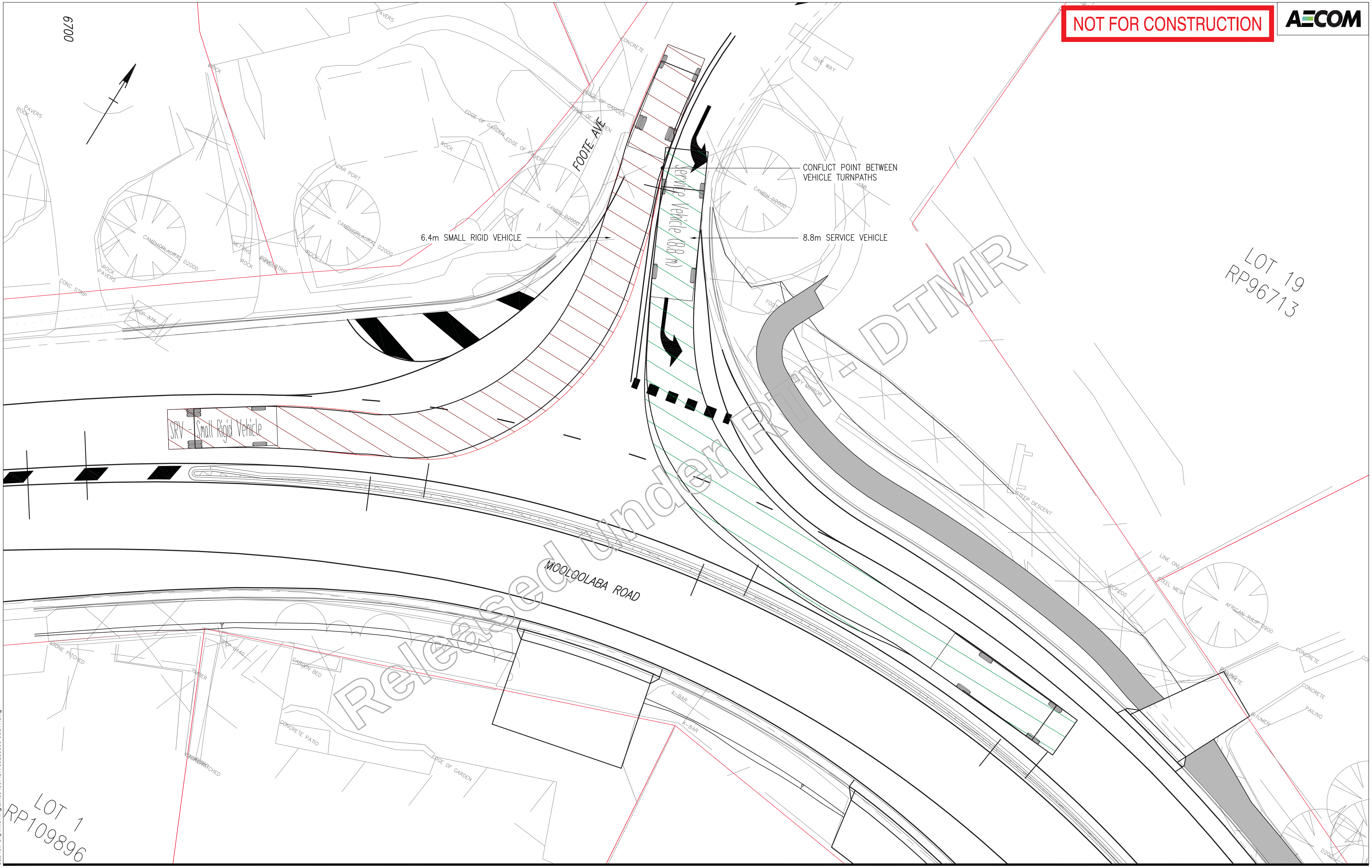
60250500
A

0 1 2 3 4m

MOOLOOLABA ROAD - BUDERIM
THOMSEN TERRACE VEHICLE TURNPATHS

SK-60250500-00146



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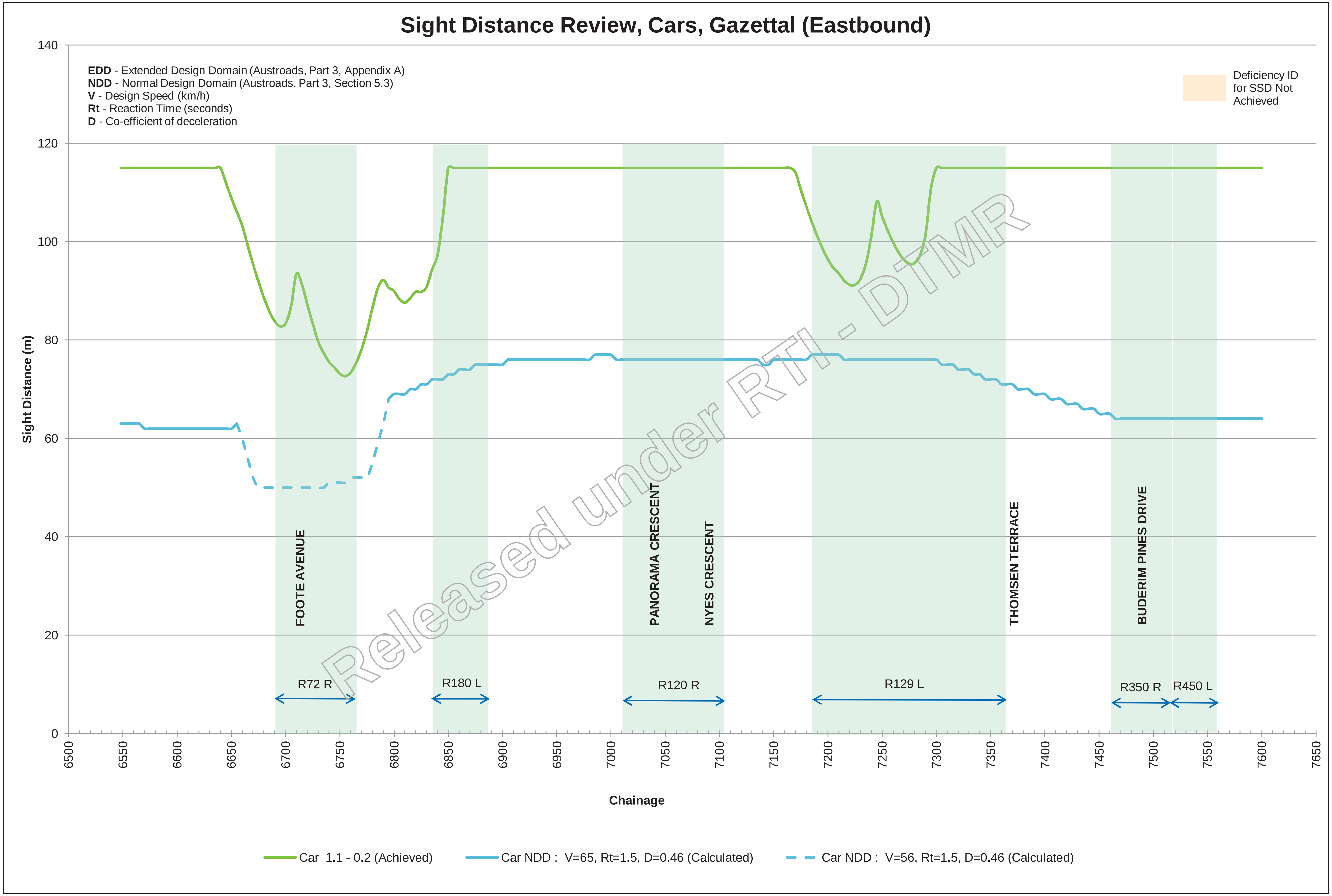
MOOLOOLABA ROAD - BUDERIM
FOOTE AVE VEHICLE TURNPATHS

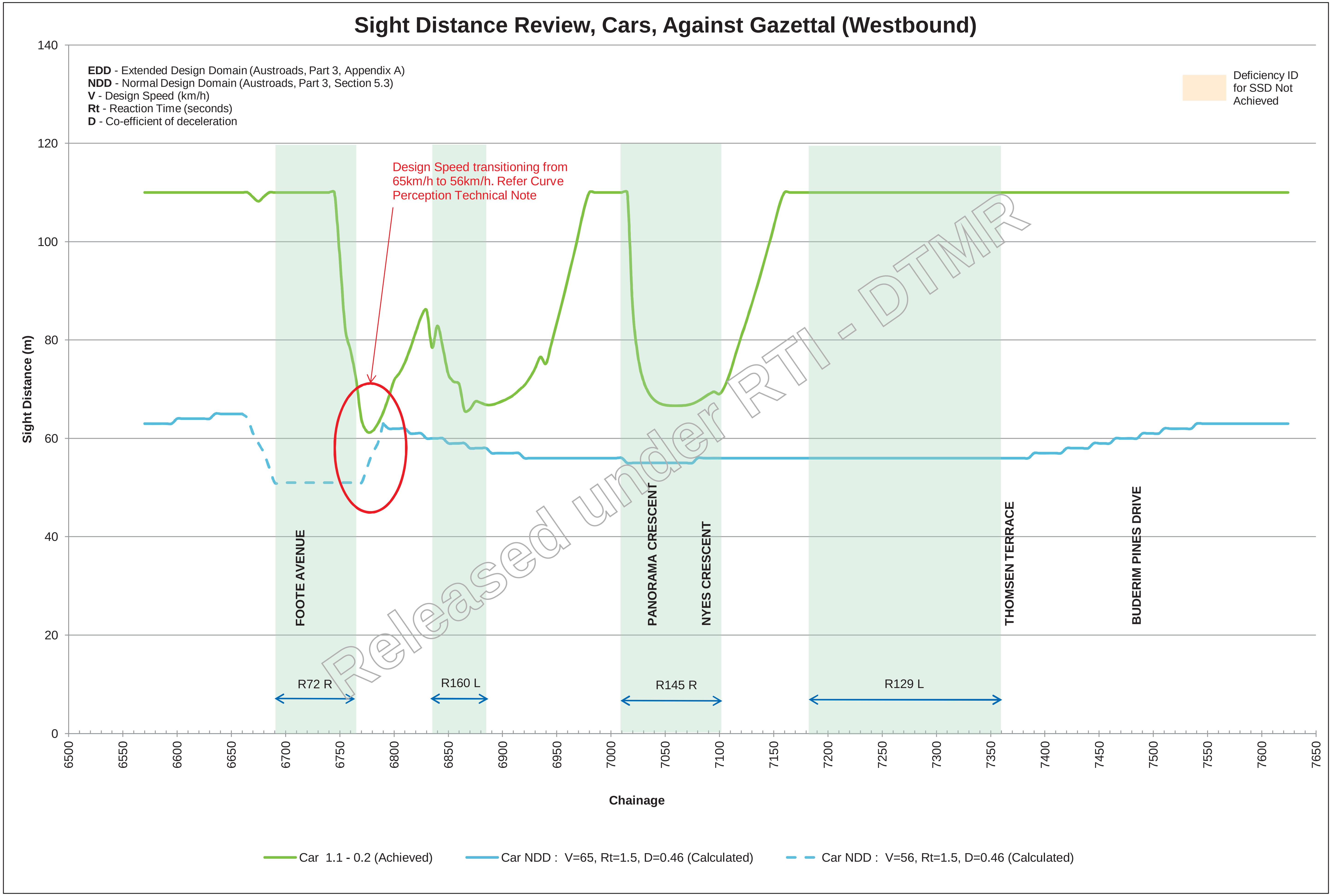
SK-60250500-00147

Appendix C

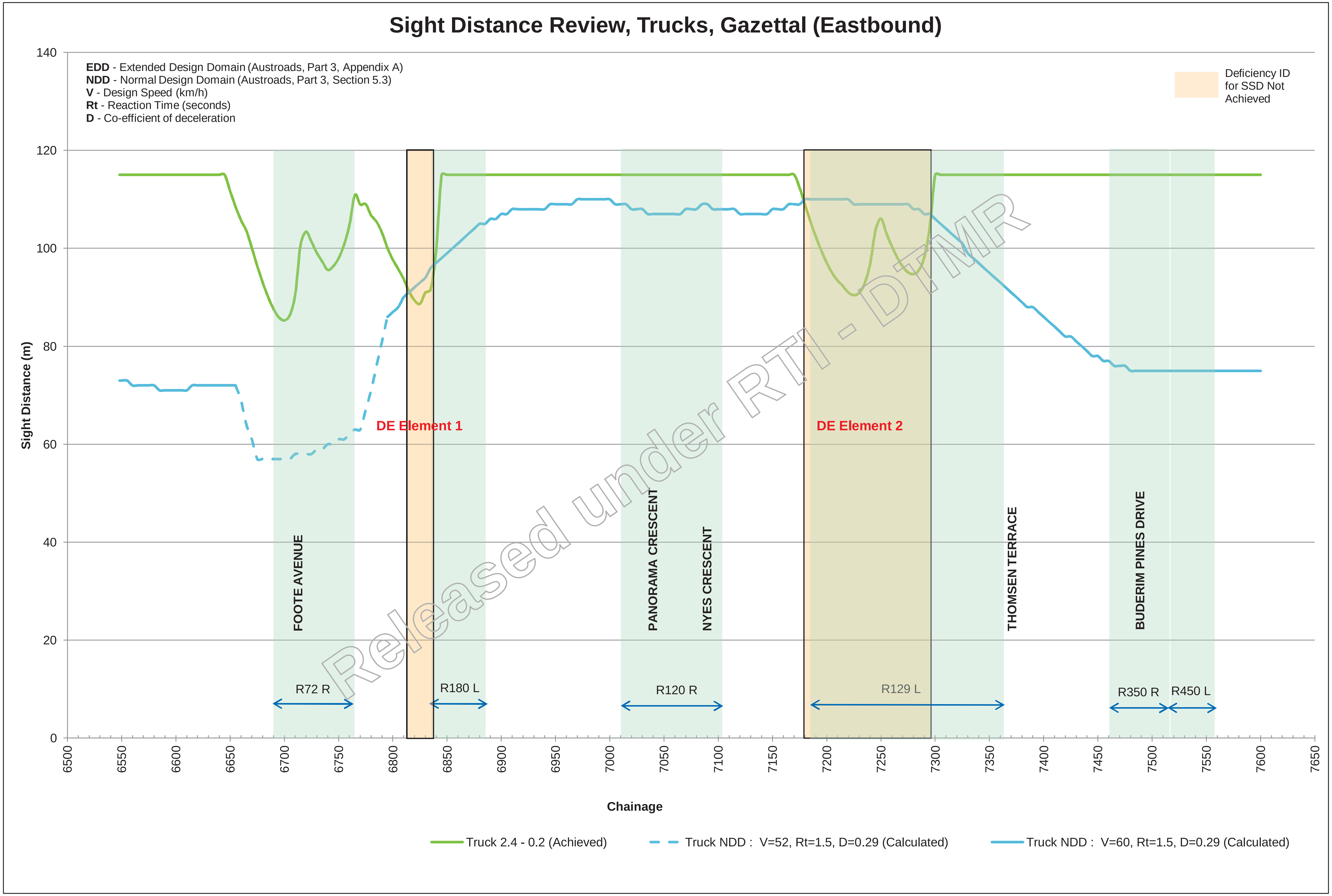
Sight Distance Graphs

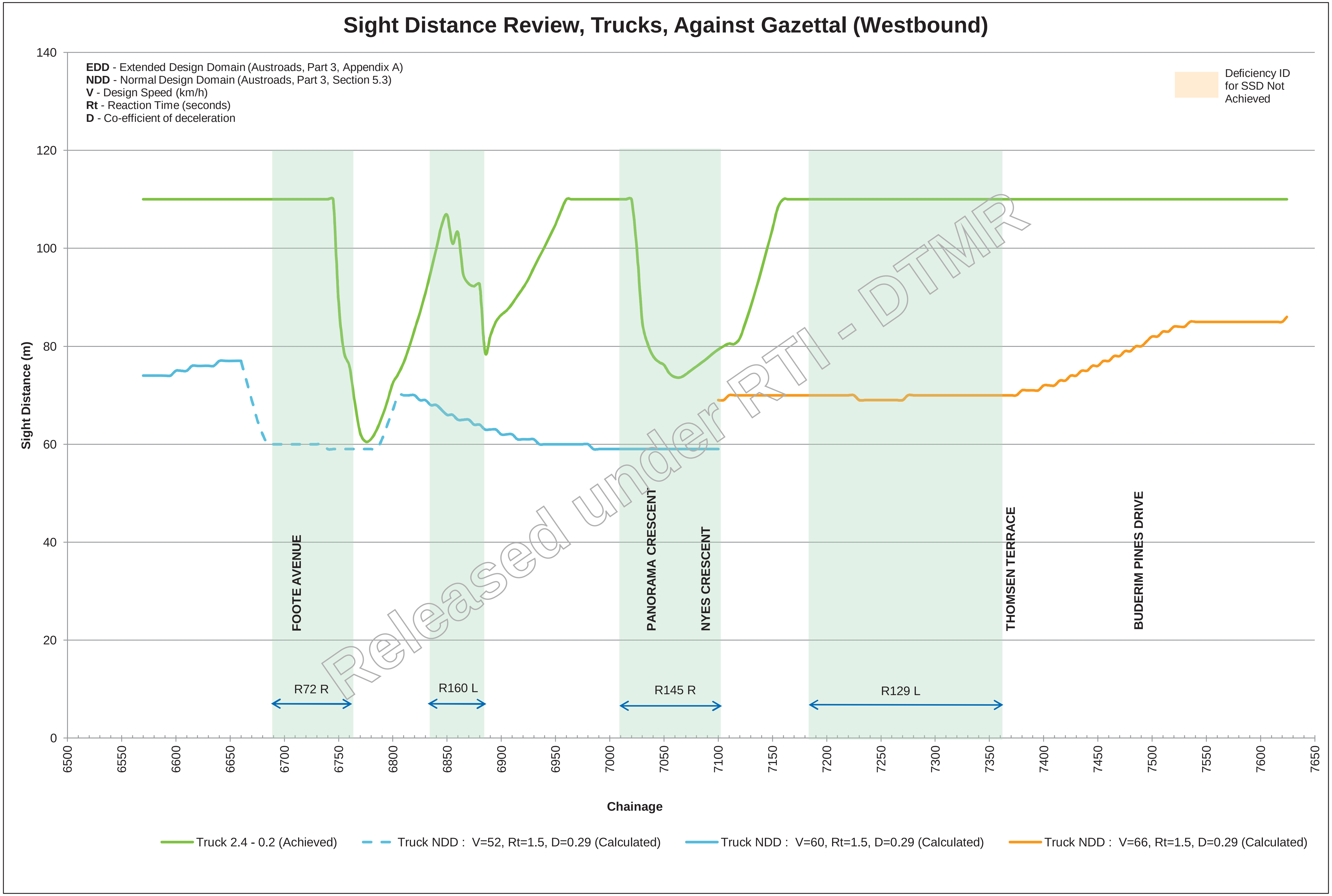


Sight Distance Review, Cars, Gazettal (Eastbound)
EDD - Extended Design Domain (Austroads, Part 3, Appendix A)
NDD - Normal Design Domain (Austroads, Part 3, Section 5.3)
V - Design Speed (km/h)
Rt - Reaction Time (seconds)
D - Co-efficient of deceleration
Deficiency ID for SSD Not Achieved
Sight Distance (m)
Chainage
FOOTE AVENUE
PANORAMA CRESCENT
NYES CRESCENT
THOMSEN TERRACE
BUDERIM PINES DRIVE
R72 R
R180 L
R120 R
R129 L
R350 R
R450 L
Car 1.1 - 0.2 (Achieved)
Car NDD : V=65, Rt=1.5, D=0.46 (Calculated)
Car NDD : V=56, Rt=1.5, D=0.46 (Calculated)



Sight Distance Review, Cars, Against Gazettal (Westbound)
EDD - Extended Design Domain (Austroads, Part 3, Appendix A)
NDD - Normal Design Domain (Austroads, Part 3, Section 5.3)
V - Design Speed (km/h)
Rt - Reaction Time (seconds)
D - Co-efficient of deceleration
Deficiency ID for SSD Not Achieved
Design Speed transitioning from 65km/h to 56km/h. Refer Curve Perception Technical Note
FOOTE AVENUE
PANORAMA CRESCENT
NYES CRESCENT
THOMSEN TERRACE
BUDERIM PINES DRIVE
R72 R
R160 L
R145 R
R129 L
Sight Distance (m)
Chainage
0
20
40
60
80
100
120
140
6500
6550
6600
6650
6700
6750
6800
6850
6900
6950
7000
7050
7100
7150
7200
7250
7300
7350
7400
7450
7500
7550
7600
7650
Car 1.1 - 0.2 (Achieved)
Car NDD : V=65, Rt=1.5, D=0.46 (Calculated)
Car NDD : V=56, Rt=1.5, D=0.46 (Calculated)


Sight Distance Review, Trucks, Gazettal (Eastbound)
EDD - Extended Design Domain (Austroads, Part 3, Appendix A)
NDD - Normal Design Domain (Austroads, Part 3, Section 5.3)
V - Design Speed (km/h)
Rt - Reaction Time (seconds)
D - Co-efficient of deceleration
Deficiency ID for SSD Not Achieved
Sight Distance (m)
Chainage
DE Element 1
DE Element 2
FOOTE AVENUE
PANORAMA CRESCENT
NYES CRESCENT
THOMSEN TERRACE
BUDERIM PINES DRIVE
R72 R
R180 L
R120 R
R129 L
R350 R
R450 L
Truck 2.4 - 0.2 (Achieved)
Truck NDD : V=52, Rt=1.5, D=0.29 (Calculated)
Truck NDD : V=60, Rt=1.5, D=0.29 (Calculated)

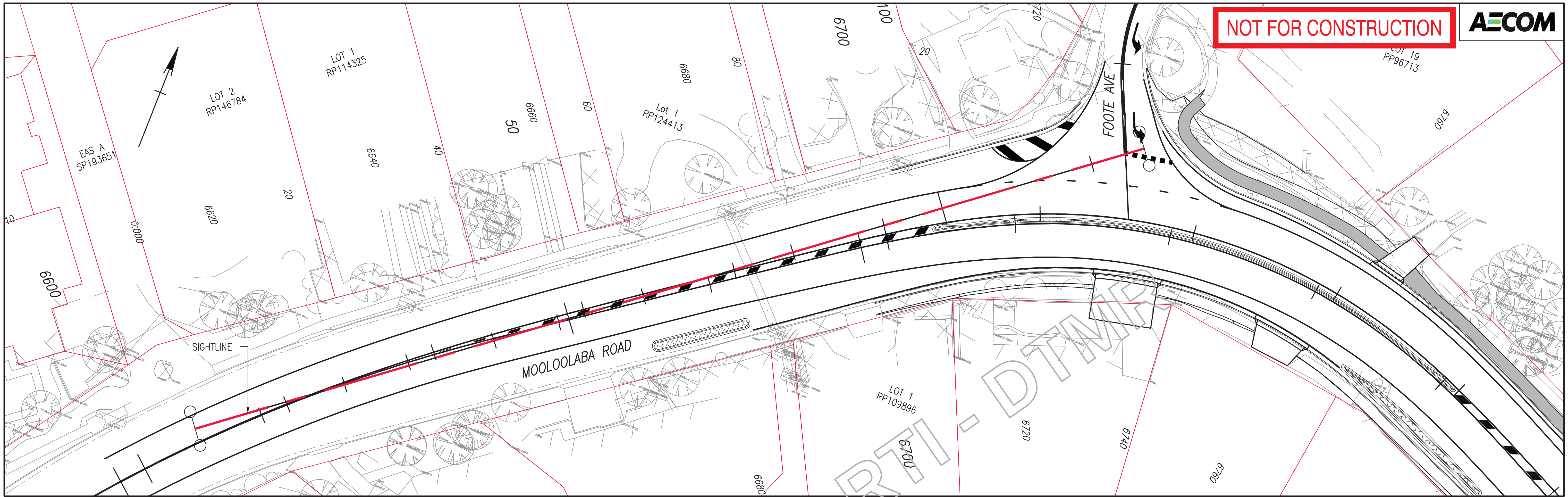


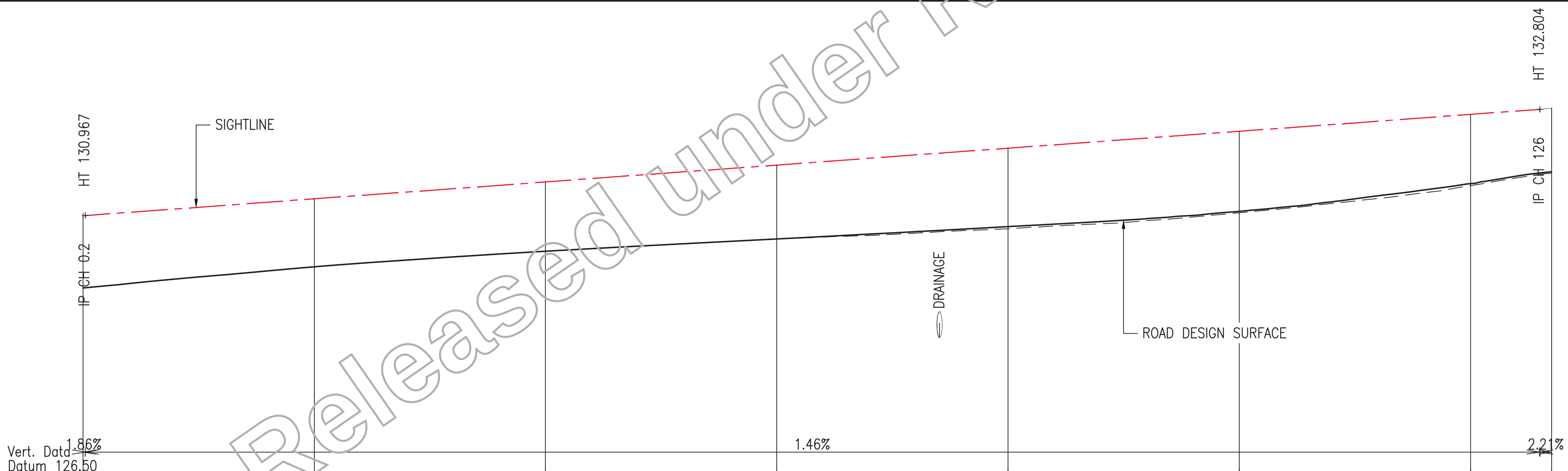
Sight Distance Review, Trucks, Against Gazettal (Westbound)
EDD - Extended Design Domain (Austroads, Part 3, Appendix A)
NDD - Normal Design Domain (Austroads, Part 3, Section 5.3)
V - Design Speed (km/h)
Rt - Reaction Time (seconds)
D - Co-efficient of deceleration
Deficiency ID for SSD Not Achieved
Sight Distance (m)
Chainage
FOOTE AVENUE
PANORAMA CRESCENT
NYES CRESCENT
THOMSEN TERRACE
BUDERIM PINES DRIVE
R72 R
R160 L
R145 R
R129 L
Truck 2.4 - 0.2 (Achieved)
Truck NDD : V=52, Rt=1.5, D=0.29 (Calculated)
Truck NDD : V=60, Rt=1.5, D=0.29 (Calculated)
Truck NDD : V=66, Rt=1.5, D=0.29 (Calculated)
Released under RTI - DTMR

Appendix D

Intersection Sight Distance Sketches

AECOM





Design Height	130.963	131.256	131.548	131.840	132.132	132.424	132.717	132.826
Natural Surface	129.715	130.081	130.349	130.559	130.739	131.015	131.485	131.704
Chainage	0	20	40	60	80	100	120	127.008
Road Design	129.713	130.079	130.348	130.561	130.776	131.038	131.519	131.726
Depth	−1.250	−1.177	−1.200	−1.279	−1.357	−1.387	−1.198	−1.100

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60250500
A

0 2 4 6 8 10m
0 1.0 2.0m

MOOLOOLABA ROAD - BUDERIM
VISIBILITY CHECKS

SK-60250500-00141

Last modified: 21 Feb 13 - 15:59
Cad ref: C:\pwworking\dms04597\SK-60250500-00142.dwg

60250500
A

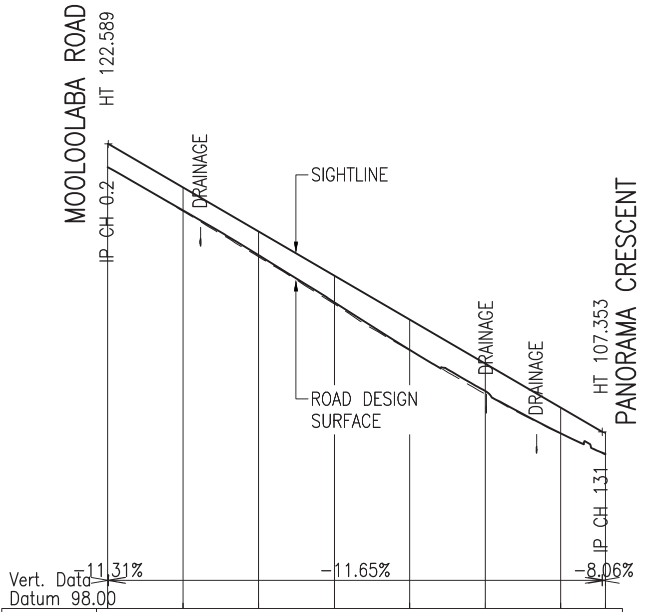
0 2 4 6 8 10m

MOOLOOLABA ROAD - BUDERIM
VISIBILITY CHECKS

SK-60250500-00142

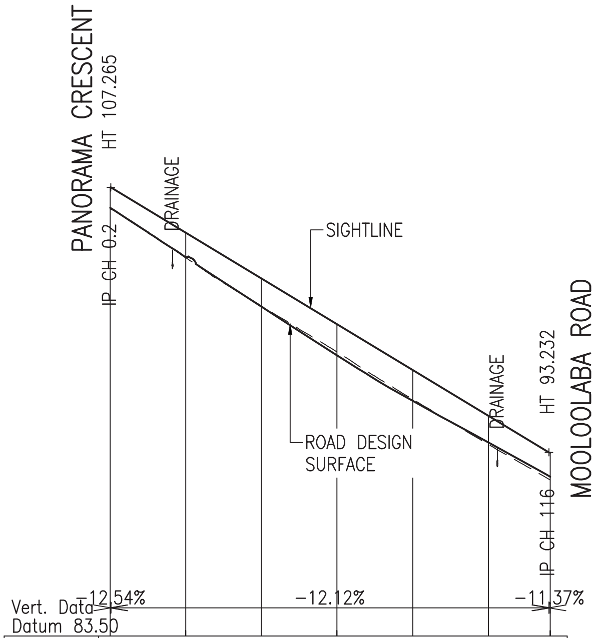
NOT FOR CONSTRUCTION

AECOM



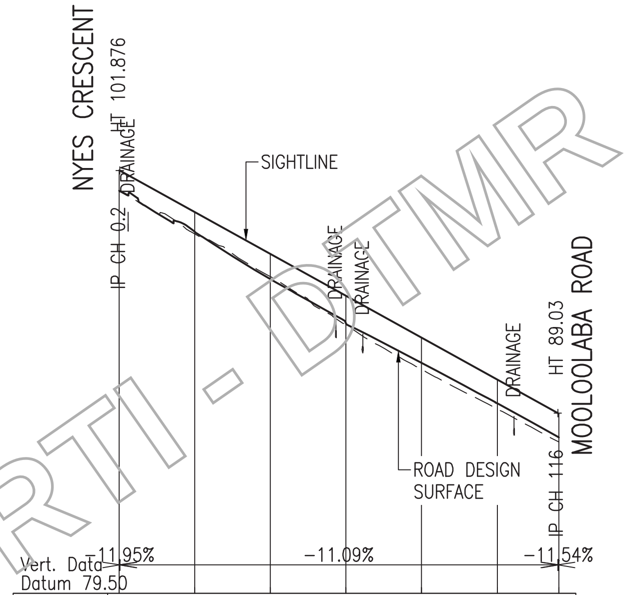
Pvt. Mkg.								
Type (TC)								
Design Height	122.611	120.282	117.953	115.623	113.293	110.964	108.634	107.290
Natural Surface	121.364	119.017	116.611	114.126	111.667	109.346	107.249	106.130
Chainage	*0*	*20*	*40*	*60*	*80*	*100*	*120*	*131.784*
Road Design	121.361	119.071	116.702	114.221	111.693	109.510	107.271	106.190
Depth	−1.250	−1.212	−1.251	−1.403	−1.601	−1.454	−1.364	−1.100

MVA22 – MOOLOOLABA ROAD EASTBOUND



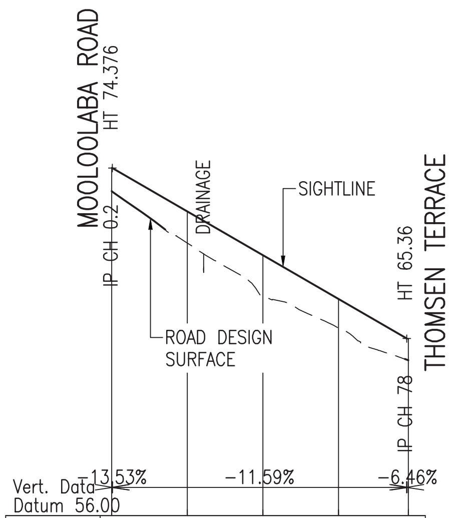
Design Height	107.290	104.865	102.442	100.018	97.595	95.171	93.196
Natural Surface	106.130	103.544	100.985	98.545	96.040	93.654	91.771
Chainage	*0*	*20*	*40*	*60*	*80*	*100*	*116.319*
Road Design	106.190	103.555	100.947	98.369	95.955	93.756	91.946
Depth	−1.100	−1.310	−1.495	−1.649	−1.639	−1.415	−1.250

MCAD02 – MOOLOOLABA ROAD WESTBOUND



Design Height	101.900	99.680	97.461	95.242	93.023	90.805	88.999
Natural Surface	100.791	98.525	96.256	93.688	91.344	89.263	87.503
Chainage	*0*	*20*	*40*	*60*	*80*	*100*	*116.265*
Road Design	100.800	98.629	96.137	93.752	91.695	89.550	87.749
Depth	−1.100	−1.051	−1.324	−1.490	−1.328	−1.255	−1.250

MCAC01 – MOOLOOLABA ROAD WESTBOUND



Design Height	74.403	72.081	69.764	67.446	65.331
Natural Surface	73.138	70.409	67.607	65.924	64.231
Chainage	*0*	*20*	*40*	*60*	*78.448*
Road Design	73.153				64.219
Depth	−1.250				−1.112

MCAC06 – MOOLOOLABA ROAD EASTBOUND

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0 10 20 30 40m
0 2 4 6 8m

MOOLOOLABA ROAD - BUDERIM
VISIBILITY CHECKS - PANORAMA, NYES CRESCENT AND THOMSEN TERRACE
LONGITUDINAL SECTIONS
SK-60250500-00143

Last modified: 21 Feb 13 - 14:43
Cad ref: C:\pwworking\dms04597\SK-60250500-00144.dwg

AECOM

60250500
A

0 2 4 6 8 10m

MOOLOOLABA ROAD - BUDERIM
VISIBILITY CHECKS - THOMSEN TERRACE

SK-60250500-00144

Appendix E

Water Flow Depths

Appendix E Water Flow Depths

Figure D-1 Chainage 6790

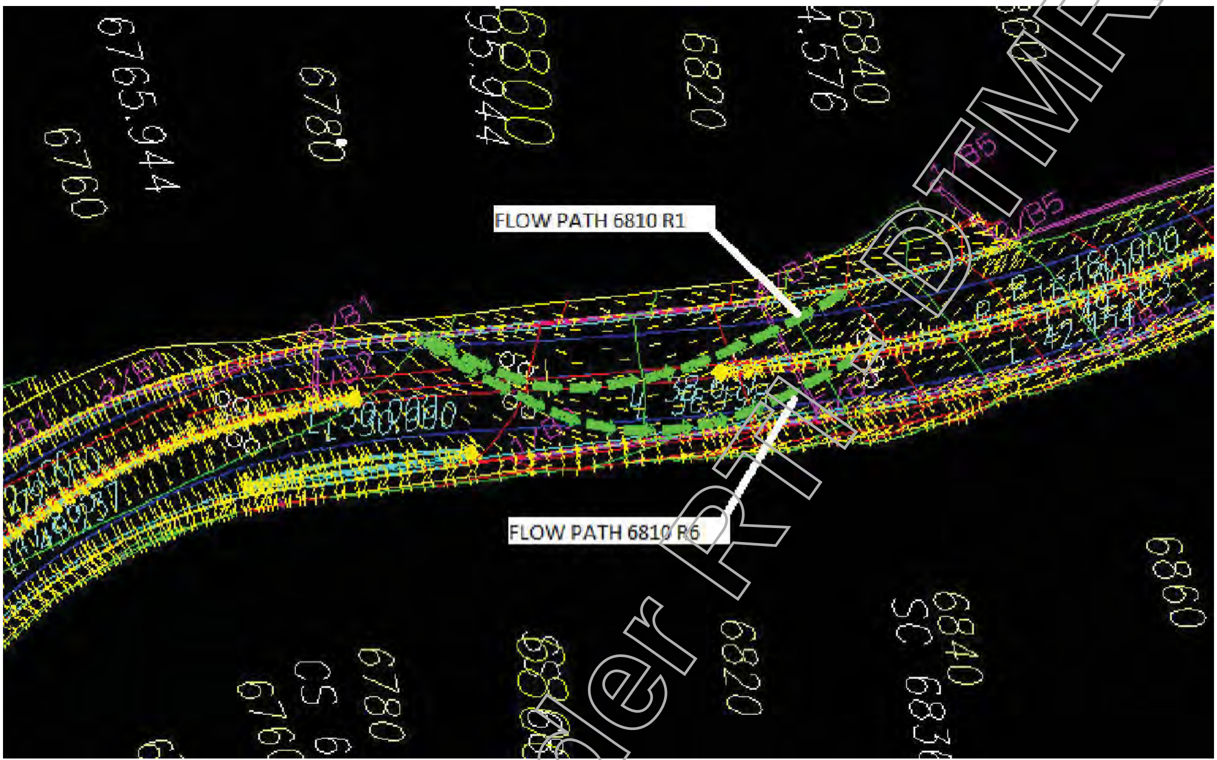
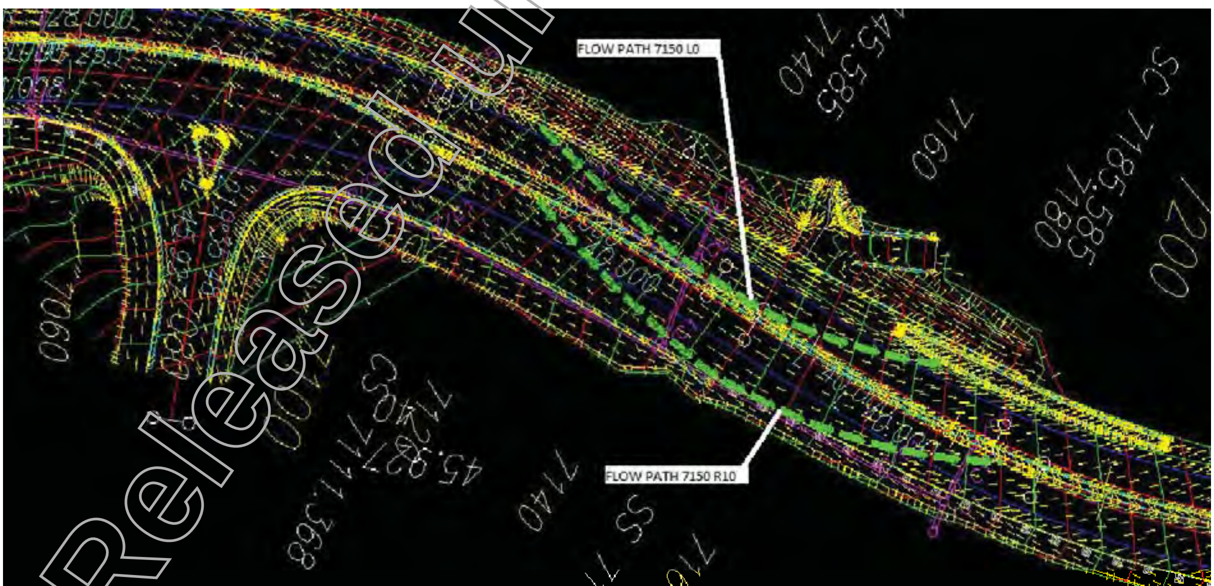


Figure D-2 Chainage 7120



AECOM ASSESSMENT OF AQUAPLANING POTENTIAL

12D MODEL VERSION 9.0C2d

12D PROJECT:	60250500 1000 RD
PROJECT DESCRIPTION:	Mooloolaba Road Buderim - 0000
DATE:	'06-DEC-2012 08:11:58
ASSESSOR:	BANNAHM
VERIFIER:	
MODEL OF FLOW PATHS:	FLOW PATH
ROAD PAVEMENT TIN:	DESIGN 1000
REFERENCE STRING:	CONTROL 1000->MCA1
RAINFALL INTENSITY (mm/hr):	50
PAVEMENT TEXTURE DEPTH (mm)	0.4
FLOW PATH SLOPE:	EQUAL-AREA SLOPE

WATER FILM DEPTH RISKS		
UNACCEPTABLE RISK >=	4.0	mm
HIGH (ACCEPTABLE) RISK >=	3.2	mm
MODERATE (ACCEPTABLE) RISK >=	2.5	mm
LOW (DESIRABLE) RISK: <	2.5	mm

WATER FILM DEPTH PREDICTION

FLOW PATH ID	POINT	LENGTH (m)	DESIGN RL (m)	SLOPE (%)	DEPTH (mm)	DEPTH RISK	DEPTH RATE (mm/m)	WARNING
6810 R6	1	4.943	130.792	4.39	0.60	LOW	0.12	
6810 R6	2	9.885	130.601	3.97	1.01	LOW	0.10	
6810 R6	3	14.828	130.420	3.81	1.30	LOW	0.09	
6810 R6	4	19.771	130.233	3.79	1.53	LOW	0.08	
6810 R6	5	24.714	130.053	3.75	1.74	LOW	0.07	
6810 R6	6	29.656	129.861	3.79	1.90	LOW	0.06	
6810 R6	7	34.599	129.648	3.93	2.02	LOW	0.06	
6810 R6	8	39.542	129.403	4.17	2.10	LOW	0.05	
6810 R6	9	44.485	129.123	4.49	2.15	LOW	0.05	
6810 R6	10	49.427	128.800	4.88	2.18	LOW	0.04	
6810 R1	1	4.752	130.756	4.47	0.58	LOW	0.12	
6810 R1	2	9.505	130.568	4.10	0.96	LOW	0.10	
6810 R1	3	14.257	130.393	3.87	1.26	LOW	0.09	
6810 R1	4	19.010	130.204	3.92	1.47	LOW	0.08	
6810 R1	5	23.762	129.996	4.09	1.62	LOW	0.07	
6810 R1	6	28.515	129.767	4.32	1.74	LOW	0.06	
6810 R1	7	33.267	129.506	4.63	1.82	LOW	0.05	
6810 R1	8	38.019	129.208	5.02	1.87	LOW	0.05	
6810 R1	9	42.772	128.877	5.42	1.91	LOW	0.04	
6810 R1	10	47.524	128.491	5.94	1.93	LOW	0.04	
7150 L0	1	6.016	96.119	12.98	0.29	LOW	0.05	
7150 L0	2	12.032	95.352	12.80	0.54	LOW	0.04	
7150 L0	3	18.048	94.607	12.56	0.72	LOW	0.04	
7150 L0	4	24.064	93.876	12.38	0.88	LOW	0.04	
7150 L0	5	30.080	93.157	12.22	1.01	LOW	0.03	
7150 L0	6	36.096	92.446	12.10	1.14	LOW	0.03	
7150 L0	7	42.112	91.729	12.05	1.24	LOW	0.03	
7150 L0	8	48.129	91.000	12.07	1.34	LOW	0.03	
7150 L0	9	54.145	90.249	12.16	1.42	LOW	0.03	
7150 L0	10	60.161	89.460	12.34	1.50	LOW	0.02	*** LENGTH > 60.0 m
7150 R10	1	6.837	95.245	12.34	0.34	LOW	0.05	
7150 R10	2	13.673	94.430	12.01	0.61	LOW	0.04	
7150 R10	3	20.510	93.649	11.69	0.82	LOW	0.04	
7150 R10	4	27.347	92.899	11.36	1.00	LOW	0.04	
7150 R10	5	34.183	92.176	11.08	1.16	LOW	0.03	
7150 R10	6	41.020	91.469	10.86	1.30	LOW	0.03	
7150 R10	7	47.856	90.764	10.71	1.43	LOW	0.03	
7150 R10	8	54.693	90.047	10.66	1.54	LOW	0.03	
7150 R10	9	61.530	89.301	10.71	1.63	LOW	0.03	*** LENGTH > 60.0 m
7150 R10	10	68.366	88.501	10.90	1.71	LOW	0.03	*** LENGTH > 60.0 m

Department of Transport and Main Roads

20 February 2013

Document No. 60250500_GEO_RP_001

Mooloolaba Road: Buderim Hill Upgrade

Pavement Design Report

Mooloolaba Road: Buderim Hill Upgrade

Pavement Design Report

NCHD-2596

Prepared for

Department of Transport and Main Roads

Prepared by

AECOM Australia Pty Ltd
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ABN 20 093 846 925

20 February 2013

60250500

AECOM in Australia and New Zealand is certified to the latest version of ISO9001 and ISO14001.

Quality Information

Document Mooloolaba Road: Buderim Hill Upgrade

Ref 60250500

Date 20 February 2013

Prepared by Jeffrey Lee, Jeong Yoon and Ross Armitage

Reviewed by Bruce Hansen

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
0	20-Feb-2013	Final Issue	Nathan Guild Project Manager	

Table of Contents

1.0 Introduction

AECOM Australia Pty Ltd (AECOM) has been commissioned by the Department of Transport and Main Roads (TMR) to prepare detailed design documentation for the upgrading of Mooloolaba Road extending from Chainage 6,650m to 7,500m.

Mooloolaba Road (134) is a State-controlled road located in the Sunshine Coast between Mooloolaba and Buderim and is identified as a Controlled Distributor on the Sunshine Coast Regional Council Maroochy Plan 2000. Mooloolaba Road provides a link between Mooloolaba and Buderim, and provides access to the Sunshine Coast Private Hospital. Mooloolaba Road also provides connections to the Sunshine Motorway in the east and the Bruce Highway in the west.

1.1 Purpose of this Report

The purpose of this report is to document the new pavement design solution and also to provide an estimation of the pavement design life after the existing open graded asphalt (OGA) surfacing is milled off and corrector and structural overlay placed prior to a new dense graded asphalt (DGA) wearing surface along Mooloolaba Road.

A Value Management Workshop held on 4th October 2012, involving representatives from AECOM, TMR and RoadTek, resolved that the primary objective of the project is to improve safety by modifying the geometry, surface profile and drainage within the project limits. The proposed work area is between Ch 6,595 and Ch 7,619m.

As a result it was confirmed that the asphalt overlay thickness, to achieve the modified geometry and surface profile, was not driven by the need to achieve a minimum pavement design life.

As such, the approach in this report for the overlay section is to provide an estimation of the pavement design life using the available theoretical technique.

2.0 Design Reference Documents

The following is a list of design reference documents to which this report refers:

- TMR Pavement Rehabilitation Manual (2012)
- TMR Pavement Design Manual (2009)
- Austroads Guide to Pavement Technology – Part 2: Pavement Structural Design (AGPT02/12)
- Austroads Guide to Pavement Technology – Part 5: Pavement Evaluation and Treatment Design (AGPT05-11).

3.0 Design Traffic

On-going discussions were undertaken between AECOM and TMR on the design traffic for the section of Mooloolaba Road. **Table 3-1** summarises the traffic parameters adopted for this project.

Table 3-1 Summary of Traffic Parameters

Traffic Parameters	Lane 1 (Eastbound)	Lane 2 (Westbound)
1-way AADT (2012)	5,802 vpd	6,244 vpd
Volume of Commercial Vehicle (CV)	4.6 %	6.1%
Year of Construction (Opening)	2013 (2014)	
Direction Factor	1.0 (for 1-way AADT)	
Lane Distribution Factor	1.0	
Annual Growth Rate (%)	1% per annum	
ESA / HV	1.8 (Austroads 2010 Table 7.8, Presumptive Urban TLD)	
Asphalt Damage Index (SAR5 / ESA)	1.1	
Subgrade Damage Index (SAR7 / ESA)	1.6	

Note: Lane 1 is in the direction of increasing TMR Gazettal Chainage

The calculated design traffic is summarised in **Table 3-2**. The design traffic for the westbound lane (Lane 2) is higher than the eastbound lane (Lane 1). The Lane 2 traffic has been adopted for the pavement design presented in this report.

Detailed design traffic calculations are attached in **Appendix A**.

Table 3-2 Summary of Design Traffic

Design Life	Lane 1 (Eastbound)	Lane 2 (Westbound)
5 years (2013 – 2018)	9.12×10^5 ESA	1.55×10^6 ESA
10 years (2013 – 2023)	1.87×10^6 ESA	2.92×10^6 ESA
20 years (2013 – 2033)	3.94×10^6 ESA	5.87×10^6 ESA

Note: It was assumed that the construction begins in 2013 and is opened to traffic in 2014.

4.0 Available Geotechnical / Pavement Investigation Information

Two pavement investigation reports were available to AECOM and they are listed as follows:

- TMR Mooloolaba Road, Buderim Hill Geotechnical Pavement Investigation Report (Ch. 1.2 – 2.0km) (TMR reference: 263/134/480), May 2012
- Falling Weight Deflection Survey – Mooloolaba Road (134) Ch. 6.40 – 8.25km (Roadtek reference: PR7002713 4100), April 2012

4.1 Test Pit Data

Eight (8) trenches and two (2) Dynamic Cone Penetrometer (DCP) tests were carried out by TMR as part of the pavement investigation in May 2012. Details of the existing pavement profiles are summarised in **Table 4-1** below. The area within the scope of this project has an open-graded asphalt surfacing. Within the current main traffic lanes, the thickness of the total asphalt layer is between 120 and 150mm. In the shoulder lane, the total asphalt thickness is between 80 and 120mm.

Two DCP readings were taken during the pavement investigation, however, both were located where pavement widening adjacent to Nyes Crescent is proposed (Ch 7.0km). DCP 1 was taken on the verge behind the guardrail, while DCP 2 was taken at the foot of the batter. No laboratory soaked CBR tests or insitu DCP tests in the trenches were carried out during the investigation. Additional laboratory subgrade testing is recommended in the widening area during construction. Appropriate testing has been specified in the contract documents for this project.

Whilst no testing was undertaken in the trafficked lanes (to reduce impact on local traffic), based on the ARMIS data (refer to **Appendix B**), borehole results and the current condition of the pavement within the section, it is contended that the pavement would be representative of the trafficked lanes.

Table 4-1 Summary of existing pavement profiles from TMR pavement investigation

Borehole No.	Chainage (m)	Thickness (mm)	Material
BH01 (WB Shoulder)	Ch 7,301	120	Surfacing (55mm OG wearing course and 65mm DG Layer)
		180	Base: Red-brown sandy gravel (Type 2.3B)
		200	Sub-base: Red-brown sandy gravel with clay (Type 2.4C)
		190	Subgrade: Shaly mudstone
BH02 (EB Shoulder)	Ch 7,203	85	Surfacing (40mm OG wearing course and 45mm DG layer)
		150	Base: Red sandy gravel with clay (Type 2.3B)
		75	Sub-base: Red sandy clayey gravel (Type 2.4C)
		110	Fill: Red silty clay (wet)
		90	Subgrade: Yellow sandy clay
BH03 (Median)	Ch 7,122	150	Surfacing (50mm OG wearing course and 100mm DG layer)
		180	Base: Red brown sandy gravel with clay (Type 2.1B)
		160	Sub-base: Red-brown sandy gravel with clay (Type 2.3B)
		170	Subgrade: Yellow mottled sandstone
BH04 (EB Shoulder)	Ch 6,960	150	Surfacing (50mm OG wearing course and 100mm DG layer)
		180	Base: Red brown sandy gravel with clay (Type 2.1C)
		180	Sub-base: Red-brown sandy gravel with clay (Type 2.3B)
		160	Subgrade: Red silty clay

Borehole No.	Chainage (m)	Thickness (mm)	Material
BH05 (Median)	Ch 6,909	120	Surfacing (45mm OG wearing course and 75mm DG layer)
		150	Base: Red-brown sandy gravel with clay (Type 2.1B)
		150	Sub-base: Red-brown sandy gravel with clay (Type 2.4D)
		170	Fill: Red silty clay
BH06 (WB Shoulder)	Ch 6,769	80	Surfacing (40mm OG wearing course and 40mm DG layer)
		120	Base: Red-brown sandy gravel with clay (Type 2.1B)
		170	Sub-base: red-brown sandy gravel with clay (Type 2.3B)
		140	Fill: Red silty clay
BH07 (EB Shoulder)	Ch 6,665	85	Surfacing: DG14 layer in good condition
		180	Base: Red-brown sandy gravel with clay (Type 2.1B)
		190	Red-brown sandy gravel with clay (Type 2.4B)
		240	Fill: Red silty clay
BH08 (Toe of LH Batter)	Ch 7,012	Pit 30m from guardrail on WB road edge	

4.2 FWD Analysis and Representative Sections

Falling Weight Deflectometer (FWD) testing was undertaken on 4th April 2012 using a 40kN, 60kN and 80kN plate load (Ch 6,420 – Ch 8,250m). The representative section has been determined based on the cumulative difference method of the FWD measurement.

Subsequent analysis to check the life of the resurfacing work is a function of the representative section as well as the variable thickness of AC overlay throughout the project. It is noted that both the insitu condition of the existing pavement and the AC overlay ultimately placed will influence the design life.

The 40kN FWD results have been analysed and used to develop the representative sections within the project scope and summarised in **Table 4-2** and **Table 4-3**. Even though an attempt was made to delineate homogeneous sections by confining the coefficient of variation to values below 30%, it was not always possible due to the scattered nature of deflection data and the need to have a minimum population size to be able to conduct a statistical analysis. Depending on the location of the FWD test in relation to cracks and patching, highly variable results may be realised even over homogeneous pavements.

FWD data has been analysed by wheel path. Analysis of test data reveals the following results:

Table 4-2 FWD Data Analysis

Lane	Wheel Path	Chainage (m)	Characteristic Maximum Deflection (mm)	D_{tol} (mm)
Lane 1 (EB)	OWP	Ch 6,574 – Ch 7,025	0.48	0.84
		Ch 7,074 – Ch 7,625	0.74	0.84
	IWP	Ch 6,599 – Ch 7,650	0.57	0.84
Lane 2 (WB)	OWP	Ch 6,599 – Ch 7,199	0.65	0.84
		Ch 7,250 – Ch 7,450	0.41	0.84
		Ch 7,500 – Ch 7,699	0.81	0.84
	IWP	Ch 6,572 – Ch 7,324	0.52	0.84
		Ch 7,375 – Ch 7,675	0.77	0.84

Tolerable deflection has been determined from Figure 5.9 in TMR Pavement Rehabilitation Manual and based on subgrade with CBR 5% over a 20 years design life.

The in situ subgrade CBR values (correlated from D_{900}) and the characteristic curvature function are listed as follows:

Table 4-3 FWD Data Analysis

Lane	Wheel Path	Chainage (m)	Estimated Subgrade CBR Value from D_{900}	Characteristic Curvature Function (mm)	Characteristic Deflection Ratio
Lane 1 (EB)	OWP	Ch 6,574 – Ch 7,025	17.22	0.08	0.56
		Ch 7,074 – Ch 7,625	17.22	0.12	0.57
	IWP	Ch 6,599 – Ch 7,650	17.65	0.10	0.53
Lane 2 (WB)	OWP	Ch 6,599 – Ch 7,199	18.48	0.10	0.57
		Ch 7,250 – Ch 7,450	18.48	0.10	0.55
		Ch 7,500 – Ch 7,699	18.48	0.14	0.47
	IWP	Ch 6,572 – Ch 7,324	28.08	0.09	0.53
		Ch 7,375 – Ch 7,675	28.08	0.12	0.54

The chart method for overlay design has not been used for overlay design. Correction factors have been applied to the above values according to TMR Pavement Rehabilitation Manual Section 2.8.10.3.7.

Representative Curvature Function (CFr) ranges from 0.08mm to 0.14mm, indicating stiff upper pavement. The representative Deflection Ratio (DRr) values range from 0.47 to 0.57m, indicating that there is a possible weakness in the pavement structure, perhaps in the granular base or subbase course. This has not presented in the pavement as fatigue cracking. The estimated CBR value from D_{900} is higher than back-calculated elastic moduli, probably due to thickness of asphalt layers.

Detailed FWD analysis is included in **Appendix C**.

4.3 Back Calculation Analysis

FWD deflection survey was undertaken in both the inner and outer wheel paths on both Lane 1 and Lane 2 using a 40kN, 60kN and 80kN plate load (Ch 6,420 – Ch 8,250m).

For the main traffic lanes, the current pavement investigation does not suggest significant changes in existing pavement profile. For the purpose of the back calculation analysis, a uniform back-calculation model presented in **Table 4-4** has been adopted. Some sublayering of subgrade/subbase was used to determine modulus of stress-dependent materials.

Table 4-4 Summary of Adopted Back-Calculation Model (Existing pavement profile after milling off existing Open-Graded Asphalt)

Layer Description	Thickness (mm)
Asphalt	150mm
Granular Base	180mm
Granular Subbase	180mm
Subgrade	Semi-infinite

Back calculation analysis was undertaken using the Rubicon software for the 40kN and 60kN deflection data. The results from Rubicon are presented in **Appendix D**. It is noted that the back-calculated moduli are similar for both nominal loads. Therefore, the back-calculated moduli from the 60kN have been adopted for the subsequent CIRCLY analysis provided in **Appendix E**.

It is noted that the pavement surface temperature measured by the FWD shows large variation in pavement surface temperature during each FWD test run (temperature variation of as much as 20°C was observed). It is contended that the variation is due to shade from trees on the northern side of the pavement, which is difficult to consider on a bowl-by-bowl basis over the duration of the project. For temperature correction of the back-calculated results, a pavement surface temperature of 42°C has been adopted and this corresponds to a temperature adjustment factor of about 0.9 (in accordance with Fig 2.18 of the TMR Pavement Rehabilitation Manual). The surface temperature of 42°C has been chosen based on the average value from the FWD runs along Lane2 (westbound).

Back calculated results at a nominal 60kN FWD load for both Lane 1 and Lane 2 are presented in **Table 4-5** below.

Table 4-5 Summary of FWD Back Calculated Moduli (Based on a 60kN FWD Load in the Outer Wheel Paths)

Lane	Chainage (m)	Modulus (E, MPa)			
		Layer 1	Layer 2	Layer 3	Layer 4
Lane 1 (EB)	Ch 6,824	1,405 (1,561*)	103	128	124
	Ch 6,875	1,775 (1,972*)	225	128	98
	Ch 7,025	5,000 (5,555*)	500	238	133
	Ch 7,074	1,100 (1,222*)	90	66	71
	Ch 7,125	1,100 (1,222*)	260	30	100
	Ch 7,224	1,170 (1,300*)	125	81	98
	Ch 7,275	1,473 (1,636*)	100	58	150
	Ch 7,425	750 (833*)	80	40	67
Lane 2 (WB)	Ch 6,750	1,449 (1,610*)	100	82	133
	Ch 6,949	781 (868*)	100	92	124
	Ch 7,150	1,168 (1,300*)	163	92	67
	Ch 7,400	1,063 (1,181*)	238	144	106
	Ch 7,500	770 (856*)	90	25	98
	Ch 7,599	1,766 (1,960*)	500	350	150

Note: (*) Asphalt back-calculated moduli after applying a temperature adjustment factor of 0.9.

5.0 Design Subgrade

5.1 Subgrade

Subgrade or select fill layers are characterised using CBR. Each of these layers has been checked using the subgrade fatigue relationship presented in the Austroads Pavement Design Guide. **Table 5-1** presents the material properties of subgrade and select fill materials.

For this project, no laboratory soaked CBR is available. The only DCP reading for the project has a DCP inferred CBR value of around CBR 5%. It is advisable that additional laboratory and field subgrade testing be carried out prior to construction.

Table 5-1 Subgrade and Select Subgrade Fill Properties

Description	Value
Vertical Modulus Ev (from AUSTROADS Section 5.6 Equation 5.2)	10 x CBR (in MPa)
Poisson's ratio υ_{VH} (from AUSTROADS Section 6.5.3.2)	0.45 (cohesive soil)
Degree of anisotropy (E_V / E_H)	2.0
Subgrade fatigue relation N = RF [k / $\mu\varepsilon$)]^7 (AUSTROADS Section 5.8 Equation 5.3)	k = 9300

6.0 Asphalt Overlay of Existing Pavement

6.1 Overlay Requirements

Prior to any asphalt overlay, all of the existing open grade asphalt (nominally 40 – 55mm thick based on testing) must be removed. To facilitate safety of cyclists during construction, "fine milling" is to be used for removing the existing open grade asphalt, particularly if resurfacing cannot be undertaken in the same shift. Fine milling has been specified in the contract documents as having teeth spacing of not >8mm.

Should the underlying asphalt base be found to be unsound (eg. stripped, ravelled or cracked) after the milling, it should be completely removed and replaced with dense graded asphalt as shown in **Table 6-1** below. This has been specified in the contract documents.

Table 6-1 Asphalt Overlay of Existing Pavement

Pavement Material	MRTS Reference	Min. Thickness (mm)
Dense graded asphalt surfacing layer with C320 binder, DG14 mix	MRTS30	50mm
PMB Seal, S4.5S binder with 10mm aggregate (Note 2)	MRTS11	(Note 1)
DG10 / DG14 (C320) / DG20 (C320 or C600) asphalt (Note 3)	MRTS30	Varies

Note: 1. The ALD of a 10mm cover aggregate is approximately 6mm.

2. In areas where there is steep climbing gradient, a lower spray rate of 1.0 – 1.2 L/m^2 should be considered in accordance with the Pavement Design Manual Clause 3.5.

3. The choice of asphalt mix (DG10/DG14 or DG20) is dependent on the thickness lift requirements nominated in Clause 12.2.6.5 of MRTS30. CIRCLY analysis has been performed assuming DG14 (320) mix for all overlays which has a lower stiffness than the two DG20 mixes.

6.2 Design Life Estimation

FWD deflection survey was undertaken in both the inner and outer wheel paths on both Lane 1 and Lane 2 (Ch. 6420 – Ch. 8250m). With variable asphalt overlay thickness throughout the project, conventional approach of analysing the deflection bowl which corresponds to the 90th percentile high deflection from each representative section is not appropriate.

The approach taken in this project is to analyse a number of deflection bowls (refer to **Section 4.3**) and apply the dense graded asphalt overlay thickness based on a DG14 (C320) overlay (after milling off the top 50mm of the existing open-graded asphalt) in CIRCLY to assess the design life expectation. Whilst it is acknowledged that this is a conservative approach, it reflects the uncertainty in the depth of OGA to be removed and the variable thicknesses of overlay across the pavement required to alter the vertical geometry. The CIRCLY models adopted in the calculation to provide 95% reliability and corresponding design life are summarised in **Table 6-2**.

Table 6-2 Summary of Design Life Estimation

Lane	Chainage (m)	New Overlay Thickness (E=1,550MPa)	Modulus (MPa)				Design Life (ESA)	Design Life (years)
			E (#) (Layer 1)	E (^) (Layer 2)	E (^) (Layer 3)	E (^) (Layer 4)		
Lane 1 (EB)	Ch 6,824	100mm*	1,550	100	125	120	2.16×10^6	7–8
	Ch 6,875	50mm*	1,950	225	125	100	9.15×10^5	2–3
	Ch 7,025	90mm*	2,000	350	235	120	9.93×10^6	20
	Ch 7,074	100mm*	1,200	90	65	70	9.48×10^5	2–3
	Ch 7,125	150mm*	1,200	260	30	100	2.75×10^6	9–10
	Ch 7,224	50mm*	1,300	125	80	100	2.75×10^5	< 1
	Ch 7,275	50mm*	1,650	100	55	120	2.7×10^5	< 1
	Ch 7,425	200mm*	775	80	40	70	4.06×10^7	20
Lane 2 (WB)	Ch 6,750	100mm*	1,600	100	80	120	1.74×10^6	5–6
	Ch 6,949	150mm*	775	100	90	120	2.70×10^7	20
	Ch 7,150	200mm*	1,300	160	90	60	2.13×10^7	20
	Ch 7,400	100mm*	1,150	235	140	100	4.92×10^6	16–17
	Ch 7,500	50mm*	775	90	25	90	5.63×10^7	20
	Ch 7,599	50 mm*	1,950	350	250	120	3.03×10^6	10–11

Note:

(#) The back-calculated moduli presented above have been adjusted in accordance with Figure 5.8 of TMR Pavement Rehabilitation Manual (2012) and rounded to the nearest 50MPa.

(^) Values have been rounded off and maximum limit for the moduli for granular materials has been applied.

(*) The thickness is determined from isopach drawings showing the change in final surface levels.

In accordance with the TMR Pavement Rehabilitation Manual, the General Mechanistic Procedure (GMP) has been adopted for granular pavements with thick (>50mm) asphalt surfacing. The FWD analysis and interpretation provided in **Section 4.2** has been provided for completeness nothing that the mode of pavement failure being considered differs across the two approaches.

It is noted that the estimation of remaining life from back calculated moduli often yields results with high variability due to the following reasons:

- Error in the elastic moduli introduced during the back calculation process
- Sensitivity of the solution for asphalt thickness between 50 to 150mm (i.e. the asphalt layer being modelled in the mechanistic design changes from a pure compression to tension under a wheel load with slight increase in asphalt thickness)

Based on the calculation presented above, on average the estimated design life for the pavement in OWP's is in excess of 7 – 8 years with the exception of the following locations:

- Lane 1 (eastbound)
  - Ch. 6850 – 7000m
  - Ch. 7050 – 7100m
  - Ch. 7180 – 7320m
- Lane 2 (westbound)
  - Ch. 6700 – 6800m

where pavement life is defined by fatigue failure in the asphalt surfacing rather than subgrade deformation

Although some of the results appear to be unsatisfactory, note that the min. overlay thickness chosen from the isopach has been selected conservatively (i.e. isopach has identified overlay thickness in increments of 50mm therefore at a particular chainage, there may be a thicker overlay thickness compared to what has been assumed for analysis). Hence, for the majority of the section along the Mooloolaba Road, the expected design life of the pavement is expected to be higher than the value presented above. The Region should allow for some crack sealing or localised patching repair should the pavement shows signs of distress in the medium term. However, the risk is considered to be low in this case.

For areas in which a lower design life is reported, as listed above, it is recommended that if funding allows, provision be made in the cost estimate for localised strengthening activities to be carried out. Alternatively if no funds are available then the sections should be monitored closely and the region is advised to carry out regular maintenance inspections and activities as required.

7.0 New Widening Pavements

In accordance with Table 2.3-1 of the TMR Pavement Design Manual (2009), for roads with an average daily ESA in the design lane in the year of opening between 100 – 1000 ESA/day, a range of permanent pavement types can be adopted, namely spray sealed on granular (SG(B)), asphalt on granular (AG(A-C)) and asphalt on cement stabilised pavement (ASt(A)).

To expedite construction, a full-depth asphalt pavement with a granular subbase (working platform) is recommended.

Based on the desire to commence construction during the summer wet season and the steep gradient, the use of unbound granular is not recommended.

Two new pavement widening designs based on subgrade CBR 5% and 7%, with a design subgrade swell of <2.5% have been provided, as shown in **Table 7-1**.

During construction, if the above design conditions cannot be met, subgrade treatment in accordance with MRTS04 will need to be followed.

Table 7-1 New Widening Pavement (10 Years and 20 Years Design Life)

Design Details	10 Years Design Life		20 Years Design Life	
	CBR 5% Design	CBR 7% Design	CBR 5% Design	CBR 7% Design
Design Traffic (ESA)	2.92E+06	2.92E+06	5.87E+06	5.87E+06
Design HV Speed (kph)	30	30	30	30
DG14 (C320) Wearing Course	50mm	50mm	50mm	50mm
PMB Seal, S4.5S binder with 10mm aggregate (Note 1)	6mm	6mm	6mm	6mm
DG20 (C600) Base Course (Note 2)	195mm	175mm	220mm	200mm
AMC0 Prime and C170 seal with 10mm Aggregate	6mm	6mm	6mm	6mm
Working Platform (Cement Modified Type 2.3 Unbound Gravel, 7-days UCS 1.5 ± 0.5 MPa)	150mm	150mm	150mm	150mm
Subgrade	Note 3			

Note: 1. In areas where there is steep climbing gradient, a reduced spray rate of 1.0 – 1.2L/m² should be considered in accordance with the Pavement Design Manual.

2. A 10mm construction tolerance has been added to the reported thickness.

3. Subgrade treatment shall be in accordance with MRTS04 and is to be confirmed during construction.

Based on **Table 7-1** above, the difference between the base course thickness for 10 and 20 years is 25mm for both subgrade CBR values analysed in the design. In terms of overall area, the percentage of new pavement is relatively small and confined to three (3) specific areas throughout the scope of works.

Examination of the estimated design life of the existing pavements, adjacent to these areas reveals that, with one exception, these areas have an estimated design life remaining of 20 years. Only the area at Ch 6,750m on the westbound lane at the crest of the hill has a short estimated design life of some 5 – 6 years.

It is considered that a reduction on the design life for the areas of new pavement from 20 years back to 10 years has little merit due to the small savings that could be realised during construction. It is therefore recommended that the 20-year design life be adopted for all areas of new pavement.

Appendix A

Appendix B

Appendix C

Appendix D

Appendix E

Road 134 **Mooloolaba Road**

Original Scope

Data			Notes
AADT (2012)	5,802	6,244	From TMR supplied information
DF	1.0	1.0	
% HV	4.60%	6.10%	From TMR supplied information
ESA/HV	1.8	1.8	ESA/HV applied as per Austroads (2008), Table 7.8
ESA (2012)	1.75E+05	2.50E+05	
% Growth	1.0%	1.0%	From TMR supplied information
LDF	1.00	1.00	Lane Distribution Factor applied as per Austroads (2008), Table 7.3
Daily ESA's in 2013	485	692	

Pavement Section	**Mooloolaba Road**	**Mooloolaba Road**
Pavement Area	Gazettal (Lane 1)	Anti-Gazettal
	Ch 6.7km - 7.5km	Ch 6.7km - 7.5km

Year	ESA	ESA	
2012	175354	250245	
2013	177108	252747	Year of construction
2014	178879	255275	
2015	180667	257827	
2016	182474	260406	
2017	184299	263010	
2018	186142	265640	
1	0	0	
2	0	0	

Cumulative ESAs	(Opening 2013)		**SAR Factors (from Austroads)**
5yr ESA	1.09E+06	1.55E+06	
SARa	1.20E+06	1.71E+06	1.1
SARs	1.74E+06	2.49E+06	1.6
SARc	1.31E+07	1.87E+07	12
Pavement Section	**Mooloolaba Road**	**Mooloolaba Road**	
Pavement Area	Gazettal (Lane 1)	Anti-Gazettal	
	Ch 6.7km - 7.5km	Ch 6.7km - 7.5km	

Summary/Notes:

TMR to confirm 10 or 20 year design period

Site 1 Ch 7.0 total veh.	124143	129010
Site 2 Ch 7.3 total veh.	116044	124882
Site 1 Ch 7.0 % HV	2.50%	6.10%
Site 2 Ch 7.3 % HV	4.60%	3.30%
March 2012 20-day count per day)	5802.2	6244.1
Design %CV	4.60%	6.10%
Assume 1%pa over 20 y	1.0%	1.0%

TMR confirmed that site is constrained for growth, so 1% has been assumed. Increasing to 2% results in an increase to $4.3x10^6$ ESA (Gazettal) and $6.2x10^6$ ESA (Against Gazettal)

Road 134 **Mooloolaba Road**

Original Scope

Data			Notes
AADT (2012)	5,802	6,244	From TMR supplied information
DF	1.0	1.0	
% HV	4.60%	6.10%	From TMR supplied information
ESA/HV	1.8	1.8	ESA/HV applied as per Austroads (2008), Table 7.8
ESA (2012)	1.75E+05	2.50E+05	
% Growth	1.0%	1.0%	From TMR supplied information
LDF	1.00	1.00	Lane Distribution Factor applied as per Austroads (2008), Table 7.3
Daily ESA's in 2013	485	692	

Pavement Section	**Mooloolaba Road**	**Mooloolaba Road**
Pavement Area	Gazettal (Lane 1)	Anti-Gazettal
	Ch 6.7km - 7.5km	Ch 6.7km - 7.5km

Year	ESA	ESA	
2012	175354	250245	
2013	177108	252747	Year of construction
2014	178879	255275	
2015	180667	257827	
2016	182474	260406	
2017	184299	263010	
2018	186142	265640	
2019	188003	268296	
2020	189883	270979	
2021	191782	273689	
2022	193700	276426	
2023	195637	279190	
1	0	0	
2	0	0	

Cumulative ESAs	(Opening 2013)		**SAR Factors (from Austroads)**
10yr ESA	2.05E+06	2.92E+06	
SARa	2.25E+06	3.22E+06	1.1
SARs	3.28E+06	4.68E+06	1.6
SARc	2.45E+07	3.51E+07	12

Pavement Section	**Mooloolaba Road**	**Mooloolaba Road**
Pavement Area	Gazettal (Lane 1)	Anti-Gazettal
	Ch 6.7km - 7.5km	Ch 6.7km - 7.5km

Summary/Notes:

TMR to confirm 10 or 20 year design period

Site 1 Ch 7.0 total veh.	124143	129010
Site 2 Ch 7.3 total veh.	116044	124882
Site 1 Ch 7.0 % HV	2.50%	6.10%
Site 2 Ch 7.3 % HV	4.60%	3.30%
March 2012 20-day count per day)	5802.2	6244.1
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Assume 1%pa over 20 y	1.0%	1.0%

TMR confirmed that site is constrained for growth, so 1% has been assumed. Increasing to 2% results in an increase to $4.3x10^6$ ESA (Gazettal) and $6.2x10^6$ ESA (Against Gazettal)

Road 134 **Mooloolaba Road**

Original Scope

Data			Notes
AADT (2012)	5,802	6,244	From TMR supplied information
DF	1.0	1.0	
% HV	4.60%	6.10%	From TMR supplied information
ESA/HV	1.8	1.8	ESA/HV applied as per Austroads (2008), Table 7.8
ESA (2012)	1.75E+05	2.50E+05	
% Growth	1.0%	1.0%	From TMR supplied information
LDF	1.00	1.00	Lane Distribution Factor applied as per Austroads (2008), Table 7.3
Daily ESA's in 2013	485	692	

Pavement Section	**Mooloolaba Road**	**Mooloolaba Road**
Pavement Area	Gazettal (Lane 1)	Anti-Gazettal
	Ch 6.7km - 7.5km	Ch 6.7km - 7.5km

Year	ESA	ESA	
2012	175354	250245	
2013	177108	252747	Year of construction
2014	178879	255275	
2015	180667	257827	
2016	182474	260406	
2017	184299	263010	
2018	186142	265640	
2019	188003	268296	
2020	189883	270979	
2021	191782	273689	
2022	193700	276426	
2023	195637	279190	
2024	197593	281982	
2025	199569	284802	
2026	201565	287650	
2027	203581	290526	
2028	205616	293432	
2029	207673	296366	
2030	209749	299330	
2031	211847	302323	
2032	213965	305346	
2033	216105	308400	
2034	218266	311484	
2035	220449	314599	

Cumulative ESAs	(Opening 2013)		**SAR Factors (from Austroads)**
20yr ESA	4.12E+06	5.87E+06	
SARa	4.53E+06	6.46E+06	1.1
SARs	6.59E+06	9.40E+06	1.6
SARc	4.94E+07	7.05E+07	12
Pavement Section	**Mooloolaba Road**	**Mooloolaba Road**	
Pavement Area	Gazettal (Lane 1)	Anti-Gazettal	
	Ch 6.7km - 7.5km	Ch 6.7km - 7.5km	

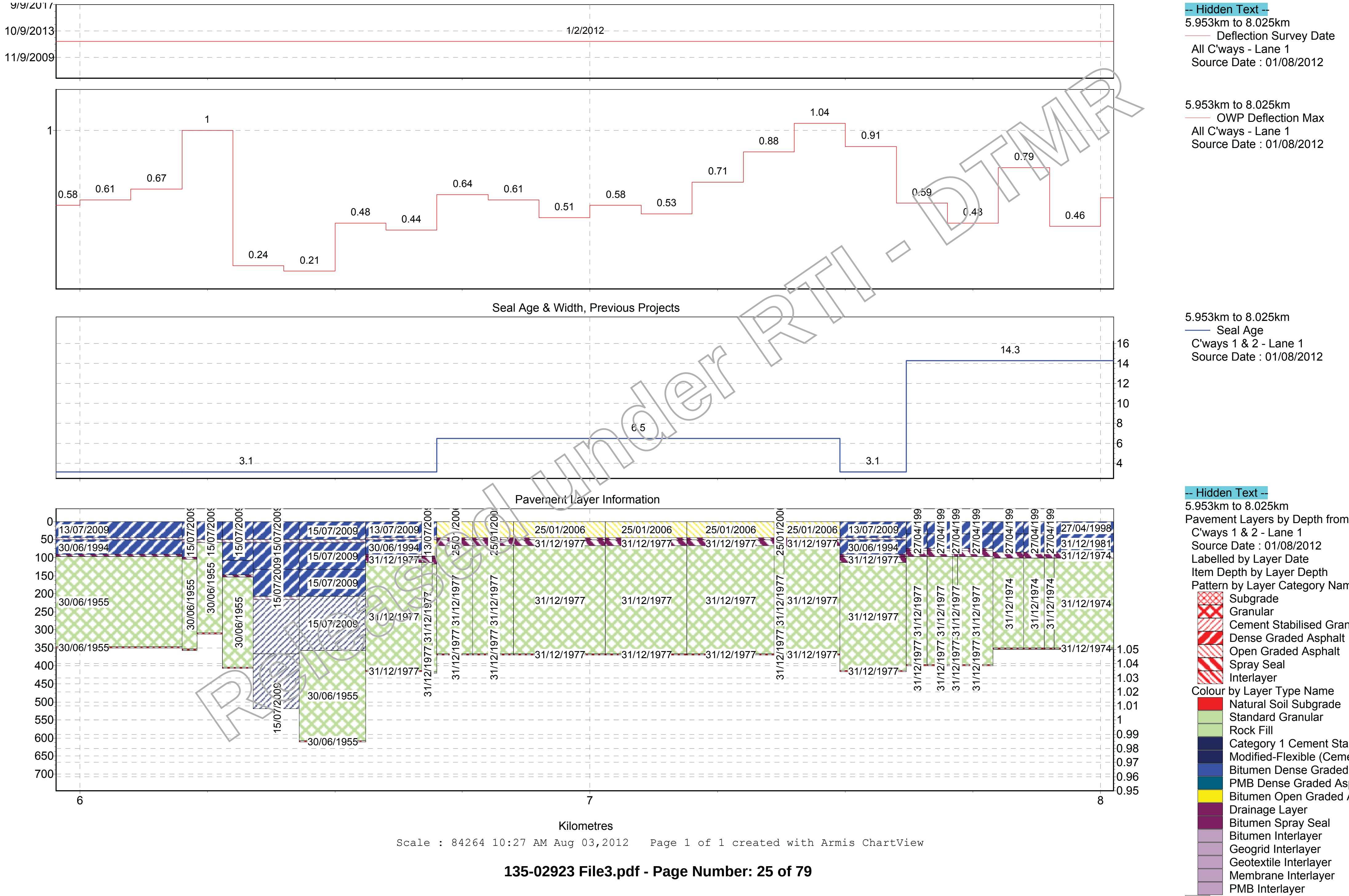
Summary/Notes:

TMR to confirm 10 or 20 year design period

Site 1 Ch 7.0 total veh.	124143	129010
Site 2 Ch 7.3 total veh.	116044	124882
Site 1 Ch 7.0 % HV	2.50%	6.10%
Site 2 Ch 7.3 % HV	4.60%	3.30%
March 2012 20-day count per day)	5802.2	6244.1
Design %CV	4.60%	6.10%
Assume 1%pa over 20 y	1.0%	1.0%

TMR confirmed that site is constrained for growth, so 1% has been assumed. Increasing to 2% results in an increase to 4.3×10^6 ESA (Gazettal) and 6.2×10^6 ESA (Against Gazettal)

Road Section 134 - MOOLOOLABA ROAD (11.5 km) from Roadlink refreshed on 02 Aug 2012 04:58



Scale : 84264 10:27 AM Aug 03,2012 Page 1 of 1 created with Armis ChartView

Report Parameters

District	2	NORTH COAST HINTERLAND DISTRICT
Road Owner	MR	DEPARTMENT OF MAIN ROADS
Local Government Authority		All
Road Section	134	MOOLOOLABA ROAD
Carriageway		All
Lane		All
Layer Type		All
Start Distance	6.2	
End Distance	7.6	
Report As At	09-AUG-2012	

Road Inventory System
Layer Details Report

District 2 NORTH COAST HINTERLAND DISTRICT
Owner MR DEPARTMENT OF MAIN ROADS
Road Section 134/C MOOLOOLABA ROAD, MOOLOOLABA ROAD
Carriageway 1 Lane 1 X-EL Type T

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	1.570	0.030	080				80/134/14	3.5	6.200	6.230	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	40	30-JUN-1994
											4	K1	Bitumen Spray Seal	6	31-MAR-1986
											5	B1	Standard Granular	250	30-JUN-1955
											6	A1	Natural Soil Subgrade	1	30-JUN-1955
2	1.600	0.050	080				80/134/14	3.5	6.230	6.280	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	B1	Standard Granular	250	30-JUN-1955
											4	A1	Natural Soil Subgrade	1	30-JUN-1955
2	1.650	0.060	080				80/134/14	3.5	6.280	6.340	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											4	G1	Bitumen Dense Graded Asphalt	40	30-JUN-1994
											5	K1	Bitumen Spray Seal	6	31-MAR-1986
											6	B1	Standard Granular	250	30-JUN-1955
											7	A1	Natural Soil Subgrade	1	30-JUN-1955
2	1.800	0.130	080					3.5	6.430	6.560	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											4	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											5	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											6	B1	Standard Granular	250	30-JUN-1955

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District 2 NORTH COAST HINTERLAND DISTRICT
Owner MR DEPARTMENT OF MAIN ROADS
Road Section 134/C MOOLOOLABA ROAD, MOOLOOLABA ROAD
Carriageway 1 Lane 1 X-EL Type T

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
											7	A1	Natural Soil Subgrade	1	30-JUN-1955
2	1.930	0.130	080					3.5	6.560	6.690	1	G1	Bitumen Dense Graded Asphalt	45	13-JUL-2009
											2	M1	Bitumen Interlayer	6	13-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	40	30-JUN-1994
											4	K1	Bitumen Spray Seal	6	30-JUN-1983
											5	K1	Bitumen Spray Seal	16	31-DEC-1977
											6	B1	Standard Granular	300	31-DEC-1977
											7	A1	Natural Soil Subgrade	1	31-DEC-1977
2	2.060	0.010	080					3.5	6.690	6.700	1	G1	Bitumen Dense Graded Asphalt	45	13-JUL-2009
											2	M1	Bitumen Interlayer	6	13-JUL-2009
											3	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											4	K1	Bitumen Spray Seal	6	30-JUN-1983
											5	K1	Bitumen Spray Seal	16	31-DEC-1977
											6	B1	Standard Granular	300	31-DEC-1977
											7	A1	Natural Soil Subgrade	1	31-DEC-1977
2	2.070	0.070	080					3.5	6.700	6.770	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	K1	Bitumen Spray Seal	6	30-JUN-1983
											3	K1	Bitumen Spray Seal	16	31-DEC-1977
											4	B1	Standard Granular	300	31-DEC-1977
											5	A1	Natural Soil Subgrade	1	31-DEC-1977
2	2.140	0.020	080					3.3	6.770	6.790	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	K1	Bitumen Spray Seal	6	30-JUN-1983

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Queensland Government
Department of Main Roads

District 2 NORTH COAST HINTERLAND DISTRICT
Owner MR DEPARTMENT OF MAIN ROADS
Road Section 134/C MOOLOOLABA ROAD, MOOLOOLABA ROAD
Carriageway 1 Lane 1 X-EL Type T

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
											3	K1	Bitumen Spray Seal	16	31-DEC-1977
											4	B1	Standard Granular	300	31-DEC-1977
											5	A1	Natural Soil Subgrade	1	31-DEC-1977
2	2.160	0.060	080					3.3	6.790	6.850	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	K1	Bitumen Spray Seal	6	30-JUN-1983
											3	K1	Bitumen Spray Seal	16	31-DEC-1977
											4	B1	Standard Granular	300	31-DEC-1977
											5	A1	Natural Soil Subgrade	1	31-DEC-1977
2	2.220	0.180	080					3.2	6.850	7.030	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	K1	Bitumen Spray Seal	6	30-JUN-1983
											3	K1	Bitumen Spray Seal	16	31-DEC-1977
											4	B1	Standard Granular	300	31-DEC-1977
											5	A1	Natural Soil Subgrade	1	31-DEC-1977
2	2.400	0.160	080					3.5	7.030	7.190	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	K1	Bitumen Spray Seal	6	30-JUN-1983
											3	K1	Bitumen Spray Seal	16	31-DEC-1977
											4	B1	Standard Granular	300	31-DEC-1977
											5	A1	Natural Soil Subgrade	1	31-DEC-1977
2	2.560	0.190	080					4	7.190	7.380	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	K1	Bitumen Spray Seal	6	30-JUN-1983
											3	K1	Bitumen Spray Seal	16	31-DEC-1977
											4	B1	Standard Granular	300	31-DEC-1977

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District	2	NORTH COAST HINTERLAND DISTRICT
Owner	MR	DEPARTMENT OF MAIN ROADS
Road Section	134/C	MOOLOOLABA ROAD, MOOLOOLABA ROAD

Carriageway 1 Lane 1 X-EL Type T

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
											5	A1	Natural Soil Subgrade	1	31-DEC-1977
2	2.750	0.110	080					3.5	7.380	7.490	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	K1	Bitumen Spray Seal	6	30-JUN-1983
											3	K1	Bitumen Spray Seal	16	31-DEC-1977
											4	B1	Standard Granular	300	31-DEC-1977
											5	A1	Natural Soil Subgrade	1	31-DEC-1977
2	2.860	0.130	080					3.5	7.490	7.620	1	G1	Bitumen Dense Graded Asphalt	45	13-JUL-2009
											2	M1	Bitumen Interlayer	6	13-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	40	30-JUN-1994
											4	K1	Bitumen Spray Seal	6	30-JUN-1983
											5	K1	Bitumen Spray Seal	16	31-DEC-1977
											6	B1	Standard Granular	300	31-DEC-1977
											7	A1	Natural Soil Subgrade	1	31-DEC-1977

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District 2 NORTH COAST HINTERLAND DISTRICT
Owner MR DEPARTMENT OF MAIN ROADS
Road Section 134/C MOOLOOLABA ROAD, MOOLOOLABA ROAD

Carriageway 1 Lane 2 X-EL Type T

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	1.570	0.030	080				80/134/14	3.5	6.200	6.230	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	40	30-JUN-1994
											4	K1	Bitumen Spray Seal	6	31-MAR-1986
											5	K1	Bitumen Spray Seal	16	30-JUN-1955
											6	B1	Standard Granular	250	30-JUN-1955
											7	A1	Natural Soil Subgrade	1	30-JUN-1955
2	1.600	0.050	080				80/134/14	3.5	6.230	6.280	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	K1	Bitumen Spray Seal	16	30-JUN-1955
											4	B1	Standard Granular	250	30-JUN-1955
											5	A1	Natural Soil Subgrade	1	30-JUN-1955
2	1.650	0.060	080				80/134/14	3.5	6.280	6.340	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											4	G1	Bitumen Dense Graded Asphalt	40	30-JUN-1994
											5	K1	Bitumen Spray Seal	6	31-MAR-1986
											6	K1	Bitumen Spray Seal	16	30-JUN-1955
											7	B1	Standard Granular	250	30-JUN-1955
											8	A1	Natural Soil Subgrade	1	30-JUN-1955
2	1.800	0.130	080					3.5	6.430	6.560	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009

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District 2 NORTH COAST HINTERLAND DISTRICT
Owner MR DEPARTMENT OF MAIN ROADS
Road Section 134/C MOOLOOLABA ROAD, MOOLOOLABA ROAD
Carriageway 1 Lane 2 X-EL Type T

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
											4	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											5	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											6	B1	Standard Granular	250	30-JUN-1955
											7	A1	Natural Soil Subgrade	1	30-JUN-1955
2	1.930	0.130	080					3.5	6.560	6.690	1	G1	Bitumen Dense Graded Asphalt	45	13-JUL-2009
											2	M1	Bitumen Interlayer	6	13-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	40	30-JUN-1994
											4	K1	Bitumen Spray Seal	6	30-JUN-1983
											5	K1	Bitumen Spray Seal	16	31-DEC-1977
											6	B1	Standard Granular	300	31-DEC-1977
											7	A1	Natural Soil Subgrade	1	31-DEC-1977
2	2.060	0.010	080					3.5	6.690	6.700	1	G1	Bitumen Dense Graded Asphalt	45	13-JUL-2009
											2	M1	Bitumen Interlayer	6	13-JUL-2009
											3	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											4	K1	Bitumen Spray Seal	6	30-JUN-1983
											5	K1	Bitumen Spray Seal	16	31-DEC-1977
											6	B1	Standard Granular	300	31-DEC-1977
											7	A1	Natural Soil Subgrade	1	31-DEC-1977
2	2.070	0.070	080					3.5	6.700	6.770	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	K1	Bitumen Spray Seal	6	30-JUN-1983
											3	K1	Bitumen Spray Seal	16	31-DEC-1977
											4	B1	Standard Granular	300	31-DEC-1977
											5	A1	Natural Soil Subgrade	1	31-DEC-1977

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District	2	NORTH COAST HINTERLAND DISTRICT
Owner	MR	DEPARTMENT OF MAIN ROADS
Road Section	134/C	MOOLOOLABA ROAD, MOOLOOLABA ROAD

Carriageway 1 Lane 2 X-EL Type T

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	2.140	0.020	080					3.3	6.770	6.790	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	K1	Bitumen Spray Seal	6	30-JUN-1983
											3	K1	Bitumen Spray Seal	16	31-DEC-1977
											4	B1	Standard Granular	300	31-DEC-1977
											5	A1	Natural Soil Subgrade	1	31-DEC-1977
2	2.160	0.060	080					3.3	6.790	6.850	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	K1	Bitumen Spray Seal	6	30-JUN-1983
											3	K1	Bitumen Spray Seal	16	31-DEC-1977
											4	B1	Standard Granular	300	31-DEC-1977
											5	A1	Natural Soil Subgrade	1	31-DEC-1977
2	2.220	0.180	080					3.2	6.850	7.030	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	K1	Bitumen Spray Seal	6	30-JUN-1983
											3	K1	Bitumen Spray Seal	16	31-DEC-1977
											4	B1	Standard Granular	300	31-DEC-1977
											5	A1	Natural Soil Subgrade	1	31-DEC-1977
2	2.400	0.160	080					3.5	7.030	7.190	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	K1	Bitumen Spray Seal	6	30-JUN-1983
											3	K1	Bitumen Spray Seal	16	31-DEC-1977
											4	B1	Standard Granular	300	31-DEC-1977
											5	A1	Natural Soil Subgrade	1	31-DEC-1977
2	2.560	0.190	080					4	7.190	7.380	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	K1	Bitumen Spray Seal	6	30-JUN-1983

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District 2 NORTH COAST HINTERLAND DISTRICT
Owner MR DEPARTMENT OF MAIN ROADS
Road Section 134/C MOOLOOLABA ROAD, MOOLOOLABA ROAD
Carriageway 1 Lane 2 X-EL Type T

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
											3	K1	Bitumen Spray Seal	16	31-DEC-1977
											4	B1	Standard Granular	300	31-DEC-1977
											5	A1	Natural Soil Subgrade	1	31-DEC-1977
2	2.750	0.110	080					3.5	7.380	7.490	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	K1	Bitumen Spray Seal	6	30-JUN-1983
											3	K1	Bitumen Spray Seal	16	31-DEC-1977
											4	B1	Standard Granular	300	31-DEC-1977
											5	A1	Natural Soil Subgrade	1	31-DEC-1977
2	2.860	0.130	080					3.5	7.490	7.620	1	G1	Bitumen Dense Graded Asphalt	45	13-JUL-2009
											2	M1	Bitumen Interlayer	6	13-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	40	30-JUN-1994
											4	K1	Bitumen Spray Seal	6	30-JUN-1983
											5	K1	Bitumen Spray Seal	16	31-DEC-1977
											6	B1	Standard Granular	300	31-DEC-1977
											7	A1	Natural Soil Subgrade	1	31-DEC-1977

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District 2 NORTH COAST HINTERLAND DISTRICT
Owner MR DEPARTMENT OF MAIN ROADS
Road Section 134/C MOOLOOLABA ROAD, MOOLOOLABA ROAD
Carriageway 1 Lane A X-EL Type L

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	1.640	0.070	080				80/134/14	3.5	6.270	6.340	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											4	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											5	M2	PMB Interlayer	8	15-JUL-2009
											6	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											7	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											8	A1	Natural Soil Subgrade	1	15-JUL-2009
2	1.800	0.120	080					2.8	6.430	6.550	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											4	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											5	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											6	B1	Standard Granular	250	30-JUN-1955
											7	A1	Natural Soil Subgrade	1	30-JUN-1955
2	2.730	0.030	080					3	7.360	7.390	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	B1	Standard Granular	300	31-DEC-1977
											3	A1	Natural Soil Subgrade	1	31-DEC-1977

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District 2 NORTH COAST HINTERLAND DISTRICT
Owner MR DEPARTMENT OF MAIN ROADS
Road Section 134/C MOOLOOLABA ROAD, MOOLOOLABA ROAD
Carriageway 1 Lane E X-EL Type S

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	1.570	0.030	080				80/134/14	.6	6.200	6.230	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	M1	Bitumen Interlayer	6	13-JUL-2009
											4	KU	Spray Seal - Quality Unknown	20	01-JAN-1986
											5	B?	Granular, CTB or AC - Quality Unknow	200	01-JAN-1900
											6	A1	Natural Soil Subgrade	1	01-JAN-1900
2	1.600	0.050	080				80/134/14	.6	6.230	6.280	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	B?	Granular, CTB or AC - Quality Unknow	200	01-JAN-1900
											4	A1	Natural Soil Subgrade	1	01-JAN-1900
2	1.650	0.060	080				80/134/14	1	6.280	6.340	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											4	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											5	M2	PMB Interlayer	8	15-JUL-2009
											6	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											7	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											8	A1	Natural Soil Subgrade	1	15-JUL-2009
2	1.800	0.130	080					.6	6.430	6.560	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											4	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											5	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009

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District 2 NORTH COAST HINTERLAND DISTRICT
Owner MR DEPARTMENT OF MAIN ROADS
Road Section 134/C MOOLOOLABA ROAD, MOOLOOLABA ROAD
Carriageway 1 Lane E X-EL Type S

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
											6	B1	Standard Granular	250	30-JUN-1955
											7	A1	Natural Soil Subgrade	1	30-JUN-1955
2	1.930	0.110	080					2.5	6.560	6.670	1	G1	Bitumen Dense Graded Asphalt	45	13-JUL-2009
											2	M1	Bitumen Interlayer	6	13-JUL-2009
											3	KU	Spray Seal - Quality Unknown	20	01-JAN-1979
											4	B?	Granular, CTB or AC - Quality Unknow	200	01-JAN-1979
											5	A1	Natural Soil Subgrade	1	01-JAN-1979
2	2.040	0.020	080					2.5	6.670	6.690	1	G1	Bitumen Dense Graded Asphalt	45	13-JUL-2009
											2	M1	Bitumen Interlayer	6	13-JUL-2009
											3	KU	Spray Seal - Quality Unknown	20	01-JAN-1979
											4	B?	Granular, CTB or AC - Quality Unknow	200	01-JAN-1977
											5	A1	Natural Soil Subgrade	1	01-JAN-1977
2	2.060	0.010	080					2.5	6.690	6.700	1	G1	Bitumen Dense Graded Asphalt	45	13-JUL-2009
											2	M1	Bitumen Interlayer	6	13-JUL-2009
											3	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											4	KU	Spray Seal - Quality Unknown	20	01-JAN-1983
											5	B?	Granular, CTB or AC - Quality Unknow	200	01-JAN-1977
											6	A1	Natural Soil Subgrade	1	01-JAN-1977
2	2.070	0.070	080					2.5	6.700	6.770	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	KU	Spray Seal - Quality Unknown	20	01-JAN-1983
											3	B?	Granular, CTB or AC - Quality Unknow	200	01-JAN-1977
											4	A1	Natural Soil Subgrade	1	01-JAN-1977

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District 2 NORTH COAST HINTERLAND DISTRICT
Owner MR DEPARTMENT OF MAIN ROADS
Road Section 134/C MOOLOOLABA ROAD, MOOLOOLABA ROAD

Carriageway 1 Lane E X-EL Type S

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	2.140	0.720	080					2	6.770	7.490	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	KU	Spray Seal - Quality Unknown	20	01-JAN-1983
											3	B?	Granular, CTB or AC - Quality Unknow	200	01-JAN-1977
											4	A1	Natural Soil Subgrade	1	01-JAN-1977
2	2.860	0.130	080					2	7.490	7.620	1	G1	Bitumen Dense Graded Asphalt	45	13-JUL-2009
											2	M1	Bitumen Interlayer	6	13-JUL-2009
											3	BU	Granular - Quality Unknown	150	01-JAN-1977
											4	AU	Subgrade - Quality Unknown	1	01-JAN-1977

Carriageway 1 Lane L X-EL Type R

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	2.800	0.060	080					3	7.430	7.490	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	K1	Bitumen Spray Seal	6	30-JUN-1983
											3	K1	Bitumen Spray Seal	16	31-DEC-1977
											4	B1	Standard Granular	300	31-DEC-1977
											5	A1	Natural Soil Subgrade	1	31-DEC-1977

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District 2 NORTH COAST HINTERLAND DISTRICT
Owner MR DEPARTMENT OF MAIN ROADS
Road Section 134/C MOOLOOLABA ROAD, MOOLOOLABA ROAD
Carriageway 1 Lane M X-EL Type M

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	2.130	0.570	080					.5	6.760	7.330	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	B1	Standard Granular	300	31-DEC-1977
											3	A1	Natural Soil Subgrade	1	31-DEC-1977
2	2.700	0.050	080					2.5	7.330	7.380	1	E1	Jointed Plain Cement Concrete	175	25-JAN-2006
											2	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											3	B1	Standard Granular	300	31-DEC-1977
											4	A1	Natural Soil Subgrade	1	31-DEC-1977
2	2.770	0.080	080					1.5	7.400	7.480	1	E1	Jointed Plain Cement Concrete	175	25-JAN-2006
											2	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											3	B1	Standard Granular	300	31-DEC-1977
											4	A1	Natural Soil Subgrade	1	31-DEC-1977
2	2.910	0.060	080					3.5	7.540	7.600	1	I1	Bitumen Open Graded Asphalt	50	20-DEC-1996
											2	G1	Bitumen Dense Graded Asphalt	40	30-JUN-1994
											3	K1	Bitumen Spray Seal	6	30-JUN-1983
											4	K1	Bitumen Spray Seal	16	31-DEC-1977
											5	B1	Standard Granular	300	31-DEC-1977
											6	A1	Natural Soil Subgrade	1	31-DEC-1977

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District 2 NORTH COAST HINTERLAND DISTRICT
Owner MR DEPARTMENT OF MAIN ROADS
Road Section 134/C MOOLOOLABA ROAD, MOOLOOLABA ROAD
Carriageway 1 Lane N X-EL Type R

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	2.750	0.040	080					3	7.380	7.420	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	B1	Standard Granular	300	31-DEC-1977
											3	A1	Natural Soil Subgrade	1	31-DEC-1977

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District 2 NORTH COAST HINTERLAND DISTRICT
Owner MR DEPARTMENT OF MAIN ROADS
Road Section 134/C MOOLOOLABA ROAD, MOOLOOLABA ROAD
Carriageway 1 Lane Q X-EL Type C

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	1.570	0.080	080				80/134/14	2.8	6.200	6.280	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	B1	Standard Granular	250	30-JUN-1955
											4	A1	Natural Soil Subgrade	1	30-JUN-1955
2	1.650	0.060	080				80/134/14	2.8	6.280	6.340	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											4	G1	Bitumen Dense Graded Asphalt	40	30-JUN-1994
											5	B1	Standard Granular	250	30-JUN-1955
											6	A1	Natural Soil Subgrade	1	30-JUN-1955
2	1.800	0.070	080					2.8	6.430	6.500	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											4	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											5	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											6	B1	Standard Granular	250	30-JUN-1955
											7	A1	Natural Soil Subgrade	1	30-JUN-1955
2	2.070	0.070	080					3.5	6.700	6.770	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	K1	Bitumen Spray Seal	6	30-JUN-1983
											3	K1	Bitumen Spray Seal	16	31-DEC-1977
											4	B1	Standard Granular	300	31-DEC-1977
											5	A1	Natural Soil Subgrade	1	31-DEC-1977

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Layer Details Report

District 2 NORTH COAST HINTERLAND DISTRICT
Owner MR DEPARTMENT OF MAIN ROADS
Road Section 134/C MOOLOOLABA ROAD, MOOLOOLABA ROAD
Carriageway 1 Lane Q X-EL Type L

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	2.140	0.080	080					3.3	6.770	6.850	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	K1	Bitumen Spray Seal	6	30-JUN-1983
											3	K1	Bitumen Spray Seal	16	31-DEC-1977
											4	B1	Standard Granular	300	31-DEC-1977
											5	A1	Natural Soil Subgrade	1	31-DEC-1977
2	2.220	0.180	080					3	6.850	7.030	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	K1	Bitumen Spray Seal	6	30-JUN-1983
											3	K1	Bitumen Spray Seal	16	31-DEC-1977
											4	B1	Standard Granular	300	31-DEC-1977
											5	A1	Natural Soil Subgrade	1	31-DEC-1977
2	2.400	0.160	080					3.5	7.030	7.190	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	K1	Bitumen Spray Seal	6	30-JUN-1983
											3	K1	Bitumen Spray Seal	16	31-DEC-1977
											4	B1	Standard Granular	300	31-DEC-1977
											5	A1	Natural Soil Subgrade	1	31-DEC-1977
2	2.560	0.170	080					4	7.190	7.360	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	K1	Bitumen Spray Seal	6	30-JUN-1983
											3	K1	Bitumen Spray Seal	16	31-DEC-1977
											4	B1	Standard Granular	300	31-DEC-1977
											5	A1	Natural Soil Subgrade	1	31-DEC-1977
2	2.850	0.060	080					3	7.480	7.540	1	G1	Bitumen Dense Graded Asphalt	45	13-JUL-2009
											2	M1	Bitumen Interlayer	6	13-JUL-2009

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District 2 NORTH COAST HINTERLAND DISTRICT
Owner MR DEPARTMENT OF MAIN ROADS
Road Section 134/C MOOLOOLABA ROAD, MOOLOOLABA ROAD
Carriageway 1 Lane Q X-EL Type L

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
											3	B1	Standard Granular	300	31-DEC-1977
											4	A1	Natural Soil Subgrade	1	31-DEC-1977

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District 2 NORTH COAST HINTERLAND DISTRICT
Owner MR DEPARTMENT OF MAIN ROADS
Road Section 134/C MOOLOOLABA ROAD, MOOLOOLABA ROAD
Carriageway 1 Lane U X-EL Type S

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	1.570	0.030	080				80/134/14	.6	6.200	6.230	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	M1	Bitumen Interlayer	6	13-JUL-2009
											4	KU	Spray Seal - Quality Unknown	20	01-JAN-1986
											5	B?	Granular, CTB or AC - Quality Unknow	200	01-JAN-1900
											6	A1	Natural Soil Subgrade	1	01-JAN-1900
2	1.600	0.050	080				80/134/14	.6	6.230	6.280	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	B?	Granular, CTB or AC - Quality Unknow	200	01-JAN-1900
											4	A1	Natural Soil Subgrade	1	01-JAN-1900
2	1.650	0.060	080				80/134/14	.6	6.280	6.340	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											4	KU	Spray Seal - Quality Unknown	20	01-JAN-1986
											5	B?	Granular, CTB or AC - Quality Unknow	200	01-JAN-1900
											6	A1	Natural Soil Subgrade	1	01-JAN-1900
2	1.800	0.130	080					.6	6.430	6.560	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											4	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											5	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											6	B1	Standard Granular	250	30-JUN-1955
											7	A1	Natural Soil Subgrade	1	30-JUN-1955

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District 2 NORTH COAST HINTERLAND DISTRICT
Owner MR DEPARTMENT OF MAIN ROADS
Road Section 134/C MOOLOOLABA ROAD, MOOLOOLABA ROAD
Carriageway 1 Lane U X-EL Type S

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	1.930	0.110	080					2.5	6.560	6.670	1	G1	Bitumen Dense Graded Asphalt	45	13-JUL-2009
											2	M1	Bitumen Interlayer	6	13-JUL-2009
											3	KU	Spray Seal - Quality Unknown	20	01-JAN-1979
											4	B?	Granular, CTB or AC - Quality Unknow	200	01-JAN-1979
											5	A1	Natural Soil Subgrade	1	01-JAN-1979
2	2.040	0.020	080					2.5	6.670	6.690	1	G1	Bitumen Dense Graded Asphalt	45	13-JUL-2009
											2	M1	Bitumen Interlayer	6	13-JUL-2009
											3	KU	Spray Seal - Quality Unknown	20	01-JAN-1979
											4	B?	Granular, CTB or AC - Quality Unknow	200	01-JAN-1977
											5	A1	Natural Soil Subgrade	1	01-JAN-1977
2	2.060	0.010	080					2.5	6.690	6.700	1	G1	Bitumen Dense Graded Asphalt	45	13-JUL-2009
											2	M1	Bitumen Interlayer	6	13-JUL-2009
											3	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											4	KU	Spray Seal - Quality Unknown	20	01-JAN-1983
											5	B?	Granular, CTB or AC - Quality Unknow	200	01-JAN-1977
											6	A1	Natural Soil Subgrade	1	01-JAN-1977
2	2.070	0.070	080					2.5	6.700	6.770	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	KU	Spray Seal - Quality Unknown	20	01-JAN-1983
											3	B?	Granular, CTB or AC - Quality Unknow	200	01-JAN-1977
											4	A1	Natural Soil Subgrade	1	01-JAN-1977
2	2.140	0.720	080					2	6.770	7.490	1	I1	Bitumen Open Graded Asphalt	45	25-JAN-2006
											2	KU	Spray Seal - Quality Unknown	20	01-JAN-1983

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District 2 NORTH COAST HINTERLAND DISTRICT
Owner MR DEPARTMENT OF MAIN ROADS
Road Section 134/C MOOLOOLABA ROAD, MOOLOOLABA ROAD

Carriageway 1 Lane U X-EL Type S

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
											3	B?	Granular, CTB or AC - Quality Unknow	200	01-JAN-1977
											4	A1	Natural Soil Subgrade	1	01-JAN-1977
2	2.860	0.130	080					1	7.490	7.620	1	G1	Bitumen Dense Graded Asphalt	45	13-JUL-2009
											2	M1	Bitumen Interlayer	6	13-JUL-2009
											3	BU	Granular - Quality Unknown	150	01-JAN-1977
											4	B?	Granular, CTB or AC - Quality Unknow	200	01-JAN-1977
											5	A1	Natural Soil Subgrade	1	01-JAN-1977

Carriageway 2 Lane 1 X-EL Type T

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	1.710	0.090	080					4.4	6.340	6.430	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											4	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											5	M2	PMB Interlayer	8	15-JUL-2009
											6	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											7	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											8	A1	Natural Soil Subgrade	1	15-JUL-2009

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District 2 NORTH COAST HINTERLAND DISTRICT
Owner MR DEPARTMENT OF MAIN ROADS
Road Section 134/C MOOLOOLABA ROAD, MOOLOOLABA ROAD

Carriageway 2 Lane 3 X-EL Type T

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	1.710	0.090	080					4.8	6.340	6.430	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											4	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											5	M2	PMB Interlayer	8	15-JUL-2009
											6	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											7	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											8	A1	Natural Soil Subgrade	1	15-JUL-2009

Carriageway 2 Lane E X-EL Type S

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	1.710	0.090	080					.6	6.340	6.430	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											4	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											5	M2	PMB Interlayer	8	15-JUL-2009
											6	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											7	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											8	A1	Natural Soil Subgrade	1	15-JUL-2009

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District 2 NORTH COAST HINTERLAND DISTRICT
Owner MR DEPARTMENT OF MAIN ROADS
Road Section 134/C MOOLOOLABA ROAD, MOOLOOLABA ROAD

Carriageway 2 Lane U X-EL Type S

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	1.710	0.090	080					.2	6.340	6.430	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											4	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											5	M2	PMB Interlayer	8	15-JUL-2009
											6	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											7	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											8	A1	Natural Soil Subgrade	1	15-JUL-2009

Carriageway 2 Lane V X-EL Type M

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	1.710	0.090	080					3	6.340	6.430	1	E1	Jointed Plain Cement Concrete	100	15-JUL-2009
											2	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											3	M2	PMB Interlayer	8	15-JUL-2009
											4	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											5	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											6	M2	PMB Interlayer	8	15-JUL-2009
											7	C2	Category 2 Cement Stabilised Granula	150	15-JUL-2009
											8	A1	Natural Soil Subgrade	1	15-JUL-2009

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Layer Details Report

District 2 NORTH COAST HINTERLAND DISTRICT
Owner MR DEPARTMENT OF MAIN ROADS
Road Section 134/C MOOLOOLABA ROAD, MOOLOOLABA ROAD

Carriageway 3 Lane 2 X-EL Type T

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	1.710	0.090	080					3.8	6.340	6.430	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											4	G1	Bitumen Dense Graded Asphalt	40	30-JUN-1994
											5	K1	Bitumen Spray Seal	6	31-MAR-1986
											6	K1	Bitumen Spray Seal	16	30-JUN-1955
											7	B1	Standard Granular	250	30-JUN-1955
											8	A1	Natural Soil Subgrade	1	30-JUN-1955

Carriageway 3 Lane 4 X-EL Type T

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	1.710	0.090	080					3.8	6.340	6.430	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											4	G1	Bitumen Dense Graded Asphalt	40	30-JUN-1994
											5	K1	Bitumen Spray Seal	6	31-MAR-1986
											6	B1	Standard Granular	250	30-JUN-1955
											7	A1	Natural Soil Subgrade	1	30-JUN-1955

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Queensland Government
Department of Main Roads

District	2	NORTH COAST HINTERLAND DISTRICT
Owner	MR	DEPARTMENT OF MAIN ROADS
Road Section	134/C	MOOLOOLABA ROAD, MOOLOOLABA ROAD

Carriageway 3 Lane E X-EL Type S

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	1.710	0.050	080					.4	6.340	6.390	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											4	KU	Spray Seal - Quality Unknown	20	01-JAN-1986
											5	B?	Granular, CTB or AC - Quality Unknow	200	01-JAN-1900
											6	A1	Natural Soil Subgrade	1	01-JAN-1900
2	1.760	0.040	080					.4	6.390	6.430	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											4	KU	Spray Seal - Quality Unknown	20	01-JAN-1979
											5	B?	Granular, CTB or AC - Quality Unknow	200	01-JAN-1974
											6	A1	Natural Soil Subgrade	1	01-JAN-1974

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District 2 NORTH COAST HINTERLAND DISTRICT
Owner MR DEPARTMENT OF MAIN ROADS
Road Section 134/C MOOLOOLABA ROAD, MOOLOOLABA ROAD
Carriageway 3 Lane U X-EL Type S

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	1.710	0.050	080					.8	6.340	6.390	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											4	KU	Spray Seal - Quality Unknown	20	01-JAN-1986
											5	B?	Granular, CTB or AC - Quality Unknow	200	01-JAN-1900
											6	A1	Natural Soil Subgrade	1	01-JAN-1900
2	1.760	0.040	080					.8	6.390	6.430	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											4	KU	Spray Seal - Quality Unknown	20	01-JAN-1979
											5	B?	Granular, CTB or AC - Quality Unknow	200	01-JAN-1974
											6	A1	Natural Soil Subgrade	1	01-JAN-1974

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District 2 NORTH COAST HINTERLAND DISTRICT
Owner MR DEPARTMENT OF MAIN ROADS
Road Section 134/C MOOLOOLABA ROAD, MOOLOOLABA ROAD

Carriageway V Lane 2 X-EL Type T

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	1.720	0.010	080					5.6	6.350	6.360	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											4	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											5	M2	PMB Interlayer	8	15-JUL-2009
											6	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											7	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											8	A1	Natural Soil Subgrade	1	15-JUL-2009

Carriageway V Lane 4 X-EL Type T

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	1.720	0.010	080					5.6	6.350	6.360	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											4	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											5	M2	PMB Interlayer	8	15-JUL-2009
											6	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											7	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											8	A1	Natural Soil Subgrade	1	15-JUL-2009

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District 2 NORTH COAST HINTERLAND DISTRICT
Owner MR DEPARTMENT OF MAIN ROADS
Road Section 134/C MOOLOOLABA ROAD, MOOLOOLABA ROAD

Carriageway V Lane E X-EL Type S

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	1.720	0.010	080					.2	6.350	6.360	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											4	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											5	M2	PMB Interlayer	8	15-JUL-2009
											6	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											7	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											8	A1	Natural Soil Subgrade	1	15-JUL-2009

Carriageway V Lane U X-EL Type S

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	1.720	0.010	080					.6	6.350	6.360	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											4	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											5	M2	PMB Interlayer	8	15-JUL-2009
											6	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											7	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											8	A1	Natural Soil Subgrade	1	15-JUL-2009

Road Inventory System
Layer Details Report

District 2 NORTH COAST HINTERLAND DISTRICT
Owner MR DEPARTMENT OF MAIN ROADS
Road Section 134/C MOOLOOLABA ROAD, MOOLOOLABA ROAD

Carriageway W Lane 1 X-EL Type T

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	1.770	0.010	080					6.4	6.400	6.410	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											4	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											5	M2	PMB Interlayer	8	15-JUL-2009
											6	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											7	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											8	A1	Natural Soil Subgrade	1	15-JUL-2009

Carriageway W Lane A X-EL Type A

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	1.770	0.010	080					5	6.400	6.410	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											4	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											5	M2	PMB Interlayer	8	15-JUL-2009
											6	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											7	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											8	A1	Natural Soil Subgrade	1	15-JUL-2009

Road Inventory System
Layer Details Report

District 2 NORTH COAST HINTERLAND DISTRICT
Owner MR DEPARTMENT OF MAIN ROADS
Road Section 134/C MOOLOOLABA ROAD, MOOLOOLABA ROAD

Carriageway W Lane E X-EL Type S

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	1.770	0.010	080					.4	6.400	6.410	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											4	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											5	M2	PMB Interlayer	8	15-JUL-2009
											6	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											7	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											8	A1	Natural Soil Subgrade	1	15-JUL-2009

Carriageway W Lane U X-EL Type S

RP	Offset	Length	LGA	FC	SLC	CLC	Cway Link Description	Lane Width	TDist Start	TDist End	Layer Num	Layer Type	Layer Description	Layer Depth	Layer Date
2	1.770	0.010	080					.2	6.400	6.410	1	G1	Bitumen Dense Graded Asphalt	50	15-JUL-2009
											2	M2	PMB Interlayer	8	15-JUL-2009
											3	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											4	G1	Bitumen Dense Graded Asphalt	75	15-JUL-2009
											5	M2	PMB Interlayer	8	15-JUL-2009
											6	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											7	C1	Category 1 Cement Stabilised Granula	150	15-JUL-2009
											8	A1	Natural Soil Subgrade	1	15-JUL-2009

Street Name: Mooloolaba Road, Buderim, 40kN

Chge (m)	Lane	Stress (kPa)	Surface Temp (Cº)	Air Temp (Cº)	Normalised Deflection Bowl (mm)							Max Defln	Curvature D0-D200	Ratio D250/D0	Subgrade CBR	Correction			Curvature Correction Factors (applied if H_{AC} > 50mm)	Chainage (m)	Lane	Corrected D_0	Corrected Curvature Function (D_0-D_{200})	Deflection Ratio = D_{250}/D_0
					0	200	300	450	600	900	1500					Moisture correction - TMR Table 2.3	WMAPT / $T_{measured}$	Temperature Adjustment for Deflection[3] (Input from TMR Figure 2.18)	Temperature Adjustment for Curvature Function (Input from TMR Figure 2.19)					
6425	1/OWP	594	45	28	0.092	0.053	0.043	0.035	0.031	0.023	0.010	0.090	0.040	0.520	25	1.00	0.711	0.90	0.75	6425	1/OWP	0.081	0.030	0.52
6474	1/OWP	600	44	28	0.185	0.137	0.122	0.100	0.083	0.055	0.019	0.170	0.050	0.700	25	1.00	0.727	0.90	0.75	6474	1/OWP	0.153	0.038	0.70
6525	1/OWP	581	42	28	0.203	0.153	0.130	0.102	0.078	0.045	0.013	0.200	0.050	0.700	25	1.00	0.762	0.90	0.75	6525	1/OWP	0.180	0.038	0.70
6574	1/OWP	572	28	27	0.545	0.360	0.268	0.180	0.127	0.074	0.031	0.540	0.180	0.580	25	1.00	1.143	0.90	0.75	6574	1/OWP	0.486	0.135	0.58
6625	1/OWP	579	29	26	0.415	0.291	0.201	0.127	0.085	0.049	0.026	0.410	0.120	0.590	25	1.00	1.103	0.90	0.75	6625	1/OWP	0.369	0.090	0.59
6675	1/OWP	583	31	25	0.313	0.248	0.205	0.154	0.116	0.068	0.029	0.300	0.060	0.720	25	1.00	1.032	0.90	0.75	6675	1/OWP	0.270	0.045	0.72
6724	1/OWP	569	26	26	0.407	0.293	0.219	0.144	0.099	0.055	0.026	0.400	0.110	0.630	25	1.00	1.231	0.90	0.75	6724	1/OWP	0.360	0.083	0.63
6775	1/OWP	571	31	26	0.501	0.357	0.257	0.159	0.108	0.058	0.025	0.500	0.140	0.610	25	1.00	1.032	0.90	0.75	6775	1/OWP	0.450	0.105	0.61
6824	1/OWP	572	26	25	0.536	0.391	0.283	0.175	0.120	0.070	0.034	0.530	0.140	0.630	25	1.00	1.231	0.90	0.75	6824	1/OWP	0.477	0.105	0.63
6875	1/OWP	572	28	26	0.424	0.312	0.238	0.160	0.109	0.055	0.022	0.420	0.110	0.650	25	1.00	1.143	0.90	0.75	6875	1/OWP	0.378	0.083	0.65
6926	1/OWP	537	27	26	0.312	0.218	0.154	0.088	0.058	0.014	0.000	0.330	0.100	0.600	25	1.00	1.185	0.90	0.75	6926	1/OWP	0.297	0.075	0.60
6974	1/OWP	534	28	26	0.347	0.274	0.225	0.172	0.133	0.080	0.041	0.370	0.080	0.720	21	1.00	1.143	0.90	0.75	6974	1/OWP	0.333	0.060	0.72
7025	1/OWP	544	27	26	0.207	0.176	0.154	0.125	0.104	0.077	0.033	0.220	0.030	0.800	23	1.00	1.185	0.90	0.75	7025	1/OWP	0.198	0.023	0.80
7074	1/OWP	508	41	26	0.660	0.500	0.374	0.247	0.160	0.081	0.037	0.740	0.180	0.660	20	1.00	0.780	0.90	0.75	7074	1/OWP	0.666	0.135	0.66
7125	1/OWP	512	42	27	0.593	0.433	0.387	0.294	0.225	0.140	0.073	0.660	0.180	0.690	9	1.00	0.762	0.90	0.75	7125	1/OWP	0.594	0.135	0.69
7175	1/OWP	525	40	28	0.252	0.183	0.144	0.112	0.081	0.056	0.036	0.270	0.070	0.650	25	1.00	0.800	0.90	0.75	7175	1/OWP	0.243	0.053	0.65
7224	1/OWP	516	38	26	0.537	0.401	0.284	0.190	0.117	0.063	0.020	0.590	0.150	0.640	25	1.00	0.842	0.90	0.75	7224	1/OWP	0.531	0.113	0.64
7275	1/OWP	516	39	27	0.487	0.347	0.251	0.156	0.090	0.037	0.003	0.530	0.150	0.610	25	1.00	0.821	0.90	0.75	7275	1/OWP	0.477	0.113	0.61
7326	1/OWP	517	41	27	0.376	0.258	0.172	0.092	0.058	0.022	0.006	0.410	0.130	0.570	25	1.00	0.780	0.90	0.75	7326	1/OWP	0.369	0.098	0.57
7375	1/OWP	548	33	27	0.597	0.462	0.363	0.273	0.187	0.121	0.048	0.620	0.140	0.690	12	1.00	0.970	0.90	0.75	7375	1/OWP	0.558	0.105	0.69
7425	1/OWP	555	44	27	0.909	0.660	0.474	0.293	0.186	0.093	0.045	0.930	0.250	0.620	18	1.00	0.727	0.90	0.75	7425	1/OWP	0.837	0.188	0.62
7474	1/OWP	576	45	27	0.529	0.395	0.295	0.200	0.137	0.071	0.027	0.520	0.130	0.650	25	1.00	0.711	0.90	0.75	7474	1/OWP	0.468	0.098	0.65
7525	1/OWP	588	28	27	0.400	0.274	0.184	0.099	0.051	0.018	0.007	0.380	0.120	0.570	25	1.00	1.143	0.90	0.75	7525	1/OWP	0.342	0.090	0.57
7574	1/OWP	576	46	27	0.821	0.565	0.385	0.203	0.097	0.016	0.001	0.810	0.250	0.580	25	1.00	0.696	0.90	0.75	7574	1/OWP	0.729	0.188	0.58
7625	1/OWP	589	35	28	0.454	0.317	0.226	0.143	0.098	0.058	0.030	0.440	0.130	0.600	25	1.00	0.914	0.90	0.75	7625	1/OWP	0.396	0.098	0.60
7675	1/OWP	589	40	28	0.368	0.227	0.130	0.060	0.033	0.017	0.010	0.350	0.140	0.490	25	1.00	0.800	0.90	0.75	7675	1/OWP	0.315	0.105	0.49
7724	1/OWP	594	30	27	0.311	0.212	0.152	0.094	0.061	0.028	0.010	0.300	0.090	0.590	25	1.00	1.067	0.90	0.75	7724	1/OWP	0.270	0.068	0.59
7775	1/OWP	580	45	27	0.325	0.230	0.154	0.089	0.054	0.026	0.010	0.320	0.090	0.590	25	1.00	0.711	0.90	0.75	7775	1/OWP	0.288	0.068	0.59
7824	1/OWP	576	45	28	0.496	0.394	0.330	0.241	0.178	0.094	0.033	0.490	0.100	0.730	19	1.00	0.711	0.90	0.75	7824	1/OWP	0.441	0.075	0.73
7875	1/OWP	570	29	28	0.464	0.335	0.260	0.171	0.106	0.040	0.006	0.460	0.130	0.640	25	1.00	1.103	0.90	0.75	7875	1/OWP	0.414	0.098	0.64
7925	1/OWP	590	28	28	0.176	0.141	0.109	0.077	0.053	0.026	0.008	0.170	0.030	0.710	25	1.00	1.143	0.90	0.75	7925	1/OWP	0.153	0.023	0.71
7974	1/OWP	573	40	27	0.457	0.334	0.251	0.174	0.127	0.081	0.047	0.450	0.120	0.640	23	1.00	0.800	0.90	0.75	7974	1/OWP	0.405	0.090	0.64
8024	1/OWP	569	41	27	0.608	0.410	0.297	0.187	0.121	0.059	0.019	0.600	0.200	0.580	25	1.00	0.780	0.90	0.75	8024	1/OWP	0.540	0.150	0.58
8074	1/OWP	580	35	26	0.355	0.269	0.201	0.135	0.084	0.038	0.008	0.350	0.080	0.660	25	1.00	0.914	0.90	0.75	8074	1/OWP	0.315	0.060	0.66
8125	1/OWP	579	36	26	0.473	0.360	0.283	0.194	0.128	0.054	0.016	0.460	0.110	0.680	25	1.00	0.889	0.90	0.75	8125	1/OWP	0.414	0.083	0.68
8177	1/OWP	573	37	26	0.603	0.472	0.353	0.244	0.174	0.090	0.033	0.600	0.130	0.680	20	1.00	0.865	0.90	0.75	8177	1/OWP	0.540	0.098	0.68
8225	1/OWP	565	32	27	0.917	0.662	0.497	0.322	0.218	0.130	0.066	0.920	0.260	0.630	11	1.00	1.000	0.90	0.75	8225	1/OWP	0.828	0.195	0.63

Mean (μ)			0.450					0.059			0.124	0.638	Estimated CBR Value
Standard Deviation (s)			0.189					0.032			0.057	0.062	
CVAR(%)			41.92					53.55			46.48	9.72	
Characteristic Value, f=	1.28		0.692					0.099			0.197	0.717	17.22

Pavement Section 1 (Ch 6574-7025) - Lane 1 (OWP)		
Average Max. Deflection (D_0)		0.36
Standard Deviation of Max. Deflection (SD_{D0})		0.09
CV (%)		**26**
Representative Deflection (D_r)	f = 1.28	**0.48**
Representative Curvature Function (CF_r)		**0.08**
Average Deflection Ratio (DR)		0.65
Standard Deviation of Deflection Ratio (SD_{DR})		0.07
Representative Deflection Ratio (DR_r)	f = 1.28	**0.56**
Average D_{900} Deflection (D_{900})		0.06
Standard Deviation of D_{900} Deflection (SD)		0.02
Representative D900 Deflection ($D_{r,900}$)	f = 1.28	**0.08**

Pavement Section 2 (Ch 7074-7625) - Lane 1 (OWP)		
Average Max. Deflection (D_0)		0.52
Standard Deviation of Max. Deflection (SD_{D0})		0.17
CV (%)		**33**
Representative Deflection (D_r)	f = 1.28	**0.74**
Representative Curvature Function (CF_r)		**0.12**
Average Deflection Ratio (DR)		0.63
Standard Deviation of Deflection Ratio (SD_{DR})		0.04
Representative Deflection Ratio (DR_r)	f = 1.28	**0.57**
Average D_{900} Deflection (D_{900})		0.06
Standard Deviation of D_{900} Deflection (SD)		0.04
Representative D900 Deflection ($D_{r,900}$)	f = 1.28	**0.12**

6449	1/IWP	605	43	26	0.106	0.057	0.041	0.033	0.028	0.016	0.004	0.100	0.050	0.460	25	1.00	0.744	0.90	0.75	6449	1/IWP	0.090	0.038	0.46
6500	1/IWP	601	38	25	0.164	0.120	0.102	0.084	0.068	0.041	0.010	0.150	0.040	0.680	25	1.00	0.842	0.90	0.75	6500	1/IWP	0.135	0.030	0.68
6550	1/IWP	595	41	26	0.193	0.140	0.115	0.095	0.076	0.048	0.015	0.180	0.050	0.660	25	1.00	0.780	0.90	0.75	6550	1/IWP	0.162	0.038	0.66
6599	1/IWP	572	38	25	0.563	0.377	0.266	0.161	0.106	0.059	0.029	0.560	0.180	0.570	25	1.00	0.842	0.90	0.75	6599	1/IWP	0.504	0.135	0.57
6650	1/IWP	582	33	25	0.447	0.297	0.202	0.121	0.081	0.046	0.024	0.430	0.150	0.560	25	1.00	0.970	0.90	0.75	6650	1/IWP	0.387	0.113	0.56
6699	1/IWP	585	30	25	0.313	0.258	0.214	0.170	0.130	0.080	0.030	0.300	0.050	0.750	24	1.00	1.067	0.90	0.75	6699	1/IWP	0.270	0.038	0.75
6750	1/IWP	573	31	25	0.354	0.262	0.199	0.134	0.096	0.053	0.021	0.350	0.090	0.650	25	1.00	1.032	0.90	0.75	6750	1/IWP	0.315	0.068	0.65
6800	1/IWP	583	28	25	0.350	0.259	0.192	0.129	0.092	0.054	0.023	0.340	0.090	0.640	25	1.00	1.143	0.90	0.75	6800	1/IWP	0.306	0.068	0.64
6849	1/IWP	569	28	25	0.445	0.326	0.243	0.167	0.118	0.070	0.032	0.440	0.120	0.640	25	1.00	1.143	0.90	0.75	6849	1/IWP	0.396	0.090	0.64
6900	1/IWP	545	28	25	0.179	0.114	0.084	0.057	0.041	0.027	0.013	0.190	0.070	0.550	25	1.00	1.143	0.90	0.75	6900	1/IWP	0.171	0.053	0.55
6949	1/IWP	519	32	25	0.499	0.370	0.284	0.187	0.132	0.064	0.010	0.540	0.140	0.660	25	1.00	1.000	0.90	0.75	6949	1/IWP	0.486	0.105	0.66
7000	1/IWP	528	33	25	0.369	0.277	0.219	0.151	0.107	0.066	0.007	0.400	0.100	0.670	25	1.00	0.970	0.90	0.75	7000	1/IWP	0.360	0.075	0.67
7085	1/IWP	523	31	25	0.185	0.110	0.095	0.071	0.048	0.032	0.018	0.200	0.080	0.550	25	1.00	1.032	0.90	0.75	7085	1/IWP	0.180	0.060	0.55
7150	1/IWP	545	35	25	0.427	0.340	0.274	0.210	0.191	0.103	0.042	0.440	0.090	0.720	15	1.00	0.914	0.90	0.75	7150	1/IWP	0.396	0.068	0.72
7199	1/IWP	530	33	25	0.256	0.212	0.151	0.123	0.107	0.085	0.042	0.270	0.050	0.710	19	1.00	0.970	0.90	0.75	7199	1/IWP	0.243	0.038	0.71
7250	1/IWP	530	34	25	0.302	0.217	0.143	0.091	0.078	0.061	0.020	0.320	0.090	0.600	25	1.00	0.941	0.90	0.75	7250	1/IWP	0.288	0.068	0.60
7300	1/IWP	519	34	25	0.447	0.317	0.221	0.121	0.067	0.034	0.005	0.490	0.140	0.600	25	1.00	0.941	0.90	0.75	7300	1/IWP	0.441	0.105	0.60
7350	1/IWP	524	32	25	0.408	0.293	0.215	0.137	0.084	0.031	0.000	0.440	0.120	0.620	25	1.00	1.000	0.90	0.75	7350	1/IWP	0.396	0.090	0.62
7400	1/IWP	568	35	25	0.522	0.389	0.292	0.203	0.150	0.098	0.053	0.520	0.130	0.650	17	1.00	0.914	0.90	0.75	7400	1/IWP	0.468	0.098	0.65
7449	1/IWP	564	34	25	0.685	0.470	0.343	0.227	0.165	0.105	0.053	0.690	0.220	0.590	16	1.00	0.941	0.90	0.75	7449	1/IWP	0.621	0.165	0.59
7500	1/IWP	577	33	25	0.834	0.553	0.359	0.196	0.115	0.050	0.017	0.820	0.280	0.550	25	1.00	0.970	0.90	0.75	7500	1/IWP	0.738	0.210	0.55
7550	1/IWP	576	30	25	0.582	0.391	0.248	0.115	0.052	0.014	0.005	0.570	0.190	0.550	25	1.00	1.067	0.90	0.75	7550	1/IWP	0.513	0.143	0.55
7599	1/IWP	589	35	25	0.460	0.288	0.186	0.099	0.063	0.035	0.016	0.440	0.170	0.520	25	1.00	0.914	0.90	0.75	7599	1/IWP	0.396	0.128	0.52
7650	1/IWP	589	34	25	0.499	0.345	0.225	0.127	0.078	0.042	0.019	0.480	0.150	0.570	25	1.00	0.941	0.90	0.75	7650	1/IWP	0.432	0.113	0.57
7699	1/IWP	589	30	25	0.299	0.203	0.142	0.091	0.064	0.038	0.018	0.290	0.090	0.580	25	1.00	1.067	0.90	0.75	7699	1/IWP	0.261	0.068	0.58
7750	1/IWP	590	30	25	0.253	0.154	0.103	0.060	0.039	0.020	0.010	0.240	0.090	0.510	25	1.00	1.067	0.90	0.75	7750	1/IWP	0.216	0.068	0.51
7800	1/IWP	572	35	25	0.634	0.477	0.362	0.244	0.170	0.100	0.046	0.630	0.160	0.660	17	1.00	0.914	0.90	0.75	7800	1/IWP	0.567	0.120	0.66
7849	1/IWP	578	35	26	0.591	0.405	0.289	0.187	0.118	0.060	0.018	0.580	0.180	0.590	25	1.00	0.914	0.90	0.75	7849	1/IWP	0.522	0.135	0.59
7900	1/IWP	590	31	25	0.233	0.176	0.121	0.076	0.040	0.009	0.007	0.220	0.050	0.640	25	1.00	1.032	0.90	0.75	7900	1/IWP	0.198	0.038	0.64
7949	1/IWP	583	30	25	0.282	0.217	0.164	0.126	0.097	0.064	0.034	0.270	0.060	0.680	25	1.00	1.067	0.90	0.75	7949	1/IWP	0.243	0.045	0.68
8000	1/IWP	572	32	25	0.632	0.491	0.378	0.261	0.179	0.089	0.023	0.630	0.140	0.690	20	1.00	1.000	0.90	0.75	8000	1/IWP	0.567	0.105	0.69
8050	1/IWP	571	33	25	0.179	0.135	0.100	0.061	0.037	0.016	0.010	0.180	0.040	0.660	25	1.00	0.970	0.90	0.75	8050	1/IWP	0.162	0.030	0.66
8100	1/IWP	581	34	25	0.397	0.323	0.267	0.193	0.135	0.062	0.011	0.390	0.070	0.740	25	1.00	0.941	0.90	0.75	8100	1/IWP	0.351	0.053	0.74
8149	1/IWP	574	33	25	0.764	0.583	0.441	0.272	0.145	0.061	0.017	0.750	0.180	0.670	25	1.00	0.970	0.90	0.75	8149	1/IWP	0.675	0.135	0.67
8199	1/IWP	562	28	25	0.548	0.423	0.350	0.262	0.201	0.133	0.064	0.550	0.130	0.710	11	1.00	1.143	0.90	0.75	8199	1/IWP	0.495	0.098	0.71
8239	1/IWP	554	33	25	1.103	0.825	0.622	0.390	0.248	0.121	0.053	1.130	0.280	0.660	12	1.00	0.970	0.90	0.75	8239	1/IWP	1.017	0.210	0.66

Mean (μ)			0.431					0.058			0.120	0.625	Estimated CBR Value
Standard Deviation (s)			0.212					0.031			0.063	0.069	
CVAR(%)			49.34					53.57			52.35	10.97	
Characteristic Value, f=	1.28		0.703					0.098			0.200	0.713	17.65

Pavement Section 1 (Ch 6599-7650) - Lane 2 (IWP)		
Average Max. Deflection (D_0)		0.40
Standard Deviation of Max. Deflection (SD_{D0})		0.14
CV (%)		**35**
Representative Deflection (D_r)	f = 1.28	**0.57**
Representative Curvature Function (CFr)		**0.10**
Average Deflection Ratio (DR)		0.62
Standard Deviation of Deflection Ratio (SD_{DR})		0.06
Representative Deflection Ratio (DR_r)	f = 1.28	**0.53**
Average D_{900} Deflection (D_{900})		0.02
Standard Deviation of D_{900} Deflection (SD)		0.02
Representative D900 Deflection ($D_{r,900}$)	f = 1.28	**0.04**

Street Name: Mooloolaba Road, Buderim, 40kN

Chge (m)	Lane	Stress (kPa)	Surface Temp (C°)	Air Temp (C°)	Normalised Deflection Bowl (mm)							Max Defln	Curvature D0-D200	Ratio D250/D0	Subgrade CBR	Correction			Curvature Correction Factors (applied if H_{AC} > 50mm)	Chainage (m)	Lane	Corrected D_0	Corrected Curvature Function (D_0-D_{200})	Deflection Ratio = D_{250}/D_0
					0	200	300	450	600	900	1500					Moisture correction - TMR Table 2.3	WMAPT / $T_{measured}$	Temperature Adjustment for Deflection[3] (Input from TMR Figure 2.18)	Temperature Adjustment for Curvature Function (Input from TMR Figure 2.19)					
6420	2/OWP	586	47	29	0.119	0.066	0.055	0.048	0.043	0.033	0.020	0.110	0.050	0.510	25.000	1.00	0.681	0.90	0.75	6420	2/OWP	0.099	0.038	0.51
6449	2/OWP	590	47	29	0.103	0.051	0.033	0.032	0.030	0.023	0.015	0.100	0.050	0.410	25.000	1.00	0.681	0.90	0.75	6449	2/OWP	0.090	0.038	0.41
6500	2/OWP	579	44	29	0.205	0.154	0.131	0.117	0.101	0.069	0.027	0.200	0.050	0.700	25.000	1.00	0.727	0.90	0.75	6500	2/OWP	0.180	0.038	0.70
6559	2/OWP	573	42	29	0.930	0.589	0.395	0.246	0.157	0.077	0.027	0.920	0.340	0.530	25.000	1.00	0.762	0.90	0.75	6559	2/OWP	0.828	0.255	0.53
6599	2/OWP	581	43	28	0.344	0.261	0.196	0.140	0.102	0.060	0.028	0.340	0.080	0.660	25.000	1.00	0.744	0.90	0.75	6599	2/OWP	0.306	0.060	0.66
6650	2/OWP	586	37	28	0.472	0.331	0.226	0.134	0.090	0.050	0.026	0.460	0.140	0.590	25.000	1.00	0.865	0.90	0.75	6650	2/OWP	0.414	0.105	0.59
6699	2/OWP	588	44	29	0.372	0.285	0.225	0.163	0.117	0.060	0.024	0.360	0.080	0.690	25.000	1.00	0.727	0.90	0.75	6699	2/OWP	0.324	0.060	0.69
6750	2/OWP	565	43	27	0.545	0.398	0.287	0.189	0.122	0.058	0.024	0.550	0.150	0.630	25.000	1.00	0.744	0.90	0.75	6750	2/OWP	0.495	0.113	0.63
6800	2/OWP	553	38	28	0.469	0.325	0.230	0.136	0.078	0.031	0.013	0.480	0.150	0.590	25.000	1.00	0.842	0.90	0.75	6800	2/OWP	0.432	0.113	0.59
6849	2/OWP	520	47	29	0.797	0.578	0.429	0.277	0.181	0.088	0.036	0.870	0.240	0.630	18.000	1.00	0.681	0.90	0.75	6849	2/OWP	0.783	0.180	0.63
6900	2/OWP	520	36	29	0.185	0.159	0.137	0.101	0.078	0.050	0.019	0.200	0.030	0.800	25.000	1.00	0.889	0.90	0.75	6900	2/OWP	0.180	0.023	0.80
6949	2/OWP	497	45	29	0.602	0.405	0.281	0.175	0.118	0.075	0.026	0.690	0.220	0.570	21.000	1.00	0.711	0.90	0.75	6949	2/OWP	0.621	0.165	0.57
7000	2/OWP	502	44	29	0.612	0.433	0.315	0.209	0.152	0.088	0.044	0.690	0.200	0.610	17.000	1.00	0.727	0.90	0.75	7000	2/OWP	0.621	0.150	0.61
7050	2/OWP	510	43	28	0.255	0.207	0.178	0.145	0.117	0.076	0.032	0.280	0.050	0.750	22.000	1.00	0.744	0.90	0.75	7050	2/OWP	0.252	0.038	0.75
7099	2/OWP	515	45	29	0.276	0.190	0.145	0.102	0.079	0.055	0.026	0.300	0.090	0.610	25.000	1.00	0.711	0.90	0.75	7099	2/OWP	0.270	0.068	0.61
7150	2/OWP	500	44	30	0.599	0.460	0.367	0.277	0.213	0.133	0.055	0.680	0.160	0.690	9.000	1.00	0.727	0.90	0.75	7150	2/OWP	0.612	0.120	0.69
7199	2/OWP	520	43	29	0.228	0.174	0.123	0.097	0.072	0.048	0.031	0.250	0.060	0.650	25.000	1.00	0.744	0.90	0.75	7199	2/OWP	0.225	0.045	0.65
7250	2/OWP	508	45	29	0.360	0.247	0.190	0.126	0.087	0.044	0.013	0.400	0.130	0.610	25.000	1.00	0.711	0.90	0.75	7250	2/OWP	0.360	0.098	0.61
7300	2/OWP	499	49	30	0.343	0.224	0.147	0.079	0.043	0.017	0.007	0.390	0.130	0.540	25.000	1.00	0.653	0.90	0.75	7300	2/OWP	0.351	0.098	0.54
7349	2/OWP	509	50	31	0.409	0.298	0.222	0.145	0.097	0.049	0.017	0.450	0.120	0.640	25.000	1.00	0.640	0.90	0.75	7349	2/OWP	0.405	0.090	0.64
7400	2/OWP	526	47	29	0.430	0.293	0.217	0.145	0.104	0.057	0.029	0.460	0.150	0.590	25.000	1.00	0.681	0.90	0.75	7400	2/OWP	0.414	0.113	0.59
7449	2/OWP	552	43	29	0.408	0.304	0.237	0.167	0.112	0.062	0.025	0.420	0.110	0.660	25.000	1.00	0.744	0.90	0.75	7449	2/OWP	0.378	0.083	0.66
7500	2/OWP	572	42	28	0.910	0.697	0.528	0.333	0.213	0.108	0.048	0.900	0.210	0.670	15.000	1.00	0.762	0.90	0.75	7500	2/OWP	0.810	0.158	0.67
7548	2/OWP	583	44	28	0.652	0.399	0.242	0.111	0.052	0.012	0.004	0.630	0.250	0.490	25.000	1.00	0.727	0.90	0.75	7548	2/OWP	0.567	0.188	0.49
7599	2/OWP	592	42	28	0.276	0.160	0.126	0.099	0.079	0.054	0.022	0.260	0.110	0.520	25.000	1.00	0.762	0.90	0.75	7599	2/OWP	0.234	0.083	0.52
7650	2/OWP	577	42	29	0.830	0.585	0.407	0.232	0.141	0.070	0.030	0.810	0.240	0.600	25.000	1.00	0.762	0.90	0.75	7650	2/OWP	0.729	0.180	0.60
7699	2/OWP	598	40	29	0.280	0.177	0.115	0.061	0.035	0.017	0.008	0.260	0.100	0.520	25.000	1.00	0.800	0.90	0.75	7699	2/OWP	0.234	0.075	0.52
7750	2/OWP	579	40	29	0.909	0.689	0.507	0.314	0.192	0.080	0.023	0.890	0.220	0.660	24.000	1.00	0.800	0.90	0.75	7750	2/OWP	0.801	0.165	0.66
7800	2/OWP	571	43	28	0.400	0.270	0.196	0.131	0.099	0.067	0.040	0.400	0.130	0.580	25.000	1.00	0.744	0.90	0.75	7800	2/OWP	0.360	0.098	0.58
7849	2/OWP	576	41	28	0.516	0.382	0.291	0.184	0.115	0.061	0.031	0.510	0.130	0.650	25.000	1.00	0.780	0.90	0.75	7849	2/OWP	0.459	0.098	0.65
7900	2/OWP	580	39	29	0.326	0.234	0.167	0.094	0.050	0.014	0.004	0.320	0.090	0.620	25.000	1.00	0.821	0.90	0.75	7900	2/OWP	0.288	0.068	0.62
7949	2/OWP	556	39	29	0.276	0.205	0.157	0.107	0.075	0.043	0.023	0.280	0.070	0.660	25.000	1.00	0.821	0.90	0.75	7949	2/OWP	0.252	0.053	0.66
8000	2/OWP	563	39	29	0.764	0.535	0.381	0.223	0.123	0.046	0.019	0.770	0.230	0.600	25.000	1.00	0.821	0.90	0.75	8000	2/OWP	0.693	0.173	0.60
8050	2/OWP	599	35	28	0.177	0.140	0.107	0.075	0.054	0.031	0.018	0.170	0.030	0.700	25.000	1.00	0.914	0.90	0.75	8050	2/OWP	0.153	0.023	0.70
8100	2/OWP	582	39	29	0.774	0.597	0.485	0.341	0.231	0.099	0.014	0.750	0.170	0.700	18.000	1.00	0.821	0.90	0.75	8100	2/OWP	0.675	0.128	0.70
8149	2/OWP	552	39	27	0.646	0.418	0.303	0.178	0.121	0.072	0.026	0.660	0.230	0.560	25.000	1.00	0.821	0.90	0.75	8149	2/OWP	0.594	0.173	0.56
8199	2/OWP	568	36	27	0.799	0.594	0.444	0.291	0.190	0.093	0.030	0.800	0.200	0.650	19.000	1.00	0.889	0.90	0.75	8199	2/OWP	0.720	0.150	0.65
8250	2/OWP	566	43	27	0.579	0.451	0.373	0.269	0.191	0.095	0.029	0.580	0.130	0.710	18.000	1.00	0.744	0.90	0.75	8250	2/OWP	0.522	0.098	0.71

Mean (μ)			0.478					0.060			0.140	0.620	Estimated CBR Value
Standard Deviation (s)			0.238					0.027			0.073	0.077	
CVAR(%)			49.74					45.95			52.41	12.38	
Characteristic Value, f=	1.28		0.783					0.095			0.234	0.718	18.48

Pavement Section 1 (Ch 6599-7199) - Lane 2 (OWP)		
Average Max. Deflection (D_0)		0.41
Standard Deviation of Max. Deflection (SD_{D0})		0.19
CV (%)		**45**
Representative Deflection (D_r)	f = 1.28	**0.65**
Representative Curvature Function (CF_r)		**0.10**
Average Deflection Ratio (DR)		0.65
Standard Deviation of Deflection Ratio (SD_{DR})		0.07
Representative Deflection Ratio (DR_r)	f = 1.28	**0.57**
Average D_{900} Deflection (D_{900})		0.07
Standard Deviation of D_{900} Deflection (SD)		0.03
Representative D900 Deflection ($D_{r,900}$)	f = 1.28	**0.10**

Pavement Section 2 (Ch 7250-7449) - Lane 2 (OWP)		
Average Max. Deflection (D_0)		0.38
Standard Deviation of Max. Deflection (SD_{D0})		0.03
CV (%)		**7**
Representative Deflection (D_r)		**0.41**
Representative Curvature Function (CF_r)		**0.10**
Average Deflection Ratio (DR)		0.61
Standard Deviation of Deflection Ratio (SD_{DR})		0.05
Representative Deflection Ratio (DR_r)	f = 1.28	**0.55**
Average D_{900} Deflection (D_{900})		0.05
Standard Deviation of D_{900} Deflection (SD)		0.02
Representative D900 Deflection ($D_{r,900}$)	f = 1.28	**0.07**

Pavement Section 3 (Ch 7500-7699) - Lane 2 (OWP)		
Average Max. Deflection (D_0)		0.51
Standard Deviation of Max. Deflection (SD_{D0})		0.27
CV (%)		**53**
Representative Deflection (D_r)		**0.81**
Representative Curvature Function (CF_r)		**0.14**
Average Deflection Ratio (DR)		0.56
Standard Deviation of Deflection Ratio (SD_{DR})		0.07
Representative Deflection Ratio (DR_r)	f = 1.28	**0.47**
Average D_{900} Deflection (D_{900})		0.05
Standard Deviation of D_{900} Deflection (SD)		0.04
Representative D900 Deflection ($D_{r,900}$)	f = 1.28	**0.10**

6425	2/IWP	584	47	28	0.143	0.086	0.067	0.057	0.048	0.034	0.015	0.140	0.060	0.530	25	1.00	0.681	0.90	0.75	6425	2/IWP	0.126	0.045	0.53
6474	2/IWP	587	43	27	0.117	0.079	0.059	0.051	0.043	0.025	0.006	0.110	0.040	0.590	25	1.00	0.744	0.90	0.75	6474	2/IWP	0.099	0.030	0.59
6524	2/IWP	589	40	27	0.172	0.104	0.092	0.083	0.070	0.047	0.017	0.170	0.070	0.570	25	1.00	0.800	0.90	0.75	6524	2/IWP	0.153	0.053	0.57
6572	2/IWP	578	40	27	0.583	0.403	0.278	0.175	0.120	0.069	0.028	0.570	0.180	0.580	25	1.00	0.800	0.90	0.75	6572	2/IWP	0.513	0.135	0.58
6625	2/IWP	589	38	27	0.421	0.298	0.215	0.140	0.100	0.061	0.031	0.400	0.120	0.610	25	1.00	0.842	0.90	0.75	6625	2/IWP	0.360	0.090	0.61
6675	2/IWP	573	46	28	0.528	0.366	0.258	0.169	0.118	0.070	0.027	0.520	0.160	0.590	25	1.00	0.696	0.90	0.75	6675	2/IWP	0.468	0.120	0.59
6724	2/IWP	571	33	28	0.353	0.255	0.190	0.126	0.086	0.044	0.016	0.350	0.100	0.630	25	1.00	0.970	0.90	0.75	6724	2/IWP	0.315	0.075	0.63
6775	2/IWP	569	38	28	0.446	0.331	0.247	0.156	0.103	0.054	0.025	0.440	0.110	0.650	25	1.00	0.842	0.90	0.75	6775	2/IWP	0.396	0.083	0.65
6824	2/IWP	541	29	28	0.362	0.254	0.190	0.123	0.085	0.048	0.022	0.380	0.110	0.610	25	1.00	1.103	0.90	0.75	6824	2/IWP	0.342	0.083	0.61
6875	2/IWP	525	38	28	0.251	0.187	0.138	0.095	0.066	0.041	0.019	0.270	0.070	0.650	25	1.00	0.842	0.90	0.75	6875	2/IWP	0.243	0.053	0.65
6925	2/IWP	509	45	29	0.342	0.212	0.143	0.092	0.063	0.037	0.020	0.380	0.140	0.520	25	1.00	0.711	0.90	0.75	6925	2/IWP	0.342	0.105	0.52
6974	2/IWP	497	39	28	0.623	0.423	0.304	0.184	0.119	0.062	0.032	0.710	0.230	0.580	25	1.00	0.821	0.90	0.75	6974	2/IWP	0.639	0.173	0.58
7025	2/IWP	503	33	29	0.266	0.173	0.116	0.072	0.054	0.035	0.014	0.300	0.100	0.540	25	1.00	0.970	0.90	0.75	7025	2/IWP	0.270	0.075	0.54
7074	2/IWP	506	45	29	0.437	0.310	0.236	0.164	0.119	0.069	0.028	0.490	0.140	0.620	25	1.00	0.711	0.90	0.75	7074	2/IWP	0.441	0.105	0.62
7125	2/IWP	500	43	29	0.483	0.339	0.257	0.179	0.132	0.082	0.046	0.550	0.160	0.620	19	1.00	0.744	0.90	0.75	7125	2/IWP	0.495	0.120	0.62
7175	2/IWP	517	42	29	0.126	0.078	0.055	0.040	0.034	0.026	0.019	0.140	0.050	0.530	25	1.00	0.762	0.90	0.75	7175	2/IWP	0.126	0.038	0.53
7224	2/IWP	511	44	29	0.271	0.174	0.124	0.085	0.064	0.039	0.015	0.300	0.110	0.550	25	1.00	0.727	0.90	0.75	7224	2/IWP	0.270	0.083	0.55
7275	2/IWP	516	47	30	0.304	0.197	0.138	0.082	0.052	0.022	0.007	0.330	0.120	0.550	25	1.00	0.681	0.90	0.75	7275	2/IWP	0.297	0.090	0.55
7324	2/IWP	515	44	30	0.251	0.157	0.105	0.063	0.038	0.018	0.006	0.280	0.100	0.520	25	1.00	0.727	0.90	0.75	7324	2/IWP	0.252	0.075	0.52
7375	2/IWP	512	45	29	0.657	0.494	0.381	0.266	0.185	0.100	0.044	0.730	0.180	0.670	15	1.00	0.711	0.90	0.75	7375	2/IWP	0.657	0.135	0.67
7425	2/IWP	542	44	28	0.213	0.143	0.105	0.084	0.067	0.045	0.028	0.220	0.070	0.580	25	1.00	0.727	0.90	0.75	7425	2/IWP	0.198	0.053	0.58
7474	2/IWP	554	44	28	0.603	0.416	0.298	0.184	0.122	0.063	0.031	0.620	0.190	0.590	25	1.00	0.727	0.90	0.75	7474	2/IWP	0.558	0.143	0.59
7525	2/IWP	590	37	29	0.430	0.282	0.180	0.102	0.064	0.031	0.013	0.410	0.140	0.540	25	1.00	0.865	0.90	0.75	7525	2/IWP	0.369	0.105	0.54
7574	2/IWP	573	44	29	0.709	0.534	0.404	0.243	0.155	0.050	0.016	0.700	0.170	0.660	25	1.00	0.727	0.90	0.75	7574	2/IWP	0.630	0.128	0.66
7625	2/IWP	583	46	30	0.472	0.345	0.236	0.133	0.078	0.042	0.026	0.460	0.120	0.620	25	1.00	0.696	0.90	0.75	7625	2/IWP	0.414	0.090	0.62
7675	2/IWP	567	45	29	0.857	0.570	0.365	0.164	0.072	0.020	0.007	0.860	0.290	0.550	25	1.00	0.711	0.90	0.75	7675	2/IWP	0.774	0.218	0.55
7724	2/IWP	588	35	29	0.431	0.323	0.235	0.149	0.094	0.039	0.015	0.410	0.100	0.650	25	1.00	0.914	0.90	0.75	7724	2/IWP	0.369	0.075	0.65
7775	2/IWP	591	45	29	0.267	0.162	0.109	0.069	0.047	0.025	0.013	0.260	0.100	0.510	25	1.00	0.711	0.90	0.75	7775	2/IWP	0.234	0.075	0.51
7824	2/IWP	577	44	29	0.527	0.356	0.256	0.167	0.117	0.077	0.041	0.520	0.170	0.580	25	1.00	0.727	0.90	0.75	7824	2/IWP	0.468	0.128	0.58
7875	2/IWP	586	44	29	0.242	0.161	0.117	0.066	0.035	0.009	0.003	0.230	0.080	0.570	25	1.00	0.727	0.90	0.75	7875	2/IWP	0.207	0.060	0.57
7925	2/IWP	557	31	29	0.142	0.104	0.073	0.048	0.030	0.013	0.006	0.140	0.040	0.620	25	1.00	1.032	0.90	0.75	7925	2/IWP	0.126	0.030	0.62
7974	2/IWP	548	42	30	0.960	0.643	0.420	0.221	0.110	0.041	0.034	0.990	0.330	0.550	25	1.00	0.762	0.90	0.75	7974	2/IWP	0.891	0.248	0.55
8024	2/IWP	585	43	29	0.186	0.164	0.142	0.112	0.086	0.054	0.028	0.180	0.020	0.820	25	1.00	0.744	0.90	0.75	8024	2/IWP	0.162	0.015	0.82
8074	2/IWP	596	40	29	0.301	0.235	0.187	0.123	0.076	0.031	0.011	0.290	0.060	0.700	25	1.00	0.800	0.90	0.75	8074	2/IWP	0.261	0.045	0.70
8125	2/IWP	593	43	29	0.359	0.273	0.210	0.138	0.089	0.040	0.014	0.340	0.080	0.670	25	1.00	0.744	0.90	0.75	8125	2/IWP	0.306	0.060	0.67
8175	2/IWP	559	42	29	0.496	0.360	0.250	0.153	0.098	0.046	0.021	0.500	0.140	0.610	25	1.00	0.762	0.90	0.75	8175	2/IWP	0.450	0.105	0.61
8225	2/IWP	543	45	30	0.799	0.551	0.388	0.222	0.129	0.061	0.000	0.830	0.260	0.590	25	1.00	0.711	0.90	0.75	8225	2/IWP	0.747	0.195	0.59

Mean (μ)			0.409					0.045			0.127	0.598	Estimated CBR Value
Standard Deviation (s)			0.210					0.020			0.069	0.061	
CVAR(%)			51.46					44.77			54.38	10.19	
Characteristic Value, f=	1.28		0.678					0.071			0.216	0.676	28.08

Pavement Section 1 (Ch 6572-7324) - Lane 2 (IWP)		
Average Max. Deflection (D_0)		0.36
Standard Deviation of Max. Deflection (SD_{D0})		0.13
CV (%)		**35**
Representative Deflection (D_r)	f = 1.28	**0.52**
Representative Curvature Function, $CF_{r,before}$		**0.09**
Average Deflection Ratio (DR)		0.58
Standard Deviation of Deflection Ratio (SD_{DR})		0.04
Representative Deflection Ratio (DR_r)	f = 1.28	**0.53**
Average D_{900} Deflection (D_{900})		0.05
Standard Deviation of D_{900} Deflection (SD)		0.02
Representative D900 Deflection ($D_{r,900}$)	f = 1.28	**0.07**

Pavement Section 2 (Ch 7375-7675) - Lane 2 (IWP)		
Average Max. Deflection (D_0)		0.51
Standard Deviation of Max. Deflection (SD_{D0})		0.20
CV (%)		**38**
Representative Deflection (D_r)		**0.77**
Representative Curvature Function, $CF_{r,before}$		**0.12**
Average Deflection Ratio (DR)		0.60
Standard Deviation of Deflection Ratio (SD_{DR})		0.05
Representative Deflection Ratio (DR_r)	f = 1.28	**0.54**
Average D_{900} Deflection (D_{900})		0.05
Standard Deviation of D_{900} Deflection (SD)		0.03
Representative D900 Deflection ($D_{r,900}$)	f = 1.28	**0.08**

Lane 1 - Back-calculated E-Moduli (40kN)

Station	Thick1	Thick2	Thick3	Thick4	Thick5	Emod1	Emod2	Emod3	Emod4	Emod5	Poiss1
6425	150	180	180	1200	Semi-Inf	5000	500	350	150	1500	0.4
6474	150	180	180	1200	Semi-Inf	5000	500	350	141	435	0.4
6525	150	180	180	1200	Semi-Inf	4438	500	268	133	1500	0.4
6574	150	180	180	1200	Semi-Inf	781	177	103	115	258	0.4
6625	150	180	180	1200	Semi-Inf	1344	148	185	150	435	0.4
6675	150	180	180	1200	Semi-Inf	2469	444	144	98	435	0.4
6724	150	180	180	1200	Semi-Inf	1414	219	103	133	435	0.4
6775	150	180	180	1200	Semi-Inf	1273	106	144	115	435	0.4
6824	150	180	180	1200	Semi-Inf	1168	106	103	133	258	0.4
6875	150	180	180	1200	Semi-Inf	1871	99	226	106	613	0.4
6926	150	180	180	1200	Semi-Inf	2047	120	350	250	1500	0.4
6974	150	180	180	1200	Semi-Inf	1906	388	144	89	213	0.4
7025	150	180	180	1200	Semi-Inf	5000	500	268	150	169	0.4
7074	150	180	180	1200	Semi-Inf	1203	50	51	106	213	0.4
7125	150	180	180	1200	Semi-Inf	711	331	72	63	86	0.4
7175	150	180	180	1200	Semi-Inf	2188	444	268	150	258	0.4
7224	150	180	180	1200	Semi-Inf	957	120	82	98	435	0.4
7275	150	180	180	1200	Semi-Inf	922	141	92	106	1500	0.4
7326	150	180	180	1200	Semi-Inf	1063	134	268	150	1500	0.4
7375	150	180	180	1200	Semi-Inf	992	163	77	89	124	0.4
7425	150	180	180	1200	Semi-Inf	658	50	61	93	169	0.4
7474	150	180	180	1200	Semi-Inf	1063	163	113	89	435	0.4
7525	150	180	180	1200	Semi-Inf	1660	92	350	250	1500	0.4
7574	150	180	180	1200	Semi-Inf	711	50	51	150	1500	0.4
7625	150	180	180	1200	Semi-Inf	1414	113	185	150	346	0.4
7675	150	180	180	1200	Semi-Inf	1133	191	350	300	1500	0.4
7724	150	180	180	1200	Semi-Inf	1203	331	309	150	1500	0.4
7775	150	180	180	1200	Semi-Inf	1344	219	350	150	1500	0.4
7824	150	180	180	1200	Semi-Inf	1484	247	103	63	258	0.4
7875	150	180	180	1200	Semi-Inf	992	219	103	98	1500	0.4
7925	150	180	180	1200	Semi-Inf	5000	500	350	150	1500	0.4
7974	150	180	180	1200	Semi-Inf	1484	134	185	115	213	0.4
8024	150	180	180	1200	Semi-Inf	711	127	113	89	790	0.4
8074	150	180	180	1200	Semi-Inf	1344	303	123	133	1500	0.4
8125	150	180	180	1200	Semi-Inf	1484	191	82	80	1500	0.4
8177	150	180	180	1200	Semi-Inf	992	134	103	76	258	0.4
8225	150	180	180	1200	Semi-Inf	658	64	66	80	102	0.4

Station	Poiss2	Poiss3	Poiss4	Poiss5	Pressure	Meas0	Meas200	Meas300	Meas450	Meas600	Meas900	Meas1500
6425	0.35	0.35	0.45	0.35	594	92	53	43	35	31	23	10
6474	0.35	0.35	0.45	0.35	600	185	137	122	100	83	55	19
6525	0.35	0.35	0.45	0.35	581	203	153	130	102	78	45	13
6574	0.35	0.35	0.45	0.35	572	545	360	268	180	127	74	31
6625	0.35	0.35	0.45	0.35	579	415	291	201	127	85	49	26
6675	0.35	0.35	0.45	0.35	583	313	248	205	154	116	68	29
6724	0.35	0.35	0.45	0.35	569	407	293	219	144	99	55	26
6775	0.35	0.35	0.45	0.35	571	501	357	257	159	108	58	25
6824	0.35	0.35	0.45	0.35	572	536	391	283	175	120	70	34
6875	0.35	0.35	0.45	0.35	572	424	312	238	160	109	55	22
6926	0.35	0.35	0.45	0.35	537	312	218	154	88	58	14	0
6974	0.35	0.35	0.45	0.35	534	347	274	225	172	133	80	41
7025	0.35	0.35	0.45	0.35	544	207	176	154	125	104	77	33
7074	0.35	0.35	0.45	0.35	508	660	500	374	247	160	81	37
7125	0.35	0.35	0.45	0.35	512	593	433	387	294	225	140	73
7175	0.35	0.35	0.45	0.35	525	252	183	144	112	81	56	36
7224	0.35	0.35	0.45	0.35	516	537	401	284	190	117	63	20
7275	0.35	0.35	0.45	0.35	516	487	347	251	156	90	37	3
7326	0.35	0.35	0.45	0.35	517	376	258	172	92	58	22	6
7375	0.35	0.35	0.45	0.35	548	597	462	363	273	187	121	48
7425	0.35	0.35	0.45	0.35	555	909	660	474	293	186	93	45
7474	0.35	0.35	0.45	0.35	576	529	395	295	200	137	71	27
7525	0.35	0.35	0.45	0.35	588	400	274	184	99	51	18	7
7574	0.35	0.35	0.45	0.35	576	821	565	385	203	97	16	1
7625	0.35	0.35	0.45	0.35	589	454	317	226	143	98	58	30
7675	0.35	0.35	0.45	0.35	589	368	227	130	60	33	17	10
7724	0.35	0.35	0.45	0.35	594	311	212	152	94	61	28	10
7775	0.35	0.35	0.45	0.35	580	325	230	154	89	54	26	10
7824	0.35	0.35	0.45	0.35	576	496	394	330	241	178	94	33
7875	0.35	0.35	0.45	0.35	570	464	335	260	171	106	40	6
7925	0.35	0.35	0.45	0.35	590	176	141	109	77	53	26	8
7974	0.35	0.35	0.45	0.35	573	457	334	251	174	127	81	47
8024	0.35	0.35	0.45	0.35	569	608	410	297	187	121	59	19
8074	0.35	0.35	0.45	0.35	580	355	269	201	135	84	38	8
8125	0.35	0.35	0.45	0.35	579	473	360	283	194	128	54	16
8177	0.35	0.35	0.45	0.35	573	603	472	353	244	174	90	33
8225	0.35	0.35	0.45	0.35	565	917	662	497	322	218	130	66

Station	Calc0	Calc200	Calc300	Calc450	Calc600	Calc900	Calc1500	Adj.Err(%)
6425	183	141	117	86.8	64.5	35	8.72	95.24
6474	207	164	139	108	84.6	53	22.4	4.95
6525	200	155	128	95.8	71.2	38.4	8.95	0.00
6574	548	359	270	182	128	69.4	29	0.00
6625	413	279	209	136	91.5	46.5	17.7	0.35
6675	311	238	198	151	116	67.5	22.9	0.00
6724	406	284	220	151	104	52.5	17.4	0.00
6775	497	345	261	171	113	54.1	17.5	0.91
6824	536	372	282	136	125	63.5	27.7	0.99
6875	424	309	240	162	109	51.7	13.7	0.00
6926	280	187	136	81	48	18.4	4.32	5.42
6974	345	264	221	171	135	85	37.7	0.28
7025	220	181	157	128	105	74.2	42.6	0.58
7074	659	486	379	253	165	73.5	27.4	0.26
7125	589	430	361	286	231	155	80.8	1.78
7175	248	182	148	113	88	56.8	28.3	0.00
7224	537	368	279	183	121	55.7	15.4	1.00
7275	485	320	237	150	95.1	38.1	4.21	1.42
7326	377	236	167	100	62.2	26.6	4.91	0.95
7375	593	429	343	250	186	113	56.5	2.45
7425	908	619	459	289	185	88	39.8	1.08
7474	524	363	280	192	133	67.2	19.4	1.45
7525	361	236	168	96.1	54.2	19.1	4.51	3.78
7574	817	534	377	210	110	25.9	1.42	1.81
7625	451	310	234	153	102	52.2	22	0.00
7675	318	182	121	67.4	39.9	17.4	4.99	4.29
7724	312	195	144	96.4	66.8	33.1	6.99	0.81
7775	327	209	153	98.2	65.6	31.3	6.53	2.75
7824	499	379	313	237	181	105	37.1	1.84
7875	467	313	237	159	107	47.6	6.1	2.31
7925	182	140	116	86.2	64	34.8	8.67	1.63
7974	457	328	257	181	131	76	35.8	1.89
8024	613	394	288	184	120	54	10.4	0.40
8074	357	241	184	124	84.1	37.9	5.81	2.71
8125	477	348	276	193	133	60.3	7.11	0.27
8177	607	430	336	234	167	89.5	31.8	1.64
8225	919	639	488	329	229	130	68.2	0.81

Scope of the project
Selected location

Lane 2 - Back-calculated E-Moduli (40kN)

Station	Thick1	Thick2	Thick3	Thick4	Thick5	Emod1	Emod2	Emod3	Emod4	Emod5	Poiss1	Poiss2	Poiss3	Poiss4	Poiss5	Pressure	Meas0	Meas200	Meas300	Meas450	Meas600	Meas900	Meas1500	Calc0	Calc200	Calc300	Calc450	Calc600	Calc900	Calc1500	Adj.Err(%)
6420	150	180	180	1200	Semi-Inf	5000	500	350	150	1500	0.4	0.35	0.35	0.45	0.35	586	119	66	55	48	43	33	20	181	139	115	85.7	63.6	34.6	8.61	55.39
6449	150	180	180	1200	Semi-Inf	5000	500	350	150	1500	0.4	0.35	0.35	0.45	0.35	590	103	51	33	32	30	23	15	182	140	116	86.2	64	34.8	8.67	107.60
6500	150	180	180	1200	Semi-Inf	5000	500	350	133	258	0.4	0.35	0.35	0.45	0.35	579	205	154	131	117	101	69	27	218	177	152	122	98.6	66.4	33.6	3.94
6559	150	180	180	1200	Semi-Inf	500	57	103	80	346	0.4	0.35	0.35	0.45	0.35	573	930	589	395	246	157	77	27	930	587	416	249	155	69.5	21.5	0.58
6599	150	180	180	1200	Semi-Inf	1906	275	185	115	435	0.4	0.35	0.35	0.45	0.35	581	344	261	196	140	102	60	28	342	248	198	143	104	58.1	20.4	0.44
6650	150	180	180	1200	Semi-Inf	1414	75	350	150	435	0.4	0.35	0.35	0.45	0.35	586	472	331	226	134	90	50	26	471	322	239	150	95.6	45.2	17.5	1.69
6699	150	180	180	1200	Semi-Inf	1766	388	103	89	790	0.4	0.35	0.35	0.45	0.35	588	372	285	225	163	117	60	24	369	273	222	164	121	63.4	14.2	0.36
6750	150	180	180	1200	Semi-Inf	1484	71	82	124	435	0.4	0.35	0.35	0.45	0.35	565	545	398	287	189	122	58	24	545	395	304	199	127	53.2	15.1	0.61
6800	150	180	180	1200	Semi-Inf	922	148	123	133	1500	0.4	0.35	0.35	0.45	0.35	553	469	325	230	136	78	31	13	466	297	214	131	81.6	32.7	4.54	1.72
6849	150	180	180	1200	Semi-Inf	676	71	72	67	213	0.4	0.35	0.35	0.45	0.35	520	797	578	429	277	181	88	36	797	549	416	275	185	91.4	32.3	0.87
6900	150	180	180	1200	Semi-Inf	5000	388	268	133	435	0.4	0.35	0.35	0.45	0.35	520	185	159	137	101	78	50	19	199	159	134	104	80.2	48.5	19.3	0.69
6949	150	180	180	1200	Semi-Inf	676	92	123	98	258	0.4	0.35	0.35	0.45	0.35	497	602	405	281	175	118	75	26	602	390	285	182	122	63.1	25.4	1.69
7000	150	180	180	1200	Semi-Inf	746	106	103	89	169	0.4	0.35	0.35	0.45	0.35	502	612	433	315	209	152	88	44	610	413	313	212	150	84.4	38.8	0.50
7050	150	180	180	1200	Semi-Inf	3313	500	185	98	213	0.4	0.35	0.35	0.45	0.35	510	255	207	178	145	117	76	32	258	208	179	143	116	76.8	36.6	0.00
7099	150	180	180	1200	Semi-Inf	1344	388	350	150	258	0.4	0.35	0.35	0.45	0.35	515	276	190	145	102	79	55	26	275	155	146	108	84.3	54.9	27.7	0.00
7150	150	180	180	1200	Semi-Inf	1168	134	82	63	102	0.4	0.35	0.35	0.45	0.35	500	599	460	367	277	213	133	55	599	455	375	282	216	135	66	1.55
7199	150	180	180	1200	Semi-Inf	3313	275	350	150	346	0.4	0.35	0.35	0.45	0.35	520	228	174	123	97	72	48	31	229	174	142	105	79.5	48.3	21.7	1.60
7250	150	180	180	1200	Semi-Inf	922	303	144	106	1500	0.4	0.35	0.35	0.45	0.35	508	360	247	190	126	87	44	13	361	232	176	120	82.9	39.2	6.11	1.25
7300	150	180	180	1200	Semi-Inf	1273	120	350	150	1500	0.4	0.35	0.35	0.45	0.35	499	343	224	147	79	43	17	7	344	222	159	96.2	59.7	25.5	4.86	6.75
7349	150	180	180	1200	Semi-Inf	1344	148	144	98	790	0.4	0.35	0.35	0.45	0.35	509	409	298	222	145	97	49	17	407	284	218	147	99	46.4	9.91	0.41
7400	150	180	180	1200	Semi-Inf	992	191	185	98	435	0.4	0.35	0.35	0.45	0.35	526	430	293	217	145	104	57	29	427	285	216	149	105	56.5	18.4	2.75
7449	150	180	180	1200	Semi-Inf	1484	247	103	98	435	0.4	0.35	0.35	0.45	0.35	552	408	304	237	167	112	62	25	407	294	234	168	120	63.2	18.9	0.00
7500	150	180	180	1200	Semi-Inf	746	61	61	67	169	0.4	0.35	0.35	0.45	0.35	572	910	697	528	333	213	108	48	915	645	499	333	225	112	43.5	2.04
7548	150	180	180	1200	Semi-Inf	729	54	350	150	1500	0.4	0.35	0.35	0.45	0.35	583	652	399	242	111	52	12	4	654	398	267	141	75	25.4	4.47	19.42
7599	150	180	180	1200	Semi-Inf	1625	500	350	150	346	0.4	0.35	0.35	0.45	0.35	592	276	160	126	99	79	54	22	273	188	150	112	87	55	25.1	5.35
7650	150	180	180	1200	Semi-Inf	693	50	82	124	258	0.4	0.35	0.35	0.45	0.35	577	830	585	407	232	141	70	30	829	547	393	234	141	61	26.7	1.11
7699	150	180	180	1200	Semi-Inf	1273	444	350	150	1500	0.4	0.35	0.35	0.45	0.35	598	280	177	115	61	35	17	8	279	175	132	91.5	65.4	33.9	7.59	27.82
7750	150	180	180	1200	Semi-Inf	746	61	56	65	346	0.4	0.35	0.35	0.45	0.35	579	909	689	507	314	192	80	23	911	640	487	317	205	88.3	21	1.92
7800	150	180	180	1200	Semi-Inf	1133	191	268	150	258	0.4	0.35	0.35	0.45	0.35	571	400	270	196	131	99	67	40	399	262	198	135	98.3	59.5	29.4	1.99
7849	150	180	180	1200	Semi-Inf	1625	78	82	150	302	0.4	0.35	0.35	0.45	0.35	576	516	382	291	184	115	61	31	515	376	291	193	126	57.6	22.4	0.77
7900	150	180	180	1200	Semi-Inf	2328	113	350	150	1500	0.4	0.35	0.35	0.45	0.35	580	326	234	167	94	50	14	4	328	234	179	116	74.6	31.5	5.59	21.45
7949	150	180	180	1200	Semi-Inf	2750	191	268	150	613	0.4	0.35	0.35	0.45	0.35	556	276	205	157	107	75	43	23	277	204	161	112	78.7	40.7	13.3	0.00
8000	150	180	180	1200	Semi-Inf	887	50	46	150	435	0.4	0.35	0.35	0.45	0.35	563	764	535	381	223	123	46	19	763	525	387	232	134	43.8	12.7	0.65
8050	150	180	180	1200	Semi-Inf	5000	500	350	150	1500	0.4	0.35	0.35	0.45	0.35	599	177	140	107	75	54	31	18	185	142	118	87.6	65	35.3	8.8	3.77
8100	150	180	180	1200	Semi-Inf	1098	120	41	45	1145	0.4	0.35	0.35	0.45	0.35	582	774	597	485	341	231	99	14	775	586	475	339	238	109	11.1	1.07
8149	150	180	180	1200	Semi-Inf	605	106	123	98	435	0.4	0.35	0.35	0.45	0.35	552	646	418	303	178	121	72	26	649	404	290	181	118	56.5	17.2	2.77
8199	150	180	180	1200	Semi-Inf	781	78	72	71	213	0.4	0.35	0.35	0.45	0.35	568	799	594	444	291	190	93	30	799	559	428	287	195	97.4	35.1	1.05
8250	150	180	180	1200	Semi-Inf	1344	191	61	63	258	0.4	0.35	0.35	0.45	0.35	566	579	451	373	269	191	95	29	575	437	358	265	196	107	33.8	1.75

Scope of the project

Selected location

Lane 1 - Back-calculated E-Moduli (60kN)

Station	Thick1	Thick2	Thick3	Thick4	Thick5	Emod1	Emod2	Emod3	Emod4	Emod5	Poiss1	Poiss2	Poiss3	Poiss4	Poiss5	Pressure	Meas0	Meas200	Meas300	Meas450	Meas600	Meas900	Meas1500	Calc0	Calc200	Calc300	Calc450	Calc600	Calc900	Calc1500	Adj.Err(%)
6425	150	180	180	1200	Semi-Inf	5000	500	500	150	1500	0.4	0.35	0.35	0.45	0.35	894	143	88	63	60	50	36	15	263	201	165	123	91.9	51.2	13.8	79.23
6474	150	180	180	1200	Semi-Inf	5000	500	300	150	346	0.4	0.35	0.35	0.45	0.35	897	286	219	191	161	133	89	31	319	254	216	169	133	85.3	39.1	4.83
6525	150	180	180	1200	Semi-Inf	4463	500	238	133	613	0.4	0.35	0.35	0.45	0.35	885	325	245	207	166	127	74	18	327	257	215	165	126	73.7	25.3	0.38
6574	150	180	180	1200	Semi-Inf	969	175	144	106	258	0.4	0.35	0.35	0.45	0.35	873	763	519	385	269	195	112	48	765	516	395	273	196	110	46.3	0.19
6625	150	180	180	1200	Semi-Inf	1842	125	300	150	346	0.4	0.35	0.35	0.45	0.35	883	570	407	294	193	133	77	40	573	406	312	211	146	79	34.2	2.41
6675	150	180	180	1200	Semi-Inf	2447	500	144	98	346	0.4	0.35	0.35	0.45	0.35	881	467	371	311	235	179	106	45	467	360	302	234	182	111	41.9	0.22
6724	150	180	180	1200	Semi-Inf	1708	213	113	133	435	0.4	0.35	0.35	0.45	0.35	862	576	419	321	220	153	86	38	576	413	324	225	157	79.8	26.7	2.38
6775	150	180	180	1200	Semi-Inf	1439	131	144	115	435	0.4	0.35	0.35	0.45	0.35	870	690	502	374	240	166	89	37	690	486	374	251	170	84.1	27.3	0.66
6824	150	180	180	1200	Semi-Inf	1405	103	128	124	258	0.4	0.35	0.35	0.45	0.35	871	763	565	418	269	188	111	52	762	543	419	283	193	101	43.3	1.54
6875	150	180	180	1200	Semi-Inf	1775	225	128	98	790	0.4	0.35	0.35	0.45	0.35	866	587	440	341	235	163	82	28	583	425	337	238	167	82.8	18.2	0.33
6926	150	180	180	1200	Semi-Inf	1850	250	80	350	1500	0.4	0.35	0.35	0.45	0.35	839	436	315	225	134	76	21	0	437	294	217	134	80.1	27.2	4.71	0.72
6974	150	180	180	1200	Semi-Inf	2313	375	144	98	191	0.4	0.35	0.35	0.45	0.35	830	512	413	344	263	205	130	63	510	397	334	261	206	133	62.7	0.38
7025	150	180	180	1200	Semi-Inf	5000	500	238	133	213	0.4	0.35	0.35	0.45	0.35	833	319	269	238	191	158	111	58	340	278	241	195	158	107	55.5	0.70
7074	150	180	180	1200	Semi-Inf	1100	90	66	71	213	0.4	0.35	0.35	0.45	0.35	800	960	743	593	395	270	132	57	989	727	576	401	280	143	50.1	1.48
7125	150	180	180	1200	Semi-Inf	1100	260	30	100	80	0.4	0.35	0.35	0.45	0.35	800	916	680	614	475	374	216	128	907	696	584	453	354	227	121	2.26
7175	150	180	180	1200	Semi-Inf	2581	500	250	150	250	0.4	0.35	0.35	0.45	0.35	821	378	285	222	173	124	86	53	367	276	229	177	139	90.9	45.7	1.40
7224	150	180	180	1200	Semi-Inf	1170	125	81	98	346	0.4	0.35	0.35	0.45	0.35	813	795	607	438	305	188	113	30	795	565	437	296	201	97.5	30.8	2.81
7275	150	180	180	1200	Semi-Inf	1473	100	58	150	613	0.4	0.35	0.35	0.45	0.35	813	728	531	394	256	152	64	22	729	522	400	258	162	61.9	13.6	0.00
7326	150	180	180	1200	Semi-Inf	1238	138	238	150	1500	0.4	0.35	0.35	0.45	0.35	818	566	397	270	149	99	37	9	569	368	265	162	101	42.7	7.61	1.67
7375	150	180	180	1200	Semi-Inf	1573	100	150	50	200	0.4	0.35	0.35	0.45	0.35	836	892	694	566	436	290	194	54	901	698	576	429	322	186	68.9	3.93
7425	150	180	180	1200	Semi-Inf	750	80	40	67	213	0.4	0.35	0.35	0.45	0.35	838	1318	996	743	480	311	153	69	1316	940	729	492	331	156	49.2	4.89
7474	150	180	180	1200	Semi-Inf	1238	156	113	84	346	0.4	0.35	0.35	0.45	0.35	862	781	599	457	322	229	120	42	777	556	437	306	217	113	36.4	2.33
7525	150	180	180	1200	Semi-Inf	1550	110	350	200	1500	0.4	0.35	0.35	0.45	0.35	880	536	368	252	140	75	29	11	547	357	255	150	89.3	35	7.43	2.72
7574	150	180	180	1200	Semi-Inf	710	75	40	190	1500	0.4	0.35	0.35	0.45	0.35	861	1078	742	519	279	135	19	0	1108	714	503	282	149	34.6	1.64	9.97
7625	150	180	180	1200	Semi-Inf	1573	131	175	141	346	0.4	0.35	0.35	0.45	0.35	882	637	456	334	220	155	92	46	640	450	345	231	158	82.3	33.5	2.95
7675	150	180	180	1200	Semi-Inf	1000	200	350	300	1500	0.4	0.35	0.35	0.45	0.35	888	482	308	184	91	52	26	14	493	274	179	99.4	59.3	26.2	7.57	1.54
7724	150	180	180	1200	Semi-Inf	1506	400	300	150	1500	0.4	0.35	0.35	0.45	0.35	894	417	290	212	137	92	46	16	418	273	207	143	101	50.8	11	0.60
7775	150	180	180	1200	Semi-Inf	1372	275	300	150	1500	0.4	0.35	0.35	0.45	0.35	883	468	330	233	140	88	42	16	472	303	225	148	101	48.8	10.1	2.21
7824	150	180	180	1200	Semi-Inf	1842	263	81	63	258	0.4	0.35	0.35	0.45	0.35	871	727	581	494	369	276	152	53	727	569	477	366	280	164	56.5	1.14
7875	150	180	180	1200	Semi-Inf	1775	188	73	115	1500	0.4	0.35	0.35	0.45	0.35	870	632	470	366	243	153	57	8	628	457	359	244	163	67.9	7.11	1.71
7925	150	180	180	1200	Semi-Inf	5000	500	200	250	1500	0.4	0.35	0.35	0.45	0.35	892	253	203	165	117	81	40	11	257	193	156	111	77.9	37.8	8.65	0.00
7974	150	180	180	1200	Semi-Inf	1305	175	144	115	213	0.4	0.35	0.35	0.45	0.35	866	694	504	385	271	198	125	70	694	491	385	273	199	116	54	2.46
8024	150	180	180	1200	Semi-Inf	902	106	97	98	435	0.4	0.35	0.35	0.45	0.35	860	918	625	464	297	193	96	33	918	621	464	300	196	90.7	26	0.00
8074	150	180	180	1200	Semi-Inf	1977	225	97	124	1145	0.4	0.35	0.35	0.45	0.35	879	555	423	326	219	139	62	16	554	403	317	218	148	66.4	10.8	0.50
8125	150	180	180	1200	Semi-Inf	1573	188	81	71	1145	0.4	0.35	0.35	0.45	0.35	874	743	568	459	317	212	91	24	739	550	442	314	221	105	15.1	2.07
8177	150	180	180	1200	Semi-Inf	1506	109	97	71	213	0.4	0.35	0.35	0.45	0.35	860	878	693	535	378	273	144	46	875	663	537	388	281	154	57.3	2.48
8225	150	180	180	1200	Semi-Inf	700	100	58	76	102	0.4	0.35	0.35	0.45	0.35	841	1302	952	732	487	335	196	96	1243	878	686	483	349	205	103	2.83

Scope of the project
Selected location

Lane 2 - Back-calculated E-Moduli (60kN)

Station	Thick1	Thick2	Thick3	Thick4	Thick5	Emod1	Emod2	Emod3	Emod4	Emod5	Poiss1	Poiss2	Poiss3	Poiss4	Poiss5	Pressure	Meas0	Meas200	Meas300	Meas450	Meas600	Meas900	Meas1500	Calc0	Calc200	Calc300	Calc450	Calc600	Calc900	Calc1500	Adj.Err(%)
6420	150	180	180	1200	Semi-Inf	5000	500	350	150	1500	0.4	0.35	0.35	0.45	0.35	892	175	101	85	75	67	52	31	275	212	175	130	96.8	52.6	13.1	57.93
6449	150	180	180	1200	Semi-Inf	5000	500	350	150	1500	0.4	0.35	0.35	0.45	0.35	892	145	70	51	48	45	39	24	275	212	175	130	96.8	52.6	13.1	118.24
6500	150	180	180	1200	Semi-Inf	5000	1200	350	100	300	0.4	0.35	0.35	0.45	0.35	884	297	236	204	182	156	108	41	296	245	217	182	153	108	53	2.96
6559	150	180	180	1200	Semi-Inf	500	100	72	76	346	0.4	0.35	0.35	0.45	0.35	859	1280	836	580	373	240	119	40	1256	799	584	374	246	115	32.9	0.75
6599	150	180	180	1200	Semi-Inf	1766	350	164	115	435	0.4	0.35	0.35	0.45	0.35	883	509	381	294	213	156	93	44	509	367	294	215	159	89.5	31.2	2.88
6650	150	180	180	1200	Semi-Inf	1414	100	350	150	346	0.4	0.35	0.35	0.45	0.35	881	656	469	333	207	141	79	41	657	447	334	216	145	76.8	33.8	0.51
6699	150	180	180	1200	Semi-Inf	1906	375	123	84	613	0.4	0.35	0.35	0.45	0.35	876	546	424	339	251	182	97	38	543	406	333	249	186	102	27.1	2.65
6750	150	180	180	1200	Semi-Inf	1449	100	82	133	346	0.4	0.35	0.35	0.45	0.35	864	776	570	420	283	186	93	37	774	555	428	283	186	85.9	30.3	0.25
6800	150	180	180	1200	Semi-Inf	1027	188	123	133	1500	0.4	0.35	0.35	0.45	0.35	853	650	454	327	200	119	50	14	650	420	308	195	125	52.2	7.43	1.50
6849	150	180	180	1200	Semi-Inf	711	113	61	76	213	0.4	0.35	0.35	0.45	0.35	807	1077	779	587	385	257	131	55	1077	741	568	386	266	136	49.7	0.94
6900	150	180	180	1200	Semi-Inf	5000	500	268	106	613	0.4	0.35	0.35	0.45	0.35	819	301	250	212	171	132	79	32	309	249	212	166	129	78.1	26.8	0.00
6949	150	180	180	1200	Semi-Inf	781	100	92	124	169	0.4	0.35	0.35	0.45	0.35	789	907	621	450	290	199	122	51	908	605	451	295	202	112	57.6	0.84
7000	150	180	180	1200	Semi-Inf	781	125	103	84	169	0.4	0.35	0.35	0.45	0.35	787	916	655	495	342	244	140	69	915	626	482	334	240	137	62	0.75
7050	150	180	180	1200	Semi-Inf	3875	500	226	98	191	0.4	0.35	0.35	0.45	0.35	804	393	326	282	229	185	122	53	390	318	276	225	184	126	63.7	1.54
7099	150	180	180	1200	Semi-Inf	1555	350	350	150	258	0.4	0.35	0.35	0.45	0.35	809	428	295	227	164	123	86	52	427	294	233	172	133	86	43.5	0.00
7150	150	180	180	1200	Semi-Inf	1168	163	92	67	83	0.4	0.35	0.35	0.45	0.35	787	902	708	571	437	341	219	107	902	638	572	440	347	229	124	2.26
7199	150	180	180	1200	Semi-Inf	2047	450	350	150	346	0.4	0.35	0.35	0.45	0.35	813	362	261	201	150	116	82	46	363	258	209	155	120	75.4	34.5	2.01
7250	150	180	180	1200	Semi-Inf	1133	325	123	115	435	0.4	0.35	0.35	0.45	0.35	800	555	386	303	209	147	82	33	552	376	294	209	151	81.2	26.7	0.19
7300	150	180	180	1200	Semi-Inf	1200	130	350	200	1500	0.4	0.35	0.35	0.45	0.35	803	516	332	226	128	72	29	10	520	320	222	128	76.5	31.8	7.09	0.29
7349	150	180	180	1200	Semi-Inf	1238	213	103	98	613	0.4	0.35	0.35	0.45	0.35	800	634	456	349	236	162	83	27	634	444	345	239	166	81	19.5	0.22
7400	150	180	180	1200	Semi-Inf	1063	238	144	106	346	0.4	0.35	0.35	0.45	0.35	817	634	438	336	232	169	96	44	630	428	331	233	168	92.5	33.9	1.83
7449	150	180	180	1200	Semi-Inf	2012	188	66	141	346	0.4	0.35	0.35	0.45	0.35	845	603	453	360	252	177	94	43	603	451	361	254	178	88.5	30.4	2.52
7500	150	180	180	1200	Semi-Inf	770	90	25	98	158	0.4	0.35	0.35	0.45	0.35	852	1290	995	766	496	324	168	73	1331	957	745	504	339	160	61.4	2.89
7548	150	180	180	1200	Semi-Inf	700	70	150	280	1500	0.4	0.35	0.35	0.45	0.35	889	897	566	357	171	80	19	6	902	521	335	163	76.5	20.9	6.13	1.69
7599	150	180	180	1200	Semi-Inf	1766	500	350	150	346	0.4	0.35	0.35	0.45	0.35	901	404	252	201	159	129	87	36	407	283	227	171	132	83.8	38.3	3.60
7650	150	180	180	1200	Semi-Inf	711	100	51	106	258	0.4	0.35	0.35	0.45	0.35	867	1134	833	601	365	231	115	47	1131	760	567	365	237	109	40.3	1.85
7699	150	180	180	1200	Semi-Inf	1400	330	230	350	1500	0.4	0.35	0.35	0.45	0.35	896	384	245	165	91	53	27	13	389	230	160	95.3	58.8	25.3	7.24	0.57
7750	150	180	180	1200	Semi-Inf	852	100	25	102	346	0.4	0.35	0.35	0.45	0.35	869	1220	929	700	448	283	123	35	1220	873	675	447	289	117	25.5	1.20
7800	150	180	180	1200	Semi-Inf	1344	225	268	141	258	0.4	0.35	0.35	0.45	0.35	864	555	386	288	200	152	103	59	557	379	293	207	153	93.7	45.5	2.06
7849	150	180	180	1200	Semi-Inf	1414	100	66	150	258	0.4	0.35	0.35	0.45	0.35	876	812	607	466	302	195	102	49	813	586	453	301	200	95.5	40.1	0.64
7900	150	180	180	1200	Semi-Inf	2200	110	180	400	1500	0.4	0.35	0.35	0.45	0.35	879	438	315	226	130	70	20	5	453	305	219	126	69.5	21.1	5.78	0.57
7949	150	180	180	1200	Semi-Inf	2891	213	309	150	524	0.4	0.35	0.35	0.45	0.35	854	405	300	234	164	117	67	35	406	300	239	170	122	66.1	24.1	2.41
8000	150	180	180	1200	Semi-Inf	781	95	32	150	524	0.4	0.35	0.35	0.45	0.35	860	1098	776	569	341	195	72	29	1112	753	558	344	206	70.1	14.4	5.71
8050	150	180	180	1200	Semi-Inf	5000	800	350	150	1500	0.4	0.35	0.35	0.45	0.35	900	241	199	154	115	85	51	28	250	193	161	123	93.7	53.3	14.3	4.43
8100	150	180	180	1200	Semi-Inf	1168	144	35	43	1145	0.4	0.35	0.35	0.45	0.35	859	1115	873	719	512	352	156	22	1117	858	703	513	367	175	19.3	2.05
8149	150	180	180	1200	Semi-Inf	711	103	144	115	258	0.4	0.35	0.35	0.45	0.35	844	920	599	446	267	184	111	40	924	589	427	272	183	97.7	42.7	1.51
8199	150	180	180	1200	Semi-Inf	816	125	61	67	213	0.4	0.35	0.35	0.45	0.35	857	1101	835	643	437	292	143	47	1101	782	613	429	303	159	55.1	2.77
8250	150	180	180	1200	Semi-Inf	1273	225	61	54	346	0.4	0.35	0.35	0.45	0.35	850	865	668	557	406	293	150	47	864	656	541	405	301	164	43.8	1.28

Scope of the project
Selected location

CIRCLY Version 5.0r (3 February 2011)

Job Title: TMR Mooloolaba Road - Buderim - Rehabilitation Design

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: MOO_T2 Title: Mooloolaba Rd, Buderim - 10 years Traffic (2013 - 2023) - 2.92e+06 ESA

Load No.	Load ID	Movements
1	ESA75-Full	2.92E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: -165 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: M_L1A_60kN Title: Mooloolaba Rd - Ch. 6824 (Lane 1, OWP)

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	AC1550_10	Iso.	1.55E+03	0.40			
2	rough	AC1550_10	Iso.	1.55E+03	0.40			
3	rough	Gran_100	Aniso.	1.00E+02	0.35	7.40E+01	5.00E+01	0.35
4	rough	Gran_125	Aniso.	1.25E+02	0.35	9.26E+01	6.25E+01	0.35
5	rough	Sub_CBR12	Aniso.	1.20E+02	0.45	8.28E+01	6.00E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	1550_10	ETH	0.004737	5.000	1.100
2	bottom	1550_10	ETH	0.004737	5.000	1.100
5	top	Sub_2004	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt
2	1.00	Asphalt
5	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 3: Austroads (2004) sublayering
Layer no. 4: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	100.00	AC1550_10	ESA75-Full	-5.95E-05	1.01E-03
2	100.00	AC1550_10	ESA75-Full	-2.52E-04	1.37E+00
3	180.00	Gran_100		n/a	n/a
4	180.00	Gran_125		n/a	n/a
5	0.00	Sub_CBR12	ESA75-Full	2.46E-04	4.27E-05

CIRCLY Version 5.0r (3 February 2011)

Job Title: TMR Mooloolaba Road - Buderim - Rehabilitation Design

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: MOO_T2 Title: Mooloolaba Rd, Buderim - 10 years Traffic (2013 - 2023) - 2.92e+06 ESA

Load No.	Load ID	Movements
1	ESA75-Full	2.92E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: -165 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: M_L1F_60kN Title: Mooloolaba Rd - Ch. 6875 (Lane 1, OWP)

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	AC1550_10	Iso.	1.55E+03	0.40			
2	rough	AC1950_10	Iso.	1.95E+03	0.40			
3	rough	Gran_225	Aniso.	2.25E+02	0.35	1.67E+02	1.13E+02	0.35
4	rough	Gran_125	Aniso.	1.25E+02	0.35	9.26E+01	6.25E+01	0.35
5	rough	Sub_CBR10	Aniso.	1.00E+02	0.45	6.90E+01	5.00E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	1550_10	ETH	0.004737	5.000	1.100
2	bottom	1950_10	ETH	0.004361	5.000	1.100
5	top	Sub_2004	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt
2	1.00	Asphalt
5	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 3: Austroads (2004) sublayering
Layer no. 4: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	50.00	AC1550_10	ESA75-Full	-2.07E-05	5.07E-06
2	100.00	AC1950_10	ESA75-Full	-2.75E-04	3.19E+00
3	180.00	Gran_225		n/a	n/a
4	180.00	Gran_125		n/a	n/a
5	0.00	Sub_CBR10	ESA75-Full	3.60E-04	6.03E-04

CIRCLY Version 5.0r (3 February 2011)

Job Title: TMR Mooloolaba Road - Buderim - Rehabilitation Design

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: MOO_T2 Title: Mooloolaba Rd, Buderim - 10 years Traffic (2013 - 2023) - 2.92e+06 ESA

Load No.	Load ID	Movements
1	ESA75-Full	2.92E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: -165 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: M_L1G_60kN Title: Mooloolaba Rd - Ch. 7025 (Lane 1, OWP)

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	AC1550_10	Iso.	1.55E+03	0.40			
2	rough	AC2000_10	Iso.	2.00E+03	0.40			
3	rough	Gran_350	Aniso.	3.50E+02	0.35	2.59E+02	1.75E+02	0.35
4	rough	Gran_235	Aniso.	2.35E+02	0.35	1.74E+02	1.18E+02	0.35
5	rough	Sub_CBR12	Aniso.	1.20E+02	0.45	8.28E+01	6.00E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	1550_10	ETH	0.004737	5.000	1.100
2	bottom	2000_10	ETH	0.004322	5.000	1.100
5	top	Sub_2004	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt
2	1.00	Asphalt
5	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 3: Austroads (2004) sublayering
Layer no. 4: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	90.00	AC1550_10	ESA75-Full	-5.48E-05	6.62E-04
2	100.00	AC2000_10	ESA75-Full	-1.69E-04	2.94E-01
3	180.00	Gran_350		n/a	n/a
4	180.00	Gran_235		n/a	n/a
5	0.00	Sub_CBR12	ESA75-Full	2.55E-04	5.50E-05

CIRCLY Version 5.0r (3 February 2011)

Job Title: TMR Mooloolaba Road - Buderim - Rehabilitation Design

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: MOO_T2 Title: Mooloolaba Rd, Buderim - 10 years Traffic (2013 - 2023) - 2.92e+06 ESA

Load No.	Load ID	Movements
1	ESA75-Full	2.92E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: -165 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: M_L1B_60kN Title: Mooloolaba Rd - Ch. 7074 (Lane 1, OWP)

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	AC1550_10	Iso.	1.55E+03	0.40			
2	rough	AC1200_10	Iso.	1.20E+03	0.40			
3	rough	Gran_90	Aniso.	9.00E+01	0.35	6.67E+01	4.50E+01	0.35
4	rough	Gran_65	Aniso.	6.50E+01	0.35	4.60E+01	3.25E+01	0.35
5	rough	Sub_CBR7	Aniso.	7.00E+01	0.45	4.83E+01	3.50E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	1550_10	ETH	0.004737	5.000	1.100
2	bottom	1200_10	ETH	0.005195	5.000	1.100
5	top	Sub_2004	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt
2	1.00	Asphalt
5	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 3: Austroads (2004) sublayering
Layer no. 4: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	100.00	AC1550_10	ESA75-Full	-1.21E-04	3.54E-02
2	100.00	AC1200_10	ESA75-Full	-3.25E-04	3.08E+00
3	180.00	Gran_90		n/a	n/a
4	180.00	Gran_65		n/a	n/a
5	0.00	Sub_CBR7	ESA75-Full	3.71E-04	7.47E-04

CIRCLY Version 5.0r (3 February 2011)

Job Title: TMR Mooloolaba Road - Buderim - Rehabilitation Design

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: MOO_T2 Title: Mooloolaba Rd, Buderim - 10 years Traffic (2013 - 2023) - 2.92e+06 ESA

Load No.	Load ID	Movements
1	ESA75-Full	2.92E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: -165 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: M_L1C_60kN Title: Mooloolaba Rd - Ch. 7125 (Lane 1, OWP)

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	AC1550_10	Iso.	1.55E+03	0.40			
2	rough	AC1200_10	Iso.	1.20E+03	0.40			
3	rough	Gran_260	Aniso.	2.60E+02	0.35	1.93E+02	1.30E+02	0.35
4	rough	Gran_30	Aniso.	3.00E+01	0.35	2.22E+01	1.50E+01	0.35
5	rough	Sub_CBR10	Aniso.	1.00E+02	0.45	6.90E+01	5.00E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	1550_10	ETH	0.004737	5.000	1.100
2	bottom	1200_10	ETH	0.005195	5.000	1.100
5	top	Sub_2004	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt
2	1.00	Asphalt
5	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 3: Austroads (2004) sublayering
Layer no. 4: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	150.00	AC1550_10	ESA75-Full	-1.07E-04	1.90E-02
2	100.00	AC1200_10	ESA75-Full	-2.62E-04	1.06E+00
3	180.00	Gran_260		n/a	n/a
4	180.00	Gran_30		n/a	n/a
5	0.00	Sub_CBR10	ESA75-Full	1.85E-04	5.80E-06

CIRCLY Version 5.0r (3 February 2011)

Job Title: TMR Mooloolaba Road - Buderim - Rehabilitation Design

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: MOO_T2 Title: Mooloolaba Rd, Buderim - 10 years Traffic (2013 - 2023) - 2.92e+06 ESA

Load No.	Load ID	Movements
1	ESA75-Full	2.92E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: -165 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: M_L1D_60kN Title: Mooloolaba Rd - Ch. 7224 (Lane 1, OWP)

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	AC1550_10	Iso.	1.55E+03	0.40			
2	rough	AC1300_10	Iso.	1.30E+03	0.40			
3	rough	Gran_125	Aniso.	1.25E+02	0.35	9.26E+01	6.25E+01	0.35
4	rough	Gran_80	Aniso.	8.00E+01	0.35	5.93E+01	4.00E+01	0.35
5	rough	Sub_CBR10	Aniso.	1.00E+02	0.45	6.90E+01	5.00E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	1550_10	ETH	0.004737	5.000	1.100
2	bottom	1300_10	ETH	0.005047	5.000	1.100
5	top	Sub_2004	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt
2	1.00	Asphalt
5	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 3: Austroads (2004) sublayering
Layer no. 4: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	50.00	AC1550_10	ESA75-Full	-6.99E-05	2.25E-03
2	100.00	AC1300_10	ESA75-Full	-4.04E-04	1.06E+01
3	180.00	Gran_125		n/a	n/a
4	180.00	Gran_80		n/a	n/a
5	0.00	Sub_CBR10	ESA75-Full	3.76E-04	8.28E-04

CIRCLY Version 5.0r (3 February 2011)

Job Title: TMR Mooloolaba Road - Buderim - Rehabilitation Design

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: MOO_T2 Title: Mooloolaba Rd, Buderim - 10 years Traffic (2013 - 2023) - 2.92e+06 ESA

Load No.	Load ID	Movements
1	ESA75-Full	2.92E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: -165 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: M_L1H_60kN Title: Mooloolaba Rd - Ch. 7275 (Lane 1, OWP)

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	AC1550_10	Iso.	1.55E+03	0.40			
2	rough	AC1650_10	Iso.	1.65E+03	0.40			
3	rough	Gran_100	Aniso.	1.00E+02	0.35	7.40E+01	5.00E+01	0.35
4	rough	Gran_55	Aniso.	5.50E+01	0.35	4.60E+01	2.75E+01	0.35
5	rough	Sub_CBR12	Aniso.	1.20E+02	0.45	8.28E+01	6.00E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	1550_10	ETH	0.004737	5.000	1.100
2	bottom	1650_10	ETH	0.004632	5.000	1.100
5	top	Sub_2004	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt
2	1.00	Asphalt
5	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 3: Austroads (2004) sublayering
Layer no. 4: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	50.00	AC1550_10	ESA75-Full	-1.21E-05	3.45E-07
2	100.00	AC1650_10	ESA75-Full	-3.72E-04	1.08E+01
3	180.00	Gran_100		n/a	n/a
4	180.00	Gran_55		n/a	n/a
5	0.00	Sub_CBR12	ESA75-Full	3.02E-04	1.79E-04

CIRCLY Version 5.0r (3 February 2011)

Job Title: TMR Mooloolaba Road - Buderim - Rehabilitation Design

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: MOO_T2 Title: Mooloolaba Rd, Buderim - 10 years Traffic (2013 - 2023) - 2.92e+06 ESA

Load No.	Load ID	Movements
1	ESA75-Full	2.92E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: -165 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: M_L1E_60kN Title: Mooloolaba Rd - Ch. 7425 (Lane 1, OWP)

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	AC1550_10	Iso.	1.55E+03	0.40			
2	rough	AC775	Iso.	7.75E+02	0.40			
3	rough	Gran_80	Aniso.	8.00E+01	0.35	5.93E+01	4.00E+01	0.35
4	rough	Gran_40	Aniso.	4.00E+01	0.35	2.96E+01	2.00E+01	0.35
5	rough	Sub_CBR7	Aniso.	7.00E+01	0.45	4.83E+01	3.50E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	1550_10	ETH	0.004737	5.000	1.100
5	top	Sub_2004	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt
5	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 3: Austroads (2004) sublayering
Layer no. 4: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	200.00	AC1550_10	ESA75-Full	-1.40E-04	7.19E-02
2	100.00	AC775		n/a	n/a
3	180.00	Gran_80		n/a	n/a
4	180.00	Gran_40		n/a	n/a
5	0.00	Sub_CBR7	ESA75-Full	2.32E-04	2.78E-05

CIRCLY Version 5.0r (3 February 2011)

Job Title: TMR Mooloolaba Road - Buderim - Rehabilitation Design

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: MOO_T2 Title: Mooloolaba Rd, Buderim - 10 years Traffic (2013 - 2023) - 2.92e+06 ESA

Load No.	Load ID	Movements
1	ESA75-Full	2.92E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: -165 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: M_L2A_60kN Title: Mooloolaba Rd - Ch. 6750 (Lane 2, OWP)

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	AC1550_10	Iso.	1.55E+03	0.40			
2	rough	AC1600_10	Iso.	1.60E+03	0.40			
3	rough	Gran_100	Aniso.	1.00E+02	0.35	7.40E+01	5.00E+01	0.35
4	rough	Gran_80	Aniso.	8.00E+01	0.35	5.93E+01	4.00E+01	0.35
5	rough	Sub_CBR12	Aniso.	1.20E+02	0.45	8.28E+01	6.00E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	1550_10	ETH	0.004737	5.000	1.100
2	bottom	1600_10	ETH	0.004684	5.000	1.100
5	top	Sub_2004	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt
2	1.00	Asphalt
5	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 3: Austroads (2004) sublayering
Layer no. 4: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	100.00	AC1550_10	ESA75-Full	-5.55E-05	7.10E-04
2	100.00	AC1600_10	ESA75-Full	-2.60E-04	1.68E+00
3	180.00	Gran_100		n/a	n/a
4	180.00	Gran_80		n/a	n/a
5	0.00	Sub_CBR12	ESA75-Full	2.37E-04	3.24E-05

CIRCLY Version 5.0r (3 February 2011)

Job Title: TMR Mooloolaba Road - Buderim - Rehabilitation Design

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: MOO_T2 Title: Mooloolaba Rd, Buderim - 10 years Traffic (2013 - 2023) - 2.92e+06 ESA

Load No.	Load ID	Movements
1	ESA75-Full	2.92E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: -165 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: M_L2B_60kN Title: Mooloolaba Rd - Ch. 6949 (Lane 2, OWP)

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	AC1550_10	Iso.	1.55E+03	0.40			
2	rough	AC775	Iso.	7.75E+02	0.40			
3	rough	Gran_100	Aniso.	1.00E+02	0.35	7.40E+01	5.00E+01	0.35
4	rough	Gran_90	Aniso.	9.00E+01	0.35	6.67E+01	4.50E+01	0.35
5	rough	Sub_CBR12	Aniso.	1.20E+02	0.45	8.28E+01	6.00E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	1550_10	ETH	0.004737	5.000	1.100
5	top	Sub_2004	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt
5	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 3: Austroads (2004) sublayering
Layer no. 4: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	150.00	AC1550_10	ESA75-Full	-1.52E-04	1.08E-01
2	100.00	AC775		n/a	n/a
3	180.00	Gran_100		n/a	n/a
4	180.00	Gran_90		n/a	n/a
5	0.00	Sub_CBR12	ESA75-Full	2.12E-04	1.50E-05

CIRCLY Version 5.0r (3 February 2011)

Job Title: TMR Mooloolaba Road - Buderim - Rehabilitation Design

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: MOO_T2 Title: Mooloolaba Rd, Buderim - 10 years Traffic (2013 - 2023) - 2.92e+06 ESA

Load No.	Load ID	Movements
1	ESA75-Full	2.92E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: -165 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: M_L2C_60kN Title: Mooloolaba Rd - Ch. 7150 (Lane 2, OWP)

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	AC1550_10	Iso.	1.55E+03	0.40			
2	rough	AC1300_10	Iso.	1.30E+03	0.40			
3	rough	Gran_160	Aniso.	1.60E+02	0.35	1.19E+02	8.00E+01	0.35
4	rough	Gran_90	Aniso.	9.00E+01	0.35	6.67E+01	4.50E+01	0.35
5	rough	Sub_CBR6	Aniso.	6.00E+01	0.45	4.14E+01	3.00E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	1550_10	ETH	0.004737	5.000	1.100
2	bottom	1300_10	ETH	0.005047	5.000	1.100
5	top	Sub_2004	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt
2	1.00	Asphalt
5	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 3: Austroads (2004) sublayering
Layer no. 4: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	200.00	AC1550_10	ESA75-Full	-8.55E-05	6.15E-03
2	100.00	AC1300_10	ESA75-Full	-1.69E-04	1.37E-01
3	180.00	Gran_160		n/a	n/a
4	180.00	Gran_90		n/a	n/a
5	0.00	Sub_CBR6	ESA75-Full	2.70E-04	8.03E-05

CIRCLY Version 5.0r (3 February 2011)

Job Title: TMR Mooloolaba Road - Buderim - Rehabilitation Design

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: MOO_T2 Title: Mooloolaba Rd, Buderim - 10 years Traffic (2013 - 2023) - 2.92e+06 ESA

Load No.	Load ID	Movements
1	ESA75-Full	2.92E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: -165 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: M_L2D_60kN Title: Mooloolaba Rd - Ch. 7400 (Lane 2, OWP)

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	AC1550_10	Iso.	1.55E+03	0.40			
2	rough	AC1150_10	Iso.	1.15E+03	0.40			
3	rough	Gran_235	Aniso.	2.35E+02	0.35	1.74E+02	1.18E+02	0.35
4	rough	Gran_140	Aniso.	1.40E+02	0.35	1.04E+02	7.00E+01	0.35
5	rough	Sub_CBR10	Aniso.	1.00E+02	0.45	6.90E+01	5.00E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	1550_10	ETH	0.004737	5.000	1.100
2	bottom	1150_10	ETH	0.005275	5.000	1.100
5	top	Sub_2004	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt
2	1.00	Asphalt
5	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 3: Austroads (2004) sublayering
Layer no. 4: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	100.00	AC1550_10	ESA75-Full	-1.22E-04	3.69E-02
2	100.00	AC1150_10	ESA75-Full	-2.37E-04	5.93E-01
3	180.00	Gran_235		n/a	n/a
4	180.00	Gran_140		n/a	n/a
5	0.00	Sub_CBR10	ESA75-Full	3.00E-04	1.70E-04

CIRCLY Version 5.0r (3 February 2011)

Job Title: TMR Mooloolaba Road - Buderim - Rehabilitation Design

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: MOO_T2 Title: Mooloolaba Rd, Buderim - 10 years Traffic (2013 - 2023) - 2.92e+06 ESA

Load No.	Load ID	Movements
1	ESA75-Full	2.92E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: -165 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: M_L2E_60kN Title: Mooloolaba Rd - Ch. 7500 (Lane 2, OWP)

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	AC1550_10	Iso.	1.55E+03	0.40			
2	rough	AC775	Iso.	7.75E+02	0.40			
3	rough	Gran_90	Aniso.	9.00E+01	0.35	6.67E+01	4.50E+01	0.35
4	rough	Gran_25	Aniso.	2.50E+01	0.35	1.85E+01	1.25E+01	0.35
5	rough	Sub_CBR9	Aniso.	9.00E+01	0.45	6.21E+01	4.50E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	1550_10	ETH	0.004737	5.000	1.100
5	top	Sub_2004	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt
5	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 3: Austroads (2004) sublayering
Layer no. 4: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	50.00	AC1550_10	ESA75-Full	-1.31E-04	5.19E-02
2	100.00	AC775		n/a	n/a
3	180.00	Gran_90		n/a	n/a
4	180.00	Gran_25		n/a	n/a
5	0.00	Sub_CBR9	ESA75-Full	3.75E-04	8.17E-04

CIRCLY Version 5.0r (3 February 2011)

Job Title: TMR Mooloolaba Road - Buderim - Rehabilitation Design

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: MOO_T2 Title: Mooloolaba Rd, Buderim - 10 years Traffic (2013 - 2023) - 2.92e+06 ESA

Load No.	Load ID	Movements
1	ESA75-Full	2.92E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: -165 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: M_L2F_60kN Title: Mooloolaba Rd - Ch. 7599 (Lane 2, OWP)

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	AC1550_10	Iso.	1.55E+03	0.40			
2	rough	AC1950_10	Iso.	1.95E+03	0.40			
3	rough	Gran_350	Aniso.	3.50E+02	0.35	2.59E+02	1.75E+02	0.35
4	rough	Gran_250	Aniso.	2.50E+02	0.35	1.90E+02	1.25E+02	0.35
5	rough	Sub_CBR12	Aniso.	1.20E+02	0.45	8.28E+01	6.00E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	1550_10	ETH	0.004737	5.000	1.100
2	bottom	1950_10	ETH	0.004361	5.000	1.100
5	top	Sub_2004	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt
2	1.00	Asphalt
5	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 3: Austroads (2004) sublayering
Layer no. 4: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	50.00	AC1550_10	ESA75-Full	-3.11E-05	3.91E-05
2	100.00	AC1950_10	ESA75-Full	-2.16E-04	9.64E-01
3	180.00	Gran_350		n/a	n/a
4	180.00	Gran_250		n/a	n/a
5	0.00	Sub_CBR12	ESA75-Full	3.06E-04	1.97E-04

CIRCLY Version 5.1a (28 November 2012)

Job Title: TMR Mooloolaba Road - Buderim - New Pavement Design

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: MOO_T2 Title: Mooloolaba Rd, Buderim - 10 years Traffic (2013 - 2023) - 2.92e+06 ESA

Load No.	Load ID	Movements
1	ESA75-Full	2.92E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: -165 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: M_New Title: Mooloolaba Road - New Pavement Design

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	AC1550_10	Iso.	1.55E+03	0.40			
2	rough	AC2050_10	Iso.	2.05E+03	0.40			
3	rough	Gran_150	Aniso.	1.50E+02	0.35	1.11E+02	7.50E+01	0.35
4	rough	Sub_CBR5	Aniso.	5.00E+01	0.45	3.45E+01	2.50E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	1550_10	ETH	0.004737	5.000	1.100
2	bottom	2050_10	ETH	0.004284	5.000	1.100
4	top	Sub_2004	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt
2	1.00	Asphalt
4	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 3: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	50.00	AC1550_10	ESA75-Full	-1.12E-05	2.36E-07
2	185.00	AC2050_10	ESA75-Full	-2.11E-04	9.30E-01
3	150.00	Gran_150		n/a	n/a
4	0.00	Sub_CBR5	ESA75-Full	4.91E-04	5.32E-03

CIRCLY Version 5.1a (28 November 2012)

Job Title: TMR Mooloolaba Road - Buderim - New Pavement Design

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: MOO_T2 Title: Mooloolaba Rd, Buderim - 10 years Traffic (2013 - 2023) - 2.92e+06 ESA

Load No.	Load ID	Movements
1	ESA75-Full	2.92E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: -165 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: M_New Title: Mooloolaba Road - New Pavement Design

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	AC1550_10	Iso.	1.55E+03	0.40			
2	rough	AC2050_10	Iso.	2.05E+03	0.40			
3	rough	Gran_150	Aniso.	1.50E+02	0.35	1.11E+02	7.50E+01	0.35
4	rough	Sub_CBR7	Aniso.	7.00E+01	0.45	4.83E+01	3.50E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	1550_10	ETH	0.004737	5.000	1.100
2	bottom	2050_10	ETH	0.004284	5.000	1.100
4	top	Sub_2004	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt
2	1.00	Asphalt
4	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 3: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	50.00	AC1550_10	ESA75-Full	-1.34E-05	5.85E-07
2	165.00	AC2050_10	ESA75-Full	-2.12E-04	9.61E-01
3	150.00	Gran_150		n/a	n/a
4	0.00	Sub_CBR7	ESA75-Full	4.65E-04	3.67E-03

CIRCLY Version 5.0r (3 February 2011)

Job Title: TMR Mooloolaba Road - Buderim - New Pavement Design

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: MOO_T1 Title: Mooloolaba Rd, Buderim - 20 years Traffic (2013 - 2034) - 5.87e+06 ESA

Load No.	Load ID	Movements
1	ESA75-Full	5.87E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: -165 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: M_New Title: Mooloolaba Road - New Pavement Design

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	AC1550_10	Iso.	1.55E+03	0.40			
2	rough	AC2050_10	Iso.	2.05E+03	0.40			
3	rough	Gran_150	Aniso.	1.50E+02	0.35	1.11E+02	7.50E+01	0.35
4	rough	Sub_CBR5	Aniso.	5.00E+01	0.45	3.45E+01	2.50E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	1550_10	ETH	0.004737	5.000	1.100
2	bottom	2050_10	ETH	0.004284	5.000	1.100
4	top	Sub_2004	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt
2	1.00	Asphalt
4	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 3: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	50.00	AC1550_10	ESA75-Full	-1.69E-05	3.74E-06
2	210.00	AC2050_10	ESA75-Full	-1.84E-04	9.51E-01
3	150.00	Gran_150		n/a	n/a
4	0.00	Sub_CBR5	ESA75-Full	4.25E-04	3.94E-03

CIRCLY Version 5.0r (3 February 2011)

Job Title: TMR Mooloolaba Road - Buderim - New Pavement Design

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: MOO_T1 Title: Mooloolaba Rd, Buderim - 20 years Traffic (2013 - 2034) - 5.87e+06 ESA

Load No.	Load ID	Movements
1	ESA75-Full	5.87E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: -165 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: M_New Title: Mooloolaba Road - New Pavement Design

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	AC1550_10	Iso.	1.55E+03	0.40			
2	rough	AC2050_10	Iso.	2.05E+03	0.40			
3	rough	Gran_150	Aniso.	1.50E+02	0.35	1.11E+02	7.50E+01	0.35
4	rough	Sub_CBR7	Aniso.	7.00E+01	0.45	4.83E+01	3.50E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	1550_10	ETH	0.004737	5.000	1.100
2	bottom	2050_10	ETH	0.004284	5.000	1.100
4	top	Sub_2004	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt
2	1.00	Asphalt
4	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 3: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	50.00	AC1550_10	ESA75-Full	-1.89E-05	6.50E-06
2	190.00	AC2050_10	ESA75-Full	-1.85E-04	9.65E-01
3	150.00	Gran_150		n/a	n/a
4	0.00	Sub_CBR7	ESA75-Full	4.01E-04	2.62E-03

DOCUMENT VERIFICATION

Document prepared by: Daniel Colborne

Department of Transport and Main Roads
Engineering & Technology
Geotechnical Branch
Level 8, 15 Adelaide Street
BRISBANE QLD 4000

Project Name	Additional Geotechnical Investigation - Mooloolaba Road (Buderim Hill)	**Project Number**	FG6082
Report Name	Additional Geotechnical Investigation - Mooloolaba Road (Buderim Hill)	**Report Number**	MR2438

Rev	Details	Date	Prepared by Name Position Signature	Reviewed by Name Position Signature	Approved by Name Position Signature
0	Report for release to client	25 October 2012	Daniel Colborne Geologist	Simon Foley Senior Engineering Geologist	Don Lalith Welikala Director

Queensland Government

Memorandum

Our ref MR2438
Your ref 263/134/480
Date 22 October 2012

To Leah McKenzie (Senior Engineer, TMR)

Copy to Eugene Lapore (Principal Geotechnical Engineer, Aecom)

Subject **Mooloolaba Road (Buderim Hill)**

1.0 INTRODUCTION

This memorandum contains factual information relating to a geotechnical investigation carried out by TMR Geotechnical Branch in August 2012 at Mooloolaba Road between chainages 6700 and 7600.

Geotechnical subsurface information is required for proposed cut widening (at approximate chainages 6750 to 6825 and 7480 to 7580), proposed embankment widening (at approximate chainages 6900 to 7075), and a proposed retaining wall construction (at approximate chainage 7075). These locations are displayed on site plans included in Appendix B.

The geotechnical investigation was carried out in accordance with a brief provided by the design engineers for the project, Aecom.

The tests and procedures used in this report and investigation are generally in accordance with the Queensland Transport & Main Roads Department Materials Testing Manual. Geotechnical Terms and Symbols are in accordance with Form *F:GEOT 017/6 2010* included in Appendix A of this report

The samples taken for this investigation are currently held by Material Services Laboratories Caboolture and Herston. These are available for inspection by contacting Geotechnical Branch South East Queensland on (07) 3066 7753.

Department of Transport and Main Roads
Engineering and Technology
Geotechnical Branch
Floor 8, 15 Adelaide St, Brisbane, 4000

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2.0 SITE GEOLOGY

According to the Queensland Geological Survey 1:100 000 series Caloundra Geology Map (sheet 9544), geological formations within close proximity to the site include; Late Triassic to Early Jurassic aged Landsborough Sandstone (sandstone, siltstone, shale, conglomerate); and Tertiary aged Volcanics (basalt lavas, some agglomerate, tuff and interbedded sediments).

3.0 FIELD INVESTIGATION

The field investigation comprised 4 test pit excavations and 7 Variable Energy Dynamic Cone Penetrometer (VDCP) tests. The subsurface investigation was limited in places due to existing services.

In situ tests (Field Shear Vane; Pocket Penetrometer) were performed during excavation of test pits.

Test pit logs are included in Appendix C and VDCP logs are included in Appendix D.

Geological mapping of exposed cut surfaces was also carried out to provide additional data for the proposed cut widening between approximate chainages 7480 to 7580.

Table 1 below shows investigation locations and proposed works. The geological mapping summary is included in Appendix E.

Table 1: Geotechnical Investigation Locations.

Geotechnical Investigation Locations				
Name	**Easting[1]**	**Northing[1]**	**Proposed Works**	**Location**
TP1/VDCP1	507689	7048684.9	Embankment Widening	Western Corner of Nyes Crescent and Mooloolaba Road
TP2/VDCP2	507711.88	7048675.5	Embankment Widening/Retaining Wall	Western Corner of Nyes Crescent and Mooloolaba Road
TP3/VDCP3	507736.44	7048651.42	Embankment Widening	Eastern Corner of Nyes Crescent and Mooloolaba Road
TP4/VDCP4	507742.36	7048648.31	Embankment Widening	Eastern Corner of Nyes Crescent and Mooloolaba Road
VDCP5	507448.7	7048749.8	Cut Widening	Western Corner of Foote Avenue and Mooloolaba Road
VDCP6	507458.56	7048745.41	Cut Widening	Western Corner of Foote Avenue and Mooloolaba Road
VDCP7	507470.92	7048739.72	Cut Widening	Western Corner of Foote Avenue and Mooloolaba Road
Geologic Mapping			Cut Widening	From approximate chainage 7480 to approximate chainage 7580.

Notes:
*1. Datum MGA94, Zone **56***

4.0 LABORATORY TESTING

Representative soil samples collected during the excavation of test pits were taken to Material Services Laboratory, Caboolture for classification testing and storage. Laboratory tests included Particle Size Distribution; Atterberg Limits; WPI and WLS.

Representative rock samples collected during the geological mapping were taken to Material Services Laboratory at Herston for strength testing which comprised irregular point load tests.

Table 2 below shows a summary of all laboratory test results for all soil and rock samples. All detailed test reports are included in Appendix F.

Table 2: Summary of Laboratory Testing for Soil and Rock Tests.

Summary of Laboratoy Testing - Mooloolaba Road (Buderim Hill)

Soil Classification Tests

Test pit No.	Depth (mm)	Sample No.	Date Sampled	Grading (% Passing AS Sieve Size) 75.0 (mm)	53.0 (mm)	37.5 (mm)	26.5 (mm)	19.0 (mm)	9.50 (mm)	4.75 (mm)	2.36 (mm)	0.425 (mm)	0.075 (mm)	LL (%)	PI (%)	L.S (%)	Dust Ratio	WLS (LS x % <425 µm)	WPI (PI x % <425 µm)	Compaction OMC (%)	MDD (t/m2)
TP1	1400-2800	12C0938	21/08/2012							100	100	90	44	30.4	15.6	8	0.48	773	1410		
TP2	1500-2500	12C0939	21/08/2012							100	100	95	82	50.4	30.4	15.6	0.87	1474	2873		
TP4	1500-2000	12C0940	21/08/2012							100	100	88	45	38.2	23.6	10	0.51	880	2077	13.9	1.84

Rock Strength Classification Tests

Lithology	Point load strength index [Is(50)] (Mpa)	Rock Material Strength Term	Standard Deviation*	Mean*	Median*	Mode*	Overall Mean Rock Material Strength Term
Sandstone	4.1	VH	0.92	2.49	2.55	3.1	VH
Sandstone	3.1	VH					
Sandstone	2.7	H					
Sandstone	1.8	H					
Sandstone	3.1	VH					
Sandstone	1.7	H					
Sandstone	0.82	M					
Sandstone	3.4	VH					
Sandstone	1.7	H					
Sandstone	2	H					
Sandstone	2.4	H					
Sandstone	3.1	VH					

Notes:

1. **All test results (including outliers) have been used in calculations.*

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5.0 SUMMARY

This report contains factual geotechnical information required for the design and construction of 2 cut widenings, 1 embankment widening, and 1 retaining wall. The geotechnical investigation for this report was completed in August 2012 and involved 7 VDCPs, the excavation of 4 test pits, and laboratory testing of soil and rock samples.

The results of field and laboratory testing are summarised in tables 1 and 2, and are displayed in full in the attached appendices.

pr

Daniel Colborne
Graduate Geologist

Appendix A – Geological Terms and Symbols

Geotechnical Terms and Symbols

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The following information is designed to assist in the interpretation of terms used in geotechnical borelogs, trench logs and reports. More detailed information can be obtained from an examination of relevant test methods in the Department of Main Roads Materials Testing Manual and the following codes AS1726 (Geotechnical Site Investigations) and AS1289 (Methods of Testing Soils for Engineering Purposes).

Soil Descriptions

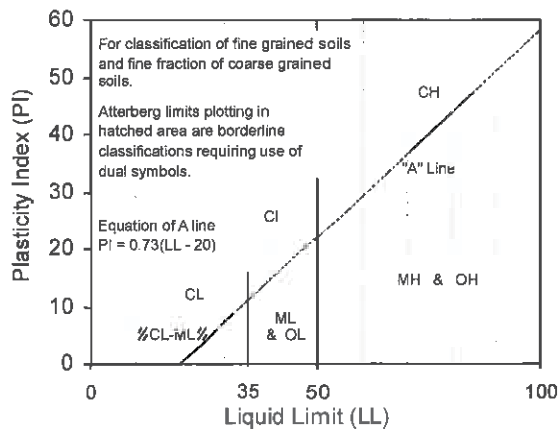
Soils for engineering purposes are the unconsolidated materials above bedrock. They can be residual, colluvial, aeolian or alluvial in origin.

Classification of material based on Unified Soil Classification System (refer Geotechnical Site Investigation Code AS1726 Appendix A). Note: Other Soil Classification systems, such as Northcote Factual key, do exist and these may be more appropriate to use in certain circumstances in conjunction with the USC system.

Unified Soil Classification System (Simplified)

Major Divisions		Particle size, mm	Group Symbol	Typical Names	Laboratory Classification				
					% < 0.075mm (2)	Plasticity of fine fraction	$Cu = \frac{D_{60}}{D_{10}}$	$Cc = \frac{(D_{30})^2}{D_{10} D_{60}}$	NOTES
	BOULDERS	200							
	COBBLES	63							
COARSE GRAINED SOILS (more than half of material less than 63 mm is larger than 0.075 mm)	GRAVELS (more than half of coarse fraction is larger than 2.36mm)	coarse 20	GW	Well graded gravels and gravel-sand mixtures, little or no fines	0-5	—	>4	Between 1 and 3	(1) Identify fines by the method given for fine-grained soils.
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines, uniform gravels	0-5	—	Fails to comply with above		
		medium 6	GM	Silty gravels, gravel-sand-silt mixtures (1)	12-50	Below 'A' line or PI<4	—	—	
		fine 2.36	GC	Clayey gravels, gravel-sand-clay mixtures (1)	12-50	Above 'A' line and PI>7	—	—	(2) Borderline classifications occur when the percentage of fines (fraction smaller than 0.075mm size) is greater than 5% and less than 12%. Borderline classifications require the use of SP-SM, GW-GC
	SANDS (more than half of coarse fraction is smaller than 2.36mm)	coarse 0.6	SW	Well graded sands and gravelly sands, little or no fines	0-5	—	>6	Between 1 and 3	
		medium 0.2	SP	Poorly graded sands and gravelly sands, little or no fines	0-5	—	Fails to comply with above		
		fine 0.075	SM	Silty sands, sand silt mixtures (1)	12-50	Below 'A' line or PI<4	—	—	
			SC	Clayey sands, sand-clay mixtures (1)	12-50	Above 'A' line and PI>7	—	—	
FINE GRAINED SOILS (more than half of material less than 63 mm is smaller than 0.075 mm)	SILTS & CLAYS (liquid limit ≤50%)		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity					
			CL CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays					
			OL	Organic silts and clays of low plasticity					
	SILTS & CLAYS (liquid limit >50%)		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts					
			CH	Inorganic clays of high plasticity, fat clays					
			OH	Organic silts and clays of high plasticity					
	HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils					

Use the gradation curve of material passing 63 mm for classification of fractions according to the criteria given in 'Major Divisions'



Consistency for cohesive soils is usually estimated using simple field tests (refer field guide), UCS (measured using penetrometer) or undrained shear strength as measured using triaxial test, shear vane or friction cone penetrometer. SPT 'N' value can also be used as an indication.

Consistency - Essentially Cohesive Soils

Term	Field Guide	Symbol	Undrained Shear Strength S_u (kPa)	SPT N Value	Unconfined Compressive Strength UCS (kPa)
Very soft	Oozes between fingers when squeezed in hand.	VS	<12	0-2	<20
Soft	Easily moulded with fingers.	S	12-25	2-4	20-50
Firm	Can be moulded by strong pressure of fingers.	F	25-50	4-8	50-100
Stiff	Not possible to mould in fingers.	St	50-100	8-15	100-200
Very stiff		VSt	100-200	15-30	200-400
Hard	Can be indented with difficulty by thumb nail.	H	>200	>30	>400

Basic Particle Sizes - Soils

Term	Size Range
BOULDERS	>200mm
COBBLES	63-200mm
Coarse GRAVEL	20-63mm
Medium GRAVEL	6-20mm
Fine GRAVEL	2.36-6mm
Coarse SAND	0.6-2.36mm
Medium SAND	0.2-0.6mm
Fine SAND	0.075-0.2mm
SILT	0.002-0.075mm
CLAY	<0.002mm

Based on AS1726.

Consistency for non-cohesive soils is generally based on the results of insitu Standard Penetration Tests.

Consistency - Essentially Non-Cohesive Soils

Term	Symbol	SPT N Value	Field Guide	Relative Density (%)
Very loose	VL	0-4	Foot imprints readily	0-15
Loose	L	4-10	Shovels easily	15-35
Medium dense	MD	10-30	Shovelling difficult	35-65
Dense	D	30-50	Pick required	65-85
Very dense	VD	>50	Picking difficult	85-100

Moisture condition based on appearance of soil.

Soil Moisture

Term	Description
Dry	Cohesive soils; hard and friable or powdery, well dry of plastic limit. Granular soils; cohesionless and free-running.
Moist	Soil feels cool, darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere.
Wet	Soil feels cool, darkened in colour. Cohesive soils usually weakened and free water forms on hands when handling. Granular soils tend to cohere and free water forms on hands when handling.

The **Colour** of a soil is determined in the moist condition using simple terms. These can be modified by the use of discriminators such as pale, dark, mottled, etc.

Rock Descriptions

Defect spacing: On the engineering borelog, a graphical representation of defect spacing is given. This corresponds to the cumulative measurements of all defect sets. The term defect includes all natural rock discontinuities, but not breaks induced by the drilling/handling of core.

Term	Symbol	Spacing (mm)
Extremely Close	EC	<6
Very Close	VC	6 – 20
Close	C	20 – 60
Medium	M	60 – 200
Wide	W	200 – 600
Very Wide	VW	600 – 2000
Extremely Wide	EW	>2000

Defect Persistence

Term	Length (m)
Very High	>10
High	5 – 10
Moderate	2 – 5
Low	0.5 – 2
Very Low	<0.5

Defect Description uses terms contained in AS1726 Table A10 to describe the type of defect (i.e, bedding, foliation, cleavage, joint, sheared zone, crushed seam/zone, decomposed seam/zone, infilled seam/zone) and character (roughness, extent coating etc).

Degree of fracturing as applied to drill cores is described by the Rock Quality Designation (RQD).

Rock quality designation (RQD) is the ratio of length of rock core recovered in pieces of 100mm or longer to length of core run drilled (usually 1.5m or 3.0m) expressed as a percentage. RQD is related to rock-mass properties.

Weathering is the destructive process or group of processes whereby rocks on exposure to atmospheric agents and groundwater at or near the surface are changed in character. The changes such as colour, texture and composition are brought about by physical, chemical and biotic processes. The degree of weathering can be a continuum from soil to fresh rock with boundaries between weathered grades often blurred. Usually rock strength decreases with an increase in weathering grade but it is not used as a primary basis of the weathering classification.

The following table summarises the criteria for describing weathering grade.

Rock Material Weathering Classification		
Term	**Symbol**	**Definition**
Residual Soil	RS	Soil like material developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the material has not been significantly transported.
Extremely weathered rock	XW	Rock is weathered to such an extent that it has 'soil' properties, i.e. it either disintegrates or can be remoulded in water, but substance fabric and rock structure still recognisable.
Highly weathered rock	HW	Weathering penetrates deeply inwards from defects usually with major discolouration throughout the rock fabric and major change in constituent minerals. The intact rock is usually much weaker than the fresh rock. Corestones, if present, form a minor component of the rock mass.
Moderately weathered rock	MW	Weathering penetrates inwards from defects often with significant discolouration of the rock fabric and minor change of constituent minerals. The rock is a continuous framework and is usually noticeably weaker than the fresh rock. Corestones, if present, form a major component of the rock mass.
Slightly weathered rock	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh Rock	FR	Rock shows no sign of decomposition or staining.

Notes:

1. The above criteria generally apply and variations will be noted on the Engineering Borelogs.
2. Extremely weathered rock is described in terms of soil engineering properties.

Strength is based on point load strength index, corrected to 50mm diameter – $I_s(50)$. Field guide used if no tests available. (Ref. AS 4133.4.1).

Strength of Rock Material			
Term	**Letter symbol**	**Point load index (MPa) *I*$_s$*50***	**Field Guide to Strength**
Extremely low	EL	≤0.03	Easily remoulded by hand to a material with soil properties.
Very low	VL	>0.03 - ≤0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 3cm thick can be broken by finger pressure.
Low	L	>0.1 - ≤0.3	Easily scored with a knife; indentations 1mm to 3mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium	M	>0.3 - ≤1.0	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High	H	>1 - ≤3	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very high	VH	>3 - ≤10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
Extremely high	EH	>10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

Notes:

1. These terms refer to the strength of the rock material and not to the strength of the rock mass which may be considerably weaker due to the effect of rock defects.
2. Anisotropy of rock material samples may affect the field assessment of strength.
3. Approximate correlation UCS = 24 x $I_s(50)$.

Insitu Test Methods

Standard Penetration Test (SPT) - (Ref. AS 1289.6.3.1). The penetration resistance for each 150mm interval and the derived N value is recorded on the borelog as one of:

(i)	4, 7, 11 N=18	(normal test)
(ii)	4, 18, 30/15 mm *N>50	(partial penetration)
(iii)	30/080 mm *N>50	(partial penetration - seating drive)
(iv)	RW N<1	(rod weight only caused penetration)
(v)	HW N<1	(hammer and rod weight only caused penetration)
(vi)	HB *N>50	(hammer bouncing)

* **Note:** N>50, is Main Roads terminology only.

Static Cone Penetration Test (CPT) - (Ref. AS 1289.6.5.1). The soil descriptions shown on the CPT plots have been inferred from the measured resistances using one of the recognised classification systems (eg. Robertson and Campanella) and correlated boreholes from the site.

Piezocone (CPTU) - Renders the same information as the CPT but in addition gives clearer definition of sand lenses and enables assessment of insitu consolidation behaviour through measurement of pore pressure.

Variable Energy Dynamic Cone Penetrometer (VDCP) – Similar to dynamic cone penetrometer (DCP) but penetration is carried out using variable energy to drive the probe (also called Panda Probe).

Field Shear Vane Test (FSV) – (Ref. AS 1289.6.2.1).

Water Pressure / Packer Test (WPT) – (Ref. Houlsby, A.C., 1976, *Routine Interpretation of the Lugeon Water Test*, Quarterly Journal of Engineering Geology, Volume 9, pp 303-313).

Symbols

The list below gives an explanation of the terms and symbols used on the borelogs, trench logs and penetrometer logs.

Test Results		**Test Results Continued**		**Test Symbols**	
PI	- Plasticity Index	c'	- Effective Cohesion	SPT	- Standard Penetration Test
LL	- Liquid Limit	ϕ_u	- Undrained Angle of Internal Friction	U50	- Undisturbed Sample 50 mm diameter
LI	- Liquidity Index	ϕ'	- Effective Angle of Internal Friction	U100	- Undisturbed Sample 100mm diameter
DD	- Dry Density	A,B	- Skempton's Pore Pressure Parameters	UCS	- Unconfined Compressive Strength
WD	- Wet Density	c_v	- Coefficient of Consolidation	Pm	- Pressuremeter
LS	- Linear Shrinkage	m_v	- Coefficient of Volume Decrease	FSV	- Field Shear Vane
MC	- Moisture Content	$c_{\alpha c}$	- Coefficient of Secondary Compression	LSV	- Laboratory Shear Vane
OC	- Organic Content	e	- Voids Ratio	DST	- Direct Shear Test
WPI	- Weighted Plasticity Index	c'_R	- Residual Cohesion	X	- Point Load Strength (diametral)
WLS	- Weighted Linear Shrinkage	ϕ'_R	- Residual Friction Angle	O	- Point Load Strength (axial)
DoS	- Degree of Saturation	ϕ'_{cv}	- Angle of Effective Stress at Constant Volume	L	- Point Load Strength (irregular lump)
APD	- Apparent Particle Density	q_t / q_c	- Piezocone Resistance	PP	- Pocket Penetrometer
S_u	- Undrained Shear Strength	q_d	- VDCP (Panda Probe) Cone Resistance	WPT	- Water Pressure Test
c_u	- Undrained Cohesion	uL	- Lugeon Value of Water Pressure Testing	Petro.	- Petrographic Analysis
				PR	- Penetration Rate

Defect Description Abbreviations

Type		**Roughness**		**Wall Alterations**		**Other**	
J, Js	Joint, Joints	R	Rough	FeSt	Iron Stained	CInf	Clay Infill
B	Bedding	SR	Slightly Rough	Wth	Weathered	CLy	Clayey
BP	Bedding Parting	S	Smooth	Smn	Secondary Mineralisation	Co	Coal Seam
FP	Foliation Parting	SL	Slickensided	Cn	Clean	Carb	Carbonaceous
LP	Lamination Parting	PO	Polished			SInf	Sand Infill
CLV	Cleavage					QZ	Quartz
Fr	Fracture	**Planarity**		**Aperture**		CA	Calcite
SZ	Sheared Zone	Pl	Planar	C	Closed	Chl	Chlorite
CZ	Crushed Zone	St	Stepped	O	Open	In	Incipient
BZ	Broken Zone	Un	Undulating	F	Filled	Int	Intersecting
HFZ	Highly Fractured Zone	Cu	Curved	T	Tight	Lam (s)	Lamination (s)
WS	Weathered Seam	Ir	Irregular			DI	Drilling Induced
VN	Vein					H	Horizontal
						V	Vertical

Graphic Symbols

12/10/86

Water level on date shown

Water Inflow

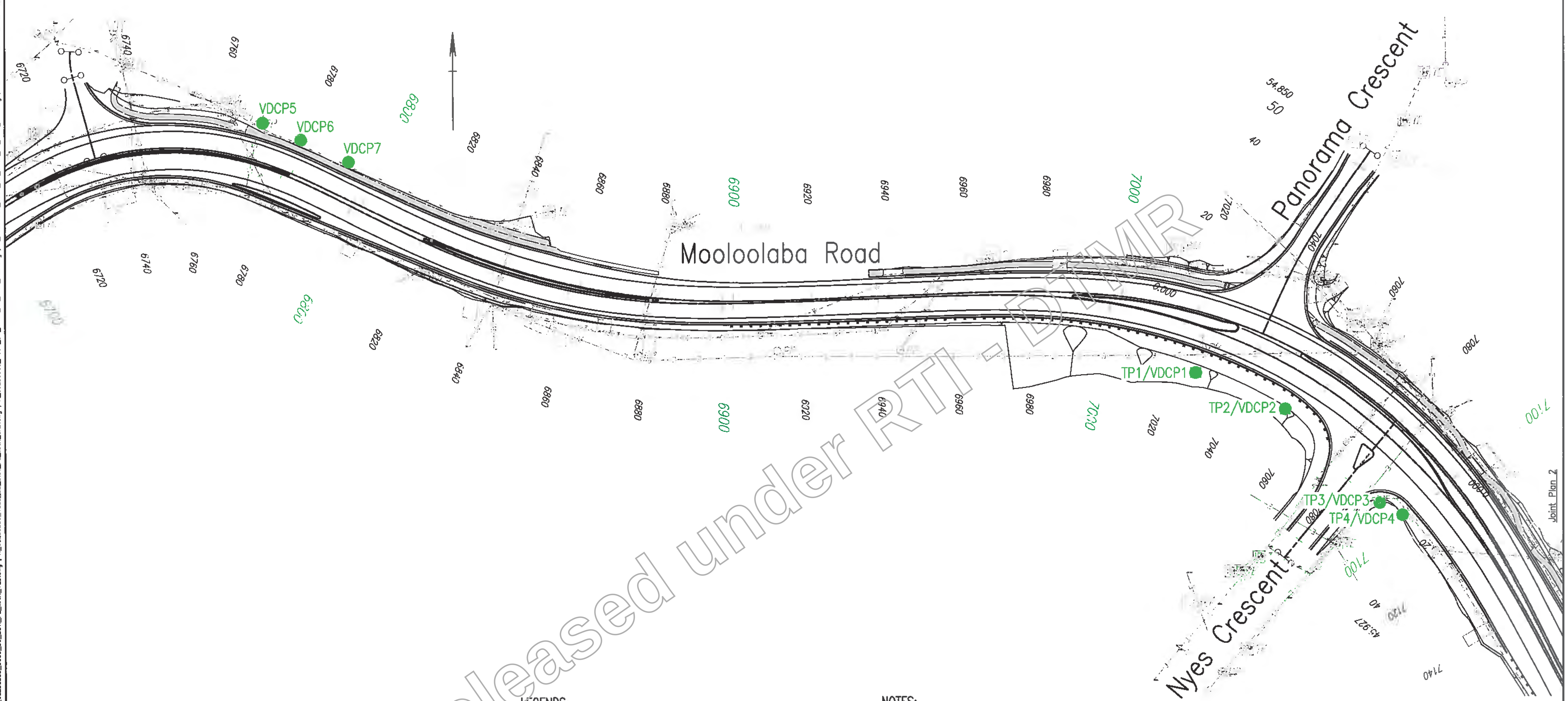
Water Outflow

Note: Other symbols used on the borelogs and trench logs referring to the unified soil classification, soil consistency, rock weathering, rock defect spacing and intact rock strength are shown in the relevant preceding tables.

Queensland Government

Appendix B – Site Plans

Last Modified :- Oct 25, 2012 – 2:20pm XREFS :- X_60250500_0000_00_SSUR_PL_MAIN_12D.dwg ; X_60250500_0000_00_SUTI_PL_MAIN_12D.dwg ; X_60250500_1000_DD_DRAI_PL_MAIN_CAD.dwg ; X_60250500_1000_DD_DROA_CL_MAIN_12D.dwg ; X_60250500_1000_DD_DROA_PL_MAIN_12D.dwg ; X_60250500_1000_DD_DROA_PL_MAIN_CAD.dwg ; X



LEGENDS:

TP1 ■ Testpit number and location

VDCP1 ● Variable energy dynamic cone penetrometer number and location

NOTES:

1. The samples on which the interpretation of this plan is based, are held by the TMR Geotechnical unit; Brisbane.
2. This plan is to be read in conjunction with Report MR2438.
3. This plan is to be used for the investigation locations and is intended for the geotechnical investigation only. This figure is not a setting out drawing as the control lines may still be revised.
4. For the purpose of the geotechnical database the geographical coordinates are from Latitude −26.682437˚ and Longitude 153.074925˚ to Latitude −26.683504˚ and Longitude 153.081217˚.
5. Drawing information was provided by the AECOM on the 22/10/12.

Rev	Revisions/Descriptions	Ref	Certification	Date	Microfilmed
E					
D					
C					
B					
A	Original Issue A3	[redacted]			

Client: NORTH COAST REGION

Project Name: ADDITIONAL GEOTECHNICAL INVESTIGATION MOOLOOLABA ROAD BUDERIM HILL

Investigation Type: GEOTECHNICAL

SURVEY DATA — GDA

Horiz. Grid: MGA94 Zone 56

Height Origin: AHD

Survey Books: –

Scales: 0 5 10 15 20m

Dimensions shown in metres except where shown otherwise

SUNSHIRE COAST REGIONAL COUNCIL

MOOLOOLABA ROAD – 134

CTL CHGE CH6720 – CH7600

Reference Points

Preceding RP	Dist. to start of job (km)	From start to end of job	From end to Following RP	Following RP
–	–	–	–	–

Through Chainage from –

PLAN 1

GEOTECHNICAL INVESTIGATION LOCATIONS

AREA	NAME	–	–
PROJECT ENGINEER	H.TAM		
PROJECT GEOLOGIST	D.COLBORNE		
DRAFTER	K.HSIEH		

Queensland Government

Transport and Main Roads

Job No.	–
Project No.	FG 6028
Plan No.	1 A
Series Number	1 of 2

MRG_Detail (01/10)

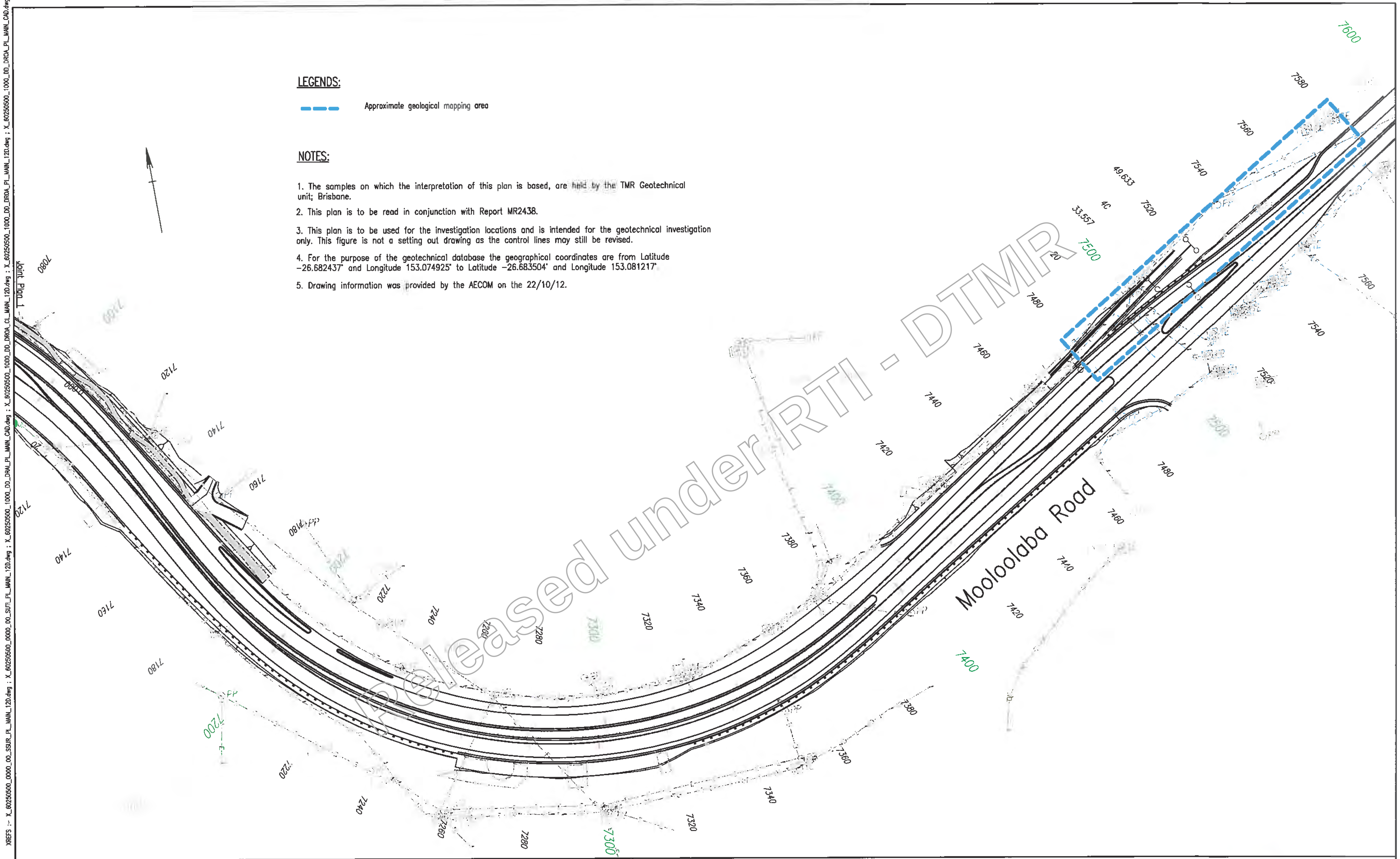
CAD FILES G:\GeotechBranchDrafting\Drafting\20121022_Mooloolaba Rd(Buderim Hill)\Plan.dwg

LEGENDS:

Approximate geological mapping area

NOTES:

1. The samples on which the interpretation of this plan is based, are held by the TMR Geotechnical unit; Brisbane.
2. This plan is to be read in conjunction with Report MR2438.
3. This plan is to be used for the investigation locations and is intended for the geotechnical investigation only. This figure is not a setting out drawing as the control lines may still be revised.
4. For the purpose of the geotechnical database the geographical coordinates are from Latitude −26.682437° and Longitude 153.074925° to Latitude −26.683504° and Longitude 153.081217°.
5. Drawing information was provided by the AECOM on the 22/10/12.



Client: NORTH COAST REGION

Project Name: ADDITIONAL GEOTECHNICAL INVESTIGATION MOOLOOLABA ROAD BUDERIM HILL

Investigation Type: GEOTECHNICAL

E				
D				
C				
B				
A	Original Issue A3	[redacted]		
Revisions/Descriptions	Ref	Certification	Date	Microfilmed

SURVEY DATA	GDA
Horiz. Grid	MGA94 Zone 56
Height Origin	AHD
Survey Books	–

Scales: 0 5 10 15 20m

Dimensions shown in metres except where shown otherwise

SUNSHINE COAST REGIONAL COUNCIL

MOOLOOLABA ROAD – 134

CTL CHGE CH6720 – CH7600

Reference Points				
Preceding RP	Dist. to start of job (km)	From start to end of job	From end to Following RP	Following RP
–	–	–	–	–

Through Chainage from –

PLAN 2

GEOTECHNICAL INVESTIGATION LOCATIONS

AREA	NAME	–	–
PROJECT ENGINEER	H.TAM		
PROJECT GEOLOGIST	D.COLBORNE		
DRAFTER	K.HSIEH		

Queensland Government

Transport and Main Roads

Job No.	–
Project No.	FG 6028
Plan No.	2 A
Series Number	2 of 2

MRG_Detail (01/10)

CAD FILES G:\GeotechBranchDrafting\Drafting\20121022_Mooloolaba Rd(Buderim Hill)\Plan.dwg

Last Modified :- Oct 25, 2012 – 2:20pm

Appendix C – Test Pit Logs

TEST PIT LOG

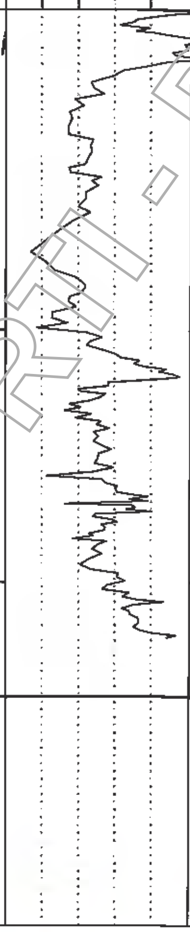
Queensland Government

FOR GEOTECHNICAL TERMS AND SYMBOLS REFER FORM F:GEOT 017/6-2010

FEATURE No: TP1
SHEET: 1 of 1
DATE EXCAVATED: 22/8/12

PROJECT: Mooloolaba Road (Buderim Hill)
LOCATION: Western Corner of Nyes Crescent and Mooloolaba Road
COORDINATES: 507689.0 E; 7048684.9 N
PROJECT No: FG6028
SURFACE R.L.: 105.10
DATUM: AHD
SYSTEM: GDA94
JOB No: 263/134/480
EQUIPMENT TYPE AND MODEL: Excavator (5t)
BUCKET SIZE: 900mm

DEPTH (m)	R.L. (m)	METHOD	USC	WEATHERING	SOIL DESCRIPTION — SOIL TYPE: Colour, grain size, plasticity or particle characteristics, moisture, consistency, density, secondary components / ROCK DESCRIPTION — ROCK SUBSTANCE: Type, colour, grain characteristics, weathering, strength, structure, inclusions	0 4 8 12 16 >20	ADDITIONAL DATA AND TEST RESULTS	SAMPLE NUMBER	TEST REPORT
0	105.10	BUCKET							
	105.00				**TOPSOIL:** Brown, moist, organic, sandy clay. Occasional boulder sizing up to 300mm.				
			CH		**Sandy CLAY (RESIDUAL):** Mottled grey to orange brown, moist, very stiff. High plasticity.		FSV: 168kPa; PP: 157kPa		
1							FSV: 111kPa		
	103.70		XW		**SANDSTONE** **Fine grained sedimentary rock** **XW:** Exhibits engineering properties of a white to mottled grey, moist, very stiff, silty clayey sand. (USC=CL). High plasticity.				
2							LL = 30; PI = 16; LS = 8; WPI=1410; WLS=773	12C0938	30124
	102.60		HW		**HW:** Grey, fine grained, low strength.				
3	102.10				Excavation terminated at 3m				
4	101.10								



REMARKS: WPI=PI×%Passing 0.425mm Seive. WLS=LS×%Passing 0.425mm Seive.

LOGGED BY: LD/DC

TEST PIT LOG

Queensland Government

FOR GEOTECHNICAL TERMS AND SYMBOLS REFER FORM F:GEOT 017/6-2010

FEATURE No	TP2
SHEET	1 of 1
DATE EXCAVATED	22/8/12

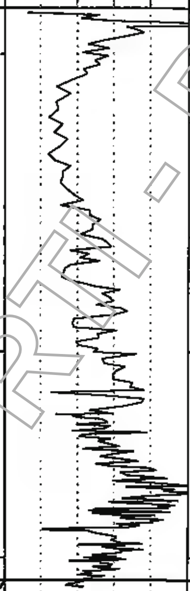
PROJECT Mooloolaba Road (Buderim Hill)

LOCATION Western Corner of Nyes Crescent and Mooloolaba Road — COORDINATES 507711.9 E; 7048675.5 N

PROJECT No FG6028 — SURFACE R.L. 102.32 — DATUM AHD — SYSTEM GDA94

JOB No 263/134/480 — EQUIPMENT TYPE AND MODEL Excavator (5t) — BUCKET SIZE 900mm

DEPTH (m)	R.L. (m)	METHOD	USC / WEATHERING	SOIL DESCRIPTION — SOIL TYPE: Colour, grain size, plasticity or particle characteristics, moisture, consistency, density, secondary components / ROCK DESCRIPTION — ROCK SUBSTANCE: Type, colour, grain characteristics, weathering, strength, structure, inclusions	0 4 8 12 16>20	ADDITIONAL DATA AND TEST RESULTS	SAMPLE NUMBER	TEST REPORT
0	102.32	BUCKET						
	102.12			**TOPSOIL:** Brown, moist, organic, sandy clay. Boulders sizing up to 500mm.				
			SC	**Sandy CLAY (RESIDUAL):** Mottled grey to orange brown, moist, very stiff. High plasticity.		Tree root. FSV: 163kPa PP: 175kPa		
1						FSV: 170kPa		
	100.82			At 1.3m colour changes to white.				
2	99.92		XW	**SANDSTONE** **Fine grained sedimentary rock** **XW:** Exhibits engineering properties of a white to mottled grey, moist, sandy silty clay. High plasticity.		LL = 50; PI = 30; LS = 16; WPI=2873; WLS=1474	12C0939	30125
	99.82		HW	HW: Grey, low strength.				
				Excavation terminated at 2.5m				
3								
4	98.32							



REMARKS WPI=PI×%Passing 0.425mm Seive. WLS=LS×%Passing 0.425mm Seive.

LOGGED BY LD/DC

QLD_DMR_LIB_01A.GLB Log A_TEST PIT LOG FG6028 - MOOLOOLABA BUDERIM RD.GPJ <<DrawingFile>> Dalgel CPT Tool gINt Add-In 26/10/2012 15:43

TEST PIT LOG

FOR GEOTECHNICAL TERMS AND SYMBOLS REFER FORM F:GEOT 017/6-2010

Queensland Government

FEATURE No TP3
SHEET 1 of 1
DATE EXCAVATED 22/8/12

PROJECT Mooloolaba Road (Buderim Hill)
LOCATION Eastern Corner of Nyes Crescent and Mooloolaba Road
COORDINATES 507736.4 E; 7048651.4 N
PROJECT No FG6028
SURFACE R.L. 98.84
DATUM AHD
SYSTEM GDA94
JOB No 263/134/480
EQUIPMENT TYPE AND MODEL Excavator (5t)
BUCKET SIZE 900mm

DEPTH (m)	R.L. (m)	METHOD	USC	WEATHERING	SOIL DESCRIPTION — SOIL TYPE: Colour, grain size, plasticity or particle characteristics, moisture, consistency, density, secondary components / ROCK DESCRIPTION — ROCK SUBSTANCE: Type, colour, grain characteristics, weathering, strength, structure, inclusions	0 4 8 12 16>20	ADDITIONAL DATA AND TEST RESULTS	SAMPLE NUMBER	TEST REPORT
0	98.84	BUCKET	SC		**Gravelly Sandy CLAY (FILL):** Brown, moist, very stiff. Medium to high plasticity. Boulders sizing up to 600mm throughout. Boulders are dominantly basalt.		FSV: 116kPa (at 1 m)		
1.4	97.44			XW	**SANDSTONE** **Fine grained sedimentary rock.** **XW:** Exhibits engineering properties of a mottled grey to orange brown, moist, very stiff, sandy silty clay. High plasticity. At 2.4m colour changes to grey.				
3.5	95.34				Excavation terminated at 3.5m				
4	94.84								

REMARKS

LOGGED BY LD/DC

Queensland Government

TEST PIT LOG

FOR GEOTECHNICAL TERMS AND SYMBOLS REFER FORM F:GEOT 017/6-2010

FEATURE No TP4
SHEET 1 of 1
DATE EXCAVATED 22/8/12

PROJECT Mooloolaba Road (Buderim Hill)
LOCATION Eastern Corner of Nyes Crescent and Mooloolaba Road
COORDINATES 507742.4 E; 7048648.3 N
PROJECT No FG6028
SURFACE R.L. 98.30
DATUM AHD
SYSTEM GDA94
JOB No 263/134/480
EQUIPMENT TYPE AND MODEL Excavator (5t)
BUCKET SIZE 900mm

DEPTH (m)	R.L. (m)	METHOD	USC	WEATHERING	SOIL DESCRIPTION — SOIL TYPE: Colour, grain size, plasticity or particle characteristics, moisture, consistency, density, secondary components / ROCK DESCRIPTION — ROCK SUBSTANCE: Type, colour, grain characteristics, weathering, strength, structure, inclusions	0 4 8 12 16>20	ADDITIONAL DATA AND TEST RESULTS	SAMPLE NUMBER	TEST REPORT
0	98.30	BUCKET	SC		**Gravelly Sandy CLAY (FILL):** Brown, moist, very stiff. Medium plasticity. Boulders sizing up to 600mm. Boulders are dominantly basalt.				
	97.80		CI-CH		**Silty CLAY (RESIDUAL):** Brown, moist, very stiff. Medium to high plasticity.		FSV: 175kPa		
1	97.30		SM		**Clayey Silty SAND (RESIDUAL):** Mottled brown to grey, moist, very stiff. Sand fraction is fine grained. High plasticity. At 1.5m colour changes to dominantly grey. Possible grading into XW SANDSTONE		FSV: 163kPa FSV: 121kPa LL = 38; PI = 24; LS = 10; DD = 1.84t/m^3; MC = 13.9%; WPI=2077; WLS=880	12C0940	30126, 30127
2									
3	94.70				Excavation terminated at 3.6m				
4	94.30								

REMARKS Termination due to refusal. WPI=PI×%Passing 0.425mm Seive. WLS=LS×%Passing 0.425mm Seive.

LOGGED BY LD/DC

QLD_DMR_LIB_01A.GLB Log A_TEST PIT LOG FG6028 - MOOLOOLABA BUDERIM RD.GPJ <<DrawingFile>> Datgel CPT Tool gINT Add-In 26/10/2012 15:45

Appendix D – VDCP Logs

Engineering & Technology Division
Geotechnical Branch
35 Butterfield St Herston, Q 4006

Queensland Government

REPORT ON VARIABLE ENERGY DYNAMIC CONE PENETROMETER TEST (PANDA)

Project: Mooloolaba Rd Buderim Hill

Project No.: FG6028

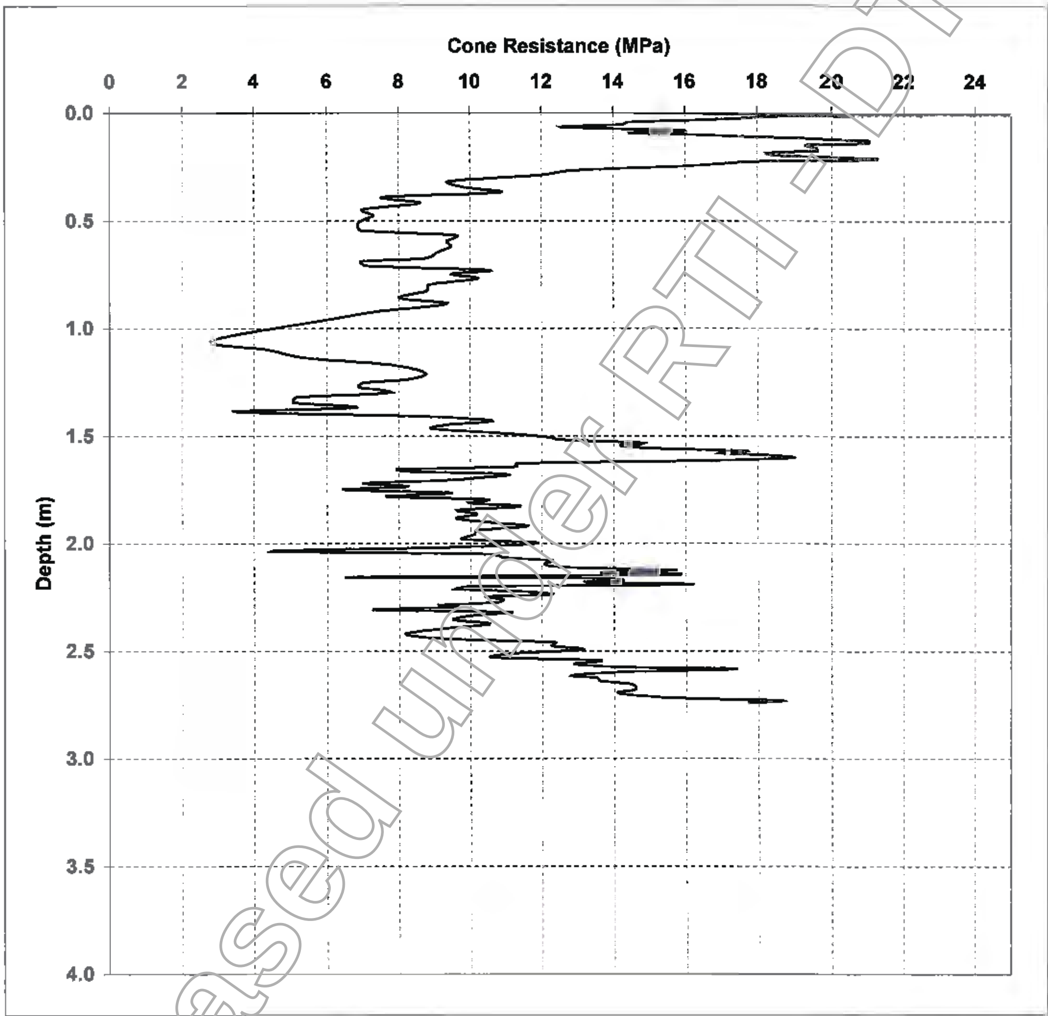
Probe No: VEDCP01

Probe Location: E507689, N7048684.9

Surface RL: 105.1

Probe Tip Area (cm^2): 4.0

Depth to Water Table (m): N/A



Remarks: Adjacent to Testpit 1

Client Details: Aecom Australia

Operator: Brad Woodgate

Date Tested: 22-Aug-12

Checked By:

Date Reported: 23-Aug-12

Authorizing Officer:

REPORT NO:

Engineering & Technology Division
Geotechnical Branch
35 Butterfield St Herston, Q 4006

Queensland Government

REPORT ON VARIABLE ENERGY DYNAMIC CONE PENETROMETER TEST (PANDA)

Project: Mooloolaba Rd Buderim Hill

Project No.: FG6028

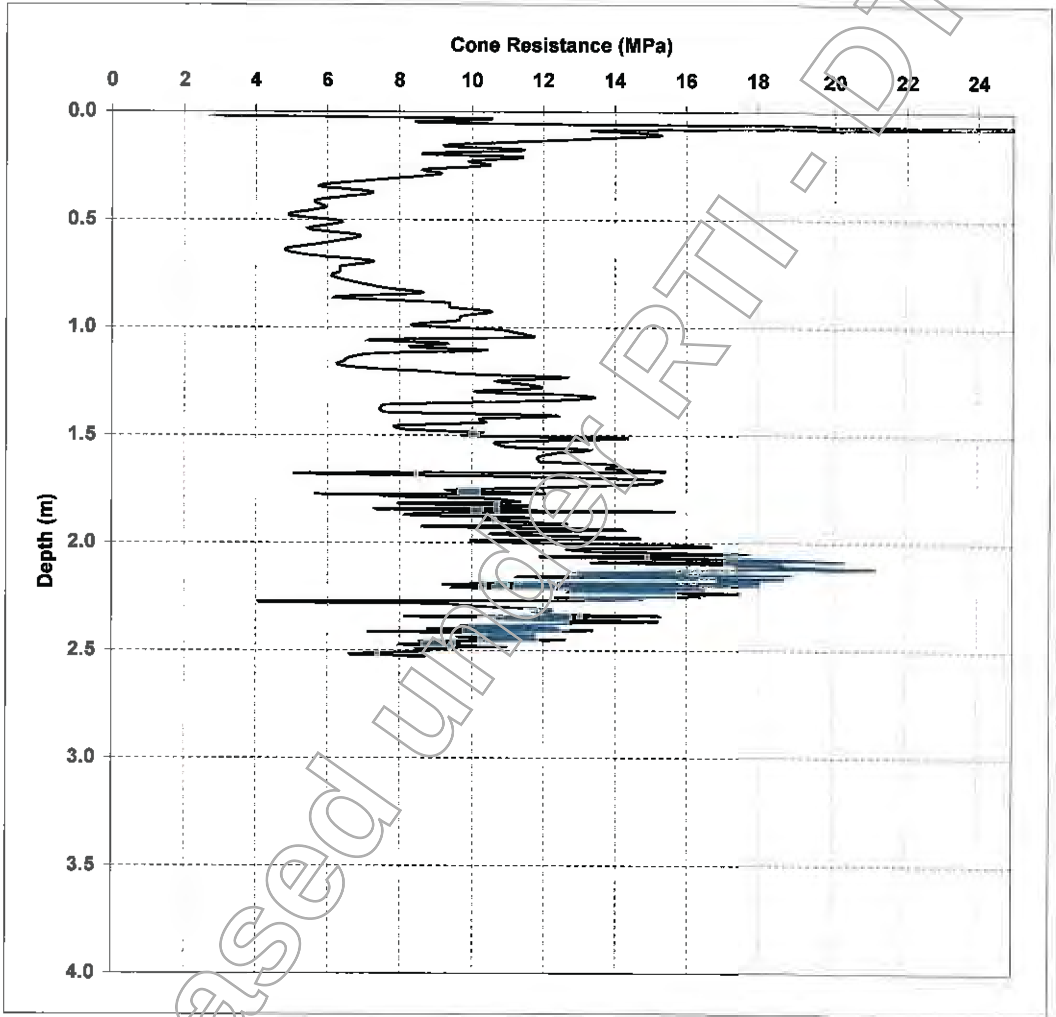
Probe No: VEDCP02

Probe Location: E507711.88, N7048675.5

Surface RL: 102.316

Probe Tip Area (cm^2): 4.0

Depth to Water Table (m): N/A



Remarks: Adjacent to Testpit 2

Client Details: Aecom Australia

Operator: Brad Woodgate

Date Tested: 22-Aug-12

Checked By:

Date Reported: 23-Aug-12

Authorizing Officer:

REPORT NO:

Engineering & Technology Division
Materials Services - Brisbane
35 Butterfield St Herston, Q 4006

Queensland Government

REPORT ON VARIABLE ENERGY DYNAMIC CONE PENETROMETER TEST (PANDA)

Project: Mooloolaba Rd Buderim Hill

Project No.: FG6028

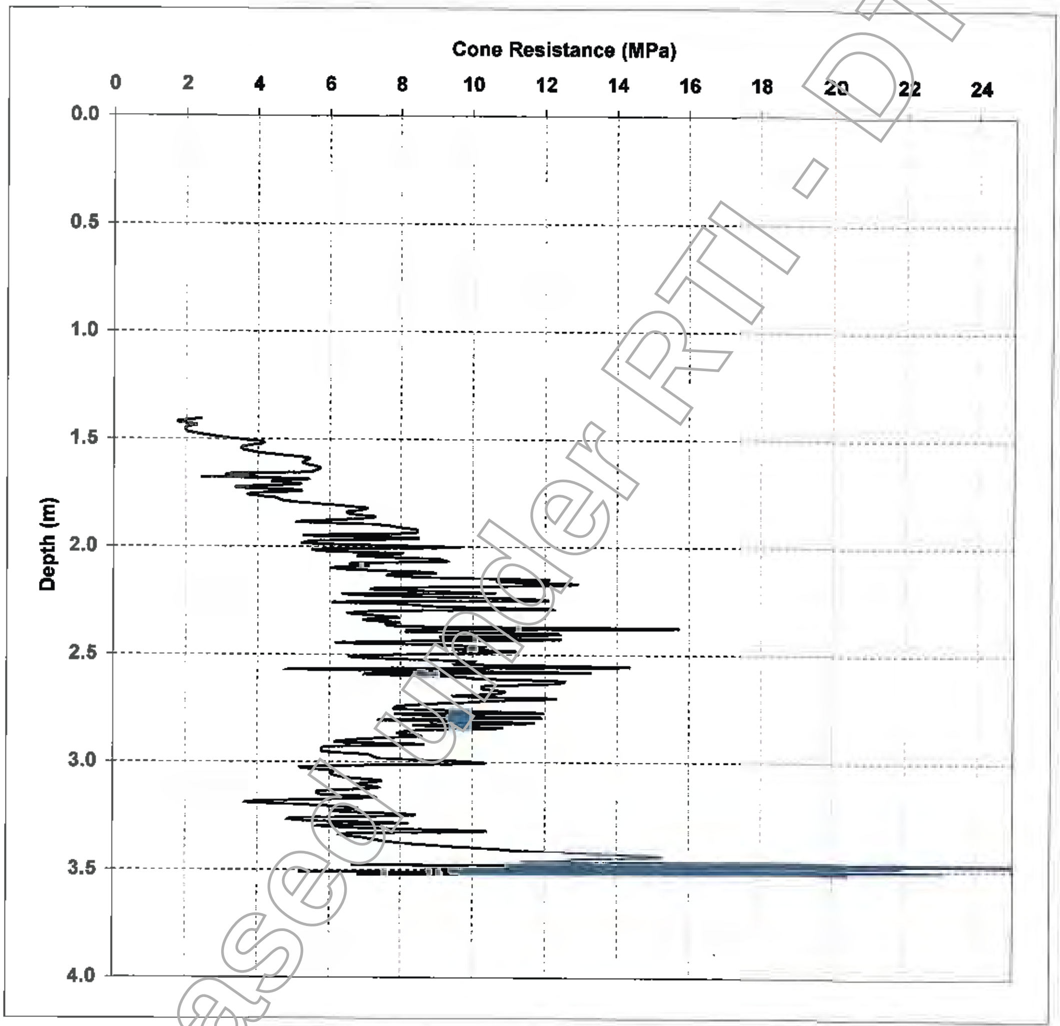
Probe No: VEDCP03

Probe Location: E507736.44, N7048651.42

Surface RL: 98.844

Probe Tip Area (cm^2): 4.0

Depth to Water Table (m): N/A



Remarks: Adjacent to Testpit 3 (Large Rock Fill to 1.4m) Testing starts at 1.40m

Client Details: Aecom Australia

Operator: Brad Woodgate

Date Tested: 22-Aug-12

Checked By:

Date Reported: 23-Aug-12

Authorizing Officer:

REPORT NO:

Engineering & Technology Division
Materials Services - Brisbane
35 Butterfield St Herston, Q 4006

Queensland Government

REPORT ON VARIABLE ENERGY DYNAMIC CONE PENETROMETER TEST (PANDA)

Project: Mooloolaba Rd Buderim Hill

Project No.: FG6028

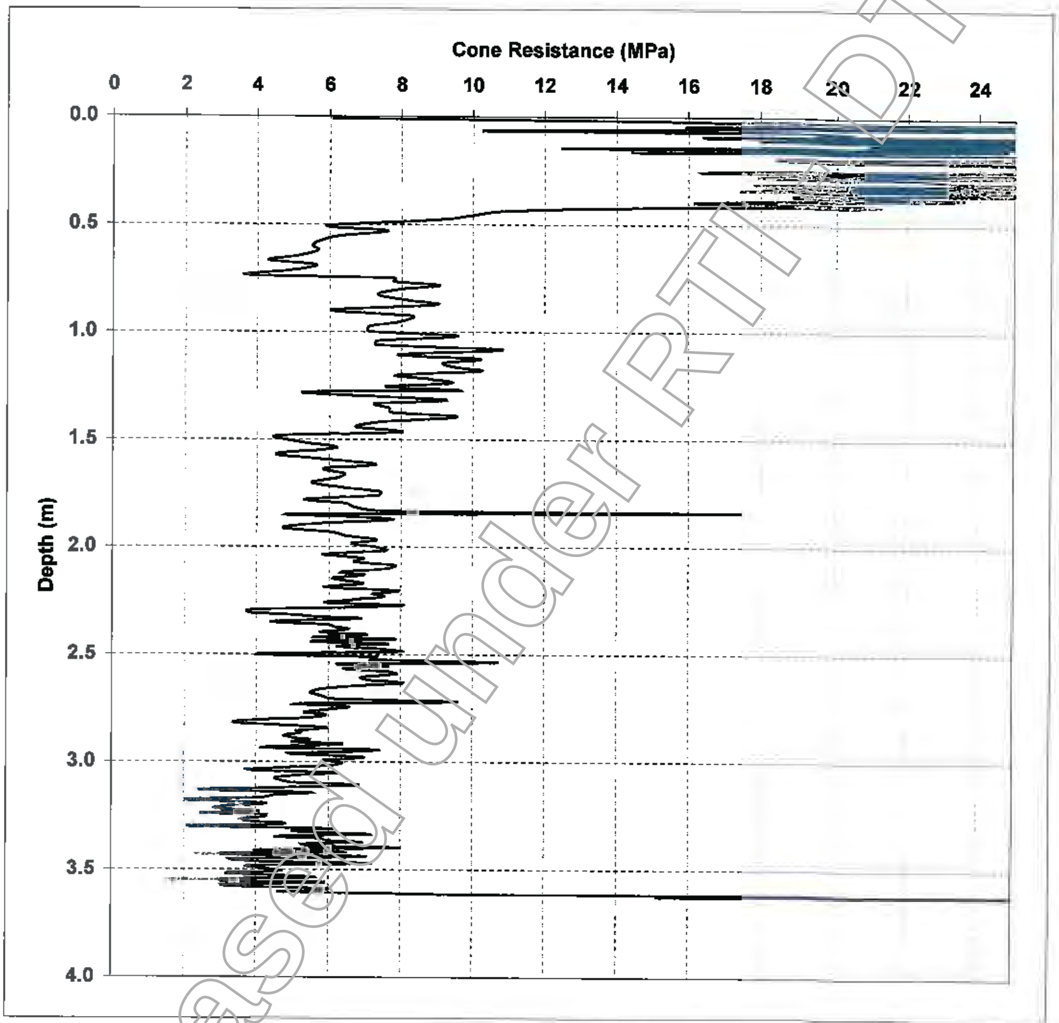
Probe No: VEDCP04

Probe Location: E507742.36, N7048648.31

Surface RL: 98.303

Probe Tip Area (cm^2): 4.0

Depth to Water Table (m): N/A



Remarks: Adjacent to Testpit 4

Client Details: Aecom Australia

Operator: Brad Woodgate

Date Tested: 22-Aug-12

Checked By:

Date Reported: 23-Aug-12

Authorizing Officer:

REPORT NO:

Engineering & Technology Division
Materials Services - Brisbane
35 Butterfield St Herston, Q 4006

Queensland Government

REPORT ON VARIABLE ENERGY CONE PENETROMETER TEST (PANDA)

Project: Mooloolaba Rd Buderim Hill

Project No.: FG6028

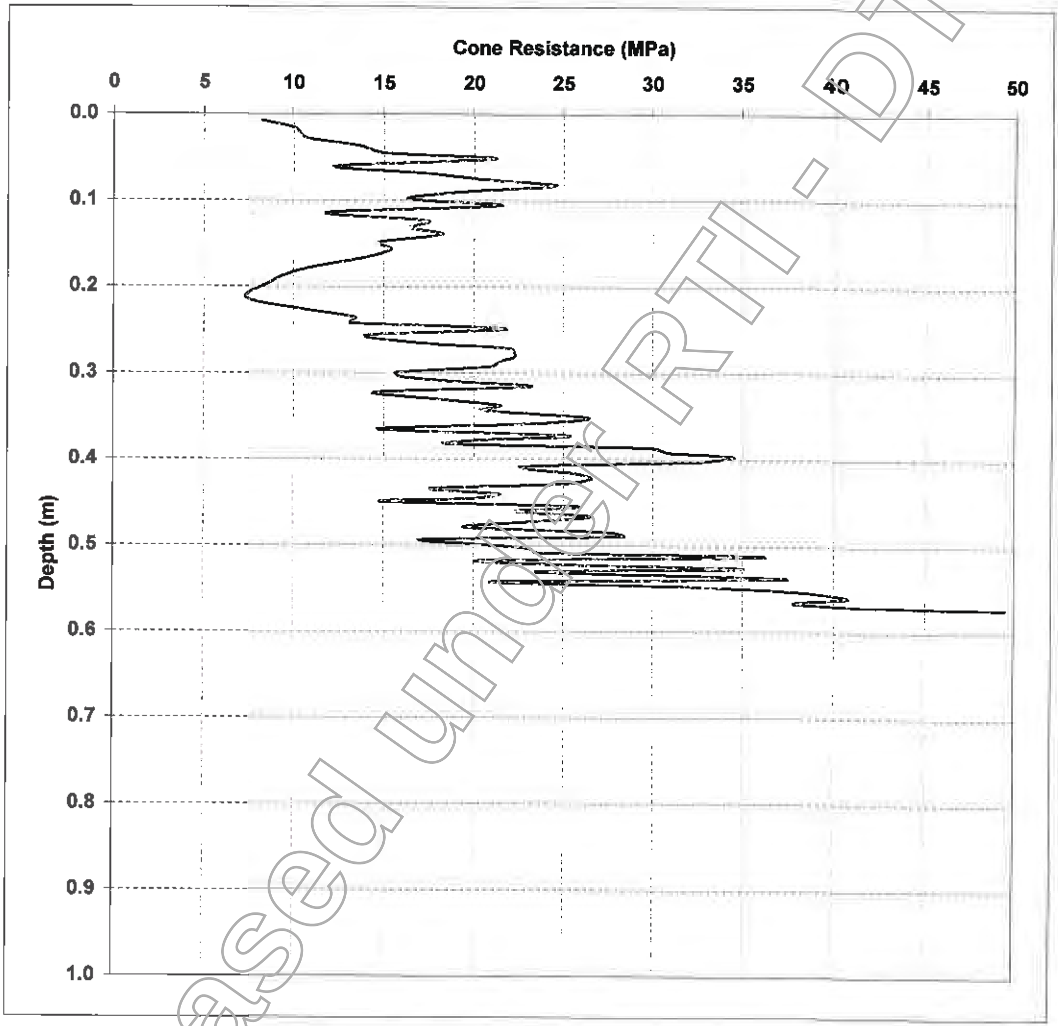
Probe No: VDCP05

Probe Location: E507448.7, N7048749.8

Surface RL: 132.34

Probe Tip Area (cm^2): 4.0

Depth to Water Table (m): N/A



Remarks:

Client Details: Aecom Australia

Operator: Brad Woodgate

Date Tested: 22-Aug-12

Checked By:

Date Reported: 23-Aug-12

Authorizing Officer:

REPORT NO:

Engineering & Technology Division
Geotechnical Branch
35 Butterfield St Herston, Q 4006

Queensland Government

REPORT ON VARIABLE ENERGY CONE PENETROMETER TEST (PANDA)

Project: Mooloolaba Rd Buderim Hill

Project No.: FG6028

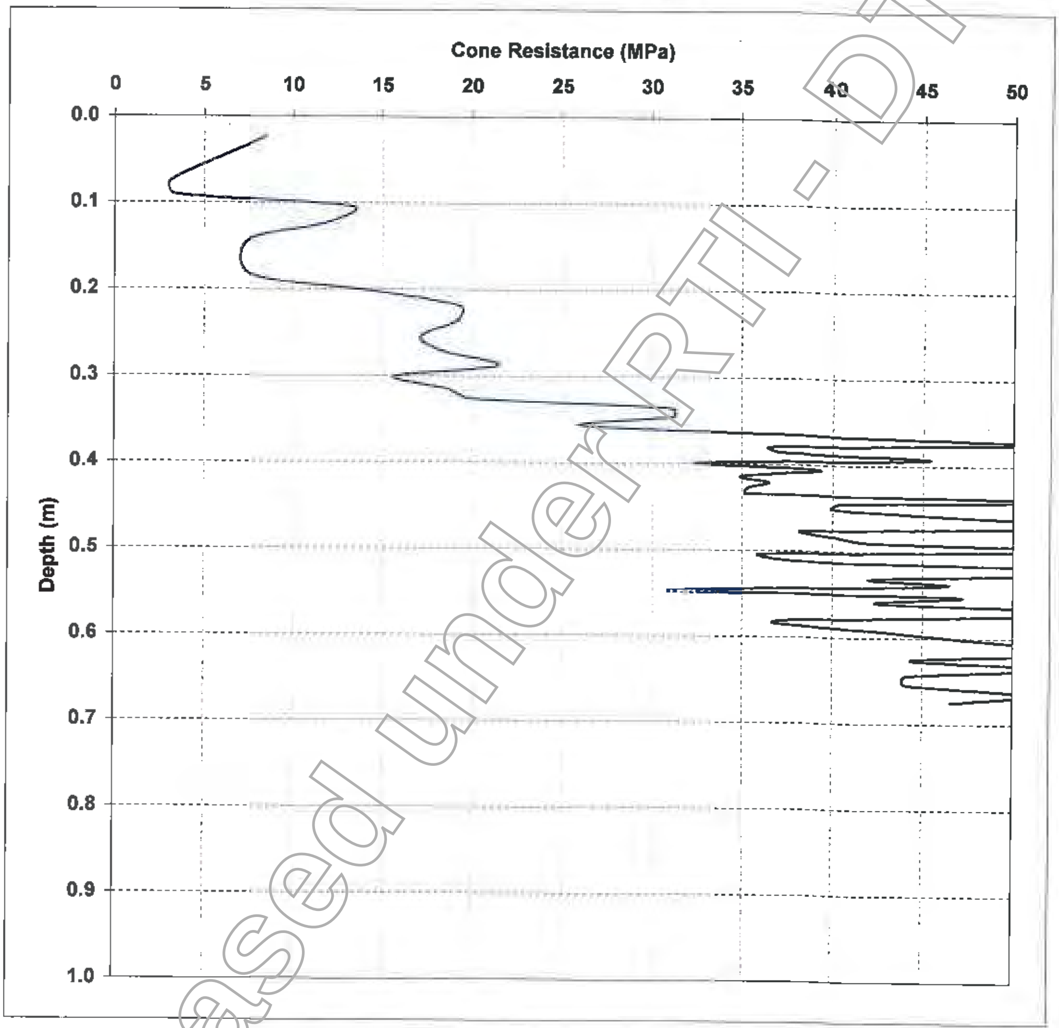
Probe No: VDCP06

Probe Location: E507458.56, N7048745.41

Surface RL: 132.11

Probe Tip Area (cm^2): 2.0

Depth to Water Table (m): N/A



Remarks:

Client Details: Aecom Australia

Operator: Brad Woodgate

Date Tested: 22-Aug-12

Checked By:

Date Reported: 23-Aug-12

Authorizing Officer:

REPORT NO:

Engineering & Technology Division
Geotechnical Branch
35 Butterfield St Herston, Q 4006

Queensland Government

REPORT ON VARIABLE ENERGY CONE PENETROMETER TEST (PANDA)

Project: Mooloolaba Rd Buderim Hill

Project No.: FG6028

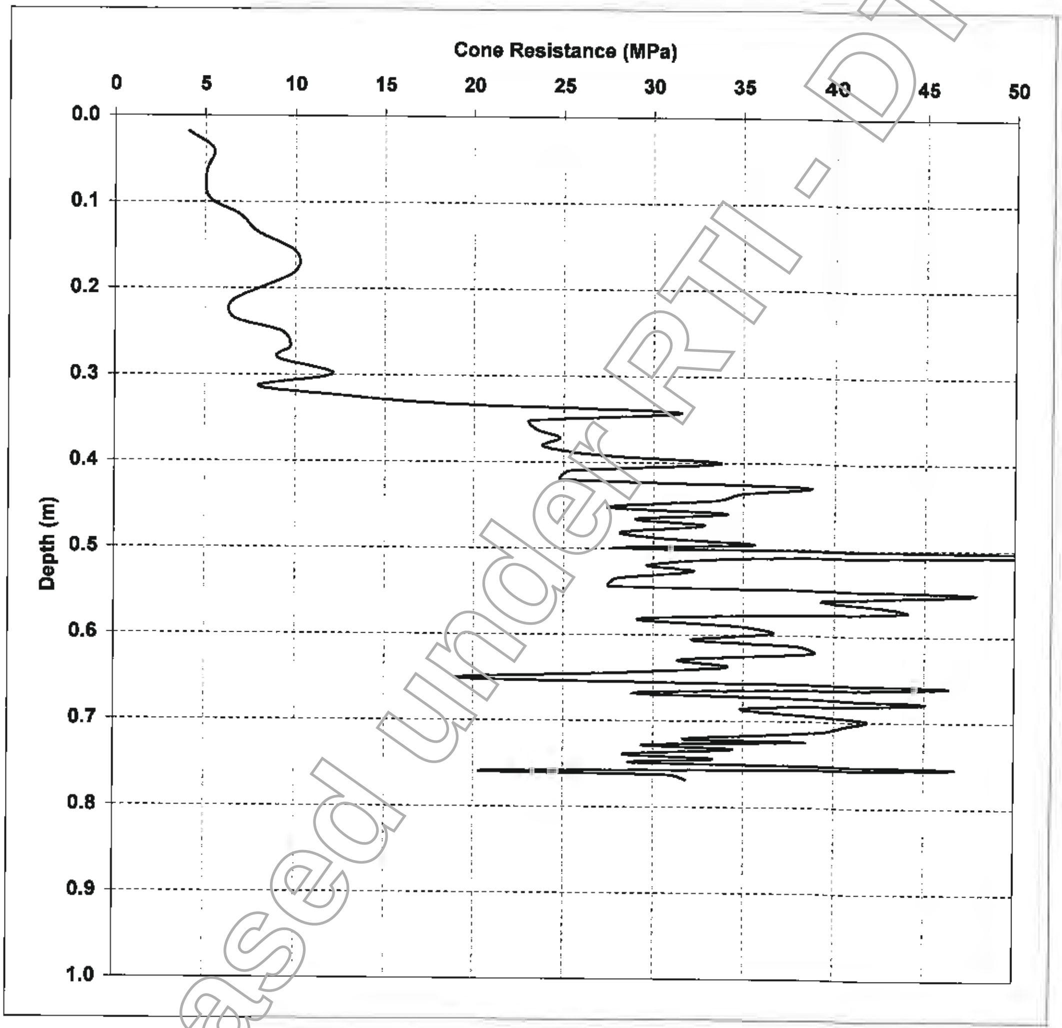
Probe No: VEDCP07

Probe Location: E507470.92, N7048739.72

Surface RL: 131.869

Probe Tip Area (cm^2): 2.0

Depth to Water Table (m): N/A



Remarks:

Client Details: Aecom Australia

Operator: Brad Woodgate

Date Tested: 22-Aug-12

Checked By:

Date Reported: 23-Aug-12

Authorizing Officer:

REPORT NO:

Appendix E – Test Reports

Department of Transport & Main Roads	Caboolture Laboratory	REPORT ON
Material Services Caboolture	98 Beerburrum Road	MATERIAL
	Caboolture Qld 4510	CLASSIFICATION

Lab Number	: 12C0938	Request No	: 15909
Job Number	: 263/134/480	Submitted by	: P.ROSS
Item number	: INV.IM	Senders No	:
Lot number	: TP1	Sampled By	: TMR HERSTON
Chainage	:	Samp. Method	: UNKNOWN
Sample Loc.	: Test Pit 1	Mat. Source	: Insitu Material
Level/Depth	:	Item Desc.	: Investigation of Insitu Material
Date sampled	: 21/08/12		
Date tested	: 03/10/12		

A.S. Sieve Size	Grading Test Method		% Passing by Mass
75 mm	Q103A		---
53 mm			---
37.5 mm			---
26.5 mm			---
19.0 mm			---
9.5 mm			---
4.75 mm			100
2.36 mm			100
0.425 mm			90
0.075 mm			44

Test Results	Units	Test Method		Result
Liquid Limit	%	Q104A		30.4
Plastic Index	%	Q105		15.6
Linear Shrinkage	%	Q106		8.0
Dust Ratio				0.48
PI x Passing 425				1410
LS x Passing 425				773

Comments

Tested as received

Comments :

Accreditation Number: 2302
Accredited for compliance with ISO/IEC 17025

This document is issued in accordance with NATA's accreditation requirements

Queensland Government Department of Main Roads Material Services Caboolture	Caboolture Laboratory 98 Beerburrum Road Caboolture Qld 4510	REPORT ON MATERIAL CLASSIFICATION

Lab Number	12C0939	Request No	15909
Job Number	263/134/480	Submitted by:	P.ROSS
Item number	INV.IM	Senders No	
Lot number	TP2	Sampled By	TMR HERSTON
Chainage		Samp. Method:	UNKNOWN
Sample Loc.	Test Pit 2	Mat Source	Insitu Material
Level/Depth		Item Desc.	Investigation of Insitu Material
Date sampled	21/08/12		
Date tested	03/10/12		

A.S. Sieve Size	Grading Test Method		% Passing by Mass
75 mm	Q103A		---
53 mm			---
37.5 mm			---
26.5 mm			---
19.0 mm			---
9.5 mm			---
4.75 mm			100
2.36 mm			100
0.425 mm			95
0.075 mm			82

Test Results	Units	Test Method		Result
Liquid Limit	%	[illegible]		50.4
Plastic Index	%	Q105		30.4
Linear Shrinkage	%	[illegible]		15.6
Dust Ratio				0.87
PI x Passing 425				2873
LS x Passing 425				1474

Comments

Tested as received

NATA
Accreditation Number: 2302
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Queensland Government Department of Main Roads Material Services Caboolture	Caboolture Laboratory 98 Beerburrum Road Caboolture Qld 4510	REPORT ON MATERIAL CLASSIFICATION

Lab Number :	12C0940	Request No :	15909
Job Number :	263/134/450	Submitted by:	P.ROSS
Item number :	INV.IM	Senders No :	
Lot number :	TP4	Sampled By :	TMR HERSTON
Chainage :		Samp. Method:	UNKNOWN
Sample Loc. :	Test Pit 4	Mat Source :	Insitu Material
Level/Depth :		Item Desc. :	Investigation of Insitu Material
Date sampled :	21/08/12		
Date tested :	03/10/12		

A.S. Sieve Size	Grading Test Method		% Passing by Mass
75 mm	[illegible]		---
53 mm			---
37.5 mm			---
26.5 mm			---
19.0 mm			---
9.5 mm			---
4.75 mm			100
2.36 mm			100
0.425 mm			88
0.075 mm			45

Test Results	Units	Test Method		Result
Liquid Limit	%	[illegible]		38.2
Plastic Index	%	[illegible]		23.6
Linear Shrinkage	%	[illegible]		10.0
Dust Ratio				0.51
PI x Passing 425				2077
LS x Passing 425				880

Comments

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Department of Transport & Main Roads Material Services Caboolture	Caboolture Laboratory 93 Beerburrum Road Caboolture Qld 4510	**REPORT ON MOISTURE DENSITY RELATIONSHIP**

Lab Number	: 12C0940	Lot Number	: TP4 Rqst No:15909
Job Number	: 263/134/480	Chainage	:
Item number	: INV.IM	Sample Loc.	: Test Pit 4
Submitted by	: P.ROSS		
Senders No	:	Depth	: Layer :
Sampled By	: TMR HERSTON	Mat Source	: Insitu Material
Samp. Method	: [illegible]		
Date sampled	: 21/08/12	Item Desc.	: Investigation of
Date tested	: 03/10/12		Insitu Material

Moisture Content (%)	Dry Density (t/m3)
9.4	1.723
11.4	1.785
13.5	1.835
15.6	1.799

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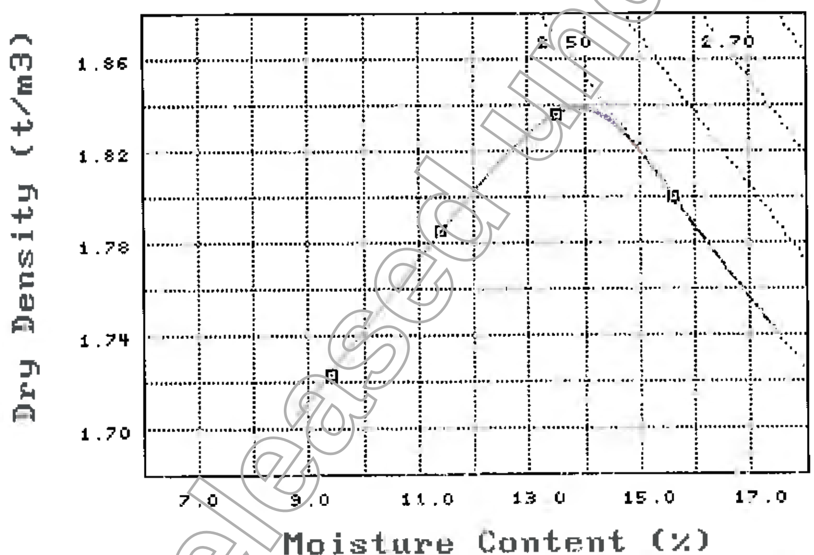
Moisture Content Test Method	Q102A
Mould Dia. (mm)	105

Max Particle Size (mm)	19.0
Oversize Stone >37.5mm (%)	0
Density of Oversize (t/m3)	



M.D.R. Comp. Effort
100% STD

Test Method
Q110A

OMC (%)	13.9
MDD (t/m3)	1.840

Remarks :	Tested as received		
Checked By	Jason	Signatory :	John Roberts
Page : 1 of 1	**Report No :** 30127	Date : 17/10/12	CF/0194/S39

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REPORT ON POINT LOAD STRENGTH INDEX

Test method AS 4133.4.1 - 2007 Rock strength tests - Determination of point load strength index
AS 1726 - 1993 Geotechnical site investigations

Queensland Government
DEPARTMENT OF TRANSPORT AND MAIN ROADS
GEOTECHNICAL BRANCH LABORATORY
Material Services - Brisbane
35 Butterfield Street, Herston Qld 4006

Client *Department of Transport and Main Roads*
PO Box 1412
Brisbane Qld 4000

Project ***Mooloolaba Rd, Buderim Hill***
Project number *FG5902 / 2741*

Sampling method *Remark 1*
Storage history *As received*

Date sampled *22-08-2012*
Date tested *27-08-2012*

Article.Specimen number	Sample location	Depth (m)	Moisture condition	Specimen shape / Test type	Load direction relative to weakness plane	Uncorrected point load strength [I_s] (MPa)	Point load strength index [$I_{s(50)}$] (MPa)	Rock material strength term	Lithology	Failure mode
GS12-0285.A	N/A	N/A	Dry	Irregular lump	Perpendicular	4.1	4.1	VH	Sandstone	-
GS12-0285.B	N/A	N/A	Dry	Irregular lump	Perpendicular	2.9	3.1	VH	Sandstone	-
GS12-0285.C	N/A	N/A	Dry	Irregular lump	Perpendicular	2.5	2.7	H	Sandstone	-
GS12-0285.D	N/A	N/A	Dry	Irregular lump	Perpendicular	1.7	1.8	H	Sandstone	-
GS12-0285.E	N/A	N/A	Dry	Irregular lump	Perpendicular	2.8	3.1	VH	Sandstone	-
GS12-0285.F	N/A	N/A	Dry	Irregular lump	Perpendicular	1.4	1.7	H	Sandstone	-
GS12-0285.G	N/A	N/A	Dry	Irregular lump	Perpendicular	0.69	0.82	M	Sandstone	-
GS12-0285.H	N/A	N/A	Dry	Irregular lump	Perpendicular	3.0	3.4	VH	Sandstone	-
GS12-0285.I	N/A	N/A	Dry	Irregular lump	Perpendicular	1.7	1.7	H	Sandstone	-
GS12-0285.J	N/A	N/A	Dry	Irregular lump	Perpendicular	2.0	2.0	H	Sandstone	-
GS12-0285.K	N/A	N/A	Dry	Irregular lump	Perpendicular	2.0	2.4	H	Sandstone	-
GS12-0285.L	N/A	N/A	Dry	Irregular lump	Perpendicular	2.7	3.1	VH	Sandstone	-

Rock material strength terms : EL - Extremely low VL - Very low L - Low M - Medium H - High VH - Very high EH - Extremely high

Variation(s) to test method -

Remark(s) 1; *Sampling method is excluded from endorsement*

Checked by

Signatory Devinder Pal 19/9/12
Devinder Pal, Senior Engineering Technologist

Report number ***GS12-0303***
Date ***19/09/2012***

Appendix F – Geologic Mapping Summary

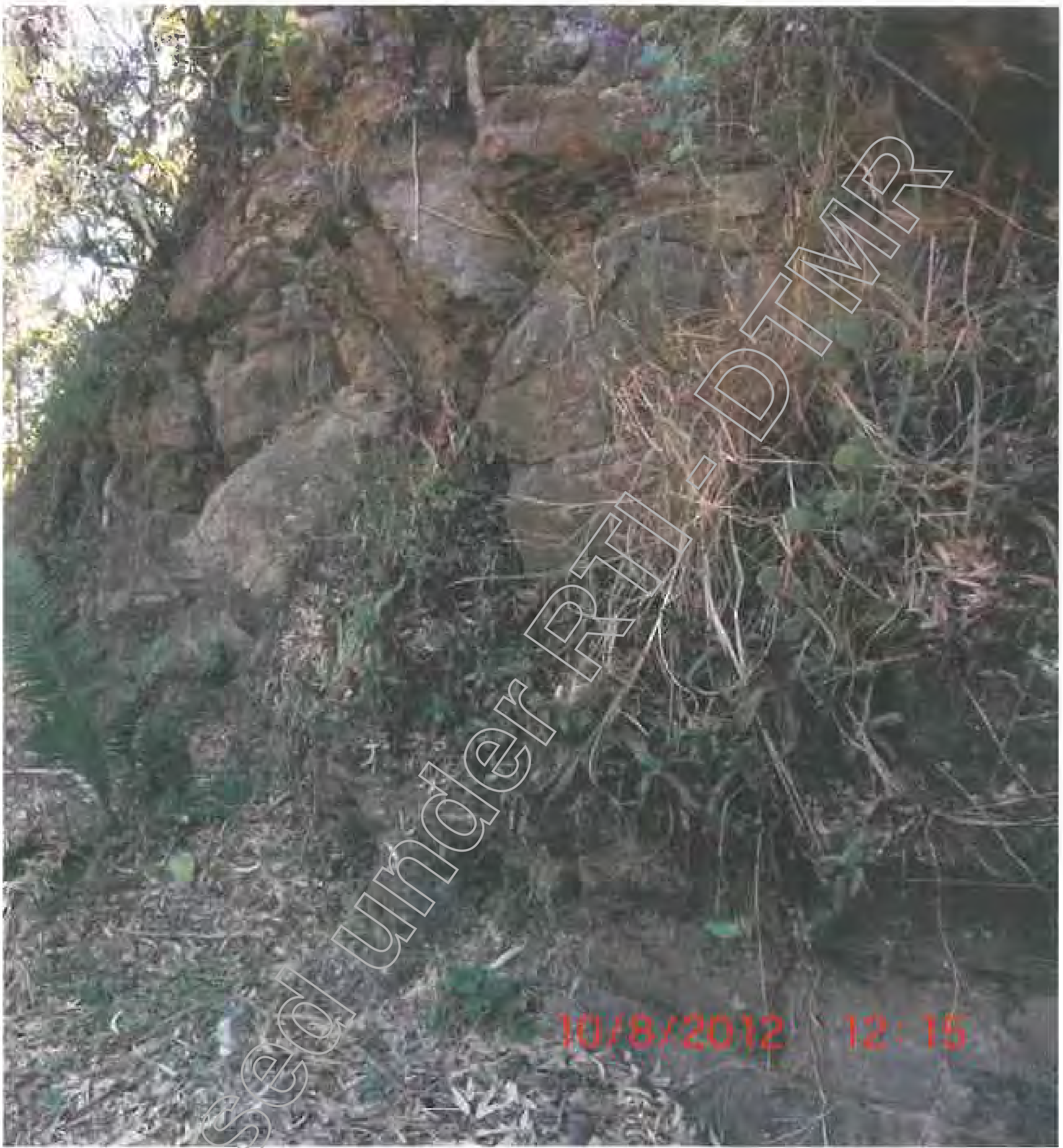
Geologic Mapping Summary

Cut face mapped:
Approximate chainages
7480 to 7580.

Mooloolaba Road (Buderim Hill)

Observations and Measurements

Approximate Chainage	From Chainage 7480 to Chainage 7580.		
Description of Site	Road cutting with exposed rock outcrop.		
Rock Description	SANDSTONE (MW/SW): Grey to yellow brown, fine grained, thinly to thickly bedded (sub-horizontal to shallow dipping), generally high strength. Cement matrix of quartz, feldspar and clay. Preferential weathering along defect surfaces.		
Defects	**Type**	**Strike and Dip Data**	**Additional Data**
	Joint Set 1	Stiking ~220° with generally steep to sub-vertical dips.	Defects are generally close to medium spaced, tight or closed and with clay infill.
	Joint Set 2	Striking ~170°- 195° with generally steep to sub-vertical dips.	(As above)
	Joint Set 3	Striking ~102° - 120° with generally steep to sub-vertical dips.	(As (above)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Technical Correspondence

Mooloolaba Road, Buderim Hill

Subject:	Embankment/Cut Slope Stability Assessment	**Project No:**	60250500
Project Phase:	Design	**Date:**	03/12/2012
Originator:	Nima Enferadi	**Reference:**	
Verifier:	Colin Bruce	**Delivered:**	Email
Attachments:			

I. Introduction

AECOM Australia Pty Ltd (AECOM) has been commissioned by the Department of Transport and Main Roads (TMR) to prepare detailed design documentation for the upgrading of Mooloolaba Road extending from Chainage 6650m to 7600m. This technical correspondence has been prepared for the slope stability assessment of proposed embankment widening at approximate chainages 6900m to 7075m and the proposed cut widening at approximate chainages 7480m to 7580m. The stability assessment presented in this memorandum has been carried out using geotechnical data provided in Geotechnical Branch Report No. MR2438 - Additional Geotechnical Investigation - Mooloolaba Road (Buderim Hill), Revision 0, 25\October\2012.

II. Slope Stability Assessment

A. Embankment Widening (CH 6+900 to CH 7+075)

The stability of the proposed road embankment was evaluated using the limit equilibrium method as implemented in the Slope/W 2007 software, which is available from Geo-Slope International Ltd. Stability of the slope was assessed against minimum factor of safety values of 1.50 for long-term conditions using the Morgenstern and Price analysis method. The cross-section used in the stability analysis for this location is shown in **Figure 01**.

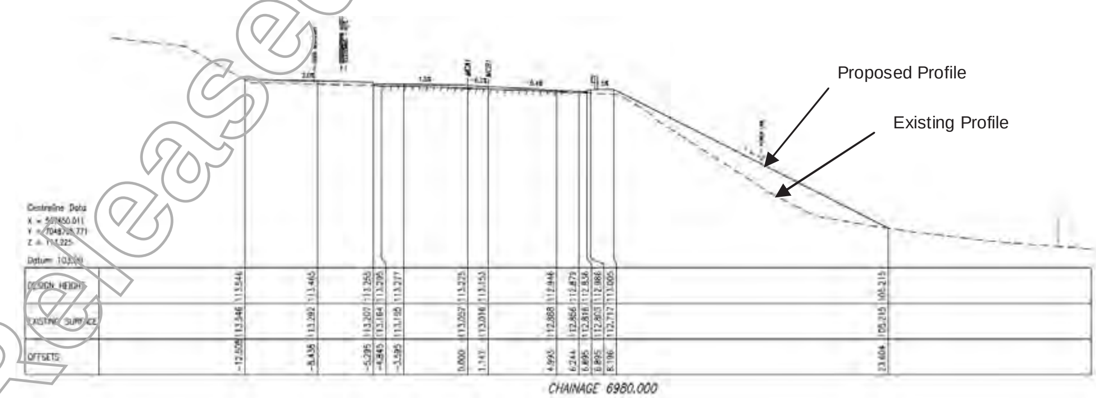

FIGURE 01: Cross-section of Road Embankment

The ground model has been developed from the site geotechnical investigations. Two test pits (TP1 & TP2) have been excavated approximately 50m and 75m east of the location. **Figure 02** shows the location of the analysed cross-section and the test pit locations.

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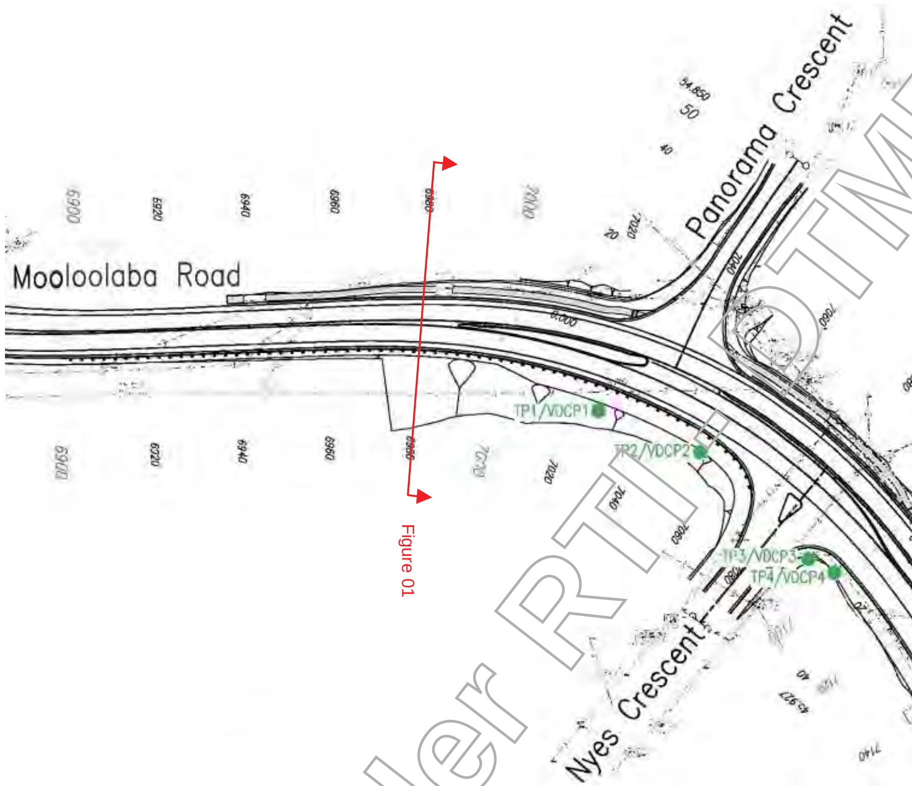

FIGURE 02: Cross-section and Test Pit Locations

The test pits were undertaken at the toe of the existing embankment. The pits did not excavate into the embankment fill. The test pits provided data to generate a ground model below the embankment. In the absence of physical data in the embankment fill, the fill has been modelled assuming it was specified and constructed in accordance with TMR standards.

Table 01 presents the ground profile below the embankment. Note that it is assumed the topsoil will be removed prior to widening and any weak materials excavated and replaced beneath the widened embankment. The adopted strength parameters for the analysis are presented in **Table 02**.

Table 01: Ground Model

Unit	Depth of top of layer [mBGL]	Thickness [m]	Comments
Topsoil	0.0	0.1-0.2	
Very stiff CLAY	0.1-0.2	1.3	VDCP≈ 6 to 12, mean≈8Mpa FSV/PP: 111 to 175kPa
Extremely weathered (XW) Sandstone	1.4-1.5	0.9-1.1	VDCP≈ 8 to 20, mean≈12Mpa
Highly weathered (HW) Sandstone	2.4-2.5	Not Proven	VDCP≈ 8 to 20, mean≈12Mpa

FSV: Field Shear Vane, PP: Pocket Penetrometer, VDCP: Variable Energy Dynamic Cone Penetrometer

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Table 02: Adopted Ground Parameters

Unit	c´ [kPa]	ø´ [°]	γ [kN/m^3]
Embankment Fill	3	30	20
Very stiff CLAY	2	28	19
Extremely weathered (XW) Sandstone	10	30	20
Highly weathered (HW) Sandstone	60	30	22

Results of the stability analysis show a potential slip plane having a minimum factor of safety of at least 1.50 as shown in the **Figure 03**.

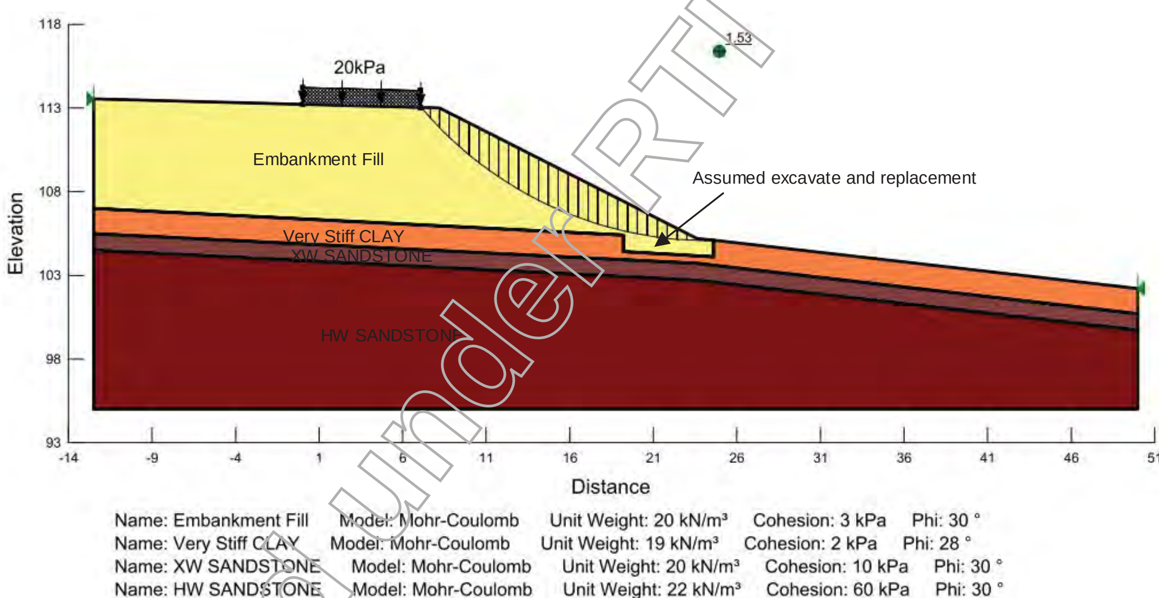

FIGURE 03: Potential Slip Surface from Stability Analysis

B. Cut Widening (CH 7+480 to CH 7+580)

The Existing rock cutting between approximately Chainage 7480 and 7580 is proposed to be widened by around 1m. This will require the existing rock face to be cut back. **Figure 04** shows the approximate location.

The Geotechnical Investigation Report records that geological mapping of the cut face was undertaken. The geological mapping provides a rock description and information on three joint sets exposed in the cut face. A series of photographs are also provided. A summary of the observed joint sets is provided in **Table 03**. The limited data available has only allowed for a preliminary kinematic analysis to be undertaken. The analysis suggests a possible structural failure plane associated with Joint Set 1 (220° strike, steep to sub-vertical dip). The analysis indicates that wedge and toppling failures are unlikely.

The photographs show the rock face to be sparsely vegetated with some reasonably sized roots on the rock face and probably within the wider discontinuities.

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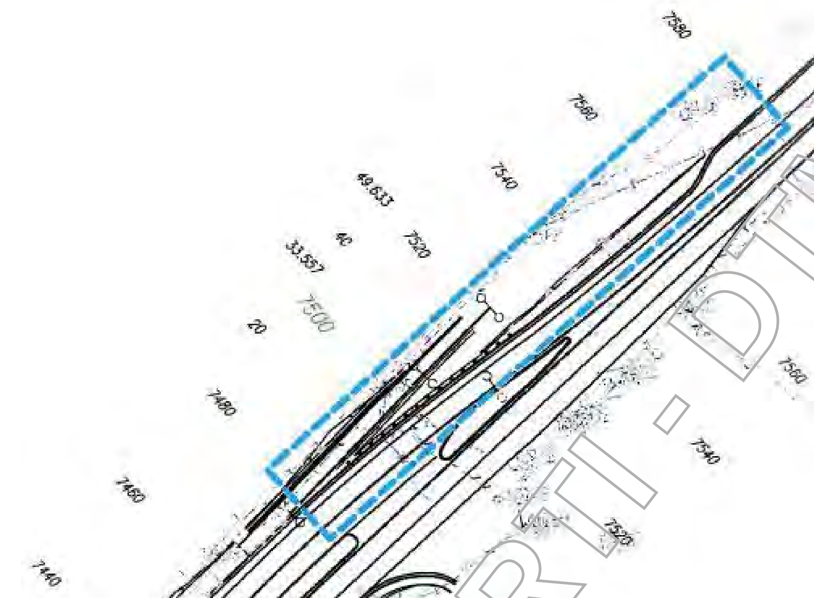

FIGURE 04: Rock Cut widening location

Table 03: Typical Joint Sets

Joint Set	Dip	Strike
1	Generally steep to sub-vertical	220°
2	Generally steep to sub-vertical	170°-195°
3	Generally steep to sub-vertical	102°-120°

III. Discussion and Recommendations

A. Embankment widening

Results show satisfactory factors of safety for the proposed embankment widening. Prior to construction of the embankment extension slope, the existing embankment slope shall be cleared of organic materials. It is assumed that at least one (1) metre thickness of the existing ground shall be excavated and the existing embankment slope benched prior to backfilling (**Figure 05**). Any soft compressible soils encountered during construction shall be also removed and notice shall be given to the designer for appropriate assessment.

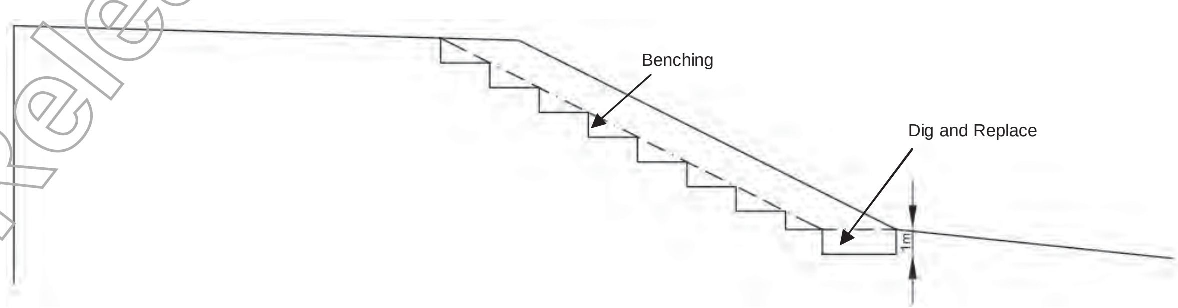

FIGURE 05: Embankment during Construction

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B. Rock cut widening

The available rock mapping is limited. Detailed analyses have not been possible but preliminary analysis suggests the potential for a preferential slip plane. It is suggested that the new cut face will also likely indicate similar conditions but it will not be guaranteed that the new face will be stable. It is therefore recommended that an observational approach be adopted during construction. An Engineering Geologist should inspect the cut face as it is cut back to identify any potential unstable situations and to provide advice on any stabilisation required.

A detailed scanline and photogrammetry log of the final cut face should be undertaken to allow a kinematic analysis to consider long-term stability of the rock cut face.

If potential instability is identified, stabilisation methods such as rock bolts, wire mesh and shotcrete could be considered.

Certificate of Compliance

Mooloolaba Road: Buderim Hill Upgrade Rate 3 Lighting

Certificate of Compliance

Mooloolaba Road: Buderim Hill Upgrade Rate 3 Lighting

NCHD-2596

Prepared for

Department of Transport and Main Roads

Prepared by

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26/02/2013

60250500

AECOM in Australia and New Zealand is certified to the latest version of ISO9001 and ISO14001.

Quality Information

Document	Certificate of Compliance
Ref	60250500
Date	26/02/2013
Prepared by	Sachin Pandey
Reviewed by	Rick Morrison

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
1	03/12/2012	Client Review	Rick Morrison / Principal Engineer	
2	26/02/2013	Final Issue	Rick Morrison / Principal Engineer	

Table of Contents

1.0 Element Details

1.1 Straight Lengths and Curves of Carriageways

Straight carriageways, curves and bends have been designed using the illuminance based parameters of AS/NZS 1158 series in particular AS/NZS1158.1.1:2005, Table 2.2, Category V3 using modelling software AGI 32. This is because all along the carriageways there are changes in carriageway width; intersections and a centre median.

1.2 Intersections

Intersections and conflict zones have been designed using the illuminance based parameters of AS/NZS 1158 series in particular AS/NZS1158.1.1:2005, Table 2.2, Category V3.

All calculations were carried out using modelling software AGI 32.

2.0 Lighting Category

Location	Category
All straight sections Mooloolaba Rd	V3 As per AS/NZS1158.1.1:2005 Table 2.2
All Intersections and Curves	V3 As per AS/NZS1158.1.1:2005 Table 2.2

Reference is also made to AS/NZS1158.3.1:2005, Table 2.2, and in particular, paragraph (e) below -

e) Footpaths associated with arterial roads are deemed not to require separate lighting provided that—

i. the road is lit to at least the applicable level of Category V lighting complying with AS/NZS 1158.1.1; and

ii. the footpath is unshaded, e.g. there are no substantially continuous building awnings, and the footpath is contiguous with the roadway.

If the footpath is shaded, or is separated from the roadway by an extensive nature strip or a service road, it shall be provided with lighting to at least subcategory P4.

3.0 Installation Geometry

Refer to the design drawings for more details.

Location	Parameter	Value
Mooloolaba Road	Arrangement Mounting Height Overhang Upcast Angle Spacing	Varies – see drawings Varies – mostly 10.5 & 12 metres– refer drawings Varies – see drawings 5 degrees Varies – see drawings

4.0 Luminaire / Lamp Details

Location	Parameter	Value
Mooloolaba Road	Manufacturer	Rexel
	Lighting tariff	Rate 3
	Model	Optispan
	I-Table number Lamp type Design lamp lumens	QMRD99A OPTISPAN AERO 400 L1560.ies 400W NAV-T 48000
	I-Table number Lamp type Design lamp lumens	QMRD99A OPTISPAN AERO 250 L1642.ies 250W NAV-T 27000
	I-Table number Lamp type Design lamp lumens	QMRD99A OPTISPAN AERO 150 L1645.ies 150W NAV-T 14000

5.0 Photometric Data Details

The .ies and cie files as per the table above were obtained from Rexel.

6.0 Light Technical Parameters

- Lighting design method: Computer based
- Elements: See illuminance plots. Illuminance values are maintained values and therefore include the maintenance factor.

7.0 Road Surface Reflection Characteristic Details

- CIE132 surface R3 (As per AS/NZS1158.2:2005 clause 4.3.4)

8.0 Computer Program Details

8.1 Straight Sections, Curves and Intersection

- Name of Program: AGI32 V2.03
- Source of Program: Lighting Analysts (USA) via LightLab International (Australia)
- Compliance: Complies with the requirements of AS/NZS1158 for intersection lighting.

9.0 Maintenance Details

9.1 Maintenance Factor Details – Vehicular Traffic

- Luminaire Maintenance Factor – 36 month duration, medium pollution category is 0.87.
- This has been applied to all Rexel Optispan luminaires
- Luminaire maintenance factor of 0.783.
- Extracted from AS/NZS1158.1.1:2005 Appendix E – Typical Luminaire Maintenance Factors.

Cleaning Interval (Months)	Typical Luminaire Maintenance Factors – IP65 Luminaire Pollution Category		
	High	Medium	Low
12	0.91	0.92	0.93
18	0.90	0.91	0.92
24	0.88	0.89	0.91
36	0.83	0.87	0.90
48	0.75	0.84	0.89

- Lamp Lumen Depreciation Factor (LLD) High Pressure Sodium
  - 150W, 250W & 400W High Pressure Sodium lamp
  - (From Rexel lamp technical guide)
  - The lamp lumen depreciation factor for a 36 month interval is:
  - LLD = 0.9

- Total Maintenance Factor = Luminaire Maintenance Factor x Lamp Lumen Depreciation Factor
  - IP66 - High Pressure Sodium - 150W, 250W and 400W Rexel Optispan
  - Total maintenance factor = 0.9 x 0.87 = 0.783

9.2 Schedule of Maintenance

The road lighting design is based on the following maintenance strategy:

(As per Department Main Roads, Road Planning and Design Manual, Ch17)

9.2.1 Bulk Lamp Replacement

Bulk lamp replacement shall be carried out at 36 month intervals. At this time the following shall also occur:

At the time of cleaning and lamp changes the following shall occur:

a) All optical surfaces, both internal and external, of the luminaire shall be cleaned

b) All gaskets shall be checked for deterioration and replaced where necessary

c) Damaged/weathered visors shall be replaced

d) All accessible screws, nuts etc. shall be checked for tightness

e) A visual check shall be made of the electrical components and wiring for signs of overheating

f) If required, the luminaire shall be realigned or adjusted to the design specification.

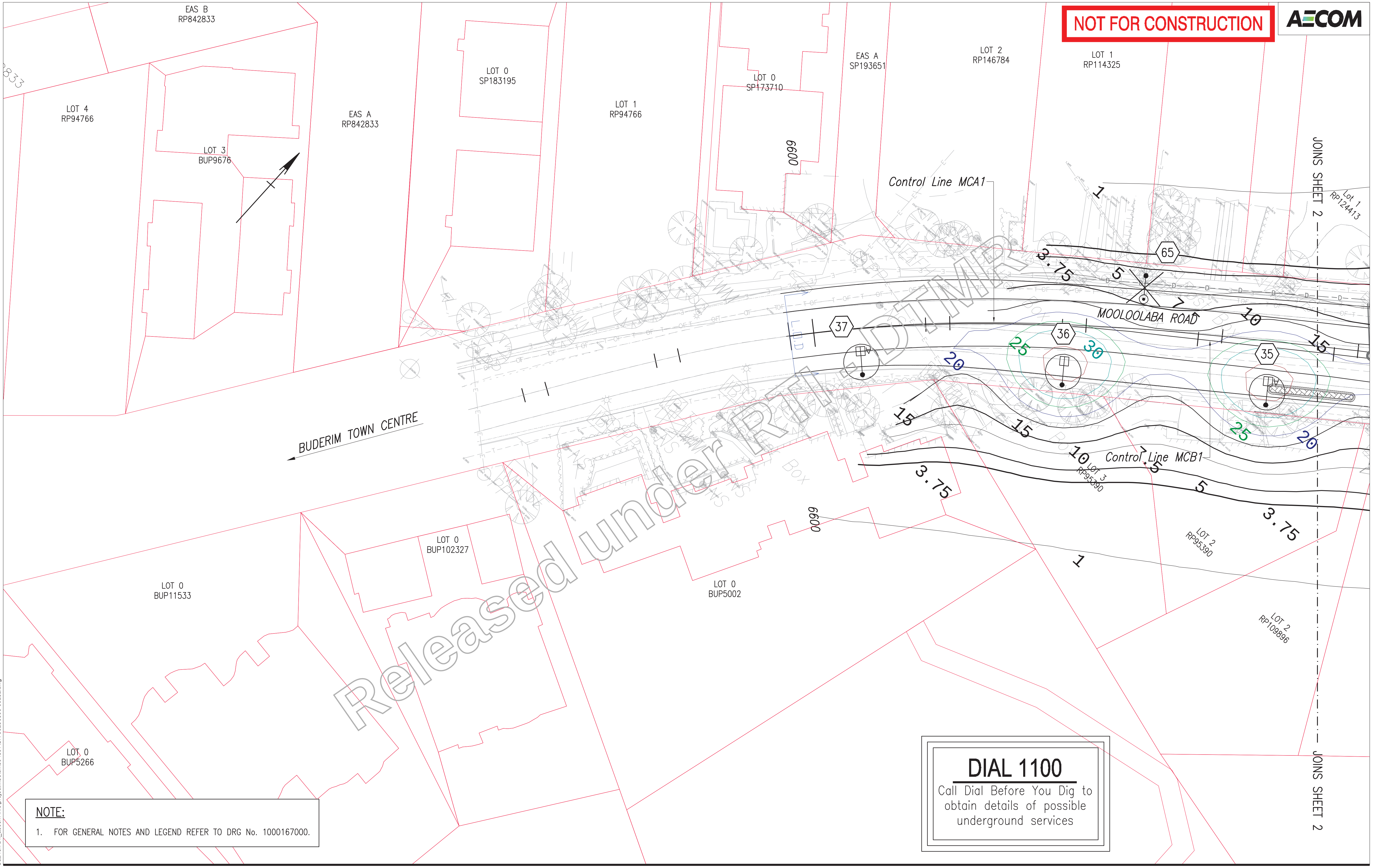
9.2.2 Spot Lamp Replacement

It is recommended that inspection patrols provide spot lamp replacements such that the maximum level of luminaire outages at any one time is not greater than 5% of the luminaire population. (i.e. service availability from the luminaires should be at least 95% in accordance with the requirements of AS1158.1.3)

Appendix A

Lux Plots

Appendix A Lux Plots



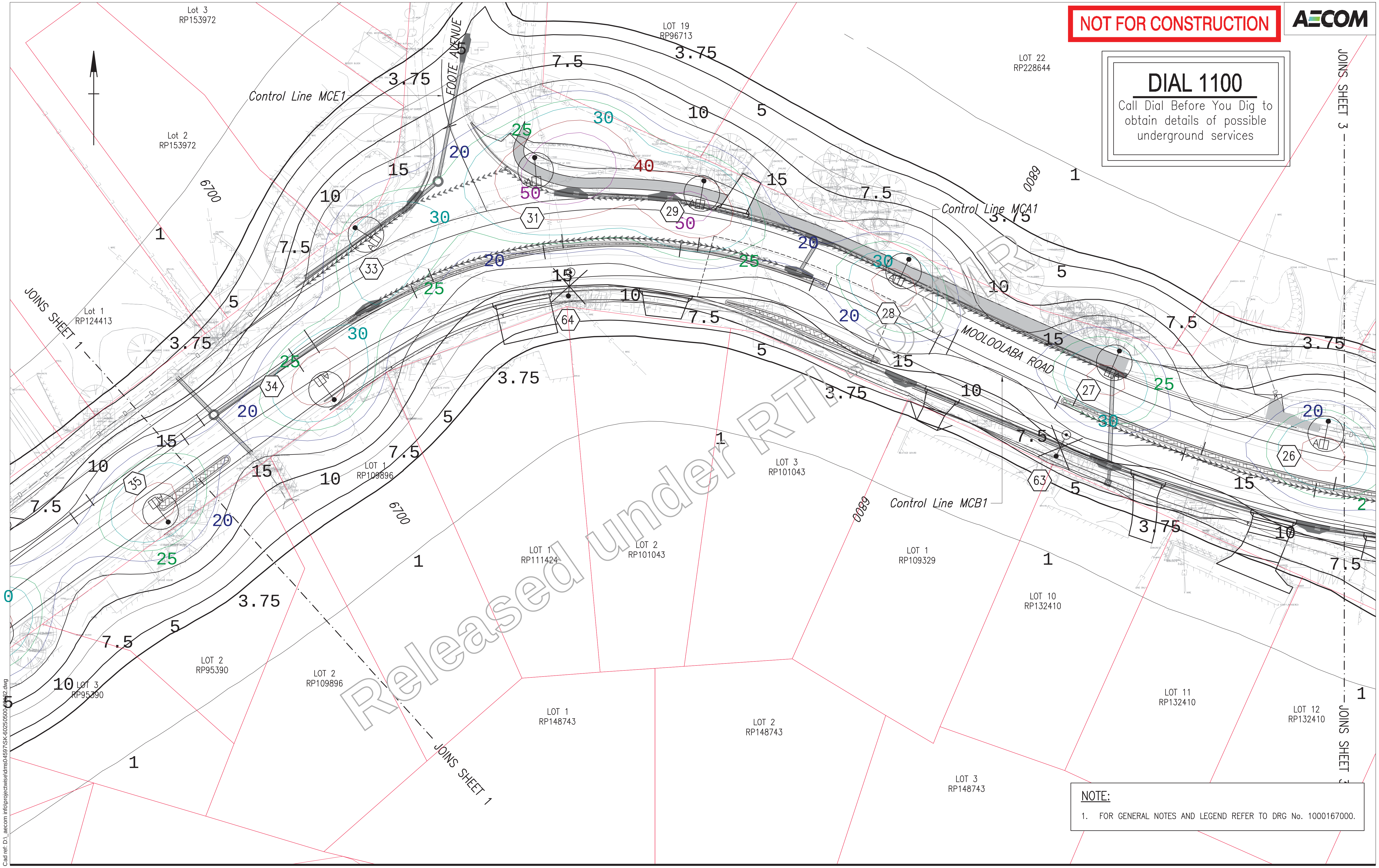
NOTE:

1. FOR GENERAL NOTES AND LEGEND REFER TO DRG No. 1000167000.

60250500
A

0 2 4 6 8 10m

ROADWAY LIGHTING LAYOUT
ISOLUX CONTOURS
SHEET 1 OF 7
SK-60250500-00131



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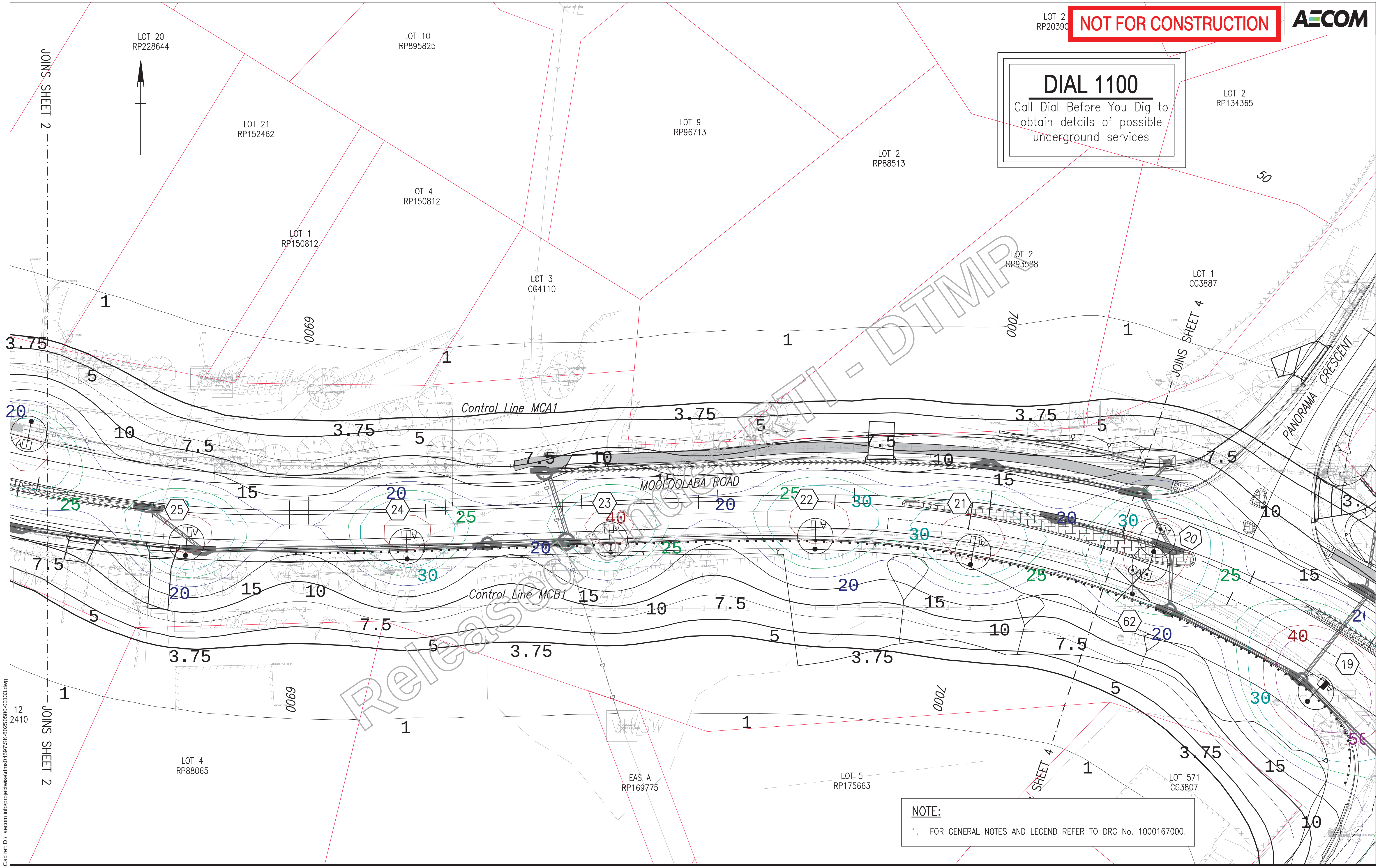
ISOLUX CONTOURS
SHEET 2 OF 7
SK-60250500-00132



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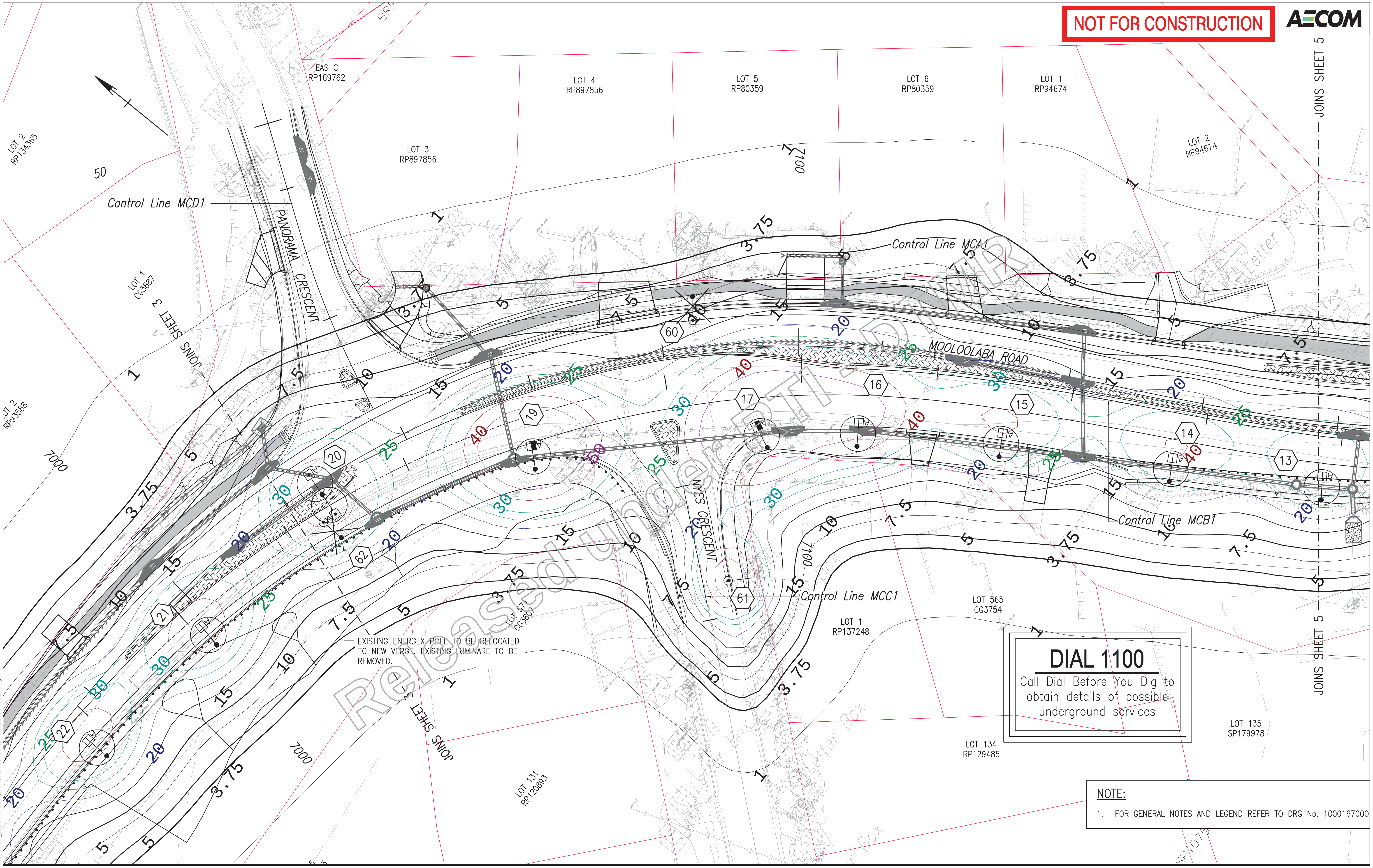
60250500

A 0 2 4 6 8 10m

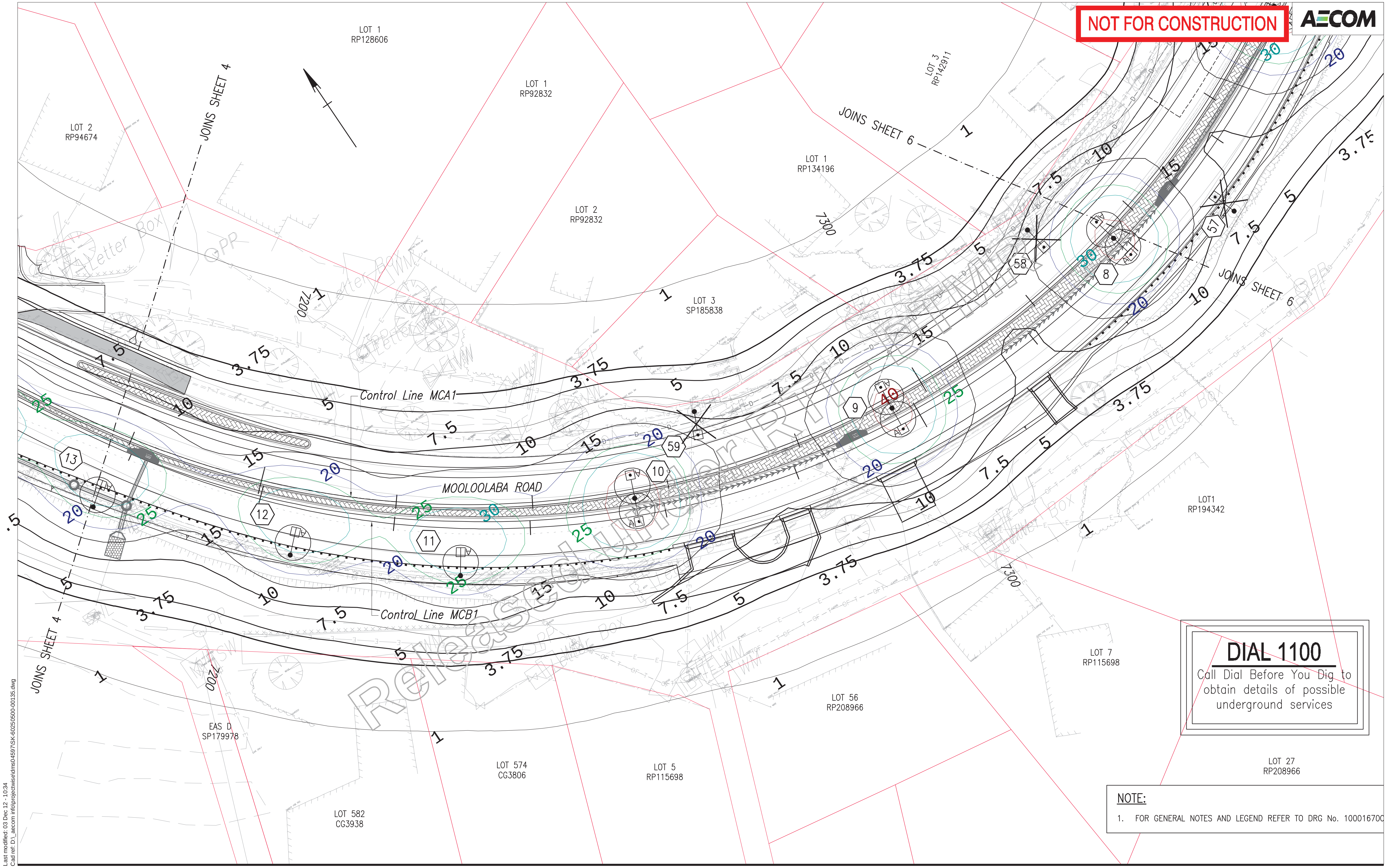
ROADWAY LIGHTING LAYOUT
ISOLUX CONTOURS
SHEET 3 OF 7
SK-60250500-00133



60250500

A 0 2 4 6 8 10m

ROADWAY LIGHTING LAYOUT
ISOLUX CONTOURS
SHEET 4 OF 7
SK-60250500-00134



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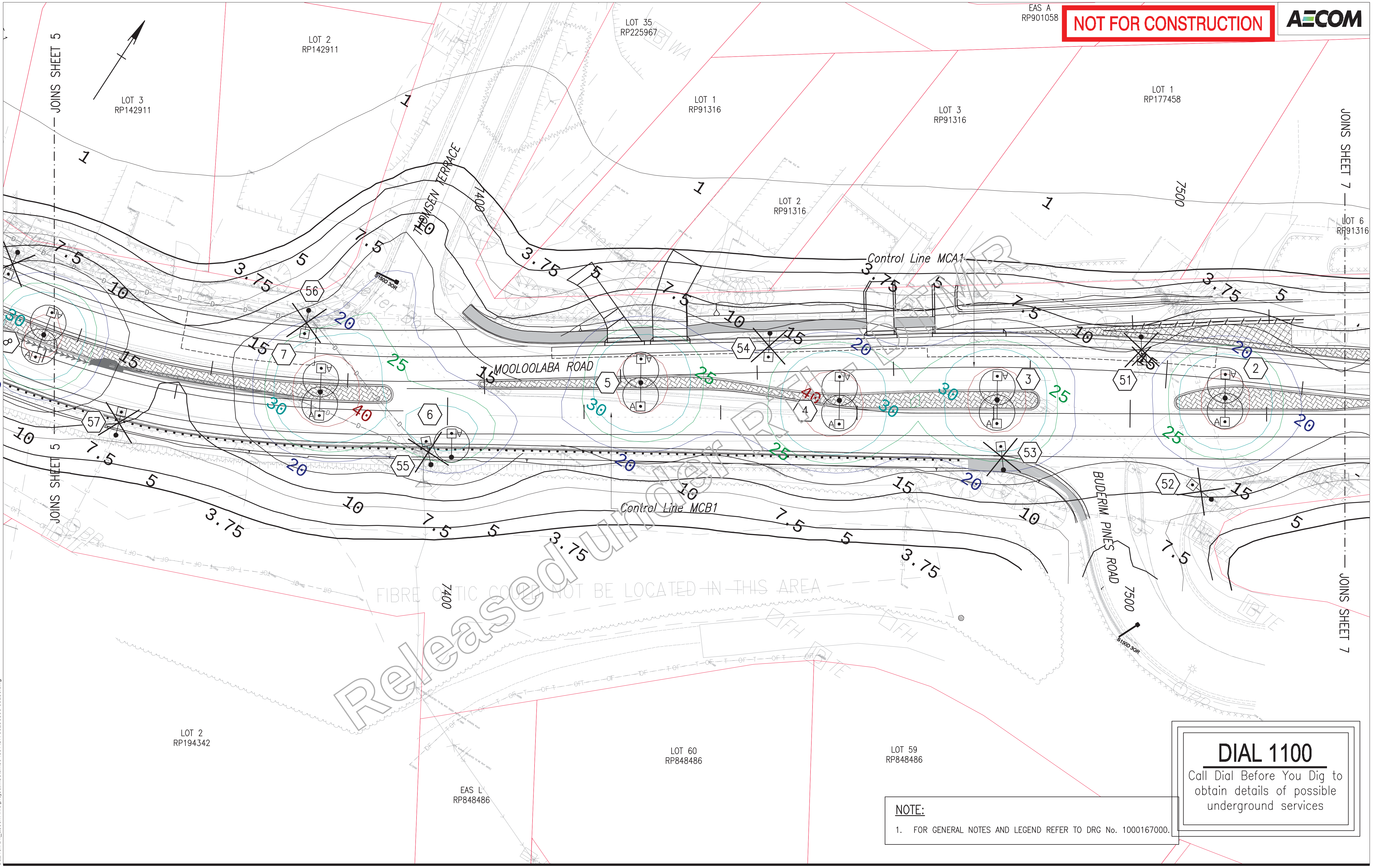
60250500
A

0 2 4 6 8 10m

ROADWAY LIGHTING LAYOUT
ISOLUX CONTOURS
SHEET 5 OF 7
SK-60250500-00135



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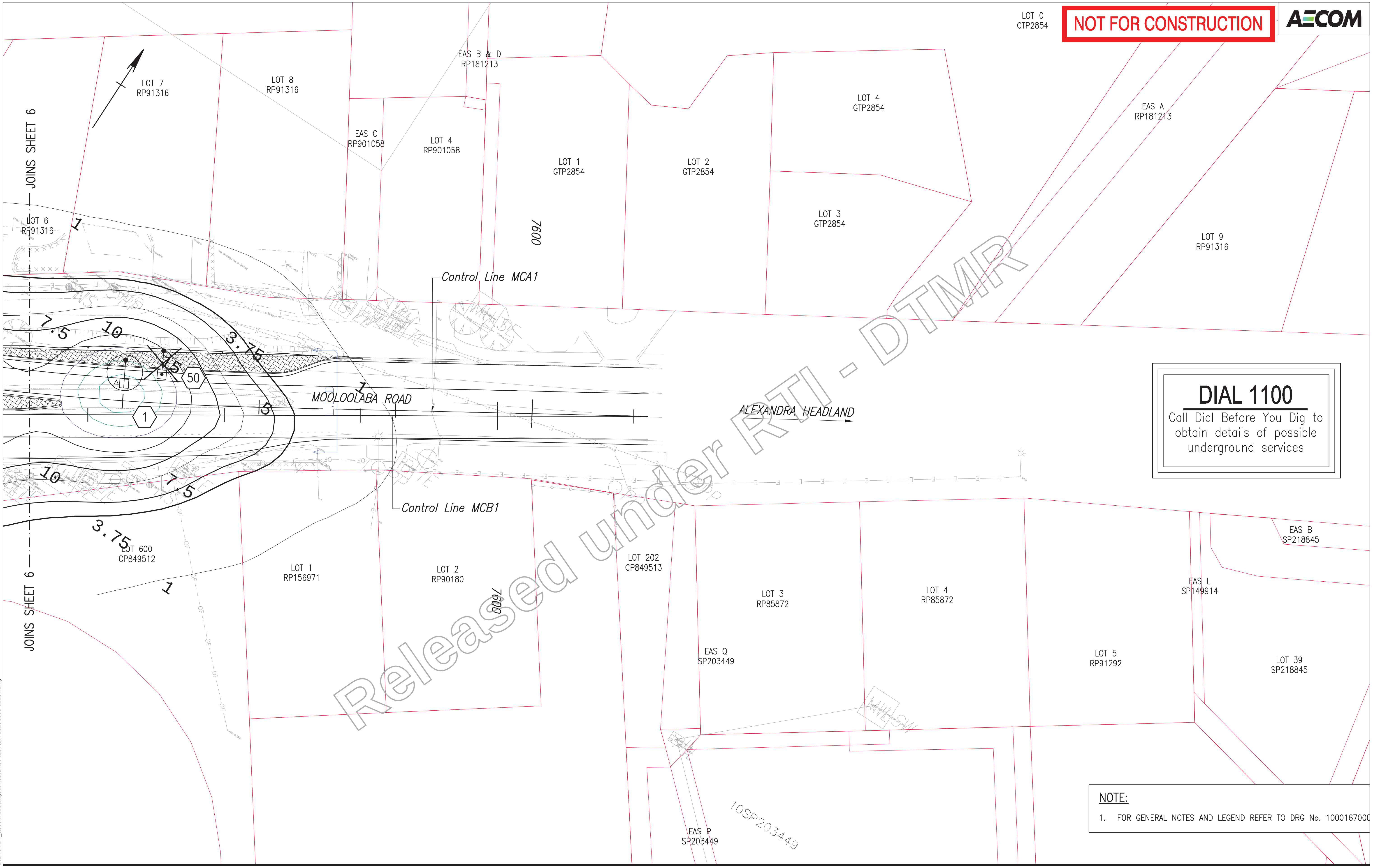
Cad ref: D:_aecom info\projectwise\dms04597\SK-60250500-00136.dwg

60250500

A 0 2 4 6 8 10m

ROADWAY LIGHTING LAYOUT
ISOLUX CONTOURS
SHEET 6 OF 7
SK-60250500-00136



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60250500
A

0 2 4 6 8 10m

ROADWAY LIGHTING LAYOUT
ISOLUX CONTOURS
SHEET 7 OF 7
SK-60250500-00137

Appendix B

Calculation

Appendix B 1. Voltage Drop Calculation

ROAD LIGHTING CIRCUIT VOLTAGE DROP CALCULATION

PROJECT DESCRIPTION	Mooloolaba Road - Rate 3
PROJECT NUMBER	S3000069
DIST BOARD/PILLAR REFERENCE	SWB101 (Energex POS P85912)
CIRCUIT NUMBER	1L1, 1L2, 1L3

LAMP DESCRIPTION	LAMP TYPE	CURRENT (A)
S150W	1	1.1
2 x S150W	2	2.2
S250W	3	1.8
S400W	4	2.93
PIT	5	0

OPERATING VOLTAGE (V)	230
MAXIMUM VOLTAGE DROP ALLOWED	4.0%

									PHASE A			PHASE B			PHASE C		
CIRCUIT SEGMENT	STATIONS FROM - TO	SEGMENT CABLE SIZE (mm)	LAMP TYPE	SEGMENT LAMP CURRENT	SEGMENT LENGTH	CABLE RESISTANCE (Ω/km)	CABLE REACTANCE (Ω/km)	CABLE IMPEDANCE (Ω/km)	ACTIVE SEGMENT CURRENT (A)	NEUTRAL SEGMENT CURRENT (A)	SEGMENT VOLTAGE DROP	ACTIVE SEGMENT CURRENT (A)	NEUTRAL SEGMENT CURRENT (A)	SEGMENT VOLTAGE DROP	ACTIVE SEGMENT CURRENT (A)	NEUTRAL SEGMENT CURRENT (A)	SEGMENT VOLTAGE DROP
1	SWB101 - 1	16	3	1.8	25	1.26	0.081	1.263	8.4	2.54	0.35	6.60	2.54	0.29	5.5	2.54	0.25
2	1 - 2	16	2	2.2	50	1.26	0.081	1.263	6.6	1.10	0.49	6.60	1.10	0.49	5.5	1.10	0.42
3	2 - P3A	16	5	0	35	1.26	0.081	1.263	6.6	1.91	0.38	4.40	1.91	0.28	5.5	1.91	0.33
4	P3A - 3	16	2	2.2	5	1.26	0.081	1.263	4.4	2.91	0.05	2.20	2.91	0.03	5.5	2.91	0.05
5	3 - 6	16	1	1.1	95	1.26	0.081	1.263	4.4	1.91	0.76	2.20	1.91	0.49	3.3	1.91	0.62
6	6 - 7	16	2	2.2	35	1.26	0.081	1.263	4.4	2.20	0.29	2.20	2.20	0.19	2.2	2.20	0.19
7	7 - 8	16	2	2.2	45	1.26	0.081	1.263	2.2	0.00	0.12	2.20	0.00	0.12	2.2	0.00	0.12
8	8 - 9	16	2	2.2	45	1.26	0.081	1.263	2.2	2.20	0.25	0.00	2.20	0.12	2.2	2.20	0.25
9	9 - 10	16	2	2.2	45	1.26	0.081	1.263	2.2	2.20	0.25	0.00	2.20	0.12	0	2.20	0.12
10	P3A - 4	16	2	2.2	30	1.26	0.081	1.263	2.2	2.20	0.17	2.20	2.20	0.17	0	2.20	0.08
11	4 - 5	16	2	2.2	35	1.26	0.081	1.263	2.2	2.20	0.19	0.00	2.20	0.10	0	2.20	0.10
										Vd TOTAL (V)	3.29		Vd TOTAL (V)	2.41		Vd TOTAL (V)	2.55
										Vd TOTAL (%)	1.43%		Vd TOTAL (%)	1.05%		Vd TOTAL (%)	1.11%
										RESULT	PASS		RESULT	PASS		RESULT	PASS

RESULTS	
TOTAL CIRCUIT CURRENT (A)	20.5
MAXIMUM Vd (V)	3.29
MAXIMUM % Vd	1.43%
RESULT	PASS
TOTAL CIRCUIT SEGMENTS	11
TOTAL SEGMENT LENGTH (m)	445

$$Vs\ Vseg = Ias \cdot \frac{Zc}{1000} \cdot Ls + Ins \cdot \frac{Zc}{1000} \cdot Ls$$

Vseg = Voltage drop in segment
Ias = Current in active segment
Ins = Current in neutral segment
Ls = Length of segment
Zc = Impedance of cable

Notes:
Segment voltage drop determined by summing active and neutral segment currents. Refer AS3008 Section 4.6.
Resistance as per AS3008 Table 35 : a.c. resistance at 50 Hz of multicore cables with circular conductors (copper, 45 degrees C).
Reactance as per AS3008 Table 30 : multicore, circular conductors with XLPE sheathing.
Maximum voltage drop of 1% from the Energex point of supply to distribution pillar has been allowed.
At the instant of the fault, the fault current will flow through the neutral conductor of the cable as there is no earth conductor.

CALCULATIONS:

REFER TO AS3008 : 4.6 DETERMINATION OF VOLTAGE DROP IN UNBALANCED MULTIPHASE CIRCUITS

Voltage Drop (V) = $\boxed{\sum_{n+1} \left(\frac{RL}{1000}\right)(Ia+In)}$

Where: n = circuit segment
R = cable resistance (Ω/km)
L = segment length (m)
Ia = active segment current (A)
In - neutral segment current (A)

CABLE RESISTANCE VALUES
REFER TO AS3008 : Table 35 : a.c. resistance at 50 Hz of multicore cables with circular conductors (copper, 45 degrees C)

ROAD LIGHTING CIRCUIT VOLTAGE DROP CALCULATION

PROJECT DESCRIPTION	Mooloolaba Road - Rate 3
PROJECT NUMBER	S3000069
DIST BOARD/PILLAR REFERENCE	SWB101 (Energex POS P85912)
CIRCUIT NUMBER	1L4, 1L5, 1L6

OPERATING VOLTAGE (V)	230
MAXIMUM VOLTAGE DROP ALLOWED	4.0%

LAMP DESCRIPTION	LAMP TYPE	CURRENT (A)
S150W	1	1.1
2 X S150W	2	2.2
S250W	3	1.8
S400W	4	2.93
PIT	5	0

									PHASE A			PHASE B			PHASE C		
CIRCUIT SEGMENT	**STATIONS FROM - TO**	**SEGMENT CABLE SIZE (mm)**	**LAMP TYPE**	**SEGMENT LAMP CURRENT**	**SEGMENT LENGTH**	**CABLE RESISTANCE (Ω/km)**	**CABLE REACTANCE (Ω/km)**	**CABLE IMPEDANCE (Ω/km)**	**ACTIVE SEGMENT CURRENT (A)**	**NEUTRAL SEGMENT CURRENT (A)**	**SEGMENT VOLTAGE DROP**	**ACTIVE SEGMENT CURRENT (A)**	**NEUTRAL SEGMENT CURRENT (A)**	**SEGMENT VOLTAGE DROP**	**ACTIVE SEGMENT CURRENT (A)**	**NEUTRAL SEGMENT CURRENT (A)**	**SEGMENT VOLTAGE DROP**
1	SWB101 - 11	16	3	1.8	400	1.26	0.086	1.263	6.53	2.93	4.78	6.53	2.93	4.78	3.6	2.93	3.30
2	11 - 12	16	3	1.8	25	1.26	0.086	1.263	4.73	2.56	0.23	6.53	2.56	0.29	3.6	2.56	0.19
3	12 - 13	16	3	1.8	35	1.26	0.086	1.263	4.73	1.13	0.26	4.73	1.13	0.26	3.6	1.13	0.21
4	13 - 14	16	3	1.8	25	1.26	0.086	1.263	4.73	2.93	0.24	4.73	2.93	0.24	1.8	2.93	0.15
5	14 - 15	16	3	1.8	25	1.26	0.086	1.263	2.93	2.56	0.17	4.73	2.56	0.23	1.8	2.56	0.14
6	15 - 16	16	3	1.8	25	1.26	0.086	1.263	2.93	1.13	0.13	2.93	1.13	0.13	1.8	1.13	0.09
7	16 -17	16	4	2.93	25	1.26	0.086	1.263	2.93	2.93	0.19	2.93	2.93	0.19	0	2.93	0.09
8	17 - 19	16	4	2.93	35	1.26	0.086	1.263	0	2.93	0.13	2.93	2.93	0.26	0	2.93	0.13

	PHASE A		PHASE B		PHASE C
Vd TOTAL (V)	6.13	Vd TOTAL (V)	6.37	Vd TOTAL (V)	4.30
Vd TOTAL (%)	2.66%	Vd TOTAL (%)	2.77%	Vd TOTAL (%)	1.87%
RESULT	PASS	RESULT	PASS	RESULT	PASS

RESULTS	
TOTAL CIRCUIT CURRENT (A)	16.66
MAXIMUM Vd (V)	6.37
MAXIMUM % Vd	2.77%
RESULT	PASS
TOTAL CIRCUIT SEGMENTS	8
TOTAL SEGMENT LENGTH (m)	595

$$Vseg = Ias \cdot \frac{Zc}{1000} \cdot Ls + Ins \cdot \frac{Zc}{1000} \cdot Ls$$

Vseg = Voltage drop in segment
Ias = Current in active segment
Ins = Current in neutral segment
Ls = Length of segment
Zc = Impedance of cable

Notes:
Segment voltage drop determined by summing active and neutral segment currents. Refer AS3008 Section 4.6.
Resistance as per AS3008 Table 35 : a.c. resistance at 50 Hz of multicore cables with circular conductors (copper, 45 degrees C).
Reactance as per AS3008 Table 30 : multicore, circular conductors with XLPE sheathing.
Maximum voltage drop of 1% from the Energex point of supply to distribution pillar has been allowed.
At the instant of the fault, the fault current will flow through the neutral conductor of the cable as there is no earth conductor.

CALCULATIONS:

REFER TO AS3008 : 4.6 DETERMINATION OF VOLTAGE DROP IN UNBALANCED MULTIPHASE CIRCUITS

Voltage Drop (V) = $\sum_{n+1} \left(\frac{RL}{1000}\right)(Ia+In)$

Where:
n = circuit segment
R = cable resistance (Ω/km)
L = segment length (m)
Ia = active segment current (A)
In - neutral segment current (A)

CABLE RESISTANCE VALUES
REFER TO AS3008 : Table 35 : a.c. resistance at 50 Hz of multicore cables with circular conductors (copper, 45 degrees C)

ROAD LIGHTING CIRCUIT VOLTAGE DROP CALCULATION

PROJECT DESCRIPTION	Mooloolaba Road - Rate 3
PROJECT NUMBER	S3000069
DIST BOARD/PILLAR REFERENCE	SWB102 (Energex POS P85931)
CIRCUIT NUMBER	2L1, 2L2, 2L3

OPERATING VOLTAGE (V)	230
MAXIMUM VOLTAGE DROP ALLOWED	4.0%

LAMP DESCRIPTION	LAMP TYPE	CURRENT (A)
S150W	1	1.1
2 X S150W	2	2.2
S250W	3	1.8
S400W	4	2.93
PIT	5	0

CIRCUIT SEGMENT	STATIONS FROM - TO	SEGMENT CABLE SIZE (mm)	LAMP TYPE	SEGMENT LAMP CURRENT	SEGMENT LENGTH	CABLE RESISTANCE (Ω/km)	CABLE REACTANCE (Ω/km)	CABLE IMPEDANCE (Ω/km)	PHASE A ACTIVE SEGMENT CURRENT (A)	PHASE A NEUTRAL SEGMENT CURRENT (A)	PHASE A SEGMENT VOLTAGE DROP	PHASE B ACTIVE SEGMENT CURRENT (A)	PHASE B NEUTRAL SEGMENT CURRENT (A)	PHASE B SEGMENT VOLTAGE DROP	PHASE C ACTIVE SEGMENT CURRENT (A)	PHASE C NEUTRAL SEGMENT CURRENT (A)	PHASE C SEGMENT VOLTAGE DROP
1	SWB102 - P21A	16	5	0	10	1.26	0.086	1.263	7.6	0.40	0.10	7.20	0.40	0.10	7.2	0.40	0.10
2	P21A - 20	16	2	2.2	15	1.26	0.086	1.263	2.2	2.20	0.08	0.00	0.00	0.00	0	0.00	0.00
3	P21A - 21	16	3	1.8	25	1.26	0.086	1.263	5.4	1.80	0.23	7.20	1.80	0.28	7.2	1.80	0.28
4	21 - 22	16	3	1.8	30	1.26	0.086	1.263	5.4	1.80	0.27	5.40	1.80	0.27	7.2	1.80	0.34
5	22 - 23	16	3	1.8	35	1.26	0.086	1.263	5.4	0.00	0.24	5.40	0.00	0.24	5.4	0.00	0.24
6	23 - 24	16	3	1.8	35	1.26	0.086	1.263	3.6	1.80	0.24	5.40	1.80	0.32	5.4	1.80	0.32
7	24 - 25	16	3	1.8	35	1.26	0.086	1.263	3.6	1.80	0.24	3.60	1.80	0.24	5.4	1.80	0.32
8	25 - 26	16	3	1.8	50	1.26	0.086	1.263	3.6	0.00	0.23	3.60	0.00	0.23	3.6	0.00	0.23
9	26 - 27	16	3	1.8	35	1.26	0.086	1.263	1.8	1.80	0.16	3.60	1.80	0.24	3.6	1.80	0.24
10	27 - 28	16	3	1.8	35	1.26	0.086	1.263	1.8	1.80	0.16	1.80	1.80	0.16	3.6	1.80	0.24
11	28 - 29	16	3	1.8	35	1.26	0.086	1.263	1.8	0.00	0.08	1.80	0.00	0.08	1.8	0.00	0.08
12	29 - 31	16	3	1.8	35	1.26	0.086	1.263	0	1.80	0.08	1.80	1.80	0.16	1.8	1.80	0.16
13	31 - 33	16	3	1.8	30	1.26	0.086	1.263	0	1.80	0.07	0.00	1.80	0.07	1.8	1.80	0.14

	PHASE A		PHASE B		PHASE C
Vd TOTAL (V)	2.17	Vd TOTAL (V)	2.38	Vd TOTAL (V)	2.68
Vd TOTAL (%)	0.95%	Vd TOTAL (%)	1.04%	Vd TOTAL (%)	1.16%
RESULT	PASS	RESULT	PASS	RESULT	PASS

RESULTS	
TOTAL CIRCUIT CURRENT (A)	22
MAXIMUM Vd (V)	2.68
MAXIMUM % Vd	1.16%
RESULT	PASS
TOTAL CIRCUIT SEGMENTS	13
TOTAL SEGMENT LENGTH (m)	405

$$Vs\ Vseg = Ias \cdot \frac{Zc}{1000} \cdot Ls + Ins \cdot \frac{Zc}{1000} \cdot Ls$$

Vseg = Voltage drop in segment
Ias = Current in active segment
Ins = Current in neutral segment
Ls = Length of segment
Zc = Impedance of cable

Notes:

Segment voltage drop determined by summing active and neutral segment currents. Refer AS3008 Section 4.6.
Resistance as per AS3008 Table 35 : a.c. resistance at 50 Hz of multicore cables with circular conductors (copper, 45 degrees C).
Reactance as per AS3008 Table 30 : multicore, circular conductors withXLPE sheathing.
Maximum voltage drop of 1% from the Energex point of supply to distribution pillar has been allowed.
At the instant of the fault, the fault current will flow through the neutral conductor of the cable as there is no earth conductor.

CALCULATIONS:

REFER TO AS3008 : 4.6 DETERMINATION OF VOLTAGE DROP IN UNBALANCED MULTIPHASE CIRCUITS

Voltage Drop (V) = $\sum_{n=1} \left(\frac{RL}{1000}\right)(Ia+In)$

Where: n = circuit segment
R = cable resistance (Ω/km)
L = segment length (m)
Ia = active segment current (A)
In - neutral segment current (A)

CABLE RESISTANCE VALUES
REFER TO AS3008 : Table 35 : a.c. resistance at 50 Hz of multicore cables with circular conductors (copper, 45 degrees C)

ROAD LIGHTING CIRCUIT VOLTAGE DROP CALCULATION

PROJECT DESCRIPTION	Mooloolaba Road - Rate 3
PROJECT NUMBER	S3000069
DIST BOARD/PILLAR REFERENCE	SWB102
CIRCUIT NUMBER	2L4, 2L5, 2L6

LAMP DESCRIPTION	LAMP TYPE	CURRENT (A)
S150W	1	1.1
2 X S150W	2	2.2
S250W	3	1.8
S400W	4	2.93
PIT	5	0

OPERATING VOLTAGE (V)	230
MAXIMUM VOLTAGE DROP ALLOWED	4.0%

									PHASE A			PHASE B			PHASE C		
CIRCUIT SEGMENT	STATIONS FROM - TO	SEGMENT CABLE SIZE (mm)	LAMP TYPE	SEGMENT LAMP CURRENT	SEGMENT LENGTH	CABLE RESISTANCE (Ω/km)	CABLE REACTANCE (Ω/km)	CABLE IMPEDANCE (Ω/km)	ACTIVE SEGMENT CURRENT (A)	NEUTRAL SEGMENT CURRENT (A)	SEGMENT VOLTAGE DROP	ACTIVE SEGMENT CURRENT (A)	NEUTRAL SEGMENT CURRENT (A)	SEGMENT VOLTAGE DROP	ACTIVE SEGMENT CURRENT (A)	NEUTRAL SEGMENT CURRENT (A)	SEGMENT VOLTAGE DROP
1	SWB102 - 34	16	3	1.8	395	1.26	0.086	1.263	3.6	1.80	2.69	1.80	1.80	1.80	1.8	1.80	1.80
2	34 - 35	16	3	1.8	35	1.26	0.086	1.263	1.8	0.00	0.08	1.80	0.00	0.08	1.8	0.00	0.08
3	35 - 36	16	3	1.8	35	1.26	0.086	1.263	1.8	1.80	0.16	0.00	1.80	0.08	1.8	1.80	0.16
4	36 - 37	16	3	1.8	35	1.26	0.086	1.263	1.8	1.80	0.16	0.00	1.80	0.08	0	1.80	0.08

	PHASE A		PHASE B		PHASE C
Vd TOTAL (V)	3.09	Vd TOTAL (V)	2.03	Vd TOTAL (V)	2.11
Vd TOTAL (%)	1.34%	Vd TOTAL (%)	0.88%	Vd TOTAL (%)	0.92%
RESULT	PASS	RESULT	PASS	RESULT	PASS

RESULTS	
TOTAL CIRCUIT CURRENT (A)	7.2
MAXIMUM Vd (V)	3.09
MAXIMUM % Vd	1.34%
RESULT	PASS
TOTAL CIRCUIT SEGMENTS	4
TOTAL SEGMENT LENGTH (m)	500

$$Vs\,Vseg = Ias \cdot \frac{Zc}{1000} \cdot Ls + Ins \cdot \frac{Zc}{1000} \cdot Ls$$

Vseg = Voltage drop in segment
Ias = Current in active segment
Ins = Current in neutral segment
Ls = Length of segment
Zc = Impedance of cable

Notes:

Segment voltage drop determined by summing active and neutral segment currents. Refer AS3008 Section 4.6.
Resistance as per AS3008 Table 35 : a.c. resistance at 50 Hz of multicore cables with circular conductors (copper, 45 degrees C).
Reactance as per AS3008 Table 30 : multicore, circular conductors with XLPE sheathing.
Maximum voltage drop of 1% from the Energex point of supply to distribution pillar has been allowed.
At the instant of the fault, the fault current will flow through the neutral conductor of the cable as there is no earth conductor.

CALCULATIONS:

REFER TO AS3008 : 4.6 DETERMINATION OF VOLTAGE DROP IN UNBALANCED MULTIPHASE CIRCUITS

Voltage Drop (V) = $\sum_{n=1} \left(\frac{RL}{1000}\right)(Ia+In)$

Where: n = circuit segment
R = cable resistance (Ω/km)
L = segment length (m)
Ia = active segment current (A)
In - neutral segment current (A)

CABLE RESISTANCE VALUES
REFER TO AS3008 : Table 35 : a.c. resistance at 50 Hz of multicore cables with circular conductors (copper, 45 degrees C)

Appendix B 2. Earth Fault Loop Calculation

RATE 3 - LIGHTING CIRCUIT : FAULT LOOP CALCULATION

Project	Mooloolaba Road(S3000069)
Distribution Board Reference	SWB101 & SWB102
Cable Number	

Operating voltage (V)	230
Protective device rating (A)	20
Protective device operation time (s)	0.4
Maximum circuit impedance Zs From AS3000-2007 Table 8.1 (Ohms)	2.09

Cable length pass
Cable lenght fail

CIRCUIT	FROM - TO	CABLE SIZE (mm)	CABLE RESISTANCE (Ω/km)	CABLE REACTANCE (Ω/km)	CABLE IMPEDANCE (Ω/km)	CABLE LENGTH (m)	CABLE IMP. LIGHT CCT (Ω)	CABLE IMP. TX TO SWBD (Ω)	TOTAL CABLE IMPEDANCE (Ω)	MAX RUN LENGTH (m)
1L1,1L2,1L3	SWB101 - 10	16	1.260	0.081	1.263	380	0.96			662.14
1L4,1L5,1L6	SWB101 - 19	16	1.260	0.081	1.263	595	1.50			662.14
2L1,2L2,2L3	SWB102- 33	16	1.260	0.081	1.263	405	1.02			662.14
2L4,2L5,2L6	SWB102 - 37	16	1.260	0.081	1.263	500	1.26			662.14

NOTE:	1. THE MAXIMUM RUN LENGTH CALCULATION IS BASED ON THE ASSUMPTION THAT THERE WILL ALWAYS BE 80% OR MORE OF THE NOMINAL PHASE VOLTAGE AVAILABLE AT THE POSITION OF THE PROTECTIVE DEVICE. (AS PER AS3000 B5.2.1)
	2. FAULT LOOP IMPEDANCE WAS CALCULATED USING THE NEUTRAL AS THE RETURN PATH AS PER AN MEN SYSTEM WHERE THE EARTH IS NOT RETICULATED
	3. INFORMATION WAS NOT AVAILABLE FROM ERGON REGARDING PROSPECTIVE SHORT CIRCUIT CURRENTS, EXTERNAL FAULT LOOP IMPEDANCE OR INFORMATION TO CALCULATE THESE VALUES (TX SIZE, CABLE SIZE, CABLE LENGTH ETC.) THEREFORE STANDARD ASSUMPTIONS IN AS3000 WERE USED.

CALCULATIONS:

REFER TO AS3008 : B5.2 CALCULATION OF MAXIMUM LENGTH OF CIRCUIT

MAX RUN LENGTH = (0.8Zs / 2Zc) x 1000

Where: Zc = cable impedance in Ohms / km downstream from the protective device; derived from AS3008 (see notes below)
Zs = maximum cable impedance allowed to ensure operation of the protective device in the required timeframe; from AS3000 Table B4.1
Lmax = maximum cable length that will ensure operation of the protective device in the required timeframe

CABLE RESISTANCE VALUES

REFER TO AS3008 : Table 30 : Reactance at 50 Hz of all cables excluding flexible cords and cables, mims cables and aerial conductors (XLPE, multicore, circular conductors)

REFER TO AS3008 : Table 35 : a.c. Resistance at 50 Hz of multicore cables with circular conductors (copper, 45 degrees C)

PUP Conflicts Register

Conflict Tag	Drawing No.	Approximate Chainage (Control Line LHS / RHS)	Service Details	Conflict type / Relationship between existing service and proposed works	Depth to service	Comments
TT-01	611187	6681 (MCA1 LHS)	Telstra undergound / Optic Fibre	Excavation required to replace existing stormwater pipe, Strucutre No 4/A1 to 5/A1. Existing service crosses above stormwater pipe	Approx clearance 200mm between top of existing service and top of new stormwater pipe.	Contractor required to liase with relevant service authroity to determine action for protection of service during construction.
TT-02	611187	6700 - 6720 (MCA1 LHS)	Telstra underground cable 10 pair	Excavation required to install new stormwater pipe, grated drain and kerb, Strucutre No 2/A1 to 3/A1	Approx 1.0m horizontal offset from existing service to centre of new stormwater pipe. Approx depth to top of service 600mm	Potential conflict, Contractor to liase with relevant service authroity to determine action for protection of service during construction.
TT-03	611187	6740 (MCA1 LHS)	Telstra underground / Optic Fibre	Excavation required to install new grated drain and kerb that connects to Structure 1/B1	Approx depth from new kerb lip to top of service 1400mm.	Potential conflict, Contractor to liase with relevant service authroity to determine action for protection of service during construction.
TT-04	611187	6700 (MCB1 RHS)	Telstra underground	Installation of new rate 3 street lighting column, electrical pit, trenching for new electrical cables behind new kerb and channel	Approx depth from new verge level to top of existing service 700mm.	Potential conflict, Contractor to liase with relevant service authroity to determine action for protection of service during construction.
TT-05	611187	6747 (MCA1 LHS)	Telstra underground / Optic Fibre	Excavation required to install new street lighting cables within verge.	Approx 450mm and 1560mm below existing surface.	Potential conflict, Contractor required to liase with relevant service authroity to determine action for protection of service during construction. Proposed alignment of electrical conduits for road lighting maybe determined on site in consultation with relevant service authority.
TT-06	611187	6765 (MCA1 LHS)	Telstra underground / Optic Fibre	Excavation required to install new stormwater pipe Structure No 2/B1 to 3/B1, grated drain and reconstruction of private access.	Approx 540mm underneath proposed stormwater pipe.	Potential conflict, Contractor to liase with relevant service authroity to determine action for protection of service during construction.
TT-07	611187	6760 (MCA1 LHS)	Telstra underground / Optic Fibre	Excavation required to replace existing pavement and installation of grated drain and new central median.	Approx 1.3m below new road design level to top of existing service.	Service Authority to confirm weather relocation is required as part of conflict TT-05
TT-08	611187	6789 (MCA1 LHS)	Telstra underground cable	Installation of new rate 3 street lighting column, electrical pit, conduits behind new kerb and channel.	Approx 900mm from top of service to new verge / footpath. Existing service lies directy below existing retaining wall.	Potential conflict, Contractor to liase with relevant service authroity to determine action for protection of service during construction.
TT-09	611187	6823 (MCA1 LHS)	Telstra underground cable	Installation of new rate 3 street lighting column, electrical pit, conduits behind new kerb and channel.	Approx 800mm from top of service to new verge / footpath. Existing service lies directy below existing retaining wall.	Potential conflict, Contractor to liase with relevant service authroity to determine action for protection of service during construction.
TT-10	611187	6831 (MCB1 RHS)	Telstra underground cable / Optic Fibre	Excavation required for installation of new field inlet pit with connection pipe to gully pit 5/B1.	Approx 750mm from top of service to new verge / footpath. Existing service lies directy below proposed field inlet pit . Proposed field inlet pit is 450mm deep.	Potential conflict, Contractor to liase with relevant service authroity to determine action for protection of service during construction.
PL-01	611187	6743 (MCB1 RHS)	Existing power pole to remain	Reconstruction of new kerb and channel along similar horizontal alignment to existing.	Approx 500mm from centre of pole to new kerb face	Potential conflict, Contractor to liase with relevant service authroity to determine action for protection of service during construction.
PL-02	611187	6773 (MCB1 RHS)	Existing power pole to remain	Reconstruction of new kerb and channel along similar horizontal alignment to existing. Excavation required to replace existing pavement and installtion of additional "Blister" island within new road shoulder.	Approx 450mm from centre of pole to new kerb face	Potential conflict, Contractor to liase with relevant service authroity to determine action for protection of service during construction.
WM-01	611187	6700 (MCB1 RHS)	Watermain	Installation of new rate 3 street lighting column, electrical pit, trenching for new electrical cables behind new kerb and channel	DBYD information shown. To date have been unable to determine exact location of this service.	Potential conflict, Contractor to liase with relevant service authroity to determine action
WM-02	611187	6718 (MCA1 LHS)	Watermain 100mm dia	Excavation required to install grated drain within new central median	Approx 1.32m from top of service to new road design level.	Potential conflict, Contractor to liase with relevant service authroity to determine action for protection of service during construction.
WM-03	611187	6720 (MCA1 LHS)	Watermain 100mm dia	Excavation required to install new gully pit 2/A1, stormwater pipe and grated drain.	DBYD information shown. To date have been unable to determine exact location of this service.	Potential conflict, Contractor to liase with relevant service authroity to determine action for protection of service during construction.
WM-04	611187	6738 (MCA1 LHS)	Watermain 150mm dia	Excavation required to install grated drain within new central median	Approx 1.29m from top of service to new road design level.	No conflict, However Contractor to be aware and may require further consultation with relevant service authroity for protection of service during construction.
WM-05	611187	6740(MCA1 LHS)	Watermain 150mm dia	Excavation required to install grated drain which connects to gully pit 1/B1	Approx 1.68m from top of service to new road design level.	No conflict, However Contractor to be aware and may require further consultation with relevant service authroity for protection of service during construction.
WM-06	611187	6831 (MCB1 RHS)	Watermain 150mm dia	Excavation required for installation of new field inlet pit with connection pipe to gully pit 5/B1.	DBYD information shown. To date have been unable to determine exact location of this service.	Potential conflict, Contractor to confirm location on site with relevant service authroity to determine action for protection of service during construction.
WM-07	611188	6915 (MCB1 RHS)	Watermain 150mm dia	Exacavtion required for installation of new stormwater pipe, kerb and channel and guardrail.	DBYD information shown for road crossing. Have been unable to determine exact location of road crossing	Requires relocation, Relevant service authority to advise.
WM-08	611188	6936 (MCA1 LHS)	Watermain 150mm dia	Exacavtion required for installation of new stormwater pipe adjacent to existing	DBYD information shown for road crossing. Have been unable to determine exact location of road crossing	Requires relocation, Relevant service authority to advise.
TT-11	611188	7016 (MCA1 LHS)	Telstra undergound / Optic Fibre	Re-alignment of concrete footpath and installation of new concrete channel.	No clash, drain realigned. Pit lid to be raised to new design levels.	No conflict, However Contractor to be aware and may require further consultation with relevant service authroity for protection of service during construction.

PUP Conflicts Register

Conflict Tag	Drawing No.	Approximate Chainage (Control Line LHS / RHS)	Service Details	Conflict type / Relationship between existing service and proposed works	Depth to service	Comments
TT-12	611189	7023 (MCA1 LHS)	Telstra undergound / Optic Fibre	Re-alignment of concrete footpath and excavation for installation of new concrete channel and inlet pit 1/C2.	Approx 1.3m from top of service to inlet pit. Existing service lies directly behind new pit. Drainage raised to provide approx 480mm clearance from pipe to top of service.	Potential conflict, Contractor to confirm location on site with relevant service authroity to determine action for protection of service during construction.
TT-13	611189	7023 (MCB1 RHS)	Telstra undergound / Optic Fibre	Excavation required for installation of new stormwater pipe, reconstruction of new road pavement.	Approx 170mm from top of service to bottom of new stormwater pipe.	Requires lowering / protection or relocation, Relevant service authority to advise.
TT-14	611189	7075 (MCA1 LHS)	Telstra undergound	Reconstruction of existing private access.	Approx 300mm from top of service to new private access level.	Requires lowering / protection or relocation, Relevant service authority to advise.
TT-15	611189	7098 (MCB1 RHS)	Telstra undergound / Optic Fibre	Excavation for installation of new stormwater pipe and gully pit.	Pothole TU 600 indicates that the existing service is 600mm below the existing surface. Horizontal offset from service to centre of new gully pit approx 1.2m.	Potential conflict, Contractor to liase with relevant service authroity to determine action for protection of service during construction.
TT-16	611189	7100 to 7140 (MCB1 RHS)	Telstra undergound / Optic Fibre	Excavation for installation of new stormwater pipes and gully pits and reconstruction of private accesses.	Depth from top of service to new verge level varies Approx depth is 450mm. New stormwater runs parallel to service.	Potential conflict, Contractor to liase with relevant service authroity to determine action for protection of service during construction.
TT-17	611189	7051 (MCA1 LHS)	Telstra undergound / Optic Fibre	Excavation for installation of new stormwater pipes that runs from private access to gully pit 1/C4	Approx 940mm from top of service to existing surface.	Requires lowering / protection or relocation, Relevant service authority to advise.
TT-18	611189	7092 (MCB1 RHS)	Telstra undergound / Optic Fibre	Excavation for installation of new rate 3 street lighting conduits	Approx 700mm from top of service to new verge level.	Requires lowering / protection or relocation, Relevant service authority to advise.
TT-22	611189	7106 (MCA1 RHS)	Telstra undergound	Excavation for installation of new stormwater pipe from private property to gully pit	Approx 700mm from top of service to new verge level.	Requires lowering / protection or relocation, Relevant service authority to advise.
WM-09	611189	7023 (MCB1 RHS)	Watermain 100mm dia poly pipe	Excavation required for installation of new stormwater pipe, reconstruction of new road pavement.	Existing service clashes with new stormwater pipe.	Existing service requires relocation.
WM-12	611189	7051 (MCA1 LHS)	Watermain	Excavation for installation of new stormwater pipes that runs from private access to gully pit 1/C4	DBYD information shown. Have been unable to determine exact location	Potential conflict, Contractor to liase with relevant service authroity to determine action for protection of service during construction.
WM-13	611189	7106 (MCA1 LHS)	Watermain	Excavation required for installation of new stormwater pipe, reconstruction of new road pavement.	DBYD information shown. Have been unable to determine exact location.	Potential conflict, Contractor to liase with relevant service authroity to determine action for protection of service during construction.
PL-03	611189	7085 (MCA1 LHS)	Existing power pole Overhead 11KV	Construction of new concrete footpath	New concrete footpath approx 100mm above existing surface level.	No conflict. Alignment of new concrete footpath may require adjustment on site. Contractor to confirm during construction and liase with relevant service authority.
PL-04	611189	7085 (MCA1 LHS)	Existing power pole Overhead 11KV	Construction of road widening and embankment	-	Existing service requires relocation.
PL-05	611189	7075 (MCB1 RHS)	Existing power pole Overhead 11KV	Construction of road widening and embankment	-	Potential conflict, Contractor to liase with relevant service authroity to determine action
PL-06	611189	7115 (MCB1 RHS)	Existing power pole and property connection	Construction of road widening and verge.	New verge level to be lowered by approx 100mm	Potential conflict, Contractor to liase with relevant service authroity to determine action
PL-07	611189	7160 (MCA1 LHS)	Existing power pole, Overhead wires and property connection	Construction of private access and earthworks	-	No conflict, However Contractor to be aware and may require further consultation with relevant service authroity
TT-19	611190	7185 (MCB1 RHS)	Telstra undergound / Optic Fibre	Excavation for installation of new stormwater pipe to outlet.	Approx 230mm from top of service to top of new stormwater pipe	Potential conflict, Contractor to liase with relevant service authroity to determine action for protection of service during construction.
TT-20	611191	7460 - 7505 (MCA1 LHS)	Telstra undergound	Exacavtion, lowering of private access road to properties	Approx 400mm from top of service to new road design level	Existing service requires relocation.
TT-21	611191	7505 (MCA1 LHS)	Telstra undergound / Optic Fibre	Exacavtion, triming of existing rock face due to carriageway widening.	DBYD information shown. Have been unable to determine exact location of road crossing. Although refer to pothole FU CL1100 which idicates approx 1100mm below existing surface.	Potential conflict, Contractor to liase with relevant service authroity to determine action for protection of service during construction.
WM-10	611191	7406 (MCB1 RHS)	Watermain >200mm dia Trunk main	Reconstruction of new kerb and channel, trenching for electrical conduits and installation of new guardrail	DBYD information shown. Have been unable to determine exact location of road crossing.	Potential conflict, Contractor to liase with relevant service authroity to determine action
WM-11	611191	7400 - 7500 (MCA1 LHS)	Watermain 150mm dia AC	Reconstruction of private access road to properties	Approx 500 to 800mm below existing surface and adjacent to construction of works.	No conflict, However Contractor to be aware and may require further consultation with relevant service authroity
WM-12	611191	7500 (MCA1 LHS)	Watermain 150mm dia AC	Exacavtion, triming of existing rock face due to carriageway widening.	Approx 1100 to 1500mm below existing surface under Mooloolaba road.	Potential conflict, Contractor to liase with relevant service authroity to determine action for protection of service during construction.
PL-08	611191	7500 (MCA1 LHS)	Existing power pole, Overhead wires	Reconstruction of private access road to properties	It is intended that the new access tie's in at this point therefore no relocation required. Contractor to protect during construction.	No conflict, However Contractor to be aware and may require further consultation with relevant service authroity for protection of service during construction.
EL-01	611191	7505 (MCA1 LHS)	<33KV underground electrical	Exacavtion, triming of existing rock face due to carriageway widening.	Approx 1.48m from top of service to new verge level (top of new kerb and channel) along Mooloolaba Rd. Have not been able to determine depth underneath local access road.	Potential conflict, Contractor to liase with relevant service authroity to determine action for protection of service during construction.

Safety in Design Register

No.	Phase	Discipline	Hazard	Mitigation at Design Stage	Owner	Consequence	Risk After Mitigation: Probability	Exposure	Risk	Mitigation Complete?	Further Action next phase
30	Design	Drainage	water flow across foot path	Provide appropriate cross fall on path and specify concrete drains adjacent to path to capture water	Not Relevant	Medical Treatment/Moderate	Has Happened	Continuous	H	No	
47	Design	Drainage	Scour Control to Outlets - downstream property protection	Check velocities to quantify impacts and liase with downstream asset owners		Medical Treatment/Moderate	Unlikely	Monthly	L		Maintain drainage outlets
12	Design	Ground Treatment	Cut slope profile	Analysis of maximum allowable cut profiles and recommendations that inspection of cuts be undertaken by a suitably experienced geotechnical engineer.		Fatality/Major	Heard Of	Yearly	M	No	
13	Design	Ground Treatment	Temporary and permanent batter profiles	Analysis batter profiles ensuring adequate factors of safety apply.		Disability/Significant	Unlikely	Yearly	M	No	
~~54~~	Design	~~Lighting~~	~~Street lighting mounted on power poles in close proximity to existing overhead lines~~	~~Liaise with Electrical authority to confirm safe construction, maintenance and operation~~		~~Fatality/Major~~	~~Heard Of~~	~~Daily~~	E		~~Address in work method statements for construction and maintenance~~
27	Design	Pavement	risk of pavement failure at interface of existing and new - potential operational and maintenance hazard	To be managed during detailed design stage		Fatality/Major	Has Happened	Continuous	E	No	
28	Design	Pavement	risk that overlay design not suitable creating early failures and mismatch with adjacent full depth	Ensure overlay design is taken through design stages. Also consider further pavement		Disability/Significant	Has Happened	Continuous	E	No	
29	Design	Pavement	potential slip hazard on foot path at joint cover plates (and service covers)	Specify non-slip treatments to all metal coverings on foot paths.		Medical Treatment/Moderate	Has Happened	Continuous	H	No	
57	Design	Pavement	poor quality control on design and construction pavement levels leading to ponding on surface course - hazard to motorists	Provide clear level information on drawings with smooth transitions to kerbs and drainage infrastructure		Serious (LTI)/Serious	Unlikely	Continuous	H		Level control of surface course during construction
66	Design	Pavement	slip on grated drains	provide cycle friendly treatments		Medical Treatment/Moderate	Unlikely	Weekly	L		apply treatments correctly
48	Design	PUP	PUP Protection works Vs relocation	Liaison with service authorities to confirm treatment		Medical Treatment/Moderate	Unlikely	Continuous	M		
49	Design	PUP	DBYD information incorrect or incomplete	Site pot hole survey to accurately locate existing services locations		Serious (LTI)/Serious	Possible	Continuous	H		Inspections prior and during works to ascertain unidentified services
58	Design	PUP	excavation near power poles - min of 3m clearance - risk of fall over	if too close will need to replace pole - consider in design stage		Disability/Significant	Almost impossible	Continuous	H		Contractor to confirm pole locations and avoid
32	Design	Roadworks Alignment	Use of EDD leads to reduced reaction time and increased chance of incident	Minimise use of EDD. Provide increase geometry awareness through signage etc.		Serious (LTI)/Serious	Possible	Continuous	H	No	
41	Design	Roadworks Alignment	NOTE EDD / DE issues			Disability/Significant	Unlikely	Continuous	H	Yes	
33	Design	Signs	Road design legibility	develop clear and concise signage design to enhance legibility and eliminate		Disability/Significant	Has Happened	Continuous	E	No	
34	Design	Signs	Proximity of sign posts to footpaths or shared paths	co-ordination of signage and path alignment to provide separation.		Medical Treatment/Moderate	Has Happened	Continuous	H	No	
2	Construction	Drainage	Construction of new drainage next to traffic (working within 1m of traffic barrier)	Nil - managed by constructor	RoadTek	Fatality/Major	Unlikely	Daily	H	No	Address in work method statements
10	Construction	Drainage	Deep excavation of trenches leading to trench collapse injuries	To be managed during detailed design/construction stage.	Not Relevant	Fatality/Major	Heard Of	Weekly	H	No	Minimise depth of trenches during detailed design. Employ appropriate work methods.
19	Construction	Drainage	~~Lifting and placement of large culvert units.~~	~~Nil - managed by constructor~~		~~Disability/Significant~~	~~Has Happened~~	~~Weekly~~	E	~~No~~	~~Address in work method statements~~
44	Construction	Drainage	Sudden failure of structures or pavements if storm occurs during construction.	Consider appropriate construction staging and erosion and sediment control	RoadTek	Medical Treatment/Moderate	Has Happened	Continuous	H		Limit open areas of construction during wet season.
60	Construction	Drainage	use of concrete barriers could potentially concentrate flows	construction staging considerations and drainage	Not Relevant	Serious (LTI)/Serious	Heard Of	Weekly	M		
22	Construction	Environment	Site clearing - trees falling on roadway	Nil - managed by constructor	RoadTek	Serious (LTI)/Serious	Heard Of	Monthly	M	No	Address in work method statements
23	Construction	Environment	snake/spider bite or other adverse reaction	Nil - managed by constructor	RoadTek	Medical Treatment/Moderate	Almost Certain	Daily	H	No	Address in work method statements
25	Construction	Environment	potential for flash flooding during construction activities	Nil - managed by constructor	RoadTek	Disability/Significant	Heard Of	Quarterly	M	No	
26	Construction	Pavement	Construction of new pavement tying into adjacent roadways	Nil - managed by constructor	RoadTek	Fatality/Major	Has Happened	Daily	E	No	Address in work method statements
45	Construction	Pavement	Ingress of water due to construction occurring during wet season.	Consider appropriate construction staging and erosion and sediment control	Not Relevant RoadTek	Medical Treatment/Moderate	Has Happened	Continuous	H		Limit open areas of construction during wet season.
56	Construction	Pavement	transport of pavement materials leading to inconvenience to road users and residents, complaints regarding delays, noise and smell to TMR.	consider staging requirements and operations during construction. Undertake consultation with residents	TMR/RoadTek	First Aid/Minor	Possible	Continuous	M		Minimise staging options/ night work.
3	Construction	PUP	Striking overhead power	DBYD to confirm services. Minimise impacts on services. Note on drawings	Not Relevant	Fatality/Major	Possible	Daily	E	No	Address in work method statements
4	Construction	PUP	Striking of underground services	Identify on drawings - Potholing		Fatality/Major	Has Happened	Weekly	E	No	Further potholing to identify services prior to
14	Construction	Roadworks Alignment	Fauna - bites, stings, etc	Nil - managed by constructor	RoadTek	Medical Treatment/Moderate	Almost Certain	Daily	H	No	Address in work method statements
15	Construction	Roadworks Alignment	Climatic extremes - heat, cold, rain	Nil - managed by constructor	RoadTek	First Aid/Minor	Almost Certain	Daily	M	No	Address in work method statements
17	Construction	Roadworks Alignment	Environmental hazards - dust, contaminated soil or water	Nil - managed by constructor	RoadTek	Medical Treatment/Moderate	Almost Certain	Continuous	H	No	Address in work method statements
42	Construction	Roadworks Alignment	Buildability - can the contractor build safely from the information presented on the design drawings.	Designs, drawings and reports to be reviewed and verified prior to release to the client. Constructability review to be undertaken with preparation of cost estimate.	Not Relevant	Disability/Significant	Possible	Daily	E		
61	Construction	Roadworks Alignment	maintain safe access to/from properties	consultation program to advise motorists + temporary access works	TMR/RoadTek	Serious (LTI)/Serious	Heard Of	Continuous	H		Contractor to provide Traffic Management Plan.
7	Construction	TTM	Access of construction vehicles to/from work site resulting in traffic accidents	Nil - managed by constructor	RoadTek	Disability/Significant	Possible	Daily	E	No	Appropriate TTM provisions to be provided to work areas during construction.
9	Construction	TTM	Constantly changing traffic conditions during construction leading to driver confusion and accidents	To be managed during detailed design/construction stage	Not Relevant RoadTek	Fatality/Major	Heard Of	Weekly	H	Yes	Investigate provision of temporary lighting to all areas of temporary traffic. Use of VMS signs to advise road users of changed
35	Construction	TTM	Plant and operations leading to driver distraction during	Nil - managed by constructor	RoadTek	Disability/Significant	Possible	Daily	E	No	Address in work method statements
36	Construction	TTM	Barriers and Anti-gawk screens reduce sight distance	Specify performance criteria and that screens are not to be used	Not Relevant	Disability/Significant	Possible	Daily	E	No	
37	Construction	TTM	narrow shoulders and reduced geometry during construction leading to accidents	minimum requirements to be defined in specifications to enable constructor to manage. Reduced speed limits		Disability/Significant	Possible	Daily	E	No	
38	Construction	TTM	hazard to workforce implementing TTM devices, lane closures etc	Nil - managed by constructor	RoadTek	Fatality/Major	Heard Of	Daily	E	No	Address in work method statements

Safety in Design Register

39	Construction	TTM	Need to maintain pedestrian movements during construction	Nil - managed by constructor	RoadTek	Serious (LTI)/Serious	Has Happened	Continuous	E	No	Address in work method statements
50	Construction	TTM	Clarity of signage, lining and intersection control	Specify performance criteria	Not Relevant	Medical Treatment/Moderate	Has Happened	Continuous	H		Contractor to provide Traffic Management Plan. Use of variable message and fixed message signs, lighting
51	Construction	TTM	Lack of publicity of changed traffic conditions or movements causes confusion	Community consultation with notices and information bulletins	TMR	Medical Treatment/Moderate	Has Happened	Continuous	H		Community consultation with notices and information bulletins
52	Construction	TTM	Inadequate control of the traffic environment -vehicles travelling too fast through construction site.	Specify performance criteria	RoadTek	Medical Treatment/Moderate	Has Happened	Continuous	H		Contractor to provide Traffic Management Plan.
55	Construction	TTM	numerous short duration traffic switches	Consider construction staging in design to minimise switches.	Not Relevant	Serious (LTI)/Serious	Possible	Continuous	H		Undertake extensive communication prior to the traffic switch. Ensure RSA are undertaken for all major switches. Monitor the performance of the traffic guidance scheme controls. The works areas will be maximised in the TTM design to ensure that there
59	Construction	TTM	road conditions outside of working hours are safe	Nil - managed by constructor	RoadTek	Fatality/Major	Heard Of	Daily	E		Contractor to provide Traffic Management Plan.
24	Operation	Environment	trees close to roadway dropping branches onto roadway	Assess proximity of large (existing) trees to roadway and ensure all achieve minimum offsets defined by TMR Guidelines.	Not Relevant	Serious (LTI)/Serious	Heard Of	Daily	H	No	
6	Operation	Ground Treatment	Uneven settlement of pavement resulting in additional aquaplaning issues	Geotechnical analysis of settlements.		Disability/Significant	Heard Of	Continuous	E	No	Additional geotechnical analysis at detailed design stage. Survey/monitoring of pavement over pavement life by TMR
46	Operation	Lighting	Lighting not effective due to low hanging tree branches and vegetation.	Review placement of lights near trees to minimise impact, consider trimming of trees.		Serious (LTI)/Serious	Possible	Continuous	H		TMR to consider maintenance strategies to ensure trees do not affect lighting
53	Operation	Pavement	Design type and thickness adequate to minimise failure and frequent maintenance	Review against current standards and traffic forecasts. Specify surfacing types.		Medical Treatment/Moderate	Has Happened	Continuous	H		On going monitoring & rehab when required
1	Operation	Roadworks Alignment	Aquaplaning of vehicles	Design out where possible - alignment and pavement and drainage		Fatality/Major	Heard Of	Continuous	E	No	Refine vertical alignment during detailed design
8	Operation	Roadworks Alignment	Increase in vehicle operating speed after road upgrade leading to increase accident risk at Foote Ave	Provide additional visual queues to enable appreciation of curve and provide 50 km/h curve warning signs plus police		Fatality/Major	Possible	Continuous	E	No	Allow for further opportunities operation, including higher friction road surfacing.
11	Operation	Roadworks Alignment	Vehicles hitting trees or other fixed objects within clear zone	Investigate opportunities to provide clear zone in conjunction with detailed design of lighting, drainage, etc. risk assessment		Fatality/Major	Almost Impossible	Continuous	H	No	
18	Operation	Roadworks Alignment	Potential confined spaces	Review major drainage structures to ensure the meet confined spaces legislation, if not provide access point etc to make compliant		Medical Treatment/Moderate	Has Happened	Quarterly	M	No	
62	Operation	Roadworks Alignment	parking being removed may force people to park illegally	consultation and enforcement - yellow line to be added	TMR Not Relev	Serious (LTI)/Serious	Unlikely	Continuous	H		
64	Operation	Roadworks Alignment	motorists using extra road width west of Thomsen Tce to pass on	Narrow carriageway to remove ability for motorists to move over.		Serious (LTI)/Serious	Almost Impossible	Continuous	M		
65	Operation	Roadworks Alignment	reduce motorists driving the 'racing line'	provide splitter islands to keep motorists in through lane		Serious (LTI)/Serious	Almost Impossible	Continuous	M		
20	Maintenance	Drainage	Existing / New pits in roadways may be dislodged or be a slip hazard	Remove pits from roadway where possible or move from wheel paths.		Serious (LTI)/Serious	Possible	Continuous	H	No	
21	Maintenance	Drainage	Access to drainage infrastructure for maintenance purposes - batter slopes, vehicle parking etc	Provide maintenance access provisions using median breaks / emergency cross over points or access from shared path where possible		Medical Treatment/Moderate	Possible	Monthly	M	Yes	
63	Maintenance	Drainage	leaf litter blocking slotted drain leading to bypass and additional water on the road.	provide treatments to minimise blockages and ensure sufficient capacity to accommodate anticipated blockages		Serious (LTI)/Serious	Possible	Weekly	H		
31	Maintenance	PUP	Service authority access within road reserve	Minimise PUP within the road reserve and where required place access away from live traffic. Provide maintenance access		Fatality/Major	Has Happened	Monthly	E	No	
16	Maintenance	Roadworks Alignment	Traffic misbehaviour during temporary lane closure	Nil - managed by constructor / maintainer	RoadTek	Fatality/Major	Has Happened	Weekly	E	No	Address in work method statements
40	Maintenance	Roadworks Alignment	Maintenance to all embankments	Provide appropriate maintenance access to all areas of road reserve.	Not Relevant	Serious (LTI)/Serious	Unlikely	Monthly	M	No	
5	Maintenance	TTM	Maintenance workers struck by vehicles	Provide shoulders and verges to enable maintenance access		Fatality/Major	Possible	Monthly	H	No	Liaison with maintenance personnel to confirm maintenance provisions
43	Maintenance	TTM	Safety of general maintenance activities	Review design for appropriate maintenance intervention levels. Meetings with TMR maintenance personnel		Disability/Significant	Possible	Weekly	H		Maintenance plans to be developed
67											
68											
69											

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Minutes of Meeting

Mooloolaba Road - Buderim Hill

Subject	Value Add and Safety in Design	Page	1
Venue	TMR - Maroochydore Office	Time	1:00pm
Participants	[LM] Leah McKenzie (TMR) [GK] Graham Keen (TMR-Roadtek) [KN] Kerry Nissen (TMR) [PB] Peter Bell (TMR) [SS] Suzanne Scott (TMR) [RE] Rob Eyre (TMR-Roadtek) [NG] Nathan Guild (AECOM) [MB] Michael Bannah (AECOM) [MG] Matthew Gallagher (AECOM) [MW] Mark Westaway (AECOM) [TE] Tom Evans (AECOM)		
Apologies	Gregory Wilson (TMR) Brett Petersen (TMR)		
File/Ref No.		Date	04-Oct-2012
Distribution	As above		

1.0 Alignment and Access

1.1	MG commenced the meeting by talking through the background of the project and discussing the key issues that have been noted from the existing conditions analysis such as: • Crash clusters • Flow paths • Less than optimal horizontal curvature • Variable cross-fall that develops within curves • Crowns in undesirable locations • Relationship between vertical grade and cross-fall	NOTE	
1.2	MG mentioned that the improvements introduced have been based around the fact that land resumption would be a highly undesirable outcome.	NOTE	
1.3	MG mentioned that the design intent has focussed on capturing as much stormwater from the road surface and to do this as quickly as possible.	NOTE	
1.4	MG mentioned that the design speed for the road was derived from recent traffic surveys.	NOTE	
1.5	MG mentioned that it was important to maintain access and egress from Panorama Crescent; however the existing line marking at this location was confusing to drivers. Drivers intending to turn right into Nyes Crescent had been observed doing so from the dedicated right turn lane into Panorama Crescent.	NOTE	

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1.6	MB mentioned that there are perception issues with the existing geometry with westbound drivers experiencing an approx. R130m curve leading to and tighter R100 curve in combination with a large amount of water on the road. a	NOTE	
2.0 Alignment and Access			
2.1	MG mentioned that the final surface levels have been driven by the geometry required to achieve improved drainage and application of superelevation.	NOTE	
2.2	MG noted that the perception analysis undertaken for the Foote Avenue curve does not rely on the raised median but rather is conservatively projected to pavement level.	NOTE	
2.3	PB proposed the possibility of banning the right turn from Thomsen Terrace onto Mooloolaba Road.	NOTE	
2.4	AECOM to investigate the option of banning the right turn movement from Thomsen Terrace and if feasible incorporate into design.	AECOM	
2.5	PB mentioned that the generous width proposed for the uphill shoulder could encourage motorists to overtake slower moving vehicles to the west of Thomsen Terrace.	NOTE	
2.6	AECOM to investigate reducing the shoulder width on the uphill approach west of Thomsen Terrace to avoid fast vehicles overtaking slow vehicles.	AECOM	
2.7	Community consultation required for residents affected by banned movements at local intersections.	TMR	
2.8	PB noted that there are two businesses located on Eckersley Avenue with cars parking on both sides of the road which prevents the free flow of two way traffic.	NOTE	
2.9	TMR to assess the design in the vicinity of Eckersley Avenue. TMR to investigate (or instruct AECOM) that the intersection can adequately cater for the increased turn movements due to the banned right turn at Foote Avenue.	TMR TMR	
2.10	PB voiced concern about the adequacy of the right turn movement from Nyes Crescent onto Dixon Road and the added pressure placed upon this movement due to banning the right turn from Nyes Crescent onto Mooloolaba Road.	NOTE	
2.11	Review the right turn movement from Nyes Crescent to Dixon Road. Ensure adequacy to cater for additional right turn movements due to the banned right turn movement from Nyes Crescent onto Mooloolaba Road.	TMR	
2.12	LM mentioned that blister islands have been introduced to deter vehicles from parking on the side of the road and reducing sight lines. Noted that parking restrictions will need to be enforced.	NOTE	

AECOM

3.0 Drainage			
3.1	Review the potential of debris blocking slotted drains. If deemed necessary investigate the option of a slot/box to capture water that may not have been captured by the 'blocked' slotted drain system.	AECOM/TMR	
3.2	AECOM to prepare a detail for draining slotted drain into stormwater pit and manhole.	AECOM	
3.3	TMR/Roadtek to investigate an approved 'non-standard' pit which is shallower than the standard pit (to minimise the extent of excavation). Roadtek to provide AECOM with pit details.	TMR/Roadtek	
3.4	AECOM to review the depths of stormwater pipes and reduce depths where possible to minimise excavation. (Class of pipe may require review at some locations)	AECOM	
3.5	TMR expressed concern about the capacity of the existing downstream stormwater network. AECOM to confirm the adequacy of the downstream network for each catchment.	AECOM	
3.6	PB expressed concerns about changes being made to the catchment areas. AECOM confirmed that catchment areas remain largely unchanged	NOTE	
3.7	AECOM to investigate slotted drain which consists of a longitudinal grate to maximise the intake of stormwater flowing longitudinally to the drain.	AECOM	
3.8	TMR do not have an approved proprietary slotted drain at this stage and therefore AECOM design drawings must detail drain dimensions whilst making no mention of drain 'brand' name.	AECOM	
4.0 Pavement			
4.1	AECOM to proceed with pavement design based on the 'do minimum' approach of removing the existing OG surfacing and placing a minimum 50mm DG14 surfacing (plus corrector where required) as increasing pavement life is not a key project consideration. AECOM to report on life achieved.	AECOM	
4.2	MG mentioned that the pavement remaining life is down to 1-2 years in some areas.	NOTE	
4.3	TMR to advise if AECOM should revisit residual life calculations based on actual ESA's as opposed to calculated ESA's. Issue to be discussed internally with Mike Pickering.	TMR	
4.4	AECOM to ensure that binder selection takes into account braking forces (both downhill and uphill)	AECOM	
4.5	AECOM to ensure that design is 'generous' with subsoil drains.	AECOM	
4.6	AECOM to rework subsoil drains in the vicinity of Buderim Pines Drive where existing is inadequate / substandard.	AECOM	
4.7	PB and KN expressed concerns about DG pavement and KN mentioned that an OG pavement 'sitting proud' could be a better option.	NOTE	

4.8	TMR to advise if OG pavement is the preferred pavement type as opposed to DG.	TMR	
5.0 Lighting			
5.1	Investigate the possibility of locating light poles within the central median (including use of non-standard/smaller pits).	AECOM	
5.2	Investigate the use of fixed base/slip base poles behind kerbs and assess the potential of frangible poles impacting with houses.	AECOM	
5.3	TMR to consult with residents regarding the increased lighting conditions proposed along Mooloolaba Road.	TMR	
5.4	NG mentioned that existing poles cannot be used for Rate 3 lighting.	NOTE	
6.0 Public Utility Plant			
6.1	NG mentioned that he had attended a meeting with Telstra and Energex to discuss the potential conflicts with Service Authority's assets and the proposed design.	NOTE	
6.2	NG advised that the Telstra Optic Fibre to the east of Nyes Crescent (currently conflicting with the stormwater design) would cost approximately $200,000 to relocate. AECOM to review the design in this location to see if impacts can be minimised.	AECOM	
6.3	NG articulated that Energex would have difficulty relocating the existing power pole located on the northern verge of Mooloolaba Road (directly opposite Nyes Crescent.)	NOTE	
7.0 Geotechnical			
7.1	TMR to provide AECOM with geotechnical results as soon as they are made available.	TMR	
7.2	PB noted the potential for earth slips to the west of Nyes Crescent. AECOM to review the potential based on geotechnical results and capture this in design and risk register.	AECOM	
7.3	AECOM to seek advice on potential vibration issues on residences during construction.	AECOM	
8.0 Construction			
8.1	Roadtek have commenced a preliminary review of a limited drawing set to date. RoadTek will commence a thorough review and provide comment once AECOM provide a drawing set (50% design). AECOM to issue a 50% design drawing set to TMR 5/10/12	Roadtek/TMR AECOM	
8.2	GK mentioned that due to the underground rock conditions excavating in the area will be difficult and time consuming. This needs to be considered when progressing the design.	NOTE	
9.0 Safety in Design			
9.1	MG presented the Safety in Design Register to the group, also introducing AECOM's Risk Assessment Methodology.	NOTE	

9.2	MG progressed through each of the safety items that had been identified to date relating to design, construction, operation and maintenance. The group was encouraged to provide comment and recommend additional items.	NOTE	
9.3	LM advised that item 25 should be combined with item 44. To be included on SID register.	AECOM	
9.4	MW mentioned that barriers introduced during construction will potentially direct stormwater flow into undesirable areas. To be included on SID register.	AECOM	
9.5	MW highlighted that the considerable longitudinal grade of the road may cause issues with construction vehicles starting/stopping when surfacing the road etc. To be included on SID register.	AECOM	
9.6	RE highlighted that minimum clearances should be adhered to when excavating near power poles. To be included on SID register.	AECOM	
9.7	LM mentioned that 'gawk screens' could potentially reduce stopping sight distance if mounted on barriers during construction and hence should not be used. To be included on SID register.	AECOM	
9.8	KN mentioned that access to residences will need to be maintained during the construction works. To be included on SID register.	AECOM	

Risk Assessment Management Template

Project Name	BUDERIM HILL UPGRADE
Project Number	60250500

Analysis									Controls									Monitoring and Close Out					
ID	Date Created	Area	Hazard Description	Unwanted Impacts/Consequences	Consequence Criterion	Before Mitigation (Inherent Risk) Likelihood	Before Mitigation (Inherent Risk) Consequence	Before Mitigation (Inherent Risk) Risk	Mitigation planned or in place	Main Risk Treatment Category	Interim Risk Likelihood	Interim Risk Consequence	Interim Risk Risk/Impact Level	Further Recommended Actions	Residual Risk Likelihood	Residual Risk Consequence	Residual Risk Risk/Impact Level	Frequency (for controls)	Action Update/Evaluation of Target	Evaluation Date	Evaluator	Date Closed	Closed By
1.00		Design																					
1.01	31-Oct-12	Design	Environmental - Flora and fauna issues	Delays to project. Possible variations required for additional studies and consultation.	Environmental	Likely	Minor	High	Design to mitigate impact where possible. Design constrained within existing road reserve. TMR undertaking necessary studies as warranted.	Reduction	Unlikely	Minor	Low	TMR to monitor during construction phase.	Unlikely	Minor	Low	As directed by TMR	Documentation finalised - TMR to manage	23-Nov-12	NG	23-Nov-12	
1.02	31-Oct-12	Design	Environmental - Sediment and Erosion issues / Water quality devices ineffective	Pollution and silting into adjacent water courses	Environmental	Possible	Moderate	High	Incorporate appropriate water quality measures at outlets. Project catchment area is not increased. Constructor to perform water quality testing in accordance with TMR guidelines.	Reduction	Unlikely	Moderate	Medium	TMR/Contractor to monitor water quality during construction phase.	Unlikely	Moderate	Medium	Prior, during and after unless unforseen extreme weather/event	Documentation finalised - TMR to manage	23-Nov-12	NG	23-Nov-12	
1.03	31-Oct-12	Design	Environmental - Cultural heritage issues.	Delays to project. Possible variations required for additional studies and consultation.	Environmental	Possible	Minor	Medium	Appropriate consultation, action plans and cultural heritage management plans.TMR undertaking necessary studies as warranted.	Reduction	Unlikely	Minor	Low	TMR to monitor through the construction phase for any unexpected situations.	Unlikely	Minor	Low	TMR/RoadTek to be aware of any sitings during construction	Documentation finalised - TMR to manage	23-Nov-12	NG	23-Nov-12	
1.04	31-Oct-12	Design	Technical - Additional PUP service impacts / relocations. All services.	Damage to existing infrastructure, delays to progress, cost to client.	Services/Systems	Probable	Major	Extreme	Confirm extents of service relocations to be carried out under the Mooloolaba Road Project prior to the construction stage of the project. Design developed to minimise existing impacts. PUP authorities are informed of design requirements and are to provide subsequent design other their relative service to mitigate impacts	Reduction	Likely	Major	Extreme	PUP services design by relevant authority to be developed to mitigate all impacts associated with design upgrade and provide a cost estimate to relocate/protect existing services as required. Cost for service impacts included in cost schedule.	Possible	Major	Extreme	TMR / Roadtek to complete relocation / protection works during construction phase to minimise impacts.	Documentation finalised - TMR to manage. PUP design prior to construction.	23-Nov-12	NG	23-Nov-12	
1.05	31-Oct-12	Design	Technical - Contractor queries	Contractor enquiries leading to Design changes/further investigation. Increase in time & cost	Relationships	Possible	Moderate	High	Construction review meetings held prior to completion to engage contractor and incorporate construction preferences and queries.	Reduction	Unlikely	Moderate	Medium	Continued liaison with TMR and Contractor until job is finalised.	Unlikely	Minor	Low	As directed by TMR	Documentation finalised - TMR to manage	23-Nov-12	NG	23-Nov-12	
1.06	31-Oct-12	Design	Technical - Production of "As Constructed" Drawings	TMR need to produce "As Constructed" drawings of completed work to fulfil internal procedures.	Relationships	Probable	Minor	High	Designer to liaise with TMR to offer assistance. TMR to consider prior to commencement of construction.	Transference	Probable	Minor	High	TMR to advise if AECOM are to provide "AS Constructed" drawings	Unlikely	Minor	Low	As directed by TMR	Documentation finalised - TMR to manage	23-Nov-12	NG	23-Nov-12	
1.03	31-Oct-12	Design	Technical - change of Legislative/Regulatory Requirements	Delays to projects and impacts on project costs	Services/Systems	Possible	Major	Extreme	Remain vigilant on statutory requirements during planning and construction phases. TMR design progress reviews completed during design development to ensure current design guidelines considered	Reduction	Unlikely	Major	High	Design completed to current Design Guidelines and reviewed by TMR	Unlikely	Major	High	As directed by TMR	Documentation finalised.	23-Nov-12	NG	23-Nov-12	
1.07	31-Oct-12	Design	Technical - Modifications to property accesses not agreed by owner	Additional cost or delays	Community/Government/Reputation/Media	Likely	Minor	High	TMR PM to liaise with political entities and major stakeholders to advise of projects outcome during consultation period	Reduction	Unlikely	Minor	Low	TMR to continue liaising with major stakeholders	Unlikely	Minor	Low	Monthly	TMR to manage	23-Nov-12	NG	23-Nov-12	
1.08	31-Oct-12	Design	Technical - No Geotech information provided when 80% Design Drawings were issued	Additional cost or delays associated with late changes to design prior to issue of 100%.	Relationships	Possible	Minor	Medium	Incorporate information into design when available. Design developed in consideration of site conditions.	Reduction	Possible	Minor	Medium	Cost schedule to allow for potential costs	Possible	Minor	Medium	TMR Sign off	TMR/RoadTek to manage	23-Nov-12	NG	23-Nov-12	
1.09	31-Oct-12	Design	Design - EDD Approval in principal not signed	Re-design, additional costs & delays	Services/Systems	Possible	Moderate	High	TMR verbally confirms acceptance of design principles.	Reduction	Unlikely	Minor	Low	TMR to approve and sign EDD	Unlikely	Minor	Low	TMR Sign off	Documentation finalised - TMR to manage	23-Nov-12	NG	23-Nov-12	
1.10	31-Oct-12	Design	Technical - Public utility plant issues. (Unknown plant / unknown location / lack of advance survey)	Delays in project, increased cost, increase in project scope.	Services/Systems	Possible	Major	Extreme	PUP investigation survey completed. Ensure constant liaison with service authorities into the design and construction stage of the project. Contractor to pothole all existing services prior to construction to confirm exact locations and depths.	Transference	Possible	Major	Extreme	TMR / Roadtek to carryout further survey to confirm exact locations and depths prior to construction.	Possible	Major	Extreme	TMR/RoadTek to monitor closely during construction	TMR to manage	23-Nov-12	NG	23-Nov-12	
1.11	31-Oct-12	Design	Technical - Geotechnical issues. (Ground conditions and suitability, additional sampling and analysis)	Delays in project, increase in pavement design/or replacement of material under pavement, increased cost, Increase in project scope.	Relationships	Possible	Moderate	High	Ground investigation completed and formed basis of the pavement design. Pavement conditions reported to TMR to consider treatments necessary during design phase. Provisional allowance include in cost schedule to allow for unsuitable area treatments.	Contingency	Possible	Moderate	High	TMR/RoadTek to assess material/pavement requirements during construction. Allowance included in cost schedule.	Possible	Moderate	High	TMR/RoadTek to monitor closely during construction	TMR to manage	23-Nov-12	NG	23-Nov-12	
1.12	31-Oct-12	Design	Technical - Pavement Design assumptions incorrect	Adverse ground conditions leading to increased foundation treatments.	Relationships	Possible	Moderate	High	Appropriate design measures and current standards adopted.	Reduction	Unlikely	Moderate	Medium	TMR/RoadTek to monitor pavement during construction phase and utilise contingency if necessary	Unlikely	Moderate	Medium	TMR/RoadTek to monitor closely during construction	Documentation finalised - TMR to manage	23-Nov-12	NG	23-Nov-12	
1.13	31-Oct-12	Design	Technical - Errors in Documentation Outputs	Redesign, time delays	Relationships	Possible	Moderate	High	AECOM review and verification procedures carried out at all stages of the design to ensure design compliance issues are detected and addressed.	Reduction	Unlikely	Minor	Low	TMR to review and approve design prior to construction	Unlikely	Minor	Low	TMR sign off.	Documentation finalised - TMR to manage	23-Nov-12	NG	23-Nov-12	
1.14	31-Oct-12	Design	Technical - Traffic/access/pedestrian/cycle/ public transport issues. (Future need and capacity).	Delays in project, increased cost, increase in consultants scope.	Community/Government/Reputation/Media	Possible	Minor	Medium	Appropriate design standards are adopted. Consultation completed within TMR departments during the design process. TMR departmental Peer reviews have been completed by TMR.	Reduction	Unlikely	Minor	Low	TMR PM to liaise with Design team if required	Unlikely	Minor	Low	As determined by TMR	Documentation finalised - TMR to manage	23-Nov-12	NG	23-Nov-12	
1.15	31-Oct-12	Design	Technical - Development of design without sufficient consideration to constructability issues	Delays in construction leading to potential claims. Increased project construction cost.	Relationships	Possible	Moderate	High	Constructability Review meetings undertaken with RoadTek. Constructability review of Detailed Design. Contractor to determine suitable constructability requirements for construction	Reduction	Unlikely	Minor	Low	Contractor and PM to monitor and review during construction to minimise any disruption to the project	Unlikely	Minor	Low	Weekly	TMR to manage	23-Nov-12	NG	23-Nov-12	
1.16	31-Oct-12	Design	Technical - Adverse Road Safety Audits.	Delays in project, increased cost of design and/or construction, increase in consultants scope.	General	Possible	Catastrophic	Extreme	Check that appropriate design measures are implemented. Adhere to desirable design standards where possible and minimum design standards where desirable standards are not possible. Implement recommendations of the Road Safety Audits for all stages.	Reduction	Unlikely	Catastrophic	Extreme	TMR to monitor during subsequent phases and implement additional controls as required.	Unlikely	Catastrophic	Extreme	Weekly	TMR to manage	23-Nov-12	NG	23-Nov-12	
1.17	31-Oct-12	Design	Financial - Inaccurate project estimates.	Cost over-runs and need for variations. Errors or omission in quantities/rates etc. will increase project cost.	Relationships	Possible	Minor	Medium	Ensure sufficient check processes are undertaken as part of the cost estimates. Quantities checked using AECOM Quality Assurance system prior to issue.	Reduction	Unlikely	Minor	Low	Further checks as required by RoadTek and TMR	Unlikely	Minor	Low	As directed by TMR	Documentation finalised - TMR to manage	23-Nov-12	NG	23-Nov-12	

Project Name	BUDERIM HILL UPGRADE
Project Number	60250500

Analysis									Controls									Monitoring and Close Out					
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						Likelihood	Consequence	Risk			Likelihood	Consequence	Risk/Impact Level		Likelihood	Consequence	Risk/Impact Level						
1.18	31-Oct-12	Design	Financial - Inaccurate inflation and contingency allowance	Increase in project cost	Relationships	Possible	Minor	Medium	Ensure adequate estimate reviews and allowances for escalation to construction year. Escalation/Contingency applied as agreed to by TMR	Reduction	Unlikely	Minor	Low	TMR to monitor	Unlikely	Minor	Low	As directed by TMR	TMR to manage	23-Nov-12	NG	23-Nov-12	
1.19	31-Oct-12	Design	Financial - Design Scope of works exceeding original scope resulting in increased fee.	Cost over-runs and need for variations.	Relationships	Unlikely	Minor	Low	Consultancy costs are monitored monthly. Scope changes are agreed with and approved by Project Manager prior to spend.	Acceptance	Unlikely	Minor	Low	Continued monthly reporting	Unlikely	Minor	Low	Monthly	Documentation finalised	23-Nov-12	NG	23-Nov-12	
1.20	31-Oct-12	Design	Political - Change to project priority	Suspension may lead to damages claim for breach of contract.	Community/Government/Reputation/Media	Possible	Moderate	High	No mitigation strategy available. Monitor political feedback & funding priorities.	Transference	Possible	Moderate	High	TMR to monitor progress and funding.	Possible	Moderate	High	As directed by TMR	Documentation finalised - TMR to manage	23-Nov-12	NG	23-Nov-12	
1.21	31-Oct-12	Design	Political - Politically unacceptable solution.	Project will not commence.	Relationships	Possible	Major	Extreme	TMR PM to liaise with political entities and major stakeholders to advise of projects development and progress	Transference	Possible	Major	Extreme	TMR to monitor progress and inform key stakeholders throughout design development phase	Possible	Major	Extreme	As directed by TMR	Documentation finalised - TMR to manage	23-Nov-12	NG	23-Nov-12	
1.22	31-Oct-12	Design	Political - Sensitive political issues (for example, road safety, environmental issues)	Scope change. Project delayed/cancelled.	Community/Government/Reputation/Media	Possible	Major	Extreme	Consult with political stakeholders as soon as possible on the project. Advise of project development and progress. Apply standards.	Transference	Possible	Major	Extreme	TMR to monitor progress and inform key stakeholders throughout design development phase	Possible	Major	Extreme	As directed by TMR	Documentation finalised - TMR to manage	23-Nov-12	NG	23-Nov-12	
1.23	31-Oct-12	Design	Project Management - Changes to key personnel during project.	Project continuity and flow of knowledge may be hindered. Delays in project delivery	Relationships	Possible	Minor	Medium	Ensure documentation is maintained and filed effectively for successive project staff. Arrange for succession planning/project handover meetings if necessary. Prepare suitable documentation, planning and design reporting.	Reduction	Unlikely	Minor	Low	Document maintenance and continued liaison to minimise any problems if further changes occur.	Unlikely	Minor	Low	As directed by TMR	TMR to manage	23-Nov-12	NG	23-Nov-12	
1.24	31-Oct-12	Design	Project Management - Project deliverables not meeting program	Delays inTMR related design development approvals	Relationships	Possible	Moderate	High	Active management of Project Program. Regular liaison between consultant and client Project Manager. Project completed on a time and cost basis in conjunction with TMR project team.	Reduction	Unlikely	Moderate	Medium	Continued meetings with Project Manager for duration of project	Rare	Moderate	Medium	Fortnightly	TMR to manage	23-Nov-12	NG	23-Nov-12	
1.25	31-Oct-12	Design	Project Management - Ongoing availability of skilled personnel. RoadTek, consultants and sub consultants	Delays to project. Reduce quality of design and construction.	Relationships	Possible	Minor	Medium	AECOM have support from Brisbane office to assist design team as required.RoadTek risks to be accepted by TMR PM.	Reduction	Unlikely	Minor	Low	TMR to monitor RoadTek during construction. AECOM to continue Design support if requested by TMR	Unlikely	Minor	Low	Weekly	TMR to manage	23-Nov-12	NG	23-Nov-12	
1.26	31-Oct-12	Design	Project Management - Correct channels of communication not maintained through project leading to errors and misunderstanding.	Could 'de-rail' project. Delays, cost increase	Relationships	Possible	Minor	Medium	Design Project team to keep TMR PM informed. TMR PM to inform relevant TMR team and Stakeholders.	Prevention	Unlikely	Minor	Low	Continued liaison with TMR PM, Design Team and contractor for duration of project	Unlikely	Minor	Low	Weekly	TMR to manage	23-Nov-12	NG	23-Nov-12	
1.27	31-Oct-12	Design	Project Management - Higher TMR administration costs than anticipated	Increased project costs	Relationships	Unlikely	Minor	Low	Ensure adequate allowance for design and administration costs in estimate. Include increased administration costs in the project estimate if appropriate.	Reduction	Rare	Minor	Low	TMR to advise of any changes during project	Rare	Minor	Low	As directed by TMR	TMR to manage	23-Nov-12	NG	23-Nov-12	
1.28	31-Oct-12	Design	Stakeholder - Some Stakeholders issues not initially identified.	Delays in design approvals and an increase in design costs.	Community/Government/Reputation/Media	Unlikely	Minor	Low	TMR in consultation with all affected stakeholders	Transference	Unlikely	Minor	Low	TMR to give regular updates to community	Unlikely	Minor	Low	Fortnightly	TMR to manage	23-Nov-12	NG	23-Nov-12	
1.29	31-Oct-12	Design	Stakeholder - Community does not accept project (e.g. land owners, businesses, developers, service authorities, public)	Delays in project, increased cost, increase in project scope.	Community/Government/Reputation/Media	Unlikely	Moderate	Medium	TMR to inform local community of project development and outcomes.	Reduction	Unlikely	Minor	Low	TMR to give regular updates to community	Unlikely	Minor	Low	Fortnightly	TMR to manage	23-Nov-12	NG	23-Nov-12	
1.30	31-Oct-12	Design	Stakeholder - Community not happy with permanent road turning closures	Delays in project, increased cost, increase in project scope.	Community/Government/Reputation/Media	Possible	Minor	Medium	TMR to inform local community of project development and outcomes.	Reduction	Unlikely	Minor	Low	TMR to give regular updates to community	Unlikely	Minor	Low	Fortnightly	TMR to manage	23-Nov-12	NG	23-Nov-12	
2.00		**Construction**																					
2.01	31-Oct-12	Construction	Delay in obtaining approved design for relocation of services & long Lead in times for designs and materials	Delay to commencement to the construction works pending approvals of watermain relocation designs from Unity water, Telstra and Energex & lead in times for materials for service relocations	General	Possible	Major	Extreme	Engage PUP providers early in the construction process and construction program to identify extents of relocations required and agreed design intent. Retain constant liaison with all service providers to advise them of timeframes for completion of the works	Reduction	Unlikely	Major	High	PM to continue liaison with PUP providers to ensure time frames are met	Unlikely	Minor	Low	As directed by TMR					
2.02	31-Oct-12	Construction	Construction impacts on unknown services	Delay during construction, re-design, additional costs	Services/Systems	Possible	Major	Extreme	TMR to transfer risk to RoadTek to confirm all service locations prior to construction.	Transference	Possible	Major	Extreme	RoadTek to Liaise with PUP providers during construction	Possible	Major	Extreme	As directed by RoadTek					
2.03	31-Oct-12	Construction	Construction sequencing	Slow progress, delays to traffic, safety issues, changed traffic conditions	General	Likely	Catastrophic	Extreme	Ensure Construction Program is approved by Principal. Regular monitoring of the program and sequencing by Superintendent. TMR/Roadtek to implement traffic control.	Transference	Likely	Catastrophic	Extreme	TMR/Roadtek to monitor traffic control to prevent excessive traffic delays or safety issues.	Likely	Catastrophic	Extreme	Daily					
2.04	31-Oct-12	Construction	Vibration Restrictions	Restrictions on hours of work	Community/Government/Reputation/Media	Likely	Moderate	High	TMR to ensure public communication carried out with adjacent residents. Condition survey to be carried out where ordered. RoadTek construction method to minimise vibration levels to appropriate standard.	Transference	Unlikely	Moderate	Medium	Ongoing TMR liaison and alteration of work hours to suit construction effort.	Unlikely	Moderate	Medium						
2.05	31-Oct-12	Construction	Material supply issues.	Delays in project, increased cost, variations issued to RoadTek.	Relationships	Possible	Moderate	High	RoadTek to be required to identify locations for obtaining fill material off site. Potential staged construction to be considered by RoadTek	Acceptance	Possible	Moderate	High	RoadTek are required to organise suitable fill material and delivery on site.	Possible	Moderate	High	Prior to construction					
2.06	31-Oct-12	Construction	Additional works (variations)	Delays in project, increased cost, variations issued to RoadTek.	Relationships	Possible	Moderate	High	Scope control. Adequate and accurate documentation and contract supervision. Fix additional costs wherever possible.	Reduction	Unlikely	Minor	Low	Work within scope and keep variations to a minimum	Unlikely	Minor	Low	As directed by TMR					
2.07	31-Oct-12	Construction	RoadTek liquidation	Change in RoadTek. Time delays	Community/Government/Reputation/Media	Rare	Major	High	TMR to monitor any changes with organisation.	Acceptance	Rare	Major	High		Rare	Major	High	As directed by TMR					
2.08	31-Oct-12	Construction	Safety - Safety on Construction Site	Site shut down by Safety Inspectors	Health & Safety	Possible	Catastrophic	Extreme	RoadTek to ensure appropriate legal standards of safety are maintain throughout the site. Regular monitoring of safety standards employed by superintendent	Transference	Possible	Catastrophic	Extreme	Ongoing safety checks through duration of project. RoadTek to adhere to all safety standards and processes	Possible	Catastrophic	Extreme	Daily					

Project Name	BUDERIM HILL UPGRADE
Project Number	60250500

Analysis									Controls									Monitoring and Close Out					
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						Likelihood	Consequence	Risk			Likelihood	Consequence	Risk/Impact Level		Likelihood	Consequence	Risk/Impact Level						
2.09	31-Oct-12	Construction	Environmental - Noise, air quality, vibration, dust issues during construction	Noise amelioration may be required to be included in the project. Increase in cost	Environmental	Possible	Moderate	High	Monitor Community Consultation and complaints register. Implement environmental management plan and maintain liaison with local residents during construction. RoadTek to adhere to TMR guidelines during construction.	Transference	Possible	Moderate	High	TMR to monitor adherence to guidelines during construction	Possible	Moderate	High	As directed by TMR					

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Memorandum

To	Leah McKenzie	Page	1
CC	Ricky Cox		
Subject	Horizontal Curve Perception Sight Distance - Mooloolaba Road		
From	Matthew Gallagher		
File/Ref No.	TI_RP_006	Date	20-Sep-2012

1.0 Background

As part of the development of the Mooloolaba Road Preliminary Design, AECOM prepared a Technical Note (TI_RP_004, August 2012) which sought to document potential Extended Design Domain and Design Exceptions to be adopted as part of the project for in-principal approval from TMR.

Design Exception 1 was documented as being insufficient side friction for cars at the horizontal curve located on Mooloolaba Road at Ch6,740 (adjacent to Foote Avenue). An assessment of the curve was undertaken in accordance with Chapter 6 of the Road Planning and Design Manual to assess the curve operating speed. This was done using TMR's OSroad program to assess the westbound carriageway for both the existing geometry and AECOM's proposed design; the results were contained within Appendix A of the aforementioned Technical Note.

The design proposed to increase the curve radius from R.71m to R.77m; however this resulted in the need to realign approximately 55m of an existing retaining wall on the northern verge of Mooloolaba Road.

In an attempt to minimise impacts to the retaining wall and associated issues, it was agreed that AECOM review the design of the curve. AECOM has therefore prepared an alternative design comprising of the following:

- radius = 72m
- superelevation = 6%
- arc length of curve = 45m
- westbound approach transition length = 30m
- eastbound approach transition length = 37m

An OSroad analysis was undertaken for the amended design (westbound) and the results are outlined below:

- section operating speed (SOS) = 56km/h
- limiting curve speed (LCS) = 60km/h
- side friction demand at SOS = 0.29

This revised design was presented to, and discussed with, TMR's Engineering and Technology Division (Ricky Cox and Mike Whitehead) on 6 September 2012. Refer attached minutes for a record of the meeting

This alternate alignment was generally accepted as being appropriate for the conditions.

It was recommended that, to ensure the proposed SOS could be achieved, the horizontal curve perception be assessed.

2.0 Horizontal Curve Perception

AECOM have undertaken an analysis of the horizontal curve perception sight distance for the westbound approach to the curve, this is to ensure that there is adequate visibility to allow for driver reaction and deceleration from the design speed (65km/h) to the SOS of the curve (56km/h). Reference was initially made to Austroads Guide to Road Design, Part 3, Section 5.10.

Section 5.10 indicates that deceleration to the SOS will have been completed when the vehicle arrives at the mid-section of the approach transition and that a minimum of 80% of the transition needs to be seen by the driver from the point of perception.

It was the opinion of the design team that requirements outlined in Section 5.10 were not suitable for this road environment (low speed, short curve with small radius and short transition) and therefore the design team adopted the approach proposed by Ricky Cox at the meeting on 6 September 2012 as noted in the meeting minutes.

The approach adopted in this analysis therefore consists of the following:

- Vehicle completes deceleration process (from design speed to SOS) at the commencement of the curve radius (Ch6,770)
- Prior to deceleration there is a period where the driver perceives the curvature of the road, this process occurs over the duration of the driver reaction time and the 'perception point' occurs at the commencement of this process.
- The available sight distance at the perception point (projected from driver eye height of 1.1m to pavement level) is assessed to determine how much of the curve is seen at this point. Engineering judgement is thus applied to the adequacy of this distance based on the road environment and the additional visual cues proposed within the design.

Perception Point

Working back from the start of the curve at Ch6,770, the driver decelerates from the design speed (65km/h) to the SOS (56km/h), this distance equates to approximately 21m based on a 2.0m/s/s deceleration rate. Deceleration commences at Ch6,791.

Prior to the deceleration commencing, the distance travelled during the reaction period equates to approximately 27m based on a 1.5s reaction time. This reaction time is consistent with the value adopted for determining sight distance requirements during the design development of the project. This suggests that the reaction process occurs between Ch6818 and 6791.

Therefore Ch6818 is the Perception Point at which point the horizontal curve must be able to be perceived to enable motorists to observe then react and decelerate in advance of the curve.

The assumed speed profile is indicated below in **Figure 1**.

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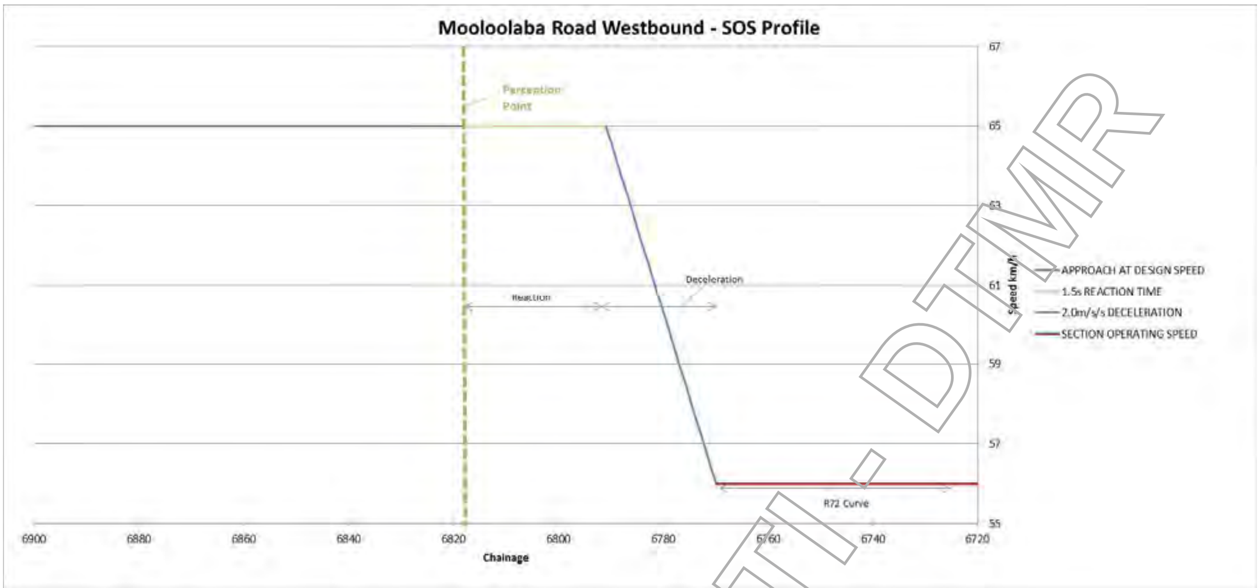

Figure 1 **Mooloolaba Road Westbound – SOS Profile**

Sighting the Arc

Figure 2 illustrates the achieved sight distance profile (projected to pavement level in the centre of the lane) throughout this section of road; this illustrates that there is 74m of sight distance available at the commencement of the reaction process (Ch6818). This indicates that the approaching driver is able to view 26m into the arc of the curve from the point of perception, therefore providing in excess of half the total length of the arc (45m).

In addition to being able to sight more than half of the pavement surface through the arc at the perception point, the curve is on 6% superelevation and is defined by median kerb. These factors will greatly aid motorists in being able to identify and appreciate the approaching geometry of the arc.

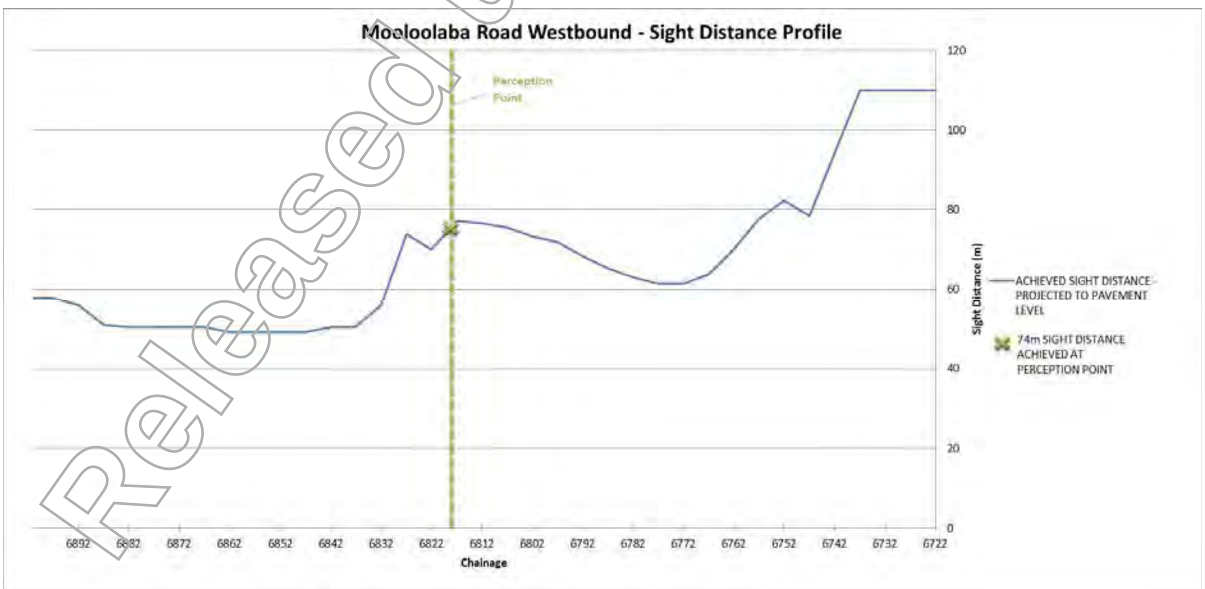

Figure 2 **Mooloolaba Road Westbound - Sight Distance Profile**

3.0 Contributing Factors

Whilst it is considered that there is adequate approach sight distance to the curve, the design team propose to improve the visual cues on the approach to the curve to increase awareness and perception of the curve; such features include:

- introducing a raised concrete median
- providing improved lighting
- installing curve advisory speed signs (50km/h)
- installation of reflective (frangible) bollards in the median to aid delineation (to be determined through further design development)
- potential introduction of Chevron Alignment Markers (to be determined through further design development)

4.0 Stopping Sight Distance

A Stopping Sight Distance (SSD) analysis was also undertaken for this approach and is based on a driver's eye height of 1.1m and an object height of 0.2m. The achieved SSD assumes the operating speed profile outlined in **Figure 1** and also accounts for grade correction. This graph indicates that the achieved SSD exceeds the requirements throughout the westbound approach to the curve. It is noted that a reaction time of 1.5s and a coefficient of deceleration of 0.41 has been adopted for the SSD analysis.

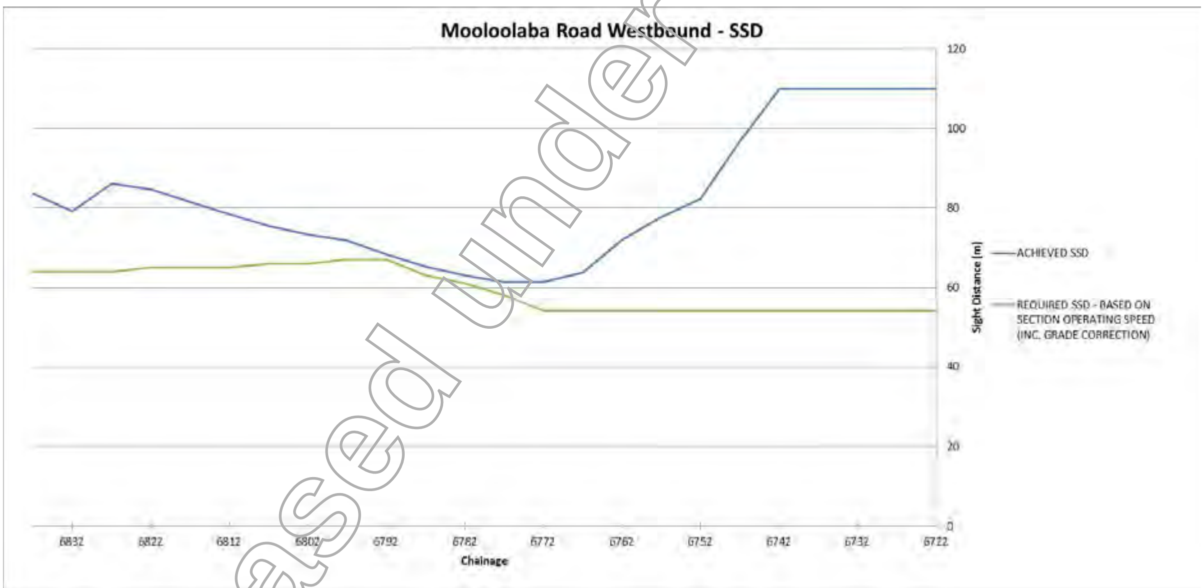

Figure 3 Mooloolaba Road Westbound – SSD

5.0 Conclusion

This analysis has investigated the curve perception of the horizontal curve on the westbound approach of Mooloolaba Road at Ch6,740.

Based on the assumptions and parameters outlined in this document, there is sufficient sight distance to allow for a driver's perception of the approaching curve and deceleration from the design speed to the SOS of the curve. Furthermore there is also sufficient SSD on the westbound approach based on the SOS profile outlined in this document.

As a result it is recommended that the R72m curve be adopted in the detail design.

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Minutes of Meeting

Mooloolaba Road - Buderim Hill

Subject	Foote Avenue Curve - Design Capability	Page	1
Venue	TMR Offices, Level 6, Boundary Street, Spring Hill	Time	11.30am
Participants	Ricky Cox (RC) (TMR) Mike Whitehead (MW) (TMR) Michael Bannah (MB) (AECOM) Matthew Gallagher (MG) (AECOM) Mark Westaway (MLW) (AECOM)		
Apologies			
File/Ref No.	60250500/MIN	Date	06-Sep-2012
Distribution	As above		

No	Item	Action	Date
1.0	**Introduction** AECOM outlined desire of meeting was to discuss the current options for the Foote Ave curve, their capability and intended drainage solutions in the area		
2.0	**Foote Avenue Curve** AECOM presented 2 option for the Foote Avenue Curve - Option 1 comprises R77 radius - Option 2 comprises R72 radius Option 1 has been amended since 30% Design Review issue to further reduce impact to wall. This has occurred through design development (reduction in median width through amended drainage solution, reduction in shoulder width and modifying spiral transition lengths through use of 0.035 radian superelevation transition) Option 1 now has approximately 35m impact to existing retaining wall on northern side Option 2 has no impact to existing retaining wall on northern side *(See attached spread sheet for Option capabilities)* **Documenting Curve Capability** Option 2 provides an approximate 20m length of SSD below 65km/h (desired speed) on the approach to the curve. RC suggested adopting the following methodology to document the capability of the curve for Option 2	NOTE	

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No	Item	Action	Date
	1) Identify the point at which the curve can be perceived (Perception Point) for vehicles approaching the element at the desired speed (65km/h). This is defined as point at which the motorist has sufficient sight distance (from Eye to Pavement) to be able to appreciate the curve. This needs to consider preceding crest VC. 2) From Perception Point, calculate the distance available to react (Reaction Time) and Decelerate (at 2.5m/s/s) to 57km/h. It is desirable that this occurs before motorists enter the curve. This will create a speed profile leading into and through the curve 3) Based on the speed profile calculated in step 2, calculate the SSD required and test against SSD available *(Note – AECOM have since reviewed AustRoads Part 3, Section 5.10, Horizontal Curve Perception Sight Distance, and will ensure that the criteria described within this section are addressed)* MW questioned if the SSD achieved was below the SSD required for the speed profile, whether the curve should then be increased slightly and retested to ensure SSD was achieved. RC confirmed this was a suitable approach. AECOM are to test the curve capability and document using the above methodology RC and MW suggested possible further mitigation of the curve could be achieved through the installation of guide posts (preferably short and flexible base)	AECOM	
3.0	**Drainage** AECOM outlined recent discussions with ACO regarding use of ACO products. Further review of 30% design has identified possibly locations where use of lengths of ACO drain may be required. AECOM presented ACO information regarding use of transverse drain on Mountain Creek Road MW noted Ross Pritchard is likely to define performance based specifications for these products instead of identifying a specific manufacturer product MW suggested possibility of raising crown of Foote Avenue to better channel water towards existing kerb and channel, potentially negating the need for a transverse cutoff drain. AECOM to investigate	AECOM	

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Memorandum

To	Leah McKenzie	Page	1
CC			
Subject	Mooloolaba Road, Buderim Hill - 80% Design Issue		
From	Matthew Gallagher		
File/Ref No.	60250500/GEN	Date	24-Oct-2012

Background

The detail design of Mooloolaba Road, Buderim Hill has progressed from 50%, issued on 5 October 2012, to 80%, issued with this Memorandum. This memo aims to capture the main design development, key outstanding issues and questions related to level of detail required for some aspects for inclusion in the 100% design issue.

A number of meetings have occurred during development of the design to 80%. Associated meeting minutes, correspondence and design reviews have also been received from various TMR sources as listed below:

- 50% design review (refer attached for responses)
- Pavement design input from Mike Pickering and associated design review (refer design report for responses)
- Drainage design input from Mike Whitehead
- Value Management Workshop
- Safety in Design Workshop
- Constructability Workshop
- Meetings with service authorities

The items identified from these sources have been considered and incorporated into the 80% design.

Changes in Design from 50% to 80%

In addition to overall design development, the following lists the key areas of development of the design from the 50% issue to the 80% issue:

- Drainage design has been developed and detailed to optimise constructability and address design issues
- Property access details have been added
- Thomsen Terrace right turn ban has been implemented
- Property access (service road) opposite Buderim Pines Drive has been reconfigured and detailed
- Pavement Design is included and addresses previous comments
- Erosion and Sediment Control Plans have been incorporated
- General addition and updating of:
    - Legends
    - Notes
    - Plan Notes

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Items that have been identified for further refinement

As part of the internal review, undertaken prior to issue of the 80% design, a number of areas that require further development have been identified. It is acknowledged that these items have not yet been addressed but it has been assessed that they do not adversely affect the intent of the design at the 80% stage and it is proposed that they will be resolved during the finalisation of the detail design.

Please be cognisant of the following items during TMR's review of the 80% design:

- General consistency of presentation across the drawing set
- Typical Sections, confirm appropriate sections are shown and pavement boxing is correct
- Ordering of control line set out information to be amended
- Drawing / Series number convention
- Detailing of kerb ramp (and TGSI) set out
- Consistency of colour on drawings
- Property Access to Lot 20 on RP228644 incomplete
- Edge detail required for MCB1 Ch6800-6840 left hand side
- Overlapping text (especially PUP information on sections)
- Detailing of Accommodation Works in Supp Spec
- Modify asphalt driveway edge restraint from 300 wide to 150 wide and provide details
- Addition of Pothole Location information and Service Conflict tables to PUP plans (currently a blank sheet)

TMR Drawing Numbers have not been allocated (XXXX is currently referenced on drawings). AECOM will confirm the number of drawing numbers required once the full drawing set has been confirmed.

It is also noted that the lighting design is not included within the 80% design package. This design package is still being refined to achieve a suitable level of detail and will be issued under a subsequent transmittal for TMR and Energex review.

Queries on level of detail / information provided

In addition to the above items noted regarding further design development and detailing, there have been some items identified where AECOM seek clarification from TMR and RoadTek on the level of detail required for this design:

- Change of Formation information has not been included in the design package
- Subgrade has not been modelled and incorporated into annotated cross sections
- Driveways are currently shown in a standardised form. Is this arrangement suitable or should the existing form be reinstated
- Is additional set out information (similar to change of formation) required by RoadTek for non-standard driveways, or are the plans as shown suitable.

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Department of Transport and Main Roads
21 February 2013
Document No. 60250500_RSA_RP_001

Mooloolaba Road: Buderim Hill Upgrade

Road Safety Audit Stage 3 - Detailed Design

Mooloolaba Road: Buderim Hill Upgrade

Road Safety Audit Stage 3 - Detailed Design

NCHD-2596

Prepared for

Department of Transport and Main Roads

Prepared by

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21 February 2013

60250500

AECOM in Australia and New Zealand is certified to the latest version of ISO9001 and ISO14001.

Quality Information

Document Mooloolaba Road: Buderim Hill Upgrade

Ref 60250500

Date 21 February 2013

Prepared by Pooya Saba & Laura Brett

Reviewed by Matthew Gallagher

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
0	21-Nov-2012	Final Issue	Nathan Guild Project Manager	Original Signed
1	22-Feb-2013	Final Issue - Updated	Nathan Guild Project Manager	

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1.0 Introduction

1.1 Background

This report represents the findings of a Detailed Design (Stage 3) Road Safety Audit (RSA) for Mooloolaba Road at Buderim Hill (TMR Job Number 263/134/480). The project involves safety improvements of the existing Mooloolaba Road based on recommendations from a Stage 6 RSA undertaken in April 2012. Proposed improvements include geometric, road furniture and line marking enhancements as well as banning of some movements. The subject area extends from the west of Foote Avenue (Chainage 6,595m) through to just east of Buderim Pines Drive (Chainage 7,619m) as illustrated in **Figure 1**. For consistency in this report the subject area will be referred to as the ***'section of road'***.

Figure 1 Study Area

AECOM Australia Pty Ltd (AECOM) has been commissioned to undertake this audit by the Department of Transport and Main Roads (TMR) as part of the Detailed Design of safety improvements to this section of road. This RSA will ultimately be included in an all-encompassing Design Report, which will inform the study options development.

1.2 Existing Situation

Mooloolaba Road (134) is a state-controlled road between Mooloolaba and Buderim. The section of road has been noted by TMR as having a high number of crashes particularly during and after wet conditions. A Stage 6 (existing road) RSA was undertaken in April 2012, which noted that in order to increase safety on this section of road, TMR has modified line marking, improved the road surface, installed additional guardrail in several locations as well as reducing the speed limit and installing additional signage as a short term temporary measure.

There are five intersections located within this section of road; they include:

- Mooloolaba Road / Buderim Pines Drive;
- Mooloolaba Road / Thomsen Terrace;
- Mooloolaba Road / Nyes Crescent;
- Mooloolaba Road / Panorama Crescent; and
- Mooloolaba Road / Foote Avenue.

1.3 Purpose of the Report

The purpose of this Road Safety Audit Report is to present the findings of a Stage 3 Road Safety Audit, undertaken at the Detail Design stage of the Buderim Hill upgrade of Mooloolaba Road.

This RSA was carried out to identify areas where the Detailed Design of the road could compromise road user safety. In addition, this report also proposes remedial treatments in accordance with *Austroads Guide to Road Safety Part 6: Road Safety Audit (2009)*. It is intended that the issues raised in this report will assist in enhancing the safety of the Detailed Design for all road users on this section of road.

1.4 Design Criteria

1.4.1 Design Speed

The existing posted speed for Mooloolaba Road through the project extents is 50km/h (long term traffic management, with original gazettal of 60km/h). The proposed posted and design speeds have been determined from speed surveys and are detailed in **Table 1-1** below:

Table 1-1 Posted and Design Speeds

Location	Posted Speed (km/h)	Design Speed (km/h)	
		Car	Truck
Mooloolaba Road eastbound	60	65	60
Mooloolaba Road westbound (between Buderim Pines Dr and Nyes Cres)	60	65	66
Mooloolaba Road westbound (west of Nyes Cres)	60	65	60

1.4.2 Design Vehicle

The design vehicle for Mooloolaba Road for this section of the road is a 19m semi-trailer.

The design vehicle for the local side roads is an 8.8m refuse vehicle, with a 12.5m rigid truck/bus as a check vehicle.

1.4.3 Extended Design Domain (EDD) / Design Exception (DE) Elements

The following departures from standard are identified in the design documentation contained within **Appendix B**.

- EDD SISD for shared residential access at Ch. 6,850m
- DE's for side friction at Foote Avenue (eastbound and westbound) for both cars and trucks
- DE SISD for cars (incl. trucks) on eastbound carriageway at Thomsen Terrace
- DE SSD for trucks on westbound carriageway at Foote Ave
- DE SSD for trucks on eastbound carriageway at horizontal curve near Thomsen Terrace
- DE SISD for cars (incl. trucks) on westbound carriageway at approx. Ch. 6,700m, southern side driveways

1.4.4 Other Design Elements

- Minimum lane widths are 3.3m
- Reaction time adopted for cars and trucks is 1.5 and 2.0 seconds respectively
- Coefficient of deceleration for cars and trucks is 0.46 (mountainous) and 0.29 respectively

1.4.5 Clear Zone

The clear zone for Mooloolaba Road is calculated to be 4.5m based on Figure 8.4 of the Road Planning and Design Manual, with Average Annual Daily Traffic (AADT) of > 6,000 vehicles.

2.0 Audit Process

2.1 The Road Safety Audit

The *Austroads Guide to Road Safety Part 6: Road Safety Audit (2009)* defines an RSA as:

"a formal examination of a future road or traffic project or an existing road, in which an independent, qualified team reports on the project's crash potential and safety performance."

The essential elements of this definition are that the audit is:

- A formal process, and not an informal check
- Carried out by people who are independent of the design or the road authority if an existing road
- Carried out by people with appropriate experience and training
- Restricted to road safety issues.

The aim of an audit is not just to check for compliance with standards as standards may represent the minimum design requirements and their application does not necessarily guarantee a safe design.

The objectives of a road safety audit are:

- To identify potential safety problems for road users and others affected by a road project
- To ensure that measures to eliminate or reduce the problems are considered in full.

The benefits of conducting road safety audits include:

- The risk of crash occurrence is reduced
- The severity of crashes can be reduced.

The aim of a road safety audit is:

"To identify any existing safety deficiencies of design, layout and road furniture, which are not consistent with the road's function and use. There should be a consistency of standards such that the road user's perception of local conditions assists safe behaviour."

2.2 Methodology

This RSA was carried out to identify areas where the proposed design has the potential to compromise road user safety by adopting the practices outlined in the *Austroads Guide to Road Safety Part 6: Road Safety Audit (2009)*. The audit covers physical features of the project 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 recommendations in the report were to be followed, this would not guarantee that the design is 'safe', rather the adoption of the recommendations should improve the level of safety of the facility.

2.3 Audit Team

This RSA was undertaken by:

Laura Brett	Senior Road Safety Auditor	AECOM Pty Ltd
Pooya Saba	Road Safety Auditor	AECOM Pty Ltd

2.4 Information Sources

Data sources for the RSA include the following items:

2.4.1 Detailed Design Drawings (80%)

The following drawings were provided for the Detailed Design:

- Drawing Index and Locality Plan
- Typical Cross Sections
- General Details
- Control Line Layouts
- General Arrangements
- Kerb and Median Setout Plans
- Private Access Details
- Drainage Layouts
- Drainage Long Sections
- Drainage Details
- Erosion and Sediment Control Layouts
- Pavement Plans
- Signs and Pavement Markings
- Public Utility Plant Layouts
- Longitudinal Sections
- Annotated Cross Sections.

For a more detailed drawing index refer to **Appendix A**. It is noted that the Road Lighting Layout and Schematic drawings listed in the drawing index were not supplied for this RSA.

2.4.2 Reports

- Design Options Development Report, by AECOM (Revision B dated Jul 2012)
- Road Safety Audit Stage 6 – Existing Road, by AECOM (Revision A dated Apr 2012)
- Existing site photos (taken in April 2012)

2.4.3 Standards

- *Queensland Department of Transport and Main Roads, Road Planning and Design Manual (RPDM)*
- *Manual of Uniform Traffic Control Devices (MUTCD)*
- *Austroads Guide to Road Design (2010) (AGTRD)*
- *Austroads Guide to Road Safety Part 6: Road Safety Audit (2009)*

2.5 Audit Entrance Meeting

An entrance meeting was held on Thursday 25th October 2012 between the design team lead, Matthew Gallagher, Michael Bannah (designer) and auditors Laura Brett and Pooya Saba. The area of works, general features and the scope of the audit were discussed.

The following information was supplied to the Audit team as part of the Entrance Meeting:

- Detailed design plans (80%);
- Technical notes, memorandums and minutes of meeting covering technical geometric design development details and changes documented with TMR (refer to **Appendix B**).

2.6 Site Inspection

No formal site inspection was undertaken.

2.7 Interpretation of Audit Results

As set out in the RSA guidelines, responsibility for the road design always rests with the project manager/designer, and not with the auditor. A project manager is under no obligation to accept all the audit recommendations. It is noted that the suggested recommendations within the audit are not the only possible remedial actions that could be taken.

Furthermore, it is not that role of the auditor to agree to or approve of the project manager's response to the audit. Rather, the audit provides the opportunity to highlight potential safety issues and have them formally considered by the project manager, in conjunction with all other project considerations.

Where there is a contradiction between the audit findings and the design requirements permitted under the contract, the designer may choose to indicate compliance with the contract in responding to the audit findings.

Safety issues raised in this audit have been ranked as a guide to the importance of the issues and for prioritising remedial action. It is not intended to imply that the suggested actions are the only possible actions.

A suggested priority for remedial work has been shown for each of the issues using the following ratings:

- Priority A: Those issues that have a high priority for action from a road safety viewpoint
- Priority B: Those issues for which action needs to be taken from a road safety viewpoint
- Priority C: Those issues for which action is desirable from a road safety viewpoint.

It is noted that the priority ranking is based on the subjective assessment of the audit team.

3.0 Audit Findings

Audit findings were established and comments are provided based on a desktop review of the design plans and the information supplied. The findings focus on road safety for all road users, from a road use and network issues perspective, auditing the road safety elements as set out in the *Austroads Guide to Road Safety Part 6: Road Safety Audit (2009)*.

The findings are presented by design element; hence the findings are not presented in order of relative safety importance or priority for treatment.

The audit findings are summarised in **Table 3-1**.

Table 3-1 Summary of Audit Findings

No.	Item / Plan	Deficiency	Ranking	Recommendation	Designers Response	Auditor Comment
1.0	**General**					
1.01	Drainage	It is unclear whether the proposed grated drains are designed for heavy vehicle use. If overrun the drains could break up leading to holes, and debris on the road, and vehicles losing control.	B	Ensure grated drains are classed or rated to withstand largest design vehicles for this road (eg. ACO type D).	Agreed, it is intended that a minimum of Class D is to be used. This will be defined in the contract documents but a note will also be added to the drawings.	No further comment. Item is closed out.
1.02	Barriers	It is noted that the typical drainage gully pits are approximately 4.5m long including transitions. In many locations these pits need to be integrated with adjacent barriers by increasing post spacing and double nesting rails. The high frequency (and close proximity) in which gully pits repeatedly interact with barriers may weaken the barrier system.	B	Consider setting barrier posts further back or reducing gully pit transitions to kerbs in order to avoid increasing post spacing.	This interface has been investigated and cannot be avoided. Moving posts back would result in offset from kerb requirements not being met. It is proposed that the detail in figure 8.16 of the RPDM be used for posts either side of the gullies to enable them to be spanned.	No further comment. Item is closed out.
1.03	131005 & 192018 Barriers	The drawings show the existing guardrail to be retained on the northern side. Changes to the vertical alignment may warrant vertically realigning the existing guardrail to ensure compliance with minimum height clearances between pavement surface level and barrier rails.	B	Ensure minimum vertical height requirements are compliant with TMR STD DRG 1474 and Section 8.2.2.2 of the RPDM where existing barriers are to be retained.	Noted. It is intended that there is no road level change at this location.	No further comment. Item is closed out.

No.	Item / Plan	Deficiency	Ranking	Recommendation	Designers Response	Auditor Comment
1.04	132001 Barrier detail	The minimum clearance for barrier face to kerb face is given, however the maximum has not been provided. The clearance affects where the height of the barrier is measured from, and the barrier will not perform correctly if the height is measured from the wrong datum.	B	Provide the proposed maximum clearance between kerb and barrier face, and corresponding barrier height datum.	Noted. "min" has been removed and offset will be defined as 0.2-0.3m. Height with datum will also be added.	No further comment. Item is closed out.

No.	Item / Plan	Deficiency	Ranking	Recommendation	Designers Response	Auditor Comment
1.05	131001 & 131006 Barrier end treatments	SKT or ET2000 end treatments are proposed for all barriers. These are gating end treatments which require a hazard free zone of 6m x 22m. This zone is not provided at the following locations: - Chainage 7060 westbound - Chainage 7470 westbound - Chainage 7490 eastbound	A	Consider providing non-gating terminals.	Chainage 7060 westbound - Trees are to be removed behind the barrier to remove hazards. - It is impractical to increase the verge and flatten the batter further than provided as maintenance access is still required at the toe of the batter. - Due to the location of the terminal it is proposed to change this to a MELT treatment. - Additionally the end treatment will be located outside the clear zone and will therefore be at low risk of being hit. Chainage 7470 westbound - It is impractical and high cost to provide a non-gating terminal at this location. - There are numerous other hazards in the vicinity (stone pitched wall etc.) that prohibit relocating the terminal to provide a hazard free zone. - It is proposed to retain the existing treatment. Chainage 7490 eastbound - Barrier has been removed, refer item 1.07	No further comment. Item is closed out.

No.	Item / Plan	Deficiency	Ranking	Recommendation	Designers Response	Auditor Comment
1.06	131006 Barrier length of need	The barrier at Chainage 7470m (westbound) does not provide adequate length of need to the hazard.	A	Extend the guardrail to achieve the required length of need.	Full length of need cannot be achieved at this location as if the barrier were to be extended there would be a 1m high stone pitched wall within the hazard free zone of the barrier. The terminal location has been chosen as the most appropriate location to commence the barrier to provide the highest protection to the hazard.. Barrier is being reinstated as per existing to minimise impacts.	No further comment. Item is closed out.
1.07	131006, 137014 &192023 Barrier arrangement	The barrier at Chainage 7490m (eastbound) is shown at the bottom of the embankment on the GA and private access detail, but at the top of the embankment on the cross section. Hazards are present to vehicles utilising the access road (slope batter and height), and Mooloolaba Road (cut slope face), and should be protected. The typical sections shown on the private access detail also show that the guardrail has only approximately 0.6m between the face of barrier and the batter hinge point behind. This may be insufficient for the barrier to perform correctly, depending upon the post foundations.	B	Consider providing two barriers with an appropriate end treatment. Ensure that barriers have sufficient space for deflection behind in accordance with TMR Standard Drawing 1474.	Guardrail was considered on the top of the cut slope. However it was determined that the risk of crash is low due to low speeds and low volumes. Also passing vehicles will likely only be local residents as it is on a service road access. Also installing barrier would further reduce available width increasing potential for crashes, particularly to roadside objects such as the power pole (refer item 1.10) The guardrail at the bottom of the cut slope has been removed as a compliant barrier and end treatment (refer item 1.05) cannot be provided at this location. Additionally there is considered to be little reduction in risk if a barrier was to be installed.	No further comment. Item is closed out.

No.	Item / Plan	Deficiency	Ranking	Recommendation	Designers Response	Auditor Comment
1.08	137011 Access	The shared access has two entry / exit points to Mooloolaba Road, generating an additional point of conflict with through traffic.	C	Consider rationalising the access to have a single entry / exit point to minimise the number of conflict points.	The existing access is to be reinstated as is to match previous approvals.	No further comment. Item is closed out.
1.09	137014 Access road	The dropped kerb for the eastbound local access road is being relocated west. This will make it more difficult for vehicles to exit the access road at this end. (It is noted that vehicles will not be able to turn right from the eastern end and may therefore try to use the u-turn facility at the western end.)	C	Ensure that vehicles can undertake all the required manoeuvres and swept paths. Consider extending the dropped crossing to facilitate movements at the western end.	The existing operation of the access is to remain. Motorists can turn right across the painted island to access the road at the eastern end.	No further comment. Item is closed out.
1.10	137014 Power pole	The typical section shows the local access road surface extending across to an existing power pole. It will be easy for a vehicle to hit the pole, particularly at night if the access road is not lit.	C	Consider relocating the pole, realigning the pavement away from the pole, or providing delineation in the form of a kerb or line marking to keep vehicles away from the pole.	This pole was identified as being retained due to relocation costs. This is an existing situation to be retained, though road level is to be slightly reduced. The risk is considered low due to it being an existing situation along with low speeds and low volumes. Also passing vehicles will likely only be local residents as it is a local property access.	No further comment. Item is closed out.
1.11	161007 U-turns	The properties on the southern side of the road at Chainage 7560m will not be able to turn right and will need to u-turn at Buderim Pines Road. The pavement width may be insufficient for this manoeuvre.	B	Ensure the intersection can accommodate the swept paths for u-turning vehicles.	These properties can currently turn right out of their property and will continue to be allowed as motorists can cross a continuous line (in this case surrounding the painted island) to enter or leave the road under the road rules.	No further comment. Item is closed out.

No.	Item / Plan	Deficiency	Ranking	Recommendation	Designers Response	Auditor Comment
1.12	192009 Barrier need	The cross section shows a steep cut slope. This may form a hazard to motorists.	C	Consider protecting this cut slope with a barrier.	This is a very short, isolated section (less than 30m) of cut slope that is located within the clear zone. It is considered that on a risk based assessment that the impact of installing a short length of barrier would be greater than that of the cut slope. A barrier would also restrict access to the property located at Ch6940	No further comment. Item is closed out.
2.0	**Design**					
2.01	141003 & 142002 Drainage	The drainage gully pit 9/B1 has 3 incoming pipes sized 525mm, 500mm and 450mm diameter. The only outgoing pipe from this pit is sized at 450mm diameter. This suggests that there is insufficient capacity to allow adequate water runoff from the road to manhole 10/B1, causing water to pond on the carriageway. The long section also suggests that water will back up out of the gully.	B	Confirm that water will not pond on the carriageway causing vehicles to swerve.	Hydraulic modelling has been undertaken to confirm capacity of the system. It is noted that the downstream 450mm pipe is on a 25% grade with very high volumes, sufficient to accept the design inflows.	No further comment. Item is closed out.
2.02	151003 Pavement subsoil drain	The pavement subsoil drainage system at approximate Chainage 7,020m is connected to a gully pit, however has an additional outlet onto the median. It is unclear whether the subsoil drain at this location discharges onto the adjacent carriageway, which may cause ponding.	C	Consider removing this outlet as it is already connected to a nearby gully pit, to avoid additional water run off onto the carriageway.	It was intended that the outlet was to be a cleanout, this was a drafting error. As part of the pavement review, subsoil drains at this location have been revised and duplicate outlets have been removed.	No further comment. Item is closed out.

No.	Item / Plan	Deficiency	Ranking	Recommendation	Designers Response	Auditor Comment
2.03	137015 & 141006 Drainage	The long section shows a sag point but there is no drainage proposed. This could lead to ponding, creating a hazard for vehicles and pedestrians.	C	Ensure that the road can drain with no water ponding.	The low point of the local access (MCF1) will drain to the kerb and channel on Mooloolaba Road (MCA1) which is on a grade falling to the east.	No further comment. Item is closed out.
2.04	141006 Drainage	There are no existing or proposed gullies shown in either direction between Thomsen Terrace and the eastern limit of works. This could lead to ponding of water which could cause vehicles to swerve.	A	Provide a drainage system in this area.	As noted there is no existing system to the east of Buderim Pines Drive. There is no existing issue with ponding of water (or water flow depths) east of Buderim Pines Drive. In addition we are improving the upstream drainage system to lessen the chances of additional flows entering this catchment. There is a continual downgrade east of Buderim Pines Drive allowing a continual flow of water within the existing kerb. As agreed with the client, the existing situation is to be retained as long as there is no net addition to the downstream flows as a result of the project. This has been checked and there is no increase in flow. Additionally flow widths have been checked and widths are sufficiently contained within the kerb and shoulder to maintain trafficable widths during design events.	No further comment. Item is closed out.

No.	Item / Plan	Deficiency	Ranking	Recommendation	Designers Response	Auditor Comment
3.0	**Alignment**					
3.01	131002 Sight distance	The existing land boundary between Lots RP101043 and 111424 appears to restrict stopping sight distance for westbound traffic around the curve. This could lead to rear-end collisions.	A	Consider adjusting the land boundary to suit the visibility splay required.	As directed by the client there is to be no property resumptions on this project. The deficiencies have been accepted (in principle) as an existing design exception to be retained. All driveways are to be checked and reported on in the EDD/DE report for TMR approval.	No further comment. Item is closed out.
3.02	111001, 161002 & 192001 Curve widening	The eastbound curve widening at Chainage 6730m has been based upon an initial lane width of 3.3m, but the drawings state that the lane commences at 3.5m. The curve widening is therefore inadequate and could lead to vehicles overrunning the median, and subsequently damaging kerbs or losing control.	B	Provide the required curve widening.	The beginning of the curve is matching the lane width which is 3.5m to the west of the project extents. Additionally due to the constraints of the project and need to maximise other features such as sight distance, it is difficult to achieve any extra lane widening through this curve. This will be noted as a design non-compliance.	No further comment. Item is closed out.
3.03	131002 Cross section and swept paths	Foote Avenue appears to have very narrow lanes (approx 2.5m). Vehicles may encroach into the adjacent lane resulting in a collision with oncoming traffic.	B	Consider widening Foote Avenue to ensure that vehicles can pass safely.	Widening of Foote Avenue has been investigated but in consultation with the client the existing trees and retaining walls were identified as having to remain untouched. It is expected that due to the banning of right turns into and out of Foote Avenue that the conflicts will reduce at this location improving safety. Linemarking will be modified to straighten vehicles prior to the pinch point.	No further comment. Item is closed out.

No.	Item / Plan	Deficiency	Ranking	Recommendation	Designers Response	Auditor Comment
4.0	**Intersections**					
4.01	131002 Sight distance	Sight distance from driveway at RP109329 appears to be reduced when egressing and turning right due to the introduction of flexible bollards in the median.	B	Ensure visibility to oncoming traffic is compliant. Consider banning the right turn out of driveway by extending the median island.	It should be noted that the top of the bollards will be 575mm from the westbound carriageway road surface and in conjunction with the 6% superelevation, it is expected that the bollards will not affect SISD which is 1.1 to 1.25. As noted in item 3.01, all driveways are to be checked for sight distance.	No further comment. Item is closed out.
4.02	131002 Drainage	The grated drain across Foote Avenue represents a polished surface in the wheel path of turning vehicles that could lead to vehicles losing control.	C	Consider adjusting the cross fall of Foote Avenue to provide drainage at the kerb line or providing a grated drain that has a skid resistant surface.	This has been considered and additional crossfall added, however due to the narrow width (refer item 3.03) and longitudinal grade there is insufficient width to be able to provide sufficient crossfall to adequately push water to the kerbs. As a result the provision of a cut off drain has been included. The drawings will note the need to ensure that the grate provides a skid resistant surface.	No further comment. Item is closed out.
4.03	131006 & 161006 Turn lane	There is nothing to stop vehicles using the left turn lane into Buderim Pines Road to overtake slow through traffic. This could lead to collisions with vehicles exiting the side road.	B	Consider providing a central island as per Nyes Crescent to prevent this potential for conflict.	Providing an island at this location has been considered but cannot be achieved due to the geometry present and need to accommodate swept path requirements of the design vehicles. It is noted that this is an existing situation (to remain) with no reported history of the defined issue.	No further comment. Item is closed out.

No.	Item / Plan	Deficiency	Ranking	Recommendation	Designers Response	Auditor Comment
4.04	161006 Right turn	There is nothing to physically prevent vehicles turning right out of Thomsen Terrace. Any vehicles doing this could collide with those turning right into Thomsen Terrace as there is no provision for them to wait in the median.	A	Consider providing a central island in Thomsen Terrace to force vehicles left.	A raised median was considered at this location however it cannot be incorporated due to the swept path requirements of the design vehicles. A painted island will be provided along with signage and further modification to the Mooloolaba Rd median to provide positive reinforcement of the right turn ban.	No further comment. Item is closed out.
5.0	**Special Road Users**					
5.01	181002, 181004 & 181006 Footpaths	There are power poles at Ch. 6690, 7085 and 7440 eastbound that appear to be located directly within the footpath. The poles restrict footpath width which may cause pedestrians to walk in the road. They also form a hazard to any cyclists using the path.	B	Consider realigning footpath to avoid obstructions within the footpath.	Care has been taken to avoid fixed objects when designing the footpaths.	No further comment. Item is closed out.
5.02	131002 Footpaths	There are no kerb ramps for pedestrians to cross Foote Avenue.	B	Ensure all pedestrians can safely cross Foote Avenue, including disabled users, by adding kerb ramps.	The existing path and crossing within Foote Ave will be retained.	No further comment. Item is closed out.
5.03	131003 Footpaths	The footpath width at Chainage 6,935m (just west of the interface between existing and new footpath) appears to be too narrow and have a sharp bend around the adjacent gully pit, potentially making it unsafe for pedestrians to negotiate past.	B	Ensure all users can safely travel past this point by widening the footpath to provide the minimum width for pedestrian, cyclists and / or wheelchair users.	Agreed. Pit 4/B5 will be changed to a kerb in line to improve pedestrian access.	No further comment. Item is closed out.

No.	Item / Plan	Deficiency	Ranking	Recommendation	Designers Response	Auditor Comment
5.04	131004 Footpaths	The footpath alignment between approximate Chainage 7,090m and 7,150m weaves horizontally, creating unnecessary difficulty for some pedestrians. There does not appear to be any power poles or other physical obstructions in this area. Also, at Chainage 7105m, a Chevron Alignment Marker (CAM) sign is located in the path which may reduce the width of the path available for pedestrians and / or cyclists.	B	Ensure all pedestrians can safely travel through this area by providing a direct route without hazards.	The footpath alignment is due to the need to match levels required for driveway access along this section of Mooloolaba Road. The horizontal radii are suitable for pedestrians. The position of the CAM will be modified to be clear of pedestrians.	No further comment. Item is closed out.
5.05	131006 Footpaths	The footpath ends at Chainage 7470m leading pedestrians directly into a local access road with no designated pedestrian provision. This will lead to conflict between pedestrians and vehicles.	B	Consider extending the footpath along the length of the access road. As a minimum provide warning signage to motorists regarding pedestrians.	In general, the intent is to reinstate existing where possible. As such the proposed footpath matches the existing facility. The property access is to be changed to incorporate a kerb crossover to remove the appearance of a continuous road to more of an access in order to slow motorists down. This is considered a low risk conflict. No changes are proposed.	No further comment. Item is closed out.
5.06	131001 Tactiles	It is not clear whether the proposed kerb ramps include tactile ground surface indicators (TGSI). A lack of TGSI presents hazardous crossing conditions for the vision impaired.	B	Provide TGSI at all crossing points.	TGSI's will be provided on new ramps to be installed on Panorama Crescent. Details are to be added to the drawings. Existing crossings are to remain unchanged.	No further comment. Item is closed out.

No.	Item / Plan	Deficiency	Ranking	Recommendation	Designers Response	Auditor Comment
5.07	131003 Crossing length	Pedestrians have to cross approximately 20m between kerb ramps across the mouth of Panorama Crescent. This is a large distance to cross whilst being cognisant of vehicles travelling in all directions, and could lead to a pedestrian / vehicle collision.	C	Consider providing a refuge to allow pedestrians to deal with only 2 traffic movements at a time instead of 4. (Refer MUTCD Part 10, Cl. 7.2.3a).	Agreed. A refuge will be provided.	No further comment. Item is closed out.
5.08	132003 Drainage	The "verge edge detail" shows a low point between the footpath and verge. This will collect water, which may cause pedestrians to walk in the road.	C	Consider re-grading the verge with a continuous fall or providing drainage adjacent to the footpath.	This treatment is provided on a 12% longitudinal grade and where regular driveways are present which will allow water to drain back into the kerb and channel. Thus there is no net low point.	No further comment. Item is closed out.
5.09	192013 & 131004 Footpath crossfall	The GA shows the footpath directly behind the kerb around Chainage 7100m, but the cross sections show a steep grade behind the kerb, which would be too steep for path users, particularly those in wheelchairs.	B	Consider relocating the footpath to the rear of the verge. (Refer also Item 5.04).	The path is located at the back of the verge. The verge shown on the section will be against an existing block wall fence.	No further comment. Item is closed out.
5.10	192014 - 192022 Fencing	Between Chainage 7180m and 7440m the path is adjacent to a steep slope. If the path is used by cyclists a partial fence is required to protect them from the slope.	C	Consider providing a partial fence in accordance with Figure 7.4 of AGTRD Part 6A.	The locations where the path is within 1m of the slope is short and isolated, as such it is not proposed to install short sections of fence.	No further comment. Item is closed out.
6.0	**Lighting, Signs and Delineation**					
6.01	Lighting	No lighting design is available. The existing lighting does not appear to be sufficient.	A	Ensure compliant AS1158.1 lighting is provided for all road users. Also consider use of slip-base poles if located within the clear zone.	Agreed. Category V3 lighting is being designed to comply with AS1158.1. Appropriate footings will be specified in accordance with AS1158.1.	No further comment. Item is closed out.

No.	Item / Plan	Deficiency	Ranking	Recommendation	Designers Response	Auditor Comment
6.02	Pavement marking	All side roads have holding lines for intersection control with Mooloolaba Road. This linetype is no longer current. Incorrect line markings can lead to driver confusion and hesitation.	B	Provide a give way line in accordance with MUTCD Part 2.	Noted. Hold line has been changed to Give Way Line.	No further comment. Item is closed out.
6.03	Signs	The driveway at Chainage 6,765m (Lot 22 RP228644) has a dedicated 'One Way' sign located in the median, however most other driveways that have banned turns do not have this sign.	B	Consider including for other driveways.	This sign was shown in error on the drawings. It is not appropriate to provide this type of signage to driveways. The sign has been removed.	No further comment. Item is closed out.
6.04	161001 & 161002 Advisory speed	Advisory 60km/h signs are retained with curve warning signs on both approaches to the curve at Foote Avenue. The friction factor is above the absolute maximum for 40km/h therefore an advisory of 60km/h is not appropriate and could lead to vehicles overshooting the curve and / or trucks tipping over.	A	Provide speed advisory signs appropriate to the friction factor.	It is noted that this curve has a design speed of 57km/h (based on operating speed assessment in accordance with RPDM Ch6). Based on this speed the friction factor for cars is less than the desirable maximum. It is noted that trucks are a Design Exception for side friction on this curve and this has been recorded in the Design Report. The 60km/h sign was shown in error on the drawings. The existing sign is a 50 advisory that is considered appropriate and is to be retained. The drawings are to be updated.	No further comment. Item is closed out.

No.	Item / Plan	Deficiency	Ranking	Recommendation	Designers Response	Auditor Comment
6.05	161001 Sign spacing	The two warning signs are to be retained but their spacing is less than the minimum 0.6V specified in the MUTCD and one may therefore block visibility of the other. Given the nature of the upcoming hazards it is important that motorists see these warning signs in advance and adjust their speed.	B	Relocate the signs to provide sufficient spacing such that they can be clearly seen.	These are existing signs that are to remain. They are positioned 30m apart which is marginally less than to 0.6V. No change proposed.	No further comment. Item is closed out.
6.06	Speed signs	There is only one speed limit sign proposed. Speed limit repeaters should be approximately 1km apart for 60km/h to confirm the required speed limit to motorists. Given the downhill gradient in particular repeater signs could serve to reinforce the required speed limit.	C	Ensure that sufficient speed signs are present to advise motorists exiting side roads, and at the eastern extent of the scheme in particular of the maximum permitted speed.	The presence of additional regulatory speed signs within the project site are not considered appropriate given that there are three substandard curves (50 advisory). There is no appropriate location to provide a 60 sign outside the influence of these advisory signs and would therefore provide a confusing message for motorists. However a reminder 60km/h sign will be provided to the east of Buderim Pine Drive to confirm the posted speed limit once motorists exit the steep downhill section.	No further comment. Item is closed out.

No.	Item / Plan	Deficiency	Ranking	Recommendation	Designers Response	Auditor Comment
6.07	161002 Number of signs	The Foote Avenue approach to Mooloolaba Road has five signs on four posts within 20m of each other ('Give Way Ahead', 2x 'Left Turn Only', street name and 'Give Way' signs). This creates unnecessary additional roadside object hazards and cluttered signage making it difficult for the road user to read.	B	Consider rationalising signage to reduce post numbers or increasing sign spacing.	In general, due to the approach geometry and presence of banned movements, it is recommended that additional signage is used at this location to make motorists aware of the approaching conditions. It is noted that 60NB posts on which these signs are to be installed are considered frangible and therefore not hazards. However, signage will be modified where possible to reduce the number of signs and increase spacing to reduce driver load.	No further comment. Item is closed out.
6.08	161002 Sign location	The unidirectional hazard marker sign (D4-1-2 A) located at the western extent of this drawing is positioned on the pavement in advance of a downstream island, creating an additional roadside hazard.	B	Consider relocating this sign to the adjacent island.	Agreed, this will be modified on the drawings.	No further comment. Item is closed out.
6.09	161002 Inappropriate sign	The TC1950 sign is to remain. This sign appears to be redundant and inappropriate to remain. This could cause driver confusion and hesitation.	C	Consider removing the sign.	Agreed, this will be modified on the drawings.	No further comment. Item is closed out.
6.10	161002 & 181002 Sign visibility	The Curve Warning sign has been located directly behind a power pole, and will not be seen.	B	Relocate the warning sign in front of the pole.	Agreed, this will be modified on the drawings.	No further comment. Item is closed out.

No.	Item / Plan	Deficiency	Ranking	Recommendation	Designers Response	Auditor Comment
6.11	161003 Sign visibility	The existing solar speed warning sign has been noted to be removed. However a new sign is also introduced adjacent to this location making the drawing unclear. If a new sign is introduced at this location, the CAM sign may be obstructed from driver's view.	B	Ensure visibility to CAM sign as per MUTCD.	This was an error on the drawings, there is no new sign. The CAM will be visible.	No further comment. Item is closed out.
6.12	161002 & 161003 Sign confusion	The existing Curve Warning (right) sign at Chainage 6920m westbound is noted to be relocated to Chainage 6825m. If relocated this will advise motorists of the wrong curve alignment.	A	Consider removing this sign.	The existing sign at Ch6920 is depicted incorrectly as a W1-3(R). It is a W1-3(L) which should be relocated prior to the left hand curve at Ch6825.	No further comment. Item is closed out.
6.13	161004 Sign type	There is an unlabelled sign in the median adjacent to the right turn bay. It appears that this should be a R2-2L A (One Way) sign.	B	Ensure this sign is correctly labelled as per MUTCD	Agreed, the arrow is missing that connects the unlabelled sign and the defined sign face.	No further comment. Item is closed out.
6.14	161004 Island sign	The Nyes Crescent median island on approach to Mooloolaba Rd does not have any delineation.	B	Consider inclusion of an R2-3(L) (Keep Left) sign on the nose of this island as per MUTCD.	Agreed, this will be modified on the drawings.	No further comment. Item is closed out.
6.15	161004 Island sign	There is no Give Way sign on the central island of Nyes Crescent.	B	Provide a duplicate Give Way sign in accordance with Clause 2.5.5 of MUTCD Part 2.	This clause of the MUTCD only requires duplicate Give Way signs for multi-lane approaches. No change proposed.	No further comment. Item is closed out.
6.16	161004 Direction sign	The G5-1 signs are to be retained at Foote Avenue and Nyes Crescent. These signs include turn arrows which could be misleading for approaching vehicles that can no longer turn into these side roads. This could lead to motorist confusion and hesitation.	C	Consider replacing these signs with a street nameplate only without the direction arrow.	The signs are existing street name signs (G5-1) with no arrow, which it to be reinstalled. The signs have been incorrectly depicted on the drawings. The drawings are to be amended.	No further comment. Item is closed out.

No.	Item / Plan	Deficiency	Ranking	Recommendation	Designers Response	Auditor Comment
6.17	161004 U turns	U-turns are prohibited for westbound traffic but not eastbound traffic. Motorists that have exited properties to the west may try and u-turn here but this might not be possible within the carriageway.	B	Consider providing a No U-Turn sign for eastbound traffic.	Agreed, this will be modified on the drawings.	No further comment. Item is closed out.
6.18	161004 Give Way sign	The Give Way sign on Panorama Crescent may be obscured by the power pole in front.		Consider an advance Give Way warning sign, and / or providing a duplicate Give Way sign on a central refuge (Refer to Item 5.07)	Agreed, this will be modified on the drawings.	No further comment. Item is closed out.
6.19	161005 and 16006 Redundant sign	The two G9-51 (Slow Vehicle Turnout) signs appear to be redundant and inappropriate to remain.	B	Remove redundant signage to comply with MUTCD.	Agreed, this will be modified on the drawings.	No further comment. Item is closed out.
6.20	161005 Incorrect sign	A T-Junction sign is shown at Chainage 7320m, but the downstream intersection is staggered side roads. The sign would cause confusion and hesitation.	B	Provide a W2-8 sign instead.	Agreed, the W2-3 is wrong. It is proposed to provide a W2-12(L) due to the horizontal curve.	No further comment. Item is closed out.
6.21	161005 CAM spacing	Some of the proposed and existing CAM's have spacing larger than that described in table 4.3 of MUTCD Part 2. Inadequate spacing will not delineate the curve properly.	C	Consider relocating the CAMs to achieve the required spacing for the curve radius.	The CAM spacing will be reviewed to best achieve the MUTCD requirements while considering the site constraints (driveways etc).	No further comment. Item is closed out.

No.	Item / Plan	Deficiency	Ranking	Recommendation	Designers Response	Auditor Comment
6.22	161006 Sign spacing	The Thomsen Terrace approach to Mooloolaba Road potentially has four signs on three posts within 12m of each other ('Stop', 'No Stopping', 'Left Turn Only' and 'No Right Turn' signs). This creates unnecessary additional roadside object hazards and cluttered signage making it difficult for the road user to read.	B	Consider rationalising signage to reduce post numbers or increasing sign spacing.	As per item 6.07 signs are required to convey a message where the conditions are changed (banned turn movement) (also refer item 4.04 re inability to provide physical barrier). It is noted that signage redundancy is also an important safety feature at these locations to minimise the chance of unsafe manoeuvres. However, signage will be modified where possible to reduce the number of signs and increase spacing to reduce driver load.	No further comment. Item is closed out.
6.23	161006 Sign location	The R6-23A (End Truck & Bus Low Gear Area) sign is to be relocated, however the new location has not been identified.	B	Identify new sign location in accordance with MUTCD.	Wording will be changed to 'reinstalled' on drawings.	No further comment. Item is closed out.
6.24	161006 Sign hazard	The new TC1201 (Concealed Driveways) sign has been positioned in front of a new barrier system creating an additional hazard.	B	Consider placing this sign post behind the barrier system to eliminate the hazard.	Agreed, this will be modified on the drawings.	No further comment. Item is closed out.
6.25	161006 Mirror	It is proposed to retain the existing sighting mirror. However, the Stage 6 RSA noted that the existing mirror was dirty and damaged and should be replaced.	A	Replace the mirror.	Mirror is no longer required due to banning of right turn from Thomsen Terrace. Mirror will be noted as being removed.	No further comment. Item is closed out.
6.26	161006 U-turns	Eastbound vehicles from properties wishing to u-turn may try and u-turn at Thomsen Terrace rather than Buderim Pines Road. There may be insufficient width for motorists to perform this manoeuvre.	B	Consider providing a No U-Turn sign for eastbound traffic.	Agreed, this will be modified on the drawings.	No further comment. Item is closed out.

No.	Item / Plan	Deficiency	Ranking	Recommendation	Designers Response	Auditor Comment
6.27	161007 Sign type	The new sign located at approximate Chainage 7,550m, facing the eastbound traffic has not been identified.	B	Remove sign if not warranted by MUTCD.	Agreed, this will be modified on the drawings.	No further comment. Item is closed out.
7.0	**Physical Objects**					
7.01	Power poles	There are power poles at various locations that are within the clear zone, creating a hazard.	A	Consider (in order of preference) undergrounding the service, relocating power poles outside the clear zone, or protecting road users from the hazard.	The cost of undergrounding is prohibitive and outside the project budget and scope as is relocating except where necessary (refer item 7.03). Provision of short sections of barrier may change an existing isolated hazard into a longitudinal hazard. Also due to the urban nature of the site with the regular occurrence of driveways, the provision of compliant guardrail cannot be achieved.	No further comment. Item is closed out.
7.02	Overhead wires	It is unclear how the change in vertical alignment affects vertical clearances to existing overhead objects.	B	Ensure that minimum vertical overhead clearances comply with Section 8.2.2 of Austroads Guide to Road Design Part 3.	Cl 7.10.7 of the RPDM is the appropriate reference (refer Interim Guide to Road Planning and Design Practice, May 2010). Table 7.22 provides minimum clearances for overhead services. This states that 5.5m is required for LV power lines over roads. The revised clearances have been checked and are generally still 7-8m above the road surface. These have also been provided to the service authority for confirmation.	No further comment. Item is closed out.

No.	Item / Plan	Deficiency	Ranking	Recommendation	Designers Response	Auditor Comment
7.03	181003 (Power pole)	The power pole PL-01 located on the southern side of the Mooloolaba Road / Panorama Crescent intersection is positioned directly in front of a new barrier system, creating a hazard.	A	Consider undergrounding the service, or relocating the power pole behind the barrier.	Pole PL-01 has been identified as being relocated to the back of the new verge behind the guardrail. This is currently being designed by the service authority and will be included on the drawings.	No further comment. Item is closed out.
7.04	Trees	The Stage 6 RSA identified that trees are present in the clear zone throughout the site representing hazards.	B	Consider removing the trees where inside the clear zone to remove the hazard.	Trees will be trimmed and removed where necessary. Notes will be added to the drawings to confirm this. As per item 7.01 these are isolated hazards.	No further comment. Item is closed out.
7.05	181006 Power pole	The power pole at Chainage 7500m eastbound is in line with the proposed barrier, and will prevent the barrier from performing correctly.	A	Consider undergrounding the service or relocating the pole outside the deflection zone of the barrier.	This pole is a street light only and will be removed.	No further comment. Item is closed out.
8.0	**Other**					
8.01	Maintenance	It is accepted that the proposed grated drains are required to capture water run-off, however if not maintained adequately debris can block the drain creating pools of water.	C	Ensure that the client is aware of the long term maintenance implications of introducing this drainage type to avoid roadside water build up as a safety hazard.	This has been discussed with the client. It is noted that the grades on this site will assist with self-cleaning (as opposed to generally flat installation of grated drains). Also additional blockage allowances have been made in the drainage design.	No further comment. Item is closed out.
8.02	Bus stop	The Stage 6 RSA identified that there is an existing bus stop within the limit of works at the western end of the project with poor facilities for pedestrians and the vision impaired. Lack of a route to the bus stop could lead to pedestrian falls or pedestrians in the road.	C	Consider improving this bus stop with safe access for pedestrians and the vision impaired.	There is not proposed to be any works in this area outside of the kerb. As such no changes are proposed. This will be raised with the client for consideration.	No further comment. Item is closed out.

No.	Item / Plan	Deficiency	Ranking	Recommendation	Designers Response	Auditor Comment
8.03	Vegetation	The Stage 6 RSA identified that vegetation is extensive throughout the site and obstructs visibility to a number of signs.	C	Consider including the clearance of vegetation in the design, and advising TMR to instigate more frequent maintenance.	As per item 7.04 trees will be trimmed and removed where necessary. This will be raised with the client for consideration.	No further comment. Item is closed out.
8.04	161007 Bus stop	The drawing states that the existing bus stop is to be removed, but a new location and facilities are not shown.	B	Ensure that appropriate facilities are provided to guide pedestrians to and from the bus stop if relocated.	The bus stop is to remain (error on drawing). The drawing is to be amended.	No further comment. Item is closed out.

4.0 Audit Statement

4.1 Lead Auditor – Laura Brett

I have undertaken a Stage 3 (detailed design) RSA for this section of Mooloolaba Road, Buderim, and have prepared this audit report for the purpose of identifying safety deficiencies which could potentially affect road safety, in accordance with the *Austroads Guide to Road Safety Part 6: Road Safety Audit (2009)*.

[redacted]

Laura Brett

Senior Civil Engineer

Date: 21st November 2012

4.2 Auditor – Pooya Saba

I have undertaken a Stage 3 (detailed design) RSA for this section of Mooloolaba Road, Buderim, and have prepared this audit report for the purpose of identifying safety deficiencies which could potentially affect road safety, in accordance with the *Austroads Guide to Road Safety Part 6: Road Safety Audit (2009)*.

Pooya Saba

Senior Engineer

Date: 21st November 2012

Appendix A

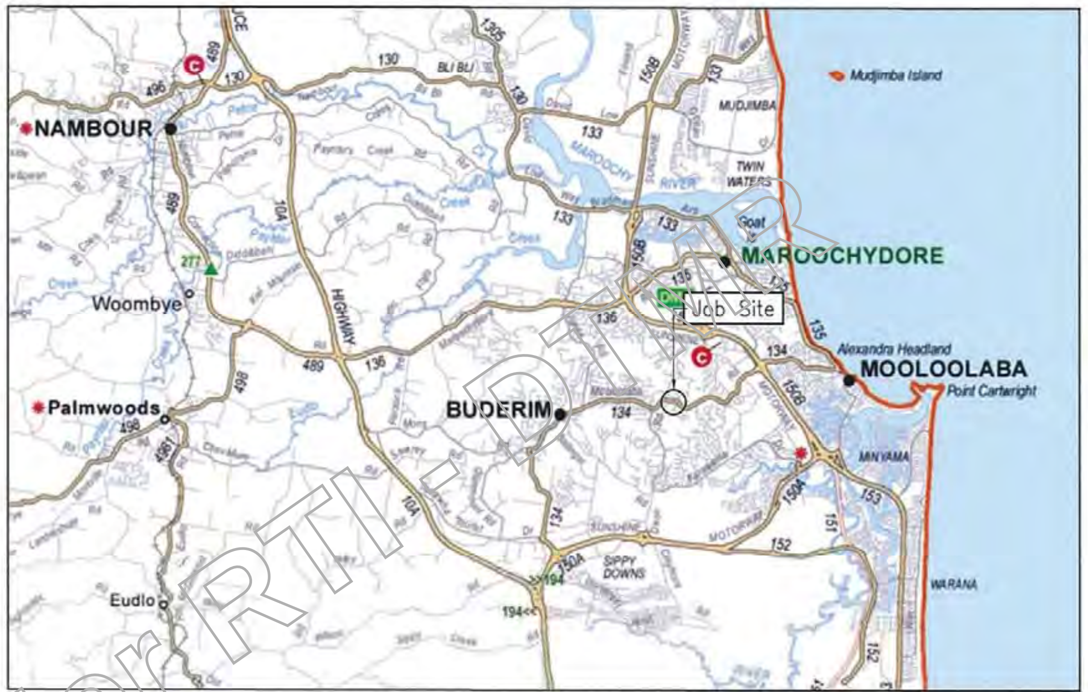
Drawing Index

NOT FOR CONSTRUCTION AECOM

BUDERIM HILL UPGRADE
MOOLOOLABA ROAD
JOB No 263/134/480
CH. 6595 - CH. 7619.370

DRAWING NUMBER	REVISION	DATE	SERIES NUMBER	DRAWING DESCRIPTION
102001	P2		DI-01 OF 2	DRAWING INDEX & LOCALITY PLAN
102002	P2		DI-02 OF 2	DRAWING INDEX
111001	P2		TCS-01 OF 5	TYPICAL CROSS SECTIONS
111002	P2		TCS-02 OF 5	TYPICAL CROSS SECTIONS
111003	P2		TCS-03 OF 5	TYPICAL CROSS SECTIONS
111004	P1		TCS-04 OF 5	TYPICAL CROSS SECTIONS
111005	P1		TCS-05 OF 5	TYPICAL CROSS SECTIONS
112001	P2		GD-01 OF 3	GENERAL DETAIL PLANS
112002	P2		GD-02 OF 3	GENERAL DETAIL PLANS
112003	P2		GD-03 OF 3	GENERAL DETAIL PLANS
121001	P2		CL-01 OF 4	CONTROL LINE LAYOUT PLANS
121002	P2		CL-02 OF 4	CONTROL LINE LAYOUT PLANS
121003	P2		CL-03 OF 4	CONTROL LINE LAYOUT PLANS
121004	P1		CL-04 OF 4	CONTROL LINE LAYOUT PLANS
131001	P3		GA-01 OF 7	GENERAL ARRANGEMENT PLANS
131002	P3		GA-02 OF 7	GENERAL ARRANGEMENT PLANS
131003	P3		GA-03 OF 7	GENERAL ARRANGEMENT PLANS
131004	P3		GA-04 OF 7	GENERAL ARRANGEMENT PLANS
131005	P3		GA-05 OF 7	GENERAL ARRANGEMENT PLANS
131006	P3		GA-06 OF 7	GENERAL ARRANGEMENT PLANS
131007	P3		GA-07 OF 7	GENERAL ARRANGEMENT PLANS
135001	P2		DS-01 OF 9	KERB AND MEDIAN SETOUT PLANS
135002	P2		DS-02 OF 9	KERB AND MEDIAN SETOUT PLANS
135003	P2		DS-03 OF 9	KERB AND MEDIAN SETOUT PLANS
135004	P2		DS-04 OF 9	KERB AND MEDIAN SETOUT PLANS
135005	P2		DS-05 OF 9	KERB AND MEDIAN SETOUT PLANS
135006	P2		DS-06 OF 9	KERB AND MEDIAN SETOUT PLANS
135007	P2		DS-07 OF 9	KERB AND MEDIAN SETOUT PLANS
135007	P2		DS-08 OF 9	KERB AND MEDIAN SETOUT PLANS
135007	P2		DS-09 OF 9	KERB AND MEDIAN SETOUT PLANS

Total NUMBER OF DRAWINGS = 131



LOCALITY PLAN

SCHEME SUBMITTED *(External Consultants or Internal Business Unit):*
This design meets the requirements of all relevant Australian Standards, Austroads Guidelines and Transport and Main Roads – Policies. References, Standards, Planning and Design Instructions, Guidelines and the requirements of the project brief/functional specifications.

SIGNED: TITLE:

Organisation: DATE:

SCHEME SCOPE AND FINANCIAL APPROVAL: *(Regional Director or Delegate):*
I hereby certify that this scheme complies with the intent of the scope and financial limits of the relevant project on QTRIP and the scheme is approved for release in accordance with that program.

SIGNED: TITLE: DATE:

Rev	Revisions/Descriptions	Ref	Certification	Date	Microfiled
P2	80% DESIGN ISSUED TO TMR				
P1	50% DESIGN ISSUED TO TMR	[redacted]			

CAD FILES C:\Users\hurstp\Documents\Buderim\PW-EXPORT\60250500-1000-102001-DI.dwg

Associated Job Nos

Auxiliary Drg Nos

SURVEY DATA GDA
Horiz. Grid: MGA94 (Zone 56)
Height Origin: AHD DERIVED
Survey Books: N/A

Scales

Dimensions shown in METRES except where shown otherwise

SUNSHINE COAST REGIONAL COUNCIL
MOOLOOLABA ROAD
CTL CHGE 6595 – 7619.037

Reference Points

Preceding RP	Dist. to start of job (km)	From start to end of job	From end to Following RP	Following RP
134/2	1.96	1.03	1.95	134/3A

Last Modified :- Oct 24, 2012 – 2:34pm
Through Chainage from INT 150B CH 6.6km – 7.6km

Drawn
Checked
Designed
Verified
Design Reviews (RPEQ)
No. Date

DRAWING INDEX & LOCALITY PLAN
SHEET 1 OF 2

ENGINEERING CERTIFICATION (RPEQ)				
ENG. AREA	NAME	SIGNATURE	NO.	DATE

For scheme approval status refer Drg. No. (DI-01of 2)

Queensland Government
Transport and Main Roads

Job No.	263/134/480
Contract. No.	NCHD 2543
Drawing No.	1000102001 P2
Series Number	DI-01 of 2

MRR_Detail (02/11)

NOT FOR CONSTRUCTION

AECOM

DRAWING NUMBER	REV	DATE	SERIES NUMBER	DRAWING DESCRIPTION
137001	P1		PA-01 OF 15	PRIVATE ACCESS DETAIL
137002	P1		PA-02 OF 15	PRIVATE ACCESS DETAIL
137003	P1		PA-03 OF 15	PRIVATE ACCESS DETAIL
137004	P1		PA-04 OF 15	PRIVATE ACCESS DETAIL
137005	P1		PA-05 OF 15	PRIVATE ACCESS DETAIL
137006	P1		PA-06 OF 15	PRIVATE ACCESS DETAIL
137007	P1		PA-07 OF 15	PRIVATE ACCESS DETAIL
137008	P1		PA-08 OF 15	PRIVATE ACCESS DETAIL
137009	P1		PA-09 OF 15	PRIVATE ACCESS DETAIL
137010	P1		PA-10 OF 15	PRIVATE ACCESS DETAIL
137011	P1		PA-11 OF 15	PRIVATE ACCESS DETAIL
137012	P1		PA-12 OF 15	PRIVATE ACCESS DETAIL
137013	P1		PA-13 OF 15	PRIVATE ACCESS DETAIL
137014	P1		PA-14 OF 15	PRIVATE ACCESS DETAIL
137015	P1		PA-15 OF 15	PRIVATE ACCESS DETAIL
141001	P3		DD-LD-01 OF 7	DRAINAGE LAYOUT PLANS
141002	P3		DD-LD-02 OF 7	DRAINAGE LAYOUT PLANS
141003	P3		DD-LD-03 OF 7	DRAINAGE LAYOUT PLANS
141004	P3		DD-LD-04 OF 7	DRAINAGE LAYOUT PLANS
141005	P3		DD-LD-05 OF 7	DRAINAGE LAYOUT PLANS
141006	P3		DD-LD-06 OF 7	DRAINAGE LAYOUT PLANS
141007	P3		DD-LD-07 OF 7	DRAINAGE LAYOUT PLANS
142001	P3		DD-LS-01 OF 5	DRAINAGE LONG SECTIONS
142002	P3		DD-LS-02 OF 5	DRAINAGE LONG SECTIONS
142003	P3		DD-LS-03 OF 5	DRAINAGE LONG SECTIONS
142004	P3		DD-LS-04 OF 5	DRAINAGE LONG SECTIONS
142005	P3		DD-LS-05 OF 5	DRAINAGE LONG SECTIONS
145001	P1		DD-MD 01 OF 1	DRAINAGE DETAILS
149001	P2		ES-01 OF 7	EROSION AND SEDIMENT CONTROL LAYOUT PLAN
149002	P2		ES-02 OF 7	EROSION AND SEDIMENT CONTROL LAYOUT PLAN
149003	P2		ES-03 OF 7	EROSION AND SEDIMENT CONTROL LAYOUT PLAN
149004	P2		ES-04 OF 7	EROSION AND SEDIMENT CONTROL LAYOUT PLAN
149005	P2		ES-05 OF 7	EROSION AND SEDIMENT CONTROL LAYOUT PLAN
149006	P2		ES-06 OF 7	EROSION AND SEDIMENT CONTROL LAYOUT PLAN
149007	P2		ES-07 OF 7	EROSION AND SEDIMENT CONTROL LAYOUT PLAN
151001	P2		PD-01 OF 8	PAVEMENT LAYOUT PLANS
151002	P2		PD-02 OF 8	PAVEMENT LAYOUT PLANS
151003	P2		PD-03 OF 8	PAVEMENT LAYOUT PLANS
151004	P2		PD-04 OF 8	PAVEMENT LAYOUT PLANS
151005	P2		PD-05 OF 8	PAVEMENT LAYOUT PLANS
151006	P2		PD-06 OF 8	PAVEMENT LAYOUT PLANS
151007	P2		PD-07 OF 8	PAVEMENT LAYOUT PLANS
151008	P2		PD-08 OF 8	PAVEMENT DETAILS
161001	P2		SL-01 OF 7	SIGNS AND PAVEMENT MARKING LAYOUT
161002	P2		SL-02 OF 7	SIGNS AND PAVEMENT MARKING LAYOUT
161003	P2		SL-03 OF 7	SIGNS AND PAVEMENT MARKING LAYOUT
161004	P2		SL-04 OF 7	SIGNS AND PAVEMENT MARKING LAYOUT
161005	P2		SL-05 OF 7	SIGNS AND PAVEMENT MARKING LAYOUT
161006	P2		SL-06 OF 7	SIGNS AND PAVEMENT MARKING LAYOUT
161007	P2		SL-07 OF 7	SIGNS AND PAVEMENT MARKING LAYOUT

DRAWING NUMBER	REV	DATE	SERIES NUMBER	DRAWING DESCRIPTION
167001	P3		RL-01 OF 9	ROAD LIGHTING LAYOUT
167002	P3		RL-02 OF 9	ROAD LIGHTING LAYOUT
167003	P3		RL-03 OF 9	ROAD LIGHTING LAYOUT
167004	P3		RL-04 OF 9	ROAD LIGHTING LAYOUT
167005	P3		RL-05 OF 9	ROAD LIGHTING LAYOUT
167006	P3		RL-06 OF 9	ROAD LIGHTING LAYOUT
167007	P3		RL-07 OF 9	ROAD LIGHTING LAYOUT
167008	P3		RL-08 OF 9	ROAD LIGHTING SCHEMATICS & DETAILS
167009	P3		RL-09 OF 9	ROAD LIGHTING SCHEMATICS & DETAILS
181001	P2		PU-01 OF 8	PUBLIC UTILITY LAYOUT
181002	P2		PU-02 OF 8	PUBLIC UTILITY LAYOUT
181003	P2		PU-03 OF 8	PUBLIC UTILITY LAYOUT
181004	P2		PU-04 OF 8	PUBLIC UTILITY LAYOUT
181005	P2		PU-05 OF 8	PUBLIC UTILITY LAYOUT
181006	P2		PU-06 OF 8	PUBLIC UTILITY LAYOUT
181007	P2		PU-07 OF 8	PUBLIC UTILITY LAYOUT
181008	P2		PU-08 OF 8	PUBLIC UTILITY LAYOUT
191001	P3		LS-01 OF 7	LONGITUDINAL SECTION
191002	P3		LS-02 OF 7	LONGITUDINAL SECTION
191003	P3		LS-03 OF 7	LONGITUDINAL SECTION
191004	P3		LS-04 OF 7	LONGITUDINAL SECTION
191005	P3		LS-05 OF 7	LONGITUDINAL SECTION
191006	P3		LS-06 OF 7	LONGITUDINAL SECTION
191007	P3		LS-07 OF 7	LONGITUDINAL SECTION
192001	P3		XS-01 OF 29	ANNOTATED CROSS SECTIONS
192002	P3		XS-02 OF 29	ANNOTATED CROSS SECTIONS
192003	P3		XS-03 OF 29	ANNOTATED CROSS SECTIONS
192004	P3		XS-04 OF 29	ANNOTATED CROSS SECTIONS
192005	P3		XS-05 OF 29	ANNOTATED CROSS SECTIONS
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192007	P3		XS-07 OF 29	ANNOTATED CROSS SECTIONS
192008	P3		XS-08 OF 29	ANNOTATED CROSS SECTIONS
192009	P3		XS-09 OF 29	ANNOTATED CROSS SECTIONS
192010	P3		XS-10 OF 29	ANNOTATED CROSS SECTIONS
192011	P3		XS-11 OF 29	ANNOTATED CROSS SECTIONS
192012	P3		XS-12 OF 29	ANNOTATED CROSS SECTIONS
192013	P3		XS-13 OF 29	ANNOTATED CROSS SECTIONS
192014	P3		XS-14 OF 29	ANNOTATED CROSS SECTIONS
192015	P3		XS-15 OF 29	ANNOTATED CROSS SECTIONS
192016	P3		XS-16 OF 29	ANNOTATED CROSS SECTIONS
192017	P3		XS-17 OF 29	ANNOTATED CROSS SECTIONS
192018	P3		XS-18 OF 29	ANNOTATED CROSS SECTIONS
192019	P3		XS-19 OF 29	ANNOTATED CROSS SECTIONS
192020	P3		XS-20 OF 29	ANNOTATED CROSS SECTIONS
192021	P3		XS-21 OF 29	ANNOTATED CROSS SECTIONS
192022	P3		XS-22 OF 29	ANNOTATED CROSS SECTIONS
192023	P3		XS-23 OF 29	ANNOTATED CROSS SECTIONS
192024	P3		XS-24 OF 29	ANNOTATED CROSS SECTIONS
192025	P3		XS-25 OF 29	ANNOTATED CROSS SECTIONS
192026	P3		XS-26 OF 29	ANNOTATED CROSS SECTIONS
192027	P1		XS-27 OF 29	ANNOTATED CROSS SECTIONS
192028	P1		XS-28 OF 29	ANNOTATED CROSS SECTIONS
192029	P1		XS-29 OF 29	ANNOTATED CROSS SECTIONS

Ref	Revisions/Descriptions	Ref	Certification	Date	Microfilmed
P2	80% DESIGN ISSUED TO TMR				
P1	50% DESIGN ISSUED TO TMR		[redacted]		

CAD FILES C:\Users\hurstp\Documents\Buderim\PW-EXPORT\60250500-1000-102002-DI.dwg

Associated Job Nos

Auxiliary Drg Nos

SURVEY DATA GDA

Horiz. Grid: MGA94 (Zone 56)

Height Origin: AHD DERIVED

Survey Books: N/A

Scales: N.T.S

Dimensions shown in METRES except where shown otherwise

SUNSHINE COAST REGIONAL COUNCIL

MOOLOOLABA ROAD

CTL CHGE 6595 – 7619.037

Reference Points

Preceding RP	Dist. to start of job (km)	From start to end of job	From end to Following RP	Following RP
134/2	1.96	1.03	1.95	134/3A

Last Modified :- Oct 24, 2012 - 2:34pm

Through Chainage from INT 150B CH 6.6km – 7.6km

Drawn

Checked

Designed

Verified

Design Reviews (RPEQ)

No. Date.

DRAWING INDEX
SHEET 2 OF 2

ENGINEERING CERTIFICATION (RPEQ)

ENG. AREA	NAME	SIGNATURE	NO.	DATE

For scheme approval status refer Drg. No. (DI-02 of 2)

Queensland Government

Transport and Main Roads

Job No. 263/134/480

Contract. No. NCHD 2543

Drawing No. 1000102002 P2

Series Number DI-02 of 2

MRR_Detail (02/11)

Appendix B

Design Documentation

AECOM Australia Pty Ltd
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540 Wickham Street
PO Box 1307
Fortitude Valley QLD 4006
Australia
www.aecom.com

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+61 7 3553 2050 fax
ABN 20 093 846 925

Memorandum

To	Leah McKenzie	Page	1
CC			
Subject	Mooloolaba Road, Buderim Hill - 80% Design Issue		
From	Matthew Gallagher		
File/Ref No.	60250500/GEN	Date	24-Oct-2012

Background

The detail design of Mooloolaba Road, Buderim Hill has progressed from 50%, issued on 5 October 2012, to 80%, issued with this Memorandum. This memo aims to capture the main design development, key outstanding issues and questions related to level of detail required for some aspects for inclusion in the 100% design issue.

A number of meetings have occurred during development of the design to 80%. Associated meeting minutes, correspondence and design reviews have also been received from various TMR sources as listed below:

- 50% design review (refer attached for responses)
- Pavement design input from Mike Pickering and associated design review (refer design report for responses)
- Drainage design input from Mike Whitehead
- Value Management Workshop
- Safety in Design Workshop
- Constructability Workshop
- Meetings with service authorities

The items identified from these sources have been considered and incorporated into the 80% design.

Changes in Design from 50% to 80%

In addition to overall design development, the following lists the key areas of development of the design from the 50% issue to the 80% issue:

- Drainage design has been developed and detailed to optimise constructability and address design issues
- Property access details have been added
- Thomsen Terrace right turn ban has been implemented
- Property access (service road) opposite Buderim Pines Drive has been reconfigured and detailed
- Pavement Design is included and addresses previous comments
- Erosion and Sediment Control Plans have been incorporated
- General addition and updating of:
    - Legends
    - Notes
    - Plan Notes

AECOM

Items that have been identified for further refinement

As part of the internal review, undertaken prior to issue of the 80% design, a number of areas that require further development have been identified. It is acknowledged that these items have not yet been addressed but it has been assessed that they do not adversely affect the intent of the design at the 80% stage and it is proposed that they will be resolved during the finalisation of the detail design.

Please be cognisant of the following items during TMR's review of the 80% design:

- General consistency of presentation across the drawing set
- Typical Sections, confirm appropriate sections are shown and pavement boxing is correct
- Ordering of control line set out information to be amended
- Drawing / Series number convention
- Detailing of kerb ramp (and TGSI) set out
- Consistency of colour on drawings
- Property Access to Lot 20 on RP228644 incomplete
- Edge detail required for MCB1 Ch6800-6840 left hand side
- Overlapping text (especially PUP information on sections)
- Detailing of Accommodation Works in Supp Spec
- Modify asphalt driveway edge restraint from 300 wide to 150 wide and provide details
- Addition of Pothole Location information and Service Conflict tables to PUP plans (currently a blank sheet)

TMR Drawing Numbers have not been allocated (XXXX is currently referenced on drawings). AECOM will confirm the number of drawing numbers required once the full drawing set has been confirmed.

It is also noted that the lighting design is not included within the 80% design package. This design package is still being refined to achieve a suitable level of detail and will be issued under a subsequent transmittal for TMR and Energex review.

Queries on level of detail / information provided

In addition to the above items noted regarding further design development and detailing, there have been some items identified where AECOM seek clarification from TMR and RoadTek on the level of detail required for this design:

- Change of Formation information has not been included in the design package
- Subgrade has not been modelled and incorporated into annotated cross sections
- Driveways are currently shown in a standardised form. Is this arrangement suitable or should the existing form be reinstated
- Is additional set out information (similar to change of formation) required by RoadTek for non-standard driveways, or are the plans as shown suitable.

Matthew Gallagher
Principal Professional - Transport
matthew.gallagher@aecom.com

Direct Dial: +61 7 3553 3281
Direct Fax: +61 7 3553 2050

Buderim Hill

Department of Transport and Main Roads

16 August 2012

Document No. TI_RP_004

D R A F T

Buderim Hill

Technical Note - Extended Design Domain and Design Exception

D R A F T

Buderim Hill

Technical Note - Extended Design Domain and Design Exception

Prepared for

Department of Transport and Main Roads

Prepared by

AECOM Australia Pty Ltd
Level 8, 540 Wickham Street, PO Box 1307, Fortitude Valley QLD 4006, Australia
T +61 7 3553 2000 F +61 7 3553 2050 www.aecom.com
ABN 20 093 846 925

16 August 2012

60250500

AECOM in Australia and New Zealand is certified to the latest version of ISO9001 and ISO14001.

D R A F T

Quality Information

Document Buderim Hill

Ref 60250500

Date 16 August 2012

Prepared by Tom Evans

Reviewed by Matthew Gallagher / Stephen Sewell

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
A	16-Aug-2012	Issued for In-Principle Approval	Nathan Guild/ Project Manager	

Client Acceptance (TMR)

The Extended Design Domain Elements and Design Exceptions outlined in this report are accepted subject to the following conditions/clarifications:

Title	Name	Comments	Signature	Date
TMR Project Manager	Leah McKenzie			
TMR Manager - Road Engineering Standards	Ricky Cox			
TMR Project owner - Regional Director, North Coast	Dennis Tennant			

D R A F T

Table of Contents

1.0 Introduction

AECOM Australia Pty Ltd (AECOM) has been commissioned by the Department of Transport and Main Roads (TMR) to prepare detailed design documentation for the upgrading of Mooloolaba Road extending from Chainage 6,650m to 7,500m.

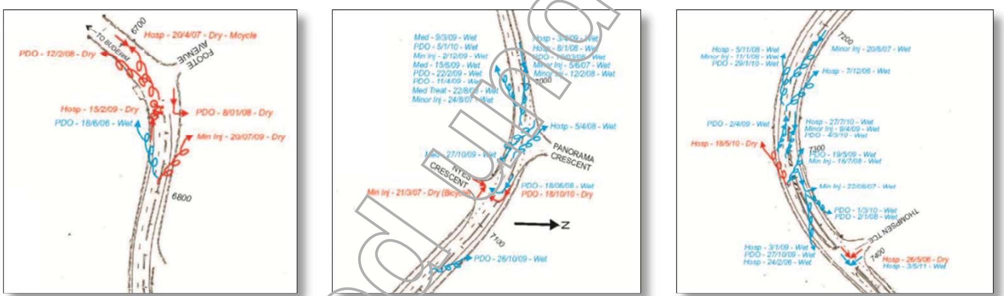
Mooloolaba Road (134) is a State-controlled road located in the Sunshine Coast between Mooloolaba and Buderim and is identified as a Controlled Distributor on the Sunshine Coast Regional Council Maroochy Plan 2000. Mooloolaba Road provides a link between Mooloolaba and Buderim, and provides access to the Sunshine Coast Private Hospital. Mooloolaba Road also provides connections to the Sunshine Motorway in the east and the Bruce Highway in the west.

1.1 Project Background

Mooloolaba Road has been subject to media interest regarding the amount of crashes that have taken place in recent times. As a result TMR engaged AECOM to review the existing conditions and develop options to improve performance of the section of road to an acceptable level. The findings of these studies have been outlined in an Existing Conditions Report (ECR) and a Design Development Report (DDR) both of which were compiled by AECOM and submitted to TMR in 2012. AECOM has worked closely with TMR through a number of design meetings in order to define both the design criteria objectives and the intended design approach for this section of road. This process resulted in the selection of a 'Preferred Design Option'. AECOM is currently progressing this option to produce detailed design documentation.

The previous studies revealed that there have been 45 crashes, in three clusters, along this section of road since 2006 and that 80% of these crashes have taken place in wet weather. The crash diagram is illustrated in **Figure 1-1**.

Figure 1-1 Crash Cluster Diagrams



The desktop study and site investigations forming the basis of the aforementioned reports have identified existing issues relating to insufficient capacity of stormwater infrastructure; excessive flow path lengths; substandard combination of curve radius and superelevation on some curves; abrupt changes in superelevation through development lengths; deficiencies in Stopping Sight Distance (SSD) due to the horizontal geometry; and insufficient Safe Intersection Sight Distance (SISD) at Nyes Crescent and Thomsen Terrace. It was also noted that there are no formalised bicycle lanes.

1.2 Purpose of this Report

This technical note has been compiled in parallel with preparing the detailed design of the Preferred Design Option. This report acts as a standalone document which outlines areas within the design which are anticipated to form either a Design Exception or will require an application of the Extended Design Domain (EDD). It is intended that this document will form the application for in-principle approval for these specific design elements from the asset owner. As the detailed design progresses these elements will be formally documented in a separate Design Report.

It should be noted that this report was issued prior to the design reaching the 30% completion milestone, and therefore additional Design Exceptions or Extended Design Domain elements may be identified during the development of the detailed design. In such an instance in-principle approval will be sought through a separate application.

D R A F T

2.0 Preferred Design Option

2.1 Design Development

In the initial stages of the project, and in the absence of speed survey information, AECOM investigated a design based on a 70km/h design speed, 10km/h above the previous posted speed. It is noted that Mooloolaba Road has historically been posted at 60km/h, although this has recently been lowered to 50km/h. In order to achieve this design speed it was identified that there would need to be geometric changes to achieve sight distance requirements as well as to address items such as flow paths, intersection arrangement, kerb and access changes and other safety issues. It became apparent that to achieve a 70km/h compliant alignment, large property impacts and construction costs would be incurred. TMR and AECOM therefore agreed on the Preferred Design Option which is based on the observed 85%ile operating speed. AECOM are now in the process of preparing the detailed design documentation for this design option.

The Preferred Design Option comprises of localised cross-fall correction to improve driveability and stormwater drainage; improvements to existing stormwater infrastructure; introduction of strategically located central medians to reduce flow path lengths; and resurfacing of the existing pavement. In some locations adjustments will be made to the lane alignment to increase sight distance and provide adequate shoulder width for flow paths, this in turn will provide sufficient width for on road cycle lanes.

The intention of this design option is to retain the existing mainline and intersection kerb alignment; this therefore forms the geometric constraint for this design option. It is however noted that embankment widening is required in the vicinity of Nyes Crescent and Panorama Crescent to facilitate local road accessibility. In light of the above constraint the preferred design option retains some of the design deficiencies identified in the existing alignment as outlined in **Section 3.0**.

2.2 Design Criteria

The design criteria for which the Preferred Design Option is based has been outlined in the ECR. This project specific design criteria defines the Extended Design Domain elements and Design Exceptions outlined in this report.

2.2.1 Design Speed

As previously mentioned the design speed for this section of road is based on the observed 85%ile operating speed as outlined below:

- Cars
  - 65km/h Chainage 6,650 to 7,500
- Trucks
  - 66km/h Westbound chainage 7,100 to 7,500
  - 60km/h Elsewhere within subject area

The above design speeds are derived from 2012 speed surveys along this section of road. The specific design speeds associated to cars and trucks were developed during the design option development stage of the project and the application of these speeds has been approved in-principle by TMR.

DRAFT

3.0 Extended Design Domain and Design Exceptions

3.1 Extended Design Domain

It is anticipated that the achieved sight distance at numerous driveways within the area of works will form Extended Design Domain Elements. The full extent of these design deficiencies will become apparent during the design development and will be formally documented in a separate Design Report.

Table 3-1 documents the Extended Design Domain elements currently identified within the Preferred Design Option. All values outlined in this table have been derived from the concept design and therefore are approximate only; these values will be confirmed and documented during the detailed design stage.

Table 3-1 Mooloolaba Road - Extended Design Domain

Item	Issue	Location / Direction	Car / Truck	Design Speed	NDD	EDD	Achieved - Existing	Achieved – Preferred Design Option
1.00 Horizontal Geometry								
There are currently no Extended Design Domain elements relating to horizontal geometry identified.								
2.00 Vertical Geometry								
There are currently no Extended Design Domain elements relating to vertical geometry identified.								
3.00 Safe Intersection Sight Distance (SISD)								
There are currently no Extended Design Domain elements relating to SISD identified.								
4.00 Stopping Sight Distance (SSD)								
There are currently no Extended Design Domain elements relating to SSD identified.								
5.00 Driveway Entrances[1]								
5.01	SISD	Shared Residential Access at Chainage 6,850	Car (inc. truck)	65km/h	108m	92m	92m	92m

[1] Further Extended Design Domain elements relating to driveway entrances will be identified during the design development.

3.2 Design Exceptions

The following section provides a summary of the Design Exceptions which have been retained from the existing alignment. A summary of the key components of each Design Exception is included in **Table 3-2** and a brief summary of each item is outlined thereafter. All values outlined in this table have been derived from the concept design and therefore are approximate only; these values will be confirmed and documented during the detailed design stage.

Table 3-2 Mooloolaba Road - Design Exceptions

Item	Issue	Location / Direction	Car / Truck	Design Speed	NDD	EDD	Achieved - Existing	Achieved – Preferred Design Option
1.00 Horizontal Geometry								
1.01	Side Friction	Mooloolaba Rd. at Foote Av. / Eastbound and Westbound	Car	65km/h	0.33	N/A	0.41	0.37
1.02	Side Friction	Mooloolaba Rd. at Foote Av. / Eastbound and Westbound	Truck	60km/h	0.24	N/A	0.34	0.31

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Item	Issue	Location / Direction	Car / Truck	Design Speed	NDD	EDD	Achieved - Existing	Achieved – Preferred Design Option
2.00 Vertical Geometry								
There are currently no Design Exceptions relating to vertical geometry identified.								
3.00 Safe Intersection Sight Distance (SISD)								
3.01	SISD	Thomsen Terrace / Eastbound	Car (inc. truck)	65km/h	130m^	112m^	90m	90m
4.00 Stopping Sight Distance (SSD)								
4.01	SSD	Mooloolaba Road at Foote Avenue / Westbound	Trucks	60km/h	74m*	74m*	58m	69m
4.02	SSD	Mooloolaba Road at horizontal curve near Thomsen Terrace / Eastbound	Trucks	60km/h	110m^	110m^	91m	91m
5.00 Driveway Entrances								
5.01	SISD	Driveways on southern side of Mooloolaba Road at approx. Chainage 6,700 / westbound.	Car (inc. truck)	65km/h	106m*	89m*	33m	33m

* Grade correction not required
^ Grade correction applied

3.2.1 Design Exception 1 – Side Friction (Cars)

A technical memorandum outlining issues relating to operating speed, side friction demand and the limiting curve speed at this location is included in **Appendix A**. Subject to TMR's approval of the attached memorandum, this element will no longer form a design exception.

3.2.2 Design Exception 2 – Side Friction (Trucks)

Location

Mooloolaba Road eastbound and westbound at the Foote Avenue curve.

Existing Situation

At this location the existing horizontal radius (R=71m) requires a side frictional demand which exceeds the maximum requirements for trucks at a 60km/h design speed.

Recent crash data indicates that there have been six crashes at this location since January 2006, four of the six crashes consisted of vehicles losing control at the horizontal curve on the westbound approach. It is noted that none of these crashes involved a truck.

Capability Provided by Preferred Design Option

The lanes are realigned within the existing kerb alignment at this location, providing an increased radius (R=77m) along the travelled path thus reducing the side friction demand. The side friction demand at this location, whilst improved, still requires a design exception for trucks in both directions.

Implications on Preferred Design Option of Providing NDD

In order to achieve NDD land resumption would be required from private properties on the southern side of Mooloolaba Road.

Mitigation Measures

The following mitigation measures will be included as part of the Preferred Design Option:

- Raised median to improve driver perception of curve
- Improved road lighting
- Curve warning speed signage
- Tilting truck signage (TBC)
- “Concealed Driveways” warning signage

3.2.3 Design Exception 3 – SISD (Cars – Includes Trucks)

Location

Thomsen Terrace and the Mooloolaba Road eastbound approach.

Existing Situation

SISD is restricted to vehicles exiting Thomsen Terrace due to the existing property boundaries on the left hand side of the eastbound approach on Mooloolaba Road.

Recent crash data indicates that there have been 20 crashes (since January 2006) within the crash cluster on the horizontal curve in the vicinity of Thomsen Terrace. Two of these crashes involved a collision between a vehicle travelling eastbound on Mooloolaba Road and a vehicle attempting to exit Thomsen Terrace.

Capability Provided by Preferred Design Option

SISD is unchanged in the Preferred Design Option.

Implications on Preferred Design Option of Providing NDD

The horizontal curve at this location would need to be increased considerably to achieve NDD. It is noted that there is a vertical drop in excess of 15m on the southern side of Mooloolaba Road at chainage 7,350. Increasing the curve radius at this location would result in significant constructability issues; considerable land resumption and anticipated relocation of adjacent services; this possibility was discounted during the design development.

Mitigation Measures

The following mitigation measures will be included as part of the Preferred Design Option:

- “Concealed Driveways” warning signage where appropriate
- T-Intersection approach warning signage

3.2.4 Design Exception 4 – SSD (Trucks)

Location

Mooloolaba Road westbound at the Foote Avenue curve.

Existing Situation

The property line on the southern side of Mooloolaba Road restricts the SSD of trucks below NDD requirements for the westbound approach.

Recent crash data indicates that there have been six crashes at this location since January 2006; one of the six crashes consisted of a westbound vehicle colliding with a bicycle on the inside of the horizontal curve. It is noted that this crash did not involve a truck.

Capability Provided by Preferred Design Option

The lanes are realigned within the existing kerb alignment at this location; whilst improving the SSD the achieved value remains substandard for trucks on the westbound approach.

Implications on Preferred Design Option of Providing NDD

In order to achieve NDD land resumption would be required from the private properties on the southern side of Mooloolaba Road.

Mitigation Measures

The following mitigation measures will be included as part of the Preferred Design Option:

- Raised median to improve driver perception of curve
- Improved road lighting
- Curve warning speed signage
- "Concealed Driveways" warning signage

3.2.5 Design Exception 5 – SSD (Trucks)

Location

Mooloolaba Road eastbound at the horizontal curve west of Thomsen Terrace.

Existing Situation

SSD is restricted for eastbound vehicles due to the existing property boundaries on the northern side of Mooloolaba Road.

Recent crash data indicates that there is a crash cluster consisting of 20 crashes along this horizontal curve since January 2006. One of these crashes involved an eastbound vehicle colliding into the rear of another vehicle entering a private property; this crash did not involve a truck.

Capability Provided by Preferred Design Option

SSD is unchanged in the Preferred Design Option.

Implications on Preferred Design Option of Providing NDD

The horizontal curve at this location would need to be increased considerably to achieve NDD. It is noted that there is a vertical drop in excess of 15m on the southern side of Mooloolaba Road at chainage 7,350. Increasing the curve radius at this location would result in significant constructability issues; considerable land resumption and anticipated relocation of adjacent services; this possibility was discounted during the design development.

Mitigation Measures

The following mitigation measures will be included as part of the Preferred Design Option:

- "Concealed Driveways" warning signage where appropriate
- T-Intersection approach warning signage

3.2.6 Design Exception 6 – SISD (Cars – Includes Trucks)

Location

Driveways on southern side of Mooloolaba Road at approximate Chainage 6,700.

Existing Situation

SISD is restricted from Mooloolaba Road westbound approach to driveways on the southern side of Mooloolaba Road.

Recent crash data indicates that there have been six crashes at this location since January 2006; none of which have included vehicles entering properties on the southern side of Mooloolaba Road.

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Capability Provided by Preferred Design Option

The lanes are realigned within the existing kerb alignment at this location; whilst improving SISD the achieved value remains substandard.

Implications on Preferred Design Option of Providing NDD

In order to achieve NDD land resumption would be required from the private properties on the southern side of Mooloolaba Road.

Mitigation Measures

The following mitigation measure will be included as part of the Preferred Design Option:

- Raised median to improve driver perception of curve
- Improved road lighting
- Curve warning speed signage
- “Concealed Driveways” warning signage

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4.0 Conclusion

The proposed design includes retained Design Exception and Extended Design Domain elements and seeks to balance providing the necessary improvements in operational capability with competing social and financial considerations in aligning with the defined budget. As such some operational risks remain and TMR as the asset owner should confirm its informed acceptance of these limitations in approving "in-principle" this design.

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Appendix A

Memorandum - *Foote Avenue Curve Design Capability*

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Memorandum

To	Leah McKenzie	Page	1
CC	Ricky Cox		
Subject	Horizontal Curve Perception Sight Distance - Mooloolaba Road		
From	Matthew Gallagher		
File/Ref No.	TI_RP_006	Date	20-Sep-2012

1.0 Background

As part of the development of the Mooloolaba Road Preliminary Design, AECOM prepared a Technical Note (TI_RP_004, August 2012) which sought to document potential Extended Design Domain and Design Exceptions to be adopted as part of the project for in-principal approval from TMR.

Design Exception 1 was documented as being insufficient side friction for cars at the horizontal curve located on Mooloolaba Road at Ch6,740 (adjacent to Foote Avenue). An assessment of the curve was undertaken in accordance with Chapter 6 of the Road Planning and Design Manual to assess the curve operating speed. This was done using TMR's OSroad program to assess the westbound carriageway for both the existing geometry and AECOM's proposed design; the results were contained within Appendix A of the aforementioned Technical Note.

The design proposed to increase the curve radius from R.71m to R.77m; however this resulted in the need to realign approximately 55m of an existing retaining wall on the northern verge of Mooloolaba Road.

In an attempt to minimise impacts to the retaining wall and associated issues, it was agreed that AECOM review the design of the curve. AECOM has therefore prepared an alternative design comprising of the following:

- radius = 72m
- superelevation = 6%
- arc length of curve = 45m
- westbound approach transition length = 30m
- eastbound approach transition length = 37m

An OSroad analysis was undertaken for the amended design (westbound) and the results are outlined below:

- section operating speed (SOS) = 56km/h
- limiting curve speed (LCS) = 60km/h
- side friction demand at SOS = 0.29

This revised design was presented to, and discussed with, TMR's Engineering and Technology Division (Ricky Cox and Mike Whitehead) on 6 September 2012. Refer attached minutes for a record of the meeting

This alternate alignment was generally accepted as being appropriate for the conditions.

It was recommended that, to ensure the proposed SOS could be achieved, the horizontal curve perception be assessed.

2.0 Horizontal Curve Perception

AECOM have undertaken an analysis of the horizontal curve perception sight distance for the westbound approach to the curve, this is to ensure that there is adequate visibility to allow for driver reaction and deceleration from the design speed (65km/h) to the SOS of the curve (56km/h). Reference was initially made to Austroads Guide to Road Design, Part 3, Section 5.10.

Section 5.10 indicates that deceleration to the SOS will have been completed when the vehicle arrives at the mid-section of the approach transition and that a minimum of 80% of the transition needs to be seen by the driver from the point of perception.

It was the opinion of the design team that requirements outlined in Section 5.10 were not suitable for this road environment (low speed, short curve with small radius and short transition) and therefore the design team adopted the approach proposed by Ricky Cox at the meeting on 6 September 2012 as noted in the meeting minutes.

The approach adopted in this analysis therefore consists of the following:

- Vehicle completes deceleration process (from design speed to SOS) at the commencement of the curve radius (Ch6,770)
- Prior to deceleration there is a period where the driver perceives the curvature of the road, this process occurs over the duration of the driver reaction time and the 'perception point' occurs at the commencement of this process.
- The available sight distance at the perception point (projected from driver eye height of 1.1m to pavement level) is assessed to determine how much of the curve is seen at this point. Engineering judgement is thus applied to the adequacy of this distance based on the road environment and the additional visual cues proposed within the design.

Perception Point

Working back from the start of the curve at Ch6,770, the driver decelerates from the design speed (65km/h) to the SOS (56km/h), this distance equates to approximately 21m based on a 2.0m/s/s deceleration rate. Deceleration commences at Ch6,791.

Prior to the deceleration commencing, the distance travelled during the reaction period equates to approximately 27m based on a 1.5s reaction time. This reaction time is consistent with the value adopted for determining sight distance requirements during the design development of the project. This suggests that the reaction process occurs between Ch6818 and 6791.

Therefore Ch6818 is the Perception Point at which point the horizontal curve must be able to be perceived to enable motorists to observe then react and decelerate in advance of the curve.

The assumed speed profile is indicated below in **Figure 1**.

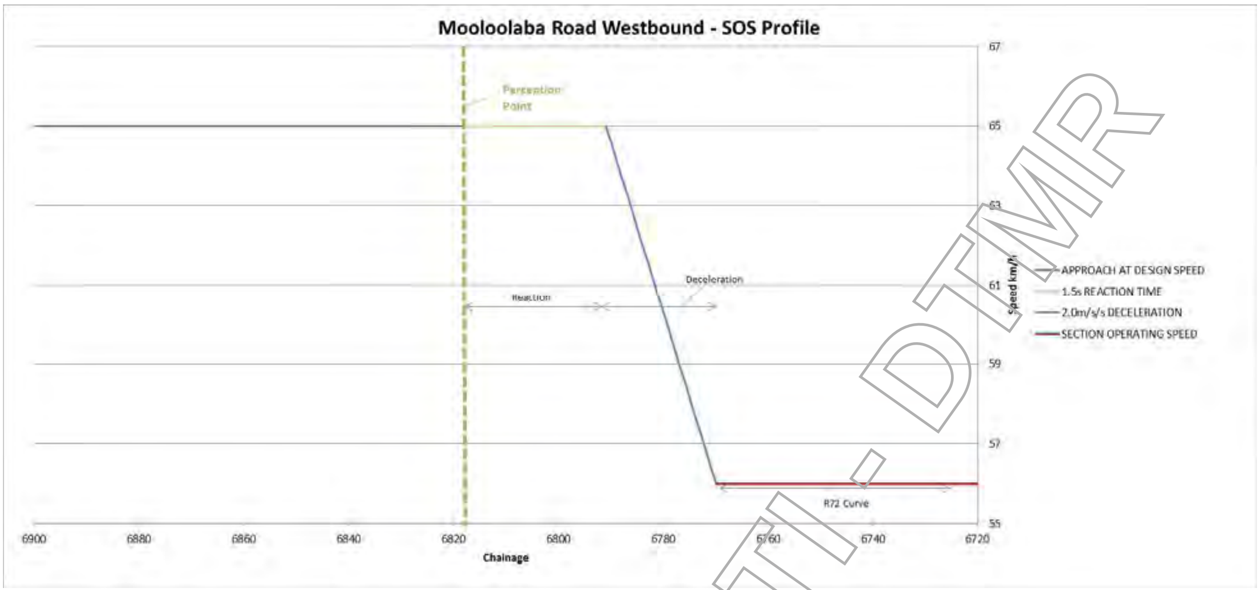

Figure 1 Mooloolaba Road Westbound – SOS Profile

Sighting the Arc

Figure 2 illustrates the achieved sight distance profile (projected to pavement level in the centre of the lane) throughout this section of road; this illustrates that there is 74m of sight distance available at the commencement of the reaction process (Ch6818). This indicates that the approaching driver is able to view 26m into the arc of the curve from the point of perception, therefore providing in excess of half the total length of the arc (45m).

In addition to being able to sight more than half of the pavement surface through the arc at the perception point, the curve is on 6% superelevation and is defined by median kerb. These factors will greatly aid motorists in being able to identify and appreciate the approaching geometry of the arc.

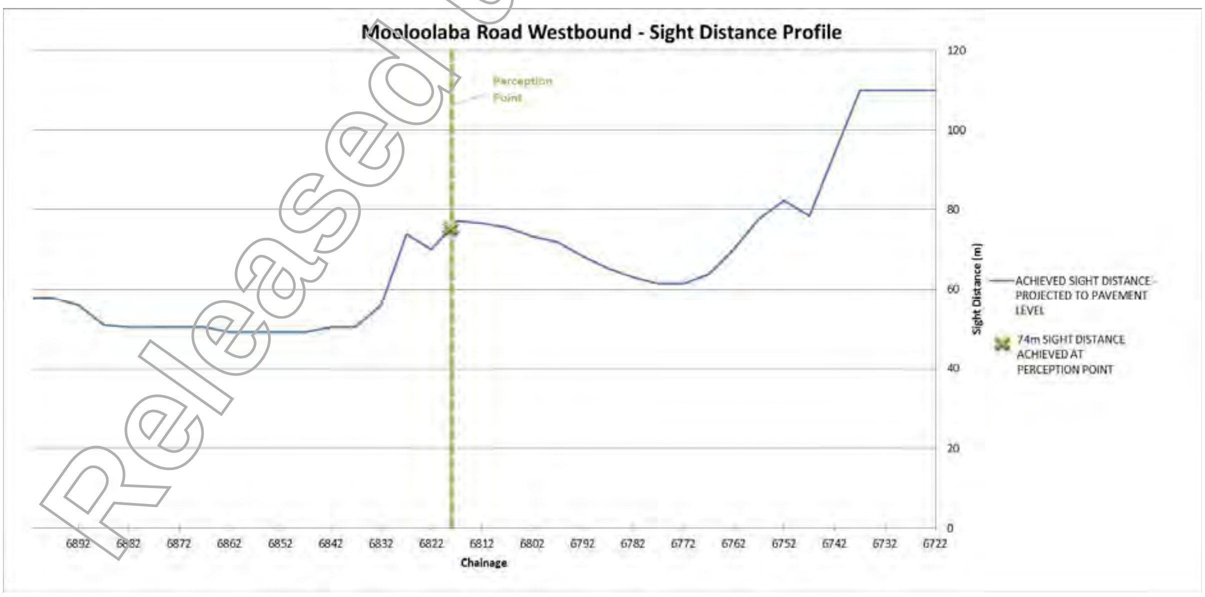

Figure 2 Mooloolaba Road Westbound - Sight Distance Profile

3.0 Contributing Factors

Whilst it is considered that there is adequate approach sight distance to the curve, the design team propose to improve the visual cues on the approach to the curve to increase awareness and perception of the curve; such features include:

- introducing a raised concrete median
- providing improved lighting
- installing curve advisory speed signs (50km/h)
- installation of reflective (frangible) bollards in the median to aid delineation (to be determined through further design development)
- potential introduction of Chevron Alignment Markers (to be determined through further design development)

4.0 Stopping Sight Distance

A Stopping Sight Distance (SSD) analysis was also undertaken for this approach and is based on a driver's eye height of 1.1m and an object height of 0.2m. The achieved SSD assumes the operating speed profile outlined in **Figure 1** and also accounts for grade correction. This graph indicates that the achieved SSD exceeds the requirements throughout the westbound approach to the curve. It is noted that a reaction time of 1.5s and a coefficient of deceleration of 0.41 has been adopted for the SSD analysis.

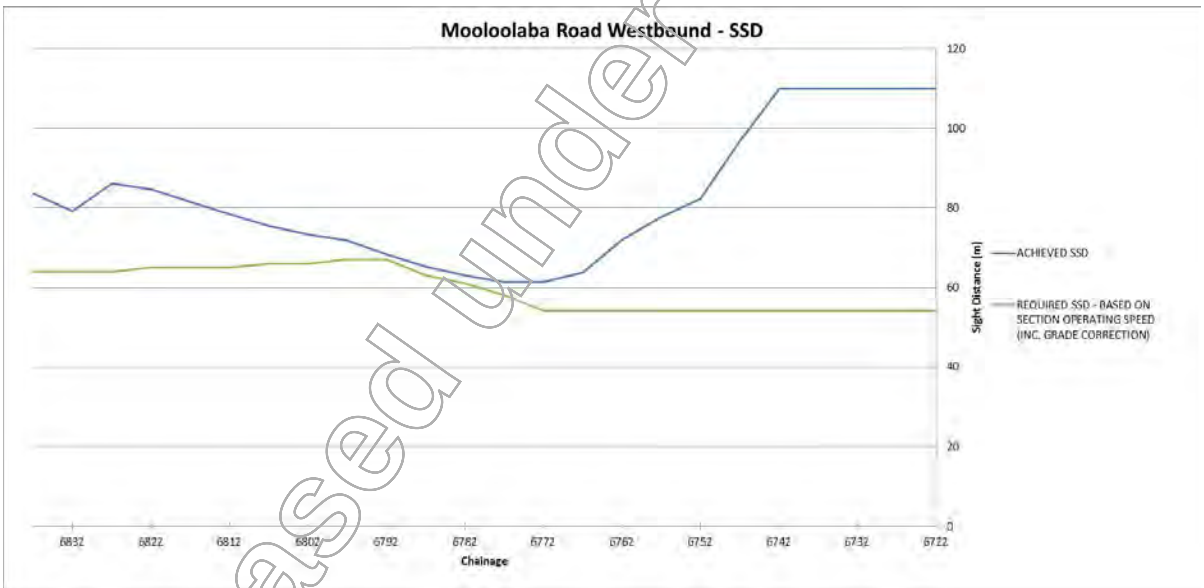

Figure 3 Mooloolaba Road Westbound – SSD

5.0 Conclusion

This analysis has investigated the curve perception of the horizontal curve on the westbound approach of Mooloolaba Road at Ch6,740.

Based on the assumptions and parameters outlined in this document, there is sufficient sight distance to allow for a driver's perception of the approaching curve and deceleration from the design speed to the SOS of the curve. Furthermore there is also sufficient SSD on the westbound approach based on the SOS profile outlined in this document.

As a result it is recommended that the R72m curve be adopted in the detail design.

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AECOM

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Minutes of Meeting

Mooloolaba Road - Buderim Hill

Subject	Foote Avenue Curve - Design Capability	Page	1
Venue	TMR Offices, Level 6, Boundary Street, Spring Hill	Time	11.30am
Participants	Ricky Cox (RC) (TMR) Mike Whitehead (MW) (TMR) Michael Bannah (MB) (AECOM) Matthew Gallagher (MG) (AECOM) Mark Westaway (MLW) (AECOM)		
Apologies			
File/Ref No.	60250500/MIN	Date	06-Sep-2012
Distribution	As above		

No	Item	Action	Date
1.0	**Introduction** AECOM outlined desire of meeting was to discuss the current options for the Foote Ave curve, their capability and intended drainage solutions in the area		
2.0	**Foote Avenue Curve** AECOM presented 2 option for the Foote Avenue Curve - Option 1 comprises R77 radius - Option 2 comprises R72 radius Option 1 has been amended since 30% Design Review issue to further reduce impact to wall. This has occurred through design development (reduction in median width through amended drainage solution, reduction in shoulder width and modifying spiral transition lengths through use of 0.035 radian superelevation transition) Option 1 now has approximately 35m impact to existing retaining wall on northern side Option 2 has no impact to existing retaining wall on northern side *(See attached spread sheet for Option capabilities)* **Documenting Curve Capability** Option 2 provides an approximate 20m length of SSD below 65km/h (desired speed) on the approach to the curve. RC suggested adopting the following methodology to document the capability of the curve for Option 2	NOTE	

No	Item	Action	Date
	1) Identify the point at which the curve can be perceived (Perception Point) for vehicles approaching the element at the desired speed (65km/h). This is defined as point at which the motorist has sufficient sight distance (from Eye to Pavement) to be able to appreciate the curve. This needs to consider preceding crest VC. 2) From Perception Point, calculate the distance available to react (Reaction Time) and Decelerate (at 2.5m/s/s) to 57km/h. It is desirable that this occurs before motorists enter the curve. This will create a speed profile leading into and through the curve 3) Based on the speed profile calculated in step 2, calculate the SSD required and test against SSD available *(Note – AECOM have since reviewed AustRoads Part 3, Section 5.10, Horizontal Curve Perception Sight Distance, and will ensure that the criteria described within this section are addressed)* MW questioned if the SSD achieved was below the SSD required for the speed profile, whether the curve should then be increased slightly and retested to ensure SSD was achieved. RC confirmed this was a suitable approach. AECOM are to test the curve capability and document using the above methodology RC and MW suggested possible further mitigation of the curve could be achieved through the installation of guide posts (preferably short and flexible base)	AECOM	
3.0	**Drainage** AECOM outlined recent discussions with ACO regarding use of ACO products. Further review of 30% design has identified possibly locations where use of lengths of ACO drain may be required. AECOM presented ACO information regarding use of transverse drain on Mountain Creek Road MW noted Ross Pritchard is likely to define performance based specifications for these products instead of identifying a specific manufacturer product MW suggested possibility of raising crown of Foote Avenue to better channel water towards existing kerb and channel, potentially negating the need for a transverse cutoff drain. AECOM to investigate	AECOM	

Buderim Hill

Department of Transport and Main Roads

16 August 2012

Document No. TI_RP_004

D R A F T

Buderim Hill

Technical Note - Extended Design Domain and Design Exception

D R A F T

Buderim Hill

Technical Note - Extended Design Domain and Design Exception

Prepared for

Department of Transport and Main Roads

Prepared by

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16 August 2012

60250500

AECOM in Australia and New Zealand is certified to the latest version of ISO9001 and ISO14001.

D R A F T

Quality Information

Document	Buderim Hill
Ref	60250500
Date	16 August 2012
Prepared by	Tom Evans
Reviewed by	Matthew Gallagher / Stephen Sewell

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
A	16-Aug-2012	Issued for In-Principle Approval	Nathan Guild/ Project Manager	

Client Acceptance (TMR)

The Extended Design Domain Elements and Design Exceptions outlined in this report are accepted subject to the following conditions/clarifications:

Title	Name	Comments	Signature	Date
TMR Project Manager	Leah McKenzie			
TMR Manager - Road Engineering Standards	Ricky Cox			
TMR Project owner - Regional Director, North Coast	Dennis Tennant			

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Table of Contents

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1.0 Introduction

AECOM Australia Pty Ltd (AECOM) has been commissioned by the Department of Transport and Main Roads (TMR) to prepare detailed design documentation for the upgrading of Mooloolaba Road extending from Chainage 6,650m to 7,500m.

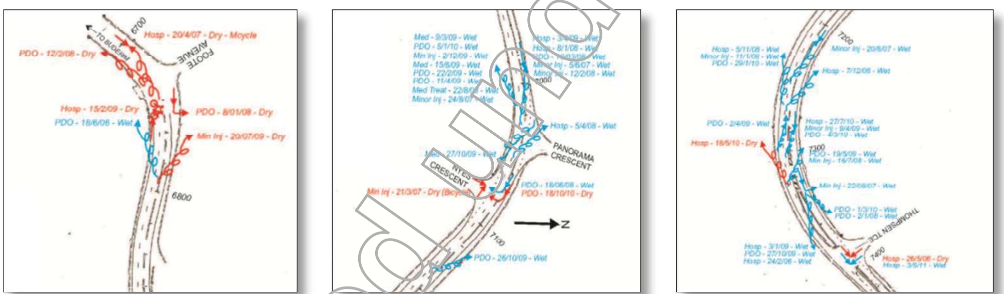
Mooloolaba Road (134) is a State-controlled road located in the Sunshine Coast between Mooloolaba and Buderim and is identified as a Controlled Distributor on the Sunshine Coast Regional Council Maroochy Plan 2000. Mooloolaba Road provides a link between Mooloolaba and Buderim, and provides access to the Sunshine Coast Private Hospital. Mooloolaba Road also provides connections to the Sunshine Motorway in the east and the Bruce Highway in the west.

1.1 Project Background

Mooloolaba Road has been subject to media interest regarding the amount of crashes that have taken place in recent times. As a result TMR engaged AECOM to review the existing conditions and develop options to improve performance of the section of road to an acceptable level. The findings of these studies have been outlined in an Existing Conditions Report (ECR) and a Design Development Report (DDR) both of which were compiled by AECOM and submitted to TMR in 2012. AECOM has worked closely with TMR through a number of design meetings in order to define both the design criteria objectives and the intended design approach for this section of road. This process resulted in the selection of a ‘Preferred Design Option’. AECOM is currently progressing this option to produce detailed design documentation.

The previous studies revealed that there have been 45 crashes, in three clusters, along this section of road since 2006 and that 80% of these crashes have taken place in wet weather. The crash diagram is illustrated in **Figure 1-1**.

Figure 1-1 Crash Cluster Diagrams



The desktop study and site investigations forming the basis of the aforementioned reports have identified existing issues relating to insufficient capacity of stormwater infrastructure; excessive flow path lengths; substandard combination of curve radius and superelevation on some curves; abrupt changes in superelevation through development lengths; deficiencies in Stopping Sight Distance (SSD) due to the horizontal geometry; and insufficient Safe Intersection Sight Distance (SISD) at Nyes Crescent and Thomsen Terrace. It was also noted that there are no formalised bicycle lanes.

1.2 Purpose of this Report

This technical note has been compiled in parallel with preparing the detailed design of the Preferred Design Option. This report acts as a standalone document which outlines areas within the design which are anticipated to form either a Design Exception or will require an application of the Extended Design Domain (EDD). It is intended that this document will form the application for in-principle approval for these specific design elements from the asset owner. As the detailed design progresses these elements will be formally documented in a separate Design Report.

It should be noted that this report was issued prior to the design reaching the 30% completion milestone, and therefore additional Design Exceptions or Extended Design Domain elements may be identified during the development of the detailed design. In such an instance in-principle approval will be sought through a separate application.

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2.0 Preferred Design Option

2.1 Design Development

In the initial stages of the project, and in the absence of speed survey information, AECOM investigated a design based on a 70km/h design speed, 10km/h above the previous posted speed. It is noted that Mooloolaba Road has historically been posted at 60km/h, although this has recently been lowered to 50km/h. In order to achieve this design speed it was identified that there would need to be geometric changes to achieve sight distance requirements as well as to address items such as flow paths, intersection arrangement, kerb and access changes and other safety issues. It became apparent that to achieve a 70km/h compliant alignment, large property impacts and construction costs would be incurred. TMR and AECOM therefore agreed on the Preferred Design Option which is based on the observed 85%ile operating speed. AECOM are now in the process of preparing the detailed design documentation for this design option.

The Preferred Design Option comprises of localised cross-fall correction to improve driveability and stormwater drainage; improvements to existing stormwater infrastructure; introduction of strategically located central medians to reduce flow path lengths; and resurfacing of the existing pavement. In some locations adjustments will be made to the lane alignment to increase sight distance and provide adequate shoulder width for flow paths, this in turn will provide sufficient width for on road cycle lanes.

The intention of this design option is to retain the existing mainline and intersection kerb alignment; this therefore forms the geometric constraint for this design option. It is however noted that embankment widening is required in the vicinity of Nyes Crescent and Panorama Crescent to facilitate local road accessibility. In light of the above constraint the preferred design option retains some of the design deficiencies identified in the existing alignment as outlined in **Section 3.0**.

2.2 Design Criteria

The design criteria for which the Preferred Design Option is based has been outlined in the ECR. This project specific design criteria defines the Extended Design Domain elements and Design Exceptions outlined in this report.

2.2.1 Design Speed

As previously mentioned the design speed for this section of road is based on the observed 85%ile operating speed as outlined below:

- Cars
  - 65km/h Chainage 6,650 to 7,500
- Trucks
  - 66km/h Westbound chainage 7,100 to 7,500
  - 60km/h Elsewhere within subject area

The above design speeds are derived from 2012 speed surveys along this section of road. The specific design speeds associated to cars and trucks were developed during the design option development stage of the project and the application of these speeds has been approved in-principle by TMR.

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3.0 Extended Design Domain and Design Exceptions

3.1 Extended Design Domain

It is anticipated that the achieved sight distance at numerous driveways within the area of works will form Extended Design Domain Elements. The full extent of these design deficiencies will become apparent during the design development and will be formally documented in a separate Design Report.

Table 3-1 documents the Extended Design Domain elements currently identified within the Preferred Design Option. All values outlined in this table have been derived from the concept design and therefore are approximate only; these values will be confirmed and documented during the detailed design stage.

Table 3-1 Mooloolaba Road - Extended Design Domain

Item	Issue	Location / Direction	Car / Truck	Design Speed	NDD	EDD	Achieved - Existing	Achieved – Preferred Design Option
1.00 Horizontal Geometry								
There are currently no Extended Design Domain elements relating to horizontal geometry identified.								
2.00 Vertical Geometry								
There are currently no Extended Design Domain elements relating to vertical geometry identified.								
3.00 Safe Intersection Sight Distance (SISD)								
There are currently no Extended Design Domain elements relating to SISD identified.								
4.00 Stopping Sight Distance (SSD)								
There are currently no Extended Design Domain elements relating to SSD identified.								
5.00 Driveway Entrances[1]								
5.01	SISD	Shared Residential Access at Chainage 6,850	Car (inc. truck)	65km/h	108m	92m	92m	92m

[1] Further Extended Design Domain elements relating to driveway entrances will be identified during the design development.

3.2 Design Exceptions

The following section provides a summary of the Design Exceptions which have been retained from the existing alignment. A summary of the key components of each Design Exception is included in **Table 3-2** and a brief summary of each item is outlined thereafter. All values outlined in this table have been derived from the concept design and therefore are approximate only; these values will be confirmed and documented during the detailed design stage.

Table 3-2 Mooloolaba Road - Design Exceptions

Item	Issue	Location / Direction	Car / Truck	Design Speed	NDD	EDD	Achieved - Existing	Achieved – Preferred Design Option
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D R A F T

Item	Issue	Location / Direction	Car / Truck	Design Speed	NDD	EDD	Achieved - Existing	Achieved – Preferred Design Option
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4.00 Stopping Sight Distance (SSD)								
4.01	SSD	Mooloolaba Road at Foote Avenue / Westbound	Trucks	60km/h	74m*	74m*	58m	69m
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5.00 Driveway Entrances								
5.01	SISD	Driveways on southern side of Mooloolaba Road at approx. Chainage 6,700 / westbound.	Car (inc. truck)	65km/h	106m*	89m*	33m	33m

* Grade correction not required
^ Grade correction applied

3.2.1 Design Exception 1 – Side Friction (Cars)

A technical memorandum outlining issues relating to operating speed, side friction demand and the limiting curve speed at this location is included in **Appendix A**. Subject to TMR's approval of the attached memorandum, this element will no longer form a design exception.

3.2.2 Design Exception 2 – Side Friction (Trucks)

Location

Mooloolaba Road eastbound and westbound at the Foote Avenue curve.

Existing Situation

At this location the existing horizontal radius (R=71m) requires a side frictional demand which exceeds the maximum requirements for trucks at a 60km/h design speed.

Recent crash data indicates that there have been six crashes at this location since January 2006, four of the six crashes consisted of vehicles losing control at the horizontal curve on the westbound approach. It is noted that none of these crashes involved a truck.

Capability Provided by Preferred Design Option

The lanes are realigned within the existing kerb alignment at this location, providing an increased radius (R=77m) along the travelled path thus reducing the side friction demand. The side friction demand at this location, whilst improved, still requires a design exception for trucks in both directions.

D R A F T

Implications on Preferred Design Option of Providing NDD

In order to achieve NDD land resumption would be required from private properties on the southern side of Mooloolaba Road.

Mitigation Measures

The following mitigation measures will be included as part of the Preferred Design Option:

- Raised median to improve driver perception of curve
- Improved road lighting
- Curve warning speed signage
- Tilting truck signage (TBC)
- “Concealed Driveways” warning signage

3.2.3 Design Exception 3 – SISD (Cars – Includes Trucks)

Location

Thomsen Terrace and the Mooloolaba Road eastbound approach.

Existing Situation

SISD is restricted to vehicles exiting Thomsen Terrace due to the existing property boundaries on the left hand side of the eastbound approach on Mooloolaba Road.

Recent crash data indicates that there have been 20 crashes (since January 2006) within the crash cluster on the horizontal curve in the vicinity of Thomsen Terrace. Two of these crashes involved a collision between a vehicle travelling eastbound on Mooloolaba Road and a vehicle attempting to exit Thomsen Terrace.

Capability Provided by Preferred Design Option

SISD is unchanged in the Preferred Design Option.

Implications on Preferred Design Option of Providing NDD

The horizontal curve at this location would need to be increased considerably to achieve NDD. It is noted that there is a vertical drop in excess of 15m on the southern side of Mooloolaba Road at chainage 7,350. Increasing the curve radius at this location would result in significant constructability issues; considerable land resumption and anticipated relocation of adjacent services; this possibility was discounted during the design development.

Mitigation Measures

The following mitigation measures will be included as part of the Preferred Design Option:

- “Concealed Driveways” warning signage where appropriate
- T-Intersection approach warning signage

3.2.4 Design Exception 4 – SSD (Trucks)

Location

Mooloolaba Road westbound at the Foote Avenue curve.

Existing Situation

The property line on the southern side of Mooloolaba Road restricts the SSD of trucks below NDD requirements for the westbound approach.

Recent crash data indicates that there have been six crashes at this location since January 2006; one of the six crashes consisted of a westbound vehicle colliding with a bicycle on the inside of the horizontal curve. It is noted that this crash did not involve a truck.

D R A F T

Capability Provided by Preferred Design Option

The lanes are realigned within the existing kerb alignment at this location; whilst improving the SSD the achieved value remains substandard for trucks on the westbound approach.

Implications on Preferred Design Option of Providing NDD

In order to achieve NDD land resumption would be required from the private properties on the southern side of Mooloolaba Road.

Mitigation Measures

The following mitigation measures will be included as part of the Preferred Design Option:

- Raised median to improve driver perception of curve
- Improved road lighting
- Curve warning speed signage
- “Concealed Driveways” warning signage

3.2.5 Design Exception 5 – SSD (Trucks)

Location

Mooloolaba Road eastbound at the horizontal curve west of Thomsen Terrace.

Existing Situation

SSD is restricted for eastbound vehicles due to the existing property boundaries on the northern side of Mooloolaba Road.

Recent crash data indicates that there is a crash cluster consisting of 20 crashes along this horizontal curve since January 2006. One of these crashes involved an eastbound vehicle colliding into the rear of another vehicle entering a private property; this crash did not involve a truck.

Capability Provided by Preferred Design Option

SSD is unchanged in the Preferred Design Option.

Implications on Preferred Design Option of Providing NDD

The horizontal curve at this location would need to be increased considerably to achieve NDD. It is noted that there is a vertical drop in excess of 15m on the southern side of Mooloolaba Road at chainage 7,350. Increasing the curve radius at this location would result in significant constructability issues; considerable land resumption and anticipated relocation of adjacent services; this possibility was discounted during the design development.

Mitigation Measures

The following mitigation measures will be included as part of the Preferred Design Option:

- “Concealed Driveways” warning signage where appropriate
- T-Intersection approach warning signage

3.2.6 Design Exception 6 – SISD (Cars – Includes Trucks)

Location

Driveways on southern side of Mooloolaba Road at approximate Chainage 6,700.

Existing Situation

SISD is restricted from Mooloolaba Road westbound approach to driveways on the southern side of Mooloolaba Road.

Recent crash data indicates that there have been six crashes at this location since January 2006; none of which have included vehicles entering properties on the southern side of Mooloolaba Road.

DRAFT

Capability Provided by Preferred Design Option

The lanes are realigned within the existing kerb alignment at this location; whilst improving SISD the achieved value remains substandard.

Implications on Preferred Design Option of Providing NDD

In order to achieve NDD land resumption would be required from the private properties on the southern side of Mooloolaba Road.

Mitigation Measures

The following mitigation measure will be included as part of the Preferred Design Option:

- Raised median to improve driver perception of curve
- Improved road lighting
- Curve warning speed signage
- "Concealed Driveways" warning signage

D R A F T

4.0 Conclusion

The proposed design includes retained Design Exception and Extended Design Domain elements and seeks to balance providing the necessary improvements in operational capability with competing social and financial considerations in aligning with the defined budget. As such some operational risks remain and TMR as the asset owner should confirm its informed acceptance of these limitations in approving “in-principle” this design.

DRAFT

Appendix A

Memorandum - *Foote Avenue Curve Design Capability*

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AECOM
Level 1
29 The Esplanade
Maroochydore QLD 4558
Attention: Nathan Guild

21 January 2013
REF: 412223

Dear Nathan

MOOLOOLABA ROAD BUDERIM HILL UPGRADE PROJECT

Thank you for your invitation to provide estimating assistance for the Mooloolaba Road Buderim Hill Upgrade Project.

Please see our attached P90 Project Cost Report.
Do not hesitate to contact the undersigned if you require anything further.

Yours faithfully
Aquenta Consulting

Dafydd Griffiths
PRINCIPAL

report

P90 Estimate Report for Mooloolaba Road Buderim Hill Upgrade Project

ISSUED TO:

AECOM

DATE:

21/01/2013

AQUENTA.COM.AU

aQuenta CONSULTING

DOCUMENT TITLE:

P90 ESTIMATE REPORT FOR MOOLOOLABA ROAD BUDERIM HILL UPGRADE PROJECT

PROJECT REFERENCE: **412223**

PURPOSE OF ISSUE: **P90 Report v02**

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ISSUE	DESCRIPTION OF AMENDMENT	AUTHOR	CHECKED	APPROVED	DATE
1	P90 Report v01	NK	RD	DG	26/11/12
2	P90 Report v02	NK	RD	DG	21/01/13

Previous issues of this document shall be destroyed or marked SUPERSEDED.

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TABLES

Figure 1 List of Appendices

APPENDIX	DESCRIPTION	USED
A	First Principles Construction Estimate	
B	Project Summary	
C	Principal"s Costs	
D	Out-turn Cost Calculation	
E	Information Reviewed	
F	Proposed Organisation Chart	Not Used
G	Construction Estimate Spread Analysis	
H	Ranked Resource Usage	
I	Plugged Rates	
J	Peer Review Report	
K	Independent Review Report	Not Used
L	Planned Risk	
M	Unplanned Risk (Project Contingency)	
N	Construction Programme	
O	Construction Methodology	
P	Estimate Approval Form	Not Used
Q	Out-turn Investment Cost Table	Not Used

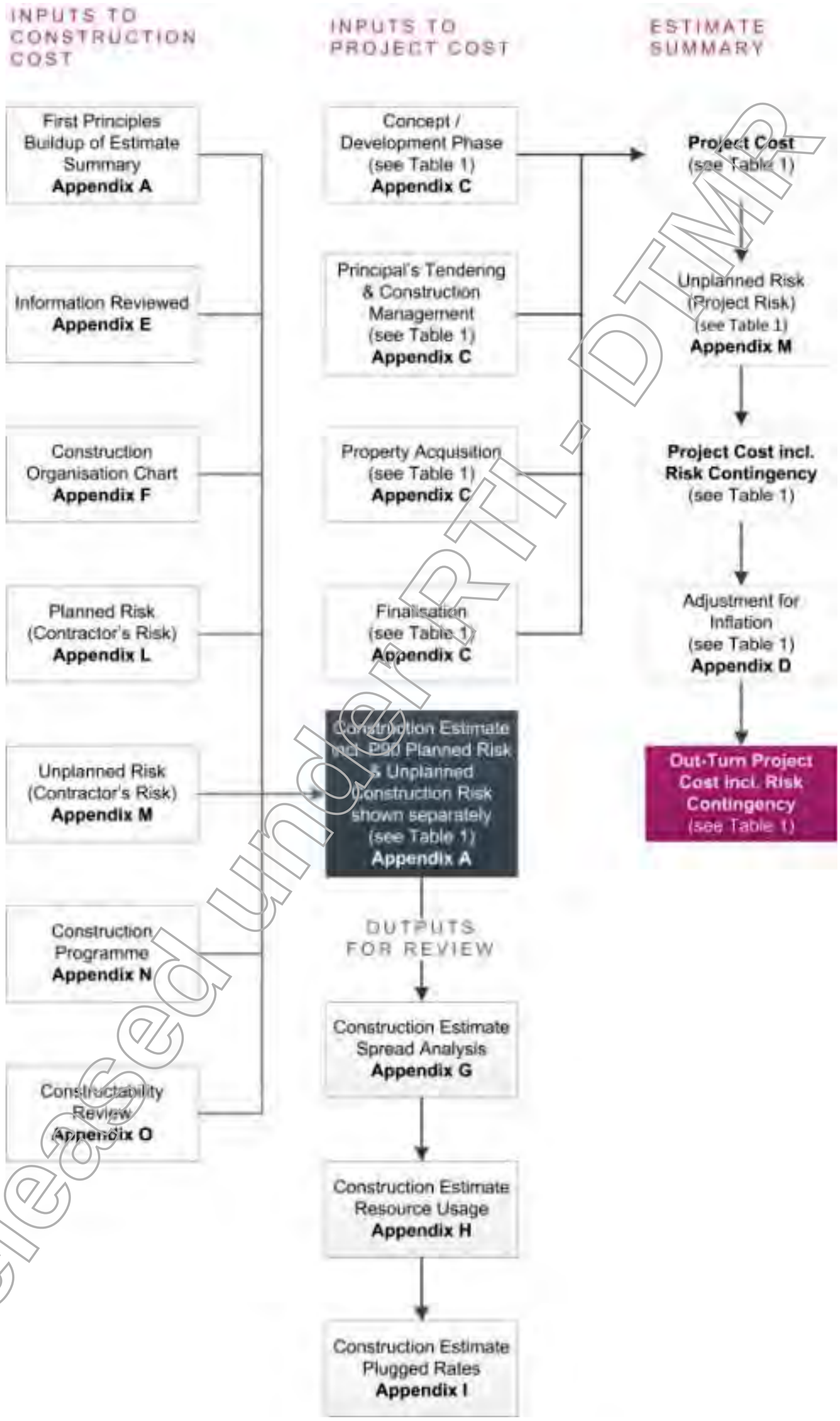
Figure 2 Glossary of Terms

For an explanation of general road construction terms please refer to the glossary in the Road Planning and Design Manual.

TERM	DEFINITION
Client Contingency	An allowance of funds to cover costs that may be incurred by the Client. In this Estimate the Client Contingency is based on all the identified planned and unplanned risks for the Project.
Construction Contingency	An allowance of funds to cover costs that may be incurred during the construction phase. In this Estimate the contractor contingency is based on the Contractor‟s rate uncertainty and of all the identified unplanned risks for the Project (Client and Contractor).
Construction Estimate	Estimate prepared covering the costs associated with the physical construction works. This item generally covers all costs that the construction Contractor will incur including the cost of plant, materials, labour, subcontractors, supervision, overheads, margin and contractor contingencies.
Direct Job Cost (DJC)	These cover the costs of material, plant, labour and Subcontractors for the construction of the physical works.
First Principles	First Principles, or „Resource Based Estimating‟, is a process of identifying every individual resource element (i.e. within labour, plant, materials and subcontract), required for the construction of a project. Direct and indirect cost schedule items contain multiple individual resources and resource rates. First Principles provides a detailed breakdown of the estimate costs of each element. A Bill of Quantities schedule item priced using First Principles achieves the most comprehensive detail possible for a cost estimate and therefore, the highest level of accuracy.
First Principles Build-up of Estimate	An Estimate prepared using First Principles as opposed to an historic rates build-up.
Indirect Job Costs (IJC)	These cover site supervision, overheads and recurring costs and all necessary insurances including Contractor‟s All Risk, Public Liability, Professional Indemnity, Workplace Health & Safety, Portable Long Service Leave Levy, Insurance Excess and Contractor‟s Security.
Monte Carlo Method	Monte Carlo refers to the traditional method of sampling random variables in simulation modelling. Samples are chosen completely randomly across the range of the distribution, thus necessitating large numbers of samples for convergence for highly skewed or long-tailed distributions.
Out-turn Cost	Cost expressed in dollars of the period in which they will be spent. Estimates prepared at a particular base date can be converted to Out-turn dollars by applying an appropriate inflationary rate over the time between the base date and period when the cost is incurred.

Planned Risks	Planned Risk Contingency relates to the risk or opportunity on items of work which must be carried out to complete the Project. It looks at the ranges of risk and opportunity on the quantities and rates of the identified items in the Project.
Project Cost	This is the combination of all costs associated with the project expressed at a particular base date. The Project cost does not include any Project Contingency or allowance for escalation.
P90 (90th Percentile)	A Percentile is an increment of the values in a data set. Percentiles divide the data into 100 equal parts, each containing one percent of the total values. The 90th Percentile (P90), for example, is the value in the data set for which 90% of the values are below it and 10% are above. This is generally used to give confidence the risk contingency is not exceeded.
Unplanned Risks	These are risks that have been identified as being related to the Project however it is not known whether or not they will eventuate.

Figure 3 Estimate Preparation Flowchart



1 Executive Summary

1.1 SCOPE OF REPORT

Aquenta Consulting has been engaged by AECOM to prepare a P90 Estimate Report for the Mooloolaba Road Buderim Hill Upgrade Project.

The proposed Project is located at Buderim and includes upgrading 1km of Mooloolaba Road to improve safety.

This Report details the Risk Adjusted Out-turn Estimate for the Mooloolaba Road Buderim Hill Upgrade Project only, which is based on the following:

- The base date for the Estimate is September 2012
- The escalation rate has been calculated using 6% escalation per annum from March 2013 to January 2014, this is discussed in detail in Section 3.5 of this Report
- A construction award date of March 2013 and an November 2013 completion of the Project
- A Roads Construction Contract (RCC) Schedule of Rates delivery
- A P90 risk allowance for both planned and unplanned risk
- Detailed Design Detail.

The Risk Adjusted Out-turned Project Costs include all Client costs associated with the Project and the Construction Estimate. The Construction Estimate includes the construction costs and any allowance that a Contractor would make in its tender for this Project to be delivered using the RCC delivery method. Given that the estimate is based on Detailed Design Detail; it should not be used in the future as a comparison with tenders without considering the following:

- Changes in scope due to revisions to TMR project requirements
- Changes in scope due to project specifications
- Changes in scope due to the proposed design in the tender
- Assessment of the latest construction industry costing data.

1.2 ESTIMATE SUMMARY

The Risk Adjusted Out-turn Project Cost for the Mooloolaba Road Buderim Hill Upgrade Project at P90 is $9,560,679 based on a construction award date of March 2013 and a November 2013 completion of all works. Table 1 below outlines the elements of the Project Cost.

TABLE 1 MOOLOOLABA ROAD BUDERIM HILL UPGRADE ESTIMATE SUMMARY

MOOLOOLABA ROAD BUDERIM HILL UPGRADE PROJECT	P50 LIKELY	P90 MAXIMUM
Principal"s Cost	**1,847,143**	**1,847,143**
Construction Cost	**6,338,186**	**6,338,186**
Contingency	**727,045**	**1,174,531**
Risk Adjusted Total Cost	**8,912,374**	**9,359,860**
Escalation	**193,070**	**200,819**
Total Risk Adjusted Out-turn Project Cost	**9,105,544**	**9,560,679**

The detailed breakdown of the Construction Estimate is contained in Appendix A. The Construction Estimate Project Summary illustrating the totals for Direct Cost, Indirect Cost and Profit is contained in Appendix B. The costs for Property Acquisitions have been supplied by TMR and are contained in Appendix C. Other costs attributable to the Principal have been determined by Aquenta Consulting based on TMR historical data are also included in Appendix C.

The calculation of the Adjustment for Inflation (Out-turn Cost) is based on an award date of March 2013. The anticipated rate of construction cost escalation is 6% compounding, and is discussed in Section 3.5 of this Report. The calculation of the Out-turn Cost is shown in Appendix D.

1.3 METHODOLOGY

The scheduled item costs have been created from First Principles. The Construction Estimate is based on a schedule of quantities prepared by AECOM. These quantities were produced from a Detailed Design produced by AECOM.

A number of elements of the Estimate rely on details that will be contained in the Annexure to the contract documents. As these documents are not currently available, recent experience from similar projects has been utilised to generate First Principles costings for these elements. A detailed list of elements where plugged rates (an estimate of the rate without a detailed build-up of the costs or no recent quotation of price from a supplier) are used, or lump sum allowances have been made is contained in Appendix I.

The Client Contingency or Risk Allowance to be retained by TMR has been determined using the P90 output from a detailed investigation of risks associated with the Project. The Client Contingency includes Client owned unplanned risks and opportunities and the risk on scheduled quantities as the design is owned by the Client. See Appendix M for the Risk Register.

The Construction Contingency, or the Risk Allowance for issues to be addressed by the Contractor, was also determined during the exercise noted above. Again the P90 output has been used. See Appendix M for the Risk Register. The planned Risk Allowance for the Contractor"s rate uncertainty (included in the Construction Contingency) and the Client"s quantity uncertainty has been evaluated and is contained in Appendix L.

1.4 MAIN ASSUMPTIONS

The key assumptions of the Construction Estimate are:

- The Project will be delivered as a TMR Construction Contract (RCC)
- Excavated material is spoiled offsite and not used for embankment construction due to construction staging
- Embankment material is imported min CBR15 material
- Class A recycled water for construction is imported to the site.

Section 3 contains all assumptions made during the Construction Estimate development.

2 Scope of Project

2.1 PROJECT DESCRIPTION

Planning for the Mooloolaba Road Buderim Hill Upgrade Project includes:

- Drainage Improvements to reduce sheeting across carriageways
- Improvement to horizontal alignment at Panorama Crescent
- Resurfacing of existing pavement.

A summary of the high level quantum of the Project is as follows:

- Total length of reconstructed road -- 1.07km
- Total area of pavement widening – 3,766m²
- Total area of pavement overlay– 14,782m²
- Total cut volume of earthworks – 3,209m³
- Total fill volume of earthworks – 4,555m³.

2.2 DOCUMENTS REVIEWED

This Report is based on all drawings, schedules and other information provided by AECOM up to and including 18 January 2013 (a summary of this information is contained in Appendix E).

2.3 LIMITATIONS OF ESTIMATE

The Estimate is limited by the detail provided in the documents which are currently at a Detailed Stage.

A number of assumptions have been made where details were not shown on the drawings or drawings were not provided. This Estimate should only be read in conjunction with the list of assumptions contained in Section 3.2.3 and the information listed in Appendix E.

Costs are quoted in September 2012 prices. While an Out-turn Cost has been provided, any future comparison with tenders should not be performed without appropriate reassessment of the design, cost rates prevailing at the time of tender, the construction programme, the latest outlook for cost escalation and the associated risk profiles of the bidding entities. All these factors will have a significant effect on the Out-turn Cost of the Project.

3 Out-Turn Project Cost (including contingency)

The Out-turn Project Cost (including contingency) presented in this Report comprises a number of parts. These are the Principal‟s Costs, Construction Estimate, Project Contingency and an Allowance for Inflation. Integral to the Construction Estimate and the Allowance for Inflation is the construction programme and methodology.

3.1 PRINCIPAL‟S COSTS

The Estimate of cost for each of the following elements was calculated by Aquenta Consulting in accordance with TMR calculations for projects at the current level of development:

TABLE 2 PRINCIPAL‟S COSTS SUMMARY

COST ELEMENT	AMOUNT
Detailed	50,000
Development	562,500
Implementation	719,643
Finalisation	65,000
Property Acquisition	Nil
Services Relocation	450,000
Principal‟s Obligations	Included
Total Principal‟s Cost	1,847,143

Property Acquisition

No property acquisition is required.

Public Utility Plant

Public Utility Costs have been provided by AECOM or where no cost provided an allowance has been made based on details provided by AECOM. The costs for Public Utilities allowed for in the Project are as follows:

Water Main	200,000
Telstra	170,000
Electrical	50,000
TMR Administration	30,000
TOTAL	**450,000**

These costs have been included in Appendix C – Principal"s Costs.

3.2 CONSTRUCTION ESTIMATE

3.2.1 Methodology

The Construction Estimate was prepared from First Principles in a manner similar to the development of a tender by a construction Contractor. The Estimate consists of the following:

Direct Job Costs: These cover the costs of material, plant, labour and Subcontractors for the construction of the physical works.

Indirect Costs: These cover the recurring and non-recurring overhead costs required to deliver the Project. The main headings contained in the Indirect Cost Schedule are:

- Supervision
- Staff allowances
- Site vehicles
- Site facilities
- Office facilities
- Insurances and fees
- Site services
- Plant and equipment transport
- Finance
- Escalation
- Survey
- Small plant
- Miscellaneous items.

For this Project the total Indirect Job Cost allowance derived from First Principles equates to 33.38% of the Direct Job Costs.

Profit: This covers the Contractor"s profit and head office overheads. For this Project, construction will be undertaken by Roadtek. Recent discussions with construction Contractors have indicated that for a project of this size a profit margin of approximately 7% to 10% on the total cost would be used based on the RCC delivery method.

However, based on the P90 approach the upper limit of the profit margin has been adopted.

The spread analysis for the Estimate shows the direct cost, indirect cost, and profit for each of the scheduled items and is contained in Appendix G.

A summary of the Ranked Resource Usage illustrating the usage by volume and value of individual resources is provided in Appendix H.

Risk and Opportunity: This covers the time lost to inclement weather, increases in sensitive material costs, availability of resources, availability of Subcontractors, a possible reduction in duration of the construction period, possible buying gains on materials and Subcontractors and other construction related issues. This is determined as a part of the Unplanned Risk Analysis discussed further in Section 3.3.

TABLE 3 CONSTRUCTION ESTIMATE SUMMARY

COST ELEMENT	AMOUNT	% OF DJC
Direct Costs	4,319,941	100.00
Indirect Costs	1,442,035	33.38
Profit	576,198	13.34
Total Construction Cost	**6,338,174**	**146.72**

3.2.2 Review

A Peer Review was carried out by an Estimator employed by Aquenta Consulting who was not directly involved with the preparation of the Estimate. This Construction Estimate responds to the comments made during this review, a list of the comments made is contained in Appendix J.

3.2.3 Assumptions/Data Used

During the preparation of the Construction Estimate the following assumptions (listed below) were made. All references to TMR item numbers correspond to the left hand column of the table in Appendix A.

Product Pricing

The following budget prices were obtained from suppliers and sub-contractors within the industry relevant to this Project:

- Asphalt — Boral Asphalt
- Reinforced Concrete Pipes — Humes
- Plant — Alexanderson Earthmover

It should be noted that the supply quotations illustrated above were for budgeting purposes only and it is likely that more competitive prices would be provided when the Project is tendered. This was considered during the Risk Analysis.

Indirect Costs / Effective Mark-up

- Contractor‟s profit is calculated as 10% of the total project value and is based on the following general allowances for projects under $10M:
  - State Head Office Requirement 6%
  - Project Profit 4%
- Contractor‟s site facilities are priced in the indirect cost schedule, however a nominated allowance based on $0.125M is used which utilises indirect cost funds and increases the Contractor‟s cash flow at the start of the Project
- Principal Contractor‟s Construction Duration is programmed at 36 weeks inclusive of four weeks wet weather allowance
- Total labour hours on site for the Project is 15,331 labour hours = 426 labour weeks approximately. Based on an average of 50 working hours per week, an average of 9 labourers and trades personnel will be on site for the construction duration
- Total plant hours allowed for the Project is estimated at 6,295 hours = 175 plant weeks approximately. Based on an average of 50 working hours per week, an average of 4 plant operators will be on site for the construction duration
- Full suite of insurances and fees has been budgeted over and above TMR “Principal Arranged Insurances” (PAI). This includes Contractors All Risk, Public Liability, Insurance Excesses and Security Retention
- The Principal Contractor‟s owned risks and opportunities have been included in the Cost Estimate Report
- Allowance is made for office facilities for the Superintendent.

Labour

Sch.4 Part

- Skilled labour is based on per hour
- Concrete workers are based on per hour
- Steel fixers are based on per hour
- Trades personnel is based on per hour

Figure 4 Schedule Item Notes

SCHEDULE A - PRELIMINARIES

Contractor's Site Facilities and Camp

Item 1101.01	The allowance for Contractor's Site Facilities has been priced using First Principles and is contained in the Indirect Cost Schedule. The amount illustrated in the priced Bill of Quantities is a nominated sum which is generally higher than that actually required and deducted from the Indirect Costs. This allows the Contractor to increase cash flow at the beginning of the Project.

Provision for Traffic

Note	The following provisions for traffic items have been allowed: Costs for a number of these items are duration based. The duration for this Project has been allowed at 36 weeks.
Item 1201.01	Provision for traffic - allowances made for traffic controllers, temporary line marking, temporary transitions, plastic Triton barriers and signs.
Item 1202.01	Traffic management plan - allowance is for two staff for duration of 1 week each.
Item 1203.01	Roadwork signing records - allowance is 1 staff to maintain records for 1hr/day for duration of Project.

Environmental Management

Note	The following Environmental Management items have been allowed: Costs for a number of these items are duration based. The duration for this Project has been allowed at 36 weeks.
Item 1331.01	Development of Environmental Management Plans - the allowance for the development of Environmental Management Plans includes 2 staff for a combined duration of 1 week.
Item 1332.01	Implementation of Environmental Management Plans - allowances have been made for environmental audits, temporary construction entry/exit points, protection of public and property, waste disposal, maintenance of existing roads and maintenance of environmental controls.
Item 1333.01	Environmental licences, permits and approvals – no allowance included.
Item 1351.01P	Cultural heritage inductions - no allowance included.
Item 1355.01	Increased noise during construction is assumed to be a low risk item, a nominal allowance has been included.
Item 1361.01P	Condition survey and vibration monitoring - a nominal allowance has been included.
Item 1365.01P	Air quality monitoring - a nominal allowance has been included.

Item 1375.01	A nominal allowance has been made to manage the fauna.
Item 1381.01P	Pest control - no allowance included.
Item 9000.01	Erosion and sediment control – an allowance for silt fences, straw bales, erosion control matting and a small sediment basin have been included.
Item 9001.01	Provide as-built data - allowance is for two staff for duration of 1 week each.
Item 9003.01	Liaison and co-ordination of affected utilities work - a nominal allowance has been included.
Item 9004.01	Relationship Management - a nominal allowance has been included.
Item 9005.01	Accommodation Works – nominal allowances for labour, plant and materials have been included based on the indicative work required as per Supplementary Specification 7.
Item 9005.02	Accommodation Works – nominal allowances for labour, plant and materials have been included based on the indicative work required as per Supplementary Specification 7.
Item 9005.03	Accommodation Works – nominal allowances for labour, plant and materials have been included based on the indicative work required as per Supplementary Specification 7.
Item 9005.04	Accommodation Works – nominal allowances for labour, plant and materials have been included based on the indicative work required as per Supplementary Specification 7.
Item 9005.05	Accommodation Works – nominal allowances for labour, plant and materials have been included based on the indicative work required as per Supplementary Specification 7.
Item 9005.06	Accommodation Works – nominal allowances for labour, plant and materials have been included based on the indicative work required as per Supplementary Specification 7.
Item 9005.07	Accommodation Works – nominal allowances for labour, plant and materials have been included based on the indicative work required as per Supplementary Specification 7.
Item 9005.08	Accommodation Works – nominal allowances for labour, plant and materials have been included based on the indicative work required as per Supplementary Specification 7.
Item 9005.09	Accommodation Works – Not priced as no details in Supp Spec.

SCHEDULE B - DRAINAGE

Removal/Demolition

Item 2101.01/ 2103.01	Quantities of culverts to be removed have been taken from the drawings with disposal off site at a licensed tip; no allowance for backfilling has been included.

Item 2106.01/ 2108.01	Disposal has been allowed off site at a licensed tip; no allowance for backfilling has been included.
Supply & Installation of Culverts	
Item 2241.01 to 2241.05/9006.01	Installation with support has been allowed with disposal off site at a licensed tip.
Concrete in Culverts and End Structures	
Item 2317.01	The assumption is that these structures are standard.
Pavement Drainage	
Item 2401.01 to 03	Type 1, 5A, 9 and 9A kerbing has been allowed as specified.
Item 2403.01/02 and 2405.01	Concrete channeling has been allowed as specified.
Item 2404.01 and 2404.02	Concrete kerbing and channeling has been allowed as specified.
Item 2413.01/ 2415.01 and 2416.01 to 05	Concrete gullies and precast chambers have been allowed as specified.
Item 9007.01 to 05	Grated drains have been sourced from ACO Australia.
Item 9008.01/ 02 Item 9009.01 Item 9010.01 Item 9011.01 Item 9012.01 Item 9013.01	All concrete works associated with these items have been formed and cast in-situ.
Protective Treatments	
Item 2631.01 to 04	Hand placed concrete paving has been allowed as specified.
Pavement Drains	
Item 2801.01 Item 2802.01/02S Item 2803.01	Pavement drains, outlets and cleanout points have been allowed as specified.

Earthworks - Preparation	
Item 3101.01 Item 3103.01P Item 3104.01	All spoiled material has been disposed off site with unsuitable material at a licensed tip.

Item 3108.01P	
Item 3304.01P	Geotextile has been allowed as specified.
Earthworks - Excavation	
Item 3201.01 Item 3211.01P Item 3212.01P Item 3215.01P	This item was made up of OTR material and non-rippable material in both confined and unconfined excavations. It has been assumed blasting will not be required so an excavator with a rock hammer will be utilised. Productivities have been reduced to take cognizance of the limitations imposed by the under traffic requirements.
Earthworks - Embankment	
Item 3301.01 and 3306.01	Embankments and verges will also be placed at reduced production rates to match the restricted site conditions.
Earthworks - Subgrade	
Item 3401.01P	Testing has been allowed as specified.
Item 3402P	An allowance has been made for this over an area of 3,770m² which is a new item that we have inserted.
Item 3403.01P	Subgrade in cuttings has been allowed as specified.
Earthworks - Backfill	
Item 3502.01P	This backfill material has been allowed to be imported and will be placed at reduced production rates to match the restricted site conditions.
Unbound Pavements/Plant Mixed Stabilised Pavements/Supply of Cover Aggregate	
Item 4153 Item 4301.01 Item 4321.01 Item 5011.01/02	These items have been allowed as specified.
Sprayed Bitumen Surfacing (Excluding Emulsions)	
Item 5101.01S Item 5103.01S/2PS Item 5112.01S/2S	These items have been allowed as specified.
Geotextiles For Paving Applications	
Item 5151.01P and Item 5153.01P	These items have been allowed as specified.
Preparation of the Existing Surface	
Item 5401.01 Item 5402.01P Item 5403.01P	These items have been allowed as specified.

Item 5404.01 Item 9115.01P/2P	

Dense Graded Asphalt

Item 5405.01/02 Item 5503.01/02 Item5504.01 Item 5543.01P Item9116.01 Item 9117.01P Item 9118.01/02	These items have been allowed as specified.

Removal/Demolition/Re-erection of Road Furniture

Item 6101.01	This item comprises approximately 500m of guardrail and approximately 100No signs.
Item 6104.01	This item comprises a single electronic speed sign.

Roadside Structures

Item 6181.01	This item has been allowed as specified.

Guidance and Information System

Item 6121.01/ 6131.01	These items comprise approximately 100No signs.
Item 6136.01	This item comprises 4No project signs.
Item 9119.01	This item has been allowed as specified.

Roadside Structures

Item 6161.01 and Item 6163.01	These items have been allowed as specified.

Line Marking

Item 6313/4.01 Item 6315/8.01 Item 6319.01/2S Item 6321/2/3.01 Item 6331/1.01	These items have been allowed as specified.

Raised Pavement Markers

Item 6351.01	This item has been allowed as specified.

Conduit and Conduit Fittings

Item 6507.01/02/03	These items have been allowed as specified.

Cable Jointing Pits	
Item 6554.03	These items have been allowed as specified.
Road Lighting Footings	
Item 6701.01	This item has been allowed as specified.
Road Lighting	
Item 6771.01 to 04	These items have been allowed as specified.
Item 6776.01 to 03	These items have been allowed as specified.
Item 6781.01	This item has been allowed as specified.
Switchboards	
Item 6801/03.01	These items have been allowed as specified.
Electrical Cables	
Item 6811.01/02 Item 6816.01 Item 6821.01/01	These items have been allowed as specified.
Item 6831	An allowance has been made for mains connection equipment; this is a new item that we have inserted.
Monitoring and Control	
Item 1345.01	This item has been allowed as specified.
Vegetation Ground Works	
Item 3713.01	This item has been allowed as specified.
Turfing	
Item 3782.01	This item has been allowed as specified.
Input Controlled Seeding	
Item 3772.01P	This item has been allowed as specified.
Preparation Treatments	
Item 3811.01	This item has been allowed as specified.

3.3 RISK AND OPPORTUNITY ANALYSIS

Details of the Risk and Opportunity Analysis undertaken is contained in Appendix M. Below is a summary of this information.

TABLE 4 P50 CONTINGENCY SUMMARY

P50 RISK	CONSTRUCTION	CLIENT	TOTAL
Planned Risk	55,169	37,270	92,439
Unplanned Risk	248,089	386,517	634,607
Total	**303,258**	**423,787**	**727,045**

TABLE 5 P90 CONTINGENCY SUMMARY

P90 RISK	CONSTRUCTION	CLIENT	TOTAL
Planned Risk	126,519	100,243	226,763
Unplanned Risk	340,985	606,784	947,768
Total	**467,504**	**707,027**	**1,174,531**

3.3.1 Construction Contingency

The Construction Contingency refers to the allowances made relating to the Contractor‟s cost to construct the Project. This includes the allowance determined from the planned and unplanned risk assessments.

Planned Risk Contingency relates to the uncertainty on items of work which must be carried out to complete the Project. It looks at the ranges of uncertainty, on the rates of the identified items in the Project.

The Project is assumed to be delivered by the RCC method therefore the Risk on Quantum resides with the Client and is included in the Client Contingency. The range on the rate for each particular type of work has been determined based on the costing data used and the level of certainty in the construction details and method. This produces a range where the cost to do the identified work will fall. The upper limit (P90 selected) of the range and likely (P50) values have been used to give a range that the Cost Estimate will fall in for construction of the scheme as it stands when this Estimate was prepared. This gives a total Contractor‟s Planned Risk of $126,519 at P90 and $55,169 at P50 which are included in respective construction contingencies shown in Table 4 and 5 of the Report. Details of the determination of the Planned Risk Contingency are contained in Appendix L.

The assessment of the Contractor owned unplanned risks was carried out as part of the overall unplanned risk evaluation. These risks include those relating to the Contractor"s physical delivery of the Project after contract award, as well as the risks relating to changes that the Contractor will have included in its tender submission that are not in the current design. A likelihood and consequence of each risk occurring was determined and fed into the Risk Analysis.

The Monte Carlo Analysis runs a series of calculations of the total unplanned risk cost using different values from the individual ranges each time. This series of total unplanned risk costs then give the distribution and range for the unplanned risk contingency. A range, P90 and P50 have been reported for the Construction Estimate. The P90 Cost Estimate for the unplanned Construction Risk is $340,985. The P50 Cost Estimate for unplanned Construction Risk is $248,089. These are included in the respective construction contingencies shown in Table 4 and 5. Details of the analysis are included in Appendix M.

The major risks that contribute to this total are:

- Increase in design detail from the current design to the Detailed Design that will be tendered upon.

3.3.2 Client Contingency

The Client Contingency consists of risk allowances from planned and unplanned assessments of various elements of the Project. These elements are:

- Uncertainty on schedule quantities – Planned Risk Assessment
- Uncertainty on events affecting the Project – Unplanned Risk Assessment.

As the Project is assumed to be delivered as an RCC (schedule of rates) the risk on quantum resides with TMR. This risk on quantum has been evaluated separately to the rate risk and the P90 and P50 allowances have been included in the project contingency shown in Table 4 and 5. The P90 allowance for uncertainty on quantity is $100,243 and $37,270 for P50. The output of this assessment is contained in Appendix L.

A number of unplanned risks and opportunities will be owned by the Client and accounted for in the Client Contingency. The Risk Register contained in Appendix M gives the probability and valuation of each risk, expressed as a range. The Monte Carlo Analysis runs a series of calculations of the total unplanned risk cost using different values from the individual ranges each time. This series of total unplanned risk costs then give the distribution and range for the unplanned risk contingency. The upper limit (P90 selected) of the range and likely (P50) values have been used to give confidence that the project cost will not be exceeded during delivery of the Project. The P90 Cost Estimate for the unplanned project risks is $606,784 and $386,517 for P50.

The data in the table contained in Appendix M is for one of the series of total unplanned risk cost calculations and cannot be related directly to the unplanned risk contingency for either option. The results of the Monte Carlo Analysis can be seen on the sheet titled Simulation Results in Appendix M.

The major risks that contribute to this total are:

- Risk of delay to the Project during any phase of the delivery process
- Scope change
- Unknown services and delays by Service Authorities.

3.4 CONSTRUCTION PROGRAMME

3.4.1 Overview

The Principal Contractors project duration is programmed at 36 weeks. The Construction Programme is included in Appendix N.

The Project comprises; new longitudinal and cross drainage, re-grading earthworks, kerbs, medians, drainage channels, replacement of deep pavement, re-surfacing of the whole road, lighting and road furniture. This sequence gives the overall critical path for the Project.

The Critical Path can vary on any project due to the phasing or sequencing of the works based on available areas and the resources which can be employed. This project has six sequential phases which have been imposed due to the need to maintain traffic flow and limit the impact of the works. However within each phase it is the drainage works which are the most critical. The drainage is critical because we have linked the work starting from the outlet and working uphill. After the drainage has been installed then the road pavement works can commence.

The programme has been prepared based on a 5 day working week with 3 days per month wet weather allowance.

3.5 ADJUSTMENT FOR ESCALATION

The allowance for escalation of costs for the Project has been calculated as shown in Appendix D. The timing for incurring costs has been prepared based on the contract award of March 2013 and a construction completion of November 2013.

The following costs have been escalated over various periods as shown in Appendix D:

- Project development
- Principal"s tendering and construction management (includes the allowance for rise and fall post contract award)
- Finalisation
- Construction Estimate (includes the escalation of cost from the date of this report to contract award)
- Project Contingency.

The following escalation allowances have been made in determining Out-turn Costs:

- July 2012 to February 2013 0%
- March 2013 to June 2014 6%

No escalation has been allowed from September 2012 to March 2013 as it is considered that likely cost increases will be minimal and covered by the 6% allowed from March 2013 through to project completion.

TABLE 6 ESCALATION SUMMARY

COST ELEMENT	P50 LIKELY	P90 MAXIMUM
Principal"s Costs	187,535	191,585
Construction Cost	0	0
Contingency	5,535	9,235
Total Escalation	**193,070**	**200,819**

Appendix A: First Principles Construction Estimate

This Appendix contains the Submission Schedule for the Construction Estimate.

This estimate has been prepared in the same manner as a Contractor would prepare an estimate and is expressed in September 2012 dollars.

Item	Description	Unit	Quantity	Unit rate	Amount
	PRELIMINARY DESIGN ESTIMATE FOR PROJECT 263/134/480				
	Local Authority: Sunshine Coast Regional Council				
	Road: 134				
	Estimate Number: A - Preliminaries				
	Estimate Location:				
	Contract Number: NCHD 2543				
	NOTE: Estimate must be considered absolutely as the property of Main Roads until the acceptance of a tender, and must under no circumstances be divulged.				
	Schedule A - Preliminaries				
	CONTRACTOR'S SITE FACILITIES AND CAMP (MRS28 Jun 09)				
1101.01	Contractor's site facilities (MRS28 Jun 09)	lump			125,000
	PROVISION FOR TRAFFIC (MRS02 Oct 10)				
1201.01	Provision for traffic (MRS02 Oct 10)	lump			463,208
1202.01	Traffic Management Plan (MRS02 Oct 10)	lump			14,964
1203.01	Roadwork signing records (MRS02 Oct 10)	lump			18,532
	ENVIRONMENTAL MANAGEMENT (MRS51 Apr 11)				
1331.01	Develop Environmental Management Plan (Construction) (MRS51 Apr 11)	lump			6,515
1332.01	Implement Environmental Management Plan (Construction) (MRS51 Apr 11)	lump			43,909
1333.01	Environmental Licences, Permits and Approvals (MRS51 Apr 11)	lump			
1351.01P	Cultural Heritage Management, if ordered (Provisional Quantity) (MRS51 Apr 11)	lump			
1355.01P	Noise monitoring, if ordered (Provisional Quantity) (MRS51 Apr 11)	lump			35,956
1361.01P	Condition survey and vibration monitoring, if ordered (Provisional Quantity) (MRS51 Apr 11)	lump			71,913
1365.01P	Air quality monitoring, if ordered (Provisional Quantity) (MRS51 Apr 11)	lump			35,956
1375.01P	Fauna management, if ordered (Provisional Quantity) (MRS51 Apr 11)	lump			14,466
1381.01P	Pest Control, if ordered (Provisional Quantity) (MRS51 Apr 11)	lump			
9000.01S	Erosion and Sedimentation Control (Refer to Supp Spec 2)	lump			57,551
9001.01S	Provide As-Built Data (SCRSS901) (Refer to Supp Spec 3)	lump			10,424
9003.01S	Liaison and Co-ordination of affected utilities work (Refer to Supp Spec 5)	lump			7,191
9004.01S	Relationship Management (Refer to Supp Spec 6)	lump			14,383
9005.01S	Accommodation Works to Lot 22 RP228644 (Refer to Supp Spec 7)	lump			1,810
9005.02S	Accommodation Works to Lot 1 RP111424 (Refer to Supp Spec 7)	lump			4,678
9005.03S	Accommodation Works to Lot 1 RP109329 (Refer to Supp Spec 7)	lump			4,344
9005.04S	Accommodation Works to Lot 10 RP132410 (Refer to Supp Spec 7)	lump			4,903
9005.05S	Accommodation Works to Lot 11 RP132410 (Refer to Supp Spec 7)	lump			1,810
9005.06S	Accommodation Works to Lot 2 RP93588 (Refer to Supp Spec 7)	lump			1,852
9005.07S	Accommodation Works to Lot 3 SP897856 (Refer to Supp Spec 7)	lump			3,620
9005.08S	Accommodation Works to Lot 5 RP80359 (Refer to Supp Spec 7)	lump			2,238
9005.09S	Accommodation Works to Lot 3 RP153972 (Refer to Supp Spec 7)	lump			
	Schedule B - Drainage				
	REMOVAL/DEMOLITION (MRS03 Oct 10)				
2101.01	Removal or demolition of culverts, complete (MRS03 Oct 10)	lump			1,899
2103.01	Removal or demolition of culverts excluding end structures (MRS03 Oct 10)	lump			1,601
2106.01	Removal or demolition of concrete kerb and channel including kerb crossings (MRS03 Oct 10)	m	Sch.4 Part 4 s.7(1)(c)		$ 39,704
2108.01	Removal or demolition of gullies	each			$ 4,315
9015.01PS	Supply and place flowable fill in abandoned pipes and culverts (Provisional Quantity) (Refer to Supp Spec 4)	m3			$ 76,118
	SUPPLY AND INSTALLATION OF CULVERTS (MRS03 Oct 10)				

Item	Description	Unit	Quantity	Unit rate	Amount
2241.01	Supply and installation of concrete pipe culvert components, Class 2, 375 mm diameter (MRS03 Oct 10)	m	Sch.4 Part 4 s.7(1)(c)		$ 55,902
2241.02	Supply and installation of concrete pipe culvert components, Class 3, 375 mm diameter (MRS03 Oct 10)	m			$ 241,220
2241.03	Supply and installation of concrete pipe culvert components, Class 2, 450 mm diameter (MRS03 Oct 10)	m			$ 45,798
2241.04	Supply and installation of concrete pipe culvert components, Class 3, 450 mm diameter (MRS03 Oct 10)	m			$ 75,010
2241.05	Supply and installation of concrete pipe culvert components, Class 3, 525 mm diameter (MRS03 Oct 10)	m			$ 12,915
9006.01	Supply and installation of uPVC pipe culvert components, 150 mm diameter (MRS03 Oct 10) (refer Supp Spec 8)	m			$ 4,043
	CONCRETE IN CULVERTS AND END STRUCTURES (MRS03 Oct 10)				
2317.01	Precast concrete end structures to culverts, 525 mm diameter (MRS03 Oct 10)	each			$ 2,617
	PAVEMENT DRAINAGE (MRS03 Oct 10)				
2401.01	Concrete kerb, Type 1 (MRS03 Oct 10)	m			$ 10,369
2401.02	Concrete kerb, Type 5A (Modified kerb dowelled with grated drain, refer detail)	m			$ 29,192
2401.03	Concrete kerb, Type 9 (MRS03 Oct 10)	m			$ 7,603
2401.04	Concrete kerb, Type 9A (Modified kerb dowelled with grated drain, refer detail)	m			$ 43,616
2403.01	Concrete channel, Type 22 (MRS03 Oct 10)	m			$ 3,405
2403.02	Concrete channel, Vee drain, refer detail	m			$ 6,410
2404.01	Concrete kerb and channel, Type 7 (MRS03 Oct 10)	m			$ 71,300
2404.02	Concrete kerb and channel, Type 15 (MRS03 Oct 10)	m			$ 14,594
2405.01	Concrete channel, Type 17 (MRS03 Oct 10)	m			$ 10,241
2405.02	Concrete kerb and channel crossings, Pedestrian Ramp Type 2, (MRS03 Oct 10) Refer to TMR STD DRG 1446	each			$ 720
2413.01	Concrete gullies, Field Inlet Type 1, single Gully, Std Drg 1309 (MRS03 Oct 10)	each			$ 2,261
2416.01	Precast concrete side inlet gullies with 1050mm diameter precast shaft, "S" lintel, Kerb in Line, Inlet on Grade (MRS03 Oct 10)	each			$ 43,858
2416.02	Precast concrete side inlet gullies with 1050mm diameter precast shaft, "S" lintel, Lip in Line, Inlet on Grade (MRS03 Oct 10)	each			$ 131,573
2416.03	Precast concrete side inlet gullies with 2100mm diameter precast shaft, "S" lintel, Kerb in Line, Inlet on Grade (MRS03 Oct 10)	each			$ 29,238
2416.04	Precast concrete side inlet gullies with 1500mm diameter precast shaft, "S" lintel, Kerb in Line, Inlet on Grade (MRS03 Oct 10)	each			$ 27,364
2415.01	Precast concrete access chambers, 1050mm dia (MRS03 Oct 10)	each			$ 13,284
9007.01S	Grated Drain, size 200mm wide x 360mm deep (Refer Supp Spec 9)	m			$ 332,521
9007.02	Grated Drain, size 100mm wide x 200mm deep, driveways (Refer Supp Spec 9)	m			$ 14,875
9007.03S	Grated Drain, size 200mm wide x 360mm deep special road crossing at Foote Ave (Refer Supp Spec 9)	m			$ 22,744
9007.04S	Grated Drain, size 300mm wide x 360mm deep (Refer Supp Spec 9)	m			$ 77,578
9007.05S	Grated Drain, size 300mm wide x 420mm deep (Refer Supp Spec 9)	m			$ 160,673
9008.01S	Junction Pit to Grated Drain, size 360mm x 540mm x 877mm (including 150mm diameter uPVC pipe to gully) (Refer Supp Spec 10)	each			$ 24,901
9008.02S	Junction Pit to Grated Drain, size 360mm x 540mm x 877mm (including 250mm diameter uPVC pipe to gully) (Refer Supp Spec 10)	each			$ 19,750
9008.03S	Junction Pit to Grated Drain, size 300mm x 300mm x 450mm (Refer Supp Spec 10)	each			$ 3,212
9009.01S	Modify existing gullies in Panorama Crescent, 2/D3 and 6/D1 to suit new kerb, kerb and channel levels (Refer Supp Spec 11)	each			$ 9,236
9010.01S	Convert existing gully pit 9C1 and 10/C1 to access chamber (Refer Supp Spec 12)	each			$ 2,540
9011.01S	Construct new gully pit over existing culvert at Ch45 MCD1 & 1/D2 (Refer Supp Spec 13)	each			$ 7,736
9012.01S	Connect new culvert to existing pit at 2/D3 (Refer Supp Spec 14)	each			$ 5,219
	PROTECTIVE TREATMENTS (MRS03 Jun 09)				
2631.01	Hand placed concrete paving to footpath, 100 mm thick (MRS03 Oct 10) reinforced concrete 25MPa/20 with SL62 mesh centrally located	m2			$ 82,124

Item	Description	Unit	Quantity	Unit rate	Amount
2631.02	Hand placed concrete paving to driveway, 125 mm thick (MRS03 Oct 10) reinforced concrete 25MPa/20 with SL82 mesh centrally located	m2	Sch.4 Part 4 s.7(1)(c)		$ 103,321
2631.03	Hand placed concrete paving to median, typically 100 mm thick (MRS03 Oct 10) unreinforced concrete 25MPa/20, finish to be terracotta with brick pattern with non slip long life seal coat	m2			$ 161,715
	PAVEMENT DRAINS (MRS38 Aug 11)				
2801.01	Pavement drain (MRS38 Aug 11)	m			$ 46,306
2802.01	Pavement drain outlets (MRS38 Aug 11)	each			$ 1,264
2802.02S	Pavement drain outlets (MRS38 Aug 11) (Refer Supp Spec 16)	each			$ 3,945
2803.01	Pavement drain cleanout point (MRS38 Aug 11)	each			$ 3,377
	Schedule C - Earthworks				
	EARTHWORKS, PREPARATION (MRS04 Oct 10)				
3101.01	Clearing and grubbing (MRS04 Oct 10)	m2			$ 31,595
3103.01P	Stripping of topsoil (Provisional Quantity as directed) (MRS04 Oct 10)	m3			$ 21,626
3104.01	Ground surface treatment under embankment, standard (MRS04 Oct 10)	m2			$ 5,697
3108.01P	Excavation and disposal of Unsuitable Material with individual excavation <= 10 m3 (Provisional Quantity as directed) (MRS04 Oct 10)	m3			$ 9,096
3304.01P	Supply and installation of geotextile, strength class C, filtration class V (Provisional Quantity) (MRS04 Oct 10) under embankment widening	m2			$ 14,276
	EARTHWORKS, EXCAVATION (MRS04 Oct 10)				
3201.01	Road excavation, all materials (MRS04 Oct 10)	m3			$ 81,477
3211.01P	Excavation of non-rippable material in road excavation, rate additional to rate for Work Item 3201 (Provisional Quantity)	m3			$ 6,908
3212.01P	Excavation of non-rippable material in confined excavation, rate additional to rates for Work Items 3203 to 3207 inclusive (Provisional Quantity) (MRS04 Oct 10)	m3			$ 12,399
3215.01P	Excavation and disposal of Unsuitable Material in and below confined excavations (Provisional Quantity as directed) (MRS04 Oct 10)	m3			$ 5,650
	EARTHWORKS, EMBANKMENT (MRS04 Oct 10)				
3301.01	Road embankment (MRS04 Oct 10)	m3			$ 181,232
3306.01	Road verges using general fill material (Type 2.5) (MRS04 Oct 10)	m3			$ 247,540
	EARTHWORKS, SUBGRADE (MRS04 Oct 10)				
3401.01P	Testing of existing material below subgrade level in cuttings (Provisional Quantity if ordered) (MRS04 Oct 10)	per s			$ 2,866
3402.01P	Subgrade treatment Type A, in cuttings and embankments, (Provisional Quantity if ordered) (MRS04 Oct 10)	m2			$ 22,922
3403.01P	Subgrade in cuttings, subgrade treatment Type B, replace with subgrade fill material (Provisional Quantity if ordered) (MRS04 Oct 10)	m2			$ 4,144
	EARTHWORKS, BACKFILL (MRS04 Oct 10)				
3501.01P	Backfill with general backfill material to below subgrade treatment (Provisional Quantity) (MRS04 Oct 10)	m3			$ 7,712
9014.01P	Backfill with lean mix concrete to depth of existing pavement (Provisional Quantity) (MRS04 Oct 10) (refer Supp Spec 17)	m3			$ 5,681
	Schedule D - Pavements				
	UNBOUND PAVEMENTS (MRS05 Apr 11)				
4153.00	Subtype 2.3 Unbound pavement, Driveways (MRS05 Apr 11)	m3			$ 11,400
	PLANT MIXED STABILISED PAVEMENTS (MRS08 Apr 12)				
4301.01	Plant mixed stabilised pavement, Type 2.3 material with 1% GB Cement (75% cement, 25% fly ash), (MRS08 Apr 12) Pavement Type 2	m3			$ 53,206
4321.01	Supply of stabilising agent, GB Cement (75% cement, 25% fly ash) (MRS08 Apr 12) Pavement Type 2	tonne			$ 2,828
	SUPPLY OF COVER AGGREGATE (MRS22 Oct 10)				
5011.01	Supply of cover aggregate precoated, 10 mm nominal size (MRS22 Oct 10)	m3			$ 16,759

Item	Description	Unit	Quantity	Unit rate	Amount
5011.02	Supply of cover aggregate precoated, 10 mm nominal size, Driveways (MRS22 Oct 10)	m3	Sch.4 Part 4 s.7(1)(c)		$ 618
	SPRAYED BITUMINOUS SURFACING (EXCLUDING EMULSION) (MRS11 Oct 10)				
5101.01	Prime, grade AMC0, spray rate 1.0L/m2, including supply of binder, Pavement Type 2 (MRS11 Oct 10)	litre			$ 3,230
5103.01S	Seal, class PMB (S4.5S), spray rate 1.8L/m2, including supply of binder, Pavement Types 1, 2, (MRS11 Oct 10)	litre			$ 57,570
5103.02	Seal, class C170, spray rate 1.2L/m2, including supply of binder, Pavement Type 2, (MRS11 Oct 10)	litre			$ 4,950
5103.03	Seal, class C170, spray rate 1.2L/m2, including supply of binder, Driveways, (MRS11 Oct 10)	litre			$ 648
5112.01S	Spreading cover aggregate 10mm, 130m2/m3, (MRS11 Oct 10) (Refer Supp Spec 18)	m3			$ 7,820
5112.02S	Spreading cover aggregate 10mm, 130m2/m3, Driveways (MRS11 Oct 10) (Refer Supp Spec 18)	m3			$ 576
	GEOTEXTILES FOR PAVING APPLICATIONS (MRS57 Jun 09)				
5151.01P	Supply of Geotextile grade >130g/m2 (Glasgrid 8550 or similar approved proprietary product) (MRS57 Jun 09) to Table 6.2 of MRTS57 (Provisional Quantity)	m2			$ 561
5153.01P	Placement of Paving Geotextile nominal weight g/m2 (MRS57 Jun 09) to Table 6.2 of MRTS57 (Provisional Quantity)	m2			$ 726
	PREPARATION OF THE EXISTING SURFACE (MRS30 Oct 10)				
5401.01	Preparation of the existing surface (MRS30 Oct 10)	m2			$ 2,585
5402.01P	Crack filling (Provisional Quantity) (MRS30 Oct 10)	m			$ 9,160
5403.01P	Strain alleviating fabric strips (Provisional Quantity) (MRS30 Oct 10)	m			$ 4,702
5404.01	Tack coat 0.2 litres/m2, residual bitumen (MRS30 Oct 10)	litre			$ 8,528
9115.01PS	Pavement Repairs (Asphalt) (Provisional Quantity, if ordered) (Refer Supp Spec 19) (Provisional Quantity)	m2			$ 2,770
9115.02PS	Pavement Repairs (Patch) (Provisional Quantity, if ordered) (Refer Supp Spec 19) (Provisional Quantity)	m2			$ 1,302
	DENSE GRADED ASPHALT (MRS30 Oct 10)				
5405.01	Dense graded asphalt corrector layer, DG14 (Class 320), Pavement Type 1	tonne			$ 97,793
5405.02	Dense graded asphalt corrector layer, DG20 (Class 600), Pavement Type 1	tonne			$ 163,656
5503.01	Dense graded asphalt, DG14 mix (MRS30 Oct 10) (Class 320), Wearing Course Pavement Type 1, 2	tonne			$ 484,787
5503.02	Dense graded asphalt, DG14 mix (MRS30 Oct 10) (Class 170), Wearing Course Pavement, Driveways	tonne			$ 37,508
5504.01	Dense graded asphalt, DG20 mix (MRS30 Oct 10) Class 600, Pavement Type 2	tonne			$ 252,198
5543.01P	Open grade asphalt, OG14 mix (MRS30 Oct 10) (Provisional, If Ordered)	tonne			$ 485,287
9116.01	Removal of existing Open Grade Asphalt wearing course, nominal 50mm (Refer Supp Spec 21)	m2			$ 63,212
9117.01P	Profile existing pavement below OGA, nominal 50mm (Refer Supp Spec 22) (Provisional Quantity)	m2			$ 7,769
9118.01S	Saw cut existing pavement (Refer to Supp Spec 23)	m			$ 3,974
9118.02S	Saw cut existing pavement, driveway (Refer to Supp Spec 23)	m			$ 1,250
	Schedule E - Road Furniture & Linemarking				
	REMOVAL, DEMOLITION AND RE-ERECTION (MRS14 Jun 09)				
6101.01	Demolition of road furniture (traffic signs, guardrail, bench) (MRS14 Jun 09)	lump			33,870
6104.01	Removal and re-erection of road furniture (electronic speed sign and equipment) (MRS14 Jun 09)	lump			11,506
	ROADSIDE STRUCTURES (MRS14 Jun 09)				
6181.01	Fencing, 1320 mm high, galvanised welded mesh (TMR STD DRG 1604)	m			$ 2,056
	GUIDANCE AND INFORMATION SYSTEMS (MRS14A Apr 11)				
6121.01	Supply of regulatory, warning and hazard sign faces, as listed in Clause 1.3 of Annexure MRS14A.1.	lump			37,395
6131.01	Installation of regulatory, warning and hazard signs, as listed in Clause 1.3 of Annexure MRS14A.1.	lump			29,854
6136.01	Supply, erection and installation of project signs	lump			10,374

Item	Description	Unit	Quantity	Unit rate	Amount
9119.01S	Supply and installation of safety bollards (Refer Supp Spec 24)	each			$ 12,944
	ROADSIDE STRUCTURES (MRS14A Apr 11)				
6161.01	Steel beam guardrail, w beam (MRS14A Apr 11)	m			$ 55,861
6163.01	Steel beam guardrail, terminal type A, SKT, ET2000 or approved equivalent (Design Speed 70km/h) (MRS14A Jun 09)	each			$ 24,819
6163.02	Steel beam guardrail, terminal type A, (Type 1) Melt or approved equivalent in accordance with TMR STD DRG No. 1474 (MRS14A Apr 11)	each			6,001
	LINE MARKING (MRS45 Apr 11)				
6313.01	Barrier line, single, 100 mm wide (MRS45 Apr 11)	m	Sch.4 Part 4 s.7(1)(c)		$ 112
6314.01	Barrier line, one direction, 80 mm wide each line, 80 mm lateral gap between lines, 3000 mm line length and 9000 mm gap length on broken side, colour white, material paint (MRS45 Apr 11)	m			$ 13
6315.01	Barrier line, both directions, 80 mm wide each line, 80 mm lateral gap between lines, colour white, material paint (MRS45 Apr 11)	m			$ 125
6318.01	Lane line, continuous, 100 mm wide, colour white, material paint (MRS45 Apr 11)	m			$ 759
6319.01S	Edge line, 150 mm wide, colour white, material paint (Refer Supp Spec 25) (MRTS45 Apr 11)	m			$ 10,872
6319.02S	Edge line, 150 mm wide, colour yellow, material paint (Refer Supp Spec 25) (MRTS45 Apr 11)	m			$ 7,539
6321.01	Continuity line, 200 mm wide, 1000mm line length, 3000mm gap length, colour white, material paint (MRS45 Apr 11)	m			$ 2,141
6322.01	Turn line, 100 mm wide, colour white, material paint (MRS45 Apr 11)	m			$ 652
6323.01	Outline, 150 mm wide, colour white, material paint (MRS45 Apr 11)	m			$ 4,560
6331.01	Transverse lines (stop lines, holding lines, markings at Stop and Give Way signs, pedestrian crosswalk lines, arrows,shapes, symbols and numerals), colour white, material paint (MRS45 Apr 11)	m2			$ 223
6332.01	Transverse lines (diagonal and chevron markings,parking areas and kerb markings), colour white, material paint (MRS45 Apr 11)	m2			$ 13,346
	RAISED PAVEMENT MARKERS (MRS45 Apr 11)				
6351.01	Retroreflective raised pavement markers (MRS45 Apr 11)	each			$ 8,382
	Schedule F - Road Lighting				
	CONDUIT AND CONDUIT FITTINGS UNDERGROUND (MRS91 Jun 09)				
6507.02	Supply and installation of 2 of 100 mm, HDPVC, electrical conduit(s), in road (MRS91 Jun 09)	m			$ 99,942
6507.03	Supply and installation of 1 of 100 mm, HDPVC, electrical conduit(s), in earth (MRS91 Jun 09)	m			$ 55,456
	CABLE JOINTING PITS (MRS91 Jun 09)				
6554.03	Supply and installation of cable jointing pit Circular (MRS91 Jun 09)	each			$ 50,735
	ROAD LIGHTING FOOTINGS (MRS92 Jun 09)				
6701.01	Road lighting pole footing, 350 mm diameter (MRS92 Jun 09)	each			$ 52,463
	ROAD LIGHTING (MRS94 Jun 09)				
6771.01	Supply and installation of slip base road lighting pole, 8500 mm vertical height, 3000 mm long double outreach arm, without outreach arm extension with loop in loop out cabling (MRS94 Jun 09)	each			$ 30,739
6771.02	Supply and installation of fixed base road lighting pole, 8500 mm vertical height, 3000 mm long single outreach arm, without outreach arm extension with loop in loop out cabling (MRS94 Jun 09)	each			$ 33,165
6771.03	Supply and installation of slip base road lighting pole, 10000 mm vertical height, 4500 mm long single outreach arm, without outreach arm extension with loop in loop out cabling (MRS94 Jun 09)	each			$ 24,895
6771.04	Supply and installation of fixed base road lighting pole, 10000 mm vertical height, 4500 mm long single outreach arm, without outreach arm extension with loop in loop out cabling (MRS94 Jun 09)	each			$ 46,506
6776.01	Supply and installation of road lighting luminaire, rexel, Optispan aeroscreen S150 (MRS94 Jun 09)	each			$ 13,923

Item	Description	Unit	Quantity	Unit rate		Amount
6776.02	Supply and installation of road lighting luminaire, rexel, Optispan aeroscreen S250 (MRS94 Jun 09)	each	Sch.4 Part 4 s.7(1)(c)		$	17,035
6776.03	Supply and installation of road lighting luminaire, rexel, Optispan aeroscreen S400 (MRS94 Jun 09)	each			$	1,784
6781.01	Removal of road lighting equipment for salvage, outreach and luminaire on existing timber poles (MRS94 Jun 09)	each			$	11,516
6781.01	Removal of road lighting equipment for salvage, outreach, luminaire and road lighting poles (MRS94 Jun 09)	each			$	10,783
	SWITCHBOARDS (MRS95 Jun 09)					
6801.01	Supply of URD pillar switchboard and ancillary components, post mounted (MRS95 Jun 09)	each			$	2,818
6803.01	Installation of URD pillar switchboard and ancillary components, post mounted (MRS95 Jun 09)	each			$	1,104
	ELECTRICAL CABLES (MRS95 Jun 09)					
6811.01	Supply of underground road lighting cable, 16mm, 4 cores, XLPE, PVC, Copper (MRS95 Jun 09)	m			$	34,566
6811.02	Supply of underground road lighting cable, 16mm, 2 cores, XLPE, PVC, Copper (MRS95 Jun 09)	m			$	558
6816.01	Supply of cable joint, fused (MRS95 Jun 09)	each			$	11,679
6821.01	Installation, jointing and termination of underground road lighting cable, 4 cores (MRS95 Jun 09)	m			$	31,247
6821.02	Installation, jointing and termination of underground road lighting cable, 2 cores (MRS95 Jun 09)	m			$	877
	Schedule G - Landscaping					
	MONITORING AND CONTROL (MRS51 Apr 11)					
3713.01	Loading, haulage and placement of site planting media	m2			$	16,632
	INPUT CONTROLLED SEEDING (MRS16C April12)					
3772.01	Hydromulching - single pass grass seed mix	m2			$	8,736
	TURFING (MRS16C April12)					
3782.01	Turf, A-Grade Green Couch	m2			$	19,010
	PREPARATION TREATMENTS (MRS16 Jun 09)					
3811.01	Herbicide application (MRS16 Jun 09) allowance for application to 75% of total project landscape area prior to planting	m2			$	5,989
	Total for project				$	6,338,186

Appendix B: Project Summary

This Appendix contains the Project Summary which illustrates the Risk Adjusted Construction Estimate Total including high level indications of Direct Cost, Indirect Cost and Profit.

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Project Summary

Mooloolaba Road Upgrade Buderim

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	Labour	Material	Plant	Subcontract	Total	% CV	% TC	% DC
Direct costs	539,557	1,751,004	589,517	1,439,863	4,319,941	68.16	74.97	100.00
Overhead costs	818,909	265,049	204,801	153,276	1,442,035	22.75	25.03	33.38
Sub total, costs	***1,358,466***	***2,016,052***	***794,318***	***1,593,139***	***5,761,976***	***90.91***	***100.00***	***133.38***
Risks and opportunities	0	0	0	0	0	0.00	0.00	0.00
Preadjustments	0	0	0	0	0	0.00	0.00	0.00
Cost Total	***1,358,466***	***2,016,052***	***794,318***	***1,593,139***	***5,761,976***	***90.91***	***100.00***	***133.38***
Overall margin	10.00	% overall (on total cost), and			576,198	9.09	10.00	13.34
Corporate margin	0.00	% overall (on total cost), and			0	0.00	0.00	0.00
Margins on direct costs (%)	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
Margins on overhead costs (%)	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
Margins on risks and opportunities (%)	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
Margins on preadjustments (%)	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
Defined margin					0	0.00	0.00	0.00
Margins on provisional sums (%)				0.00	0	0.00	0.00	0.00
			Margins total		***576,198***	***9.09***	***10.00***	***13.34***
			Items on which no margin is calculated		0	0.00	0.00	0.00
			Post adjustments		0	0.00	0.00	0.00
			Provisional sums		0	0.00	0.00	0.00
			Anticipated Direct Costs		0	0.00	0.00	0.00
			Anticipated Overhead Costs		0	0.00	0.00	0.00
			Project Total		***6,338,174***	***100.00***	***110.00***	***146.72***

0 unfinished direct cost items exist in a total of 164 items
0 unfinished overhead cost items exist in a total of 51 items

Appendix C: Principal‟s Costs

This Appendix contains the Principal‟s Costs.

AECOM
Mooloolaba Rd Buderim Hill

Principal's Costs

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Project Phase	Base of Cost	Rate	Amount	Total	Comment
Concept Phase					
11100.01 Project Proposal		$ -	$ -		
11101.01 Project Management		$ -	$ -		
12100.01 Options Analysis		$ -	$ -		
12200.01 Business Case		$ 50,000	$ 50,000		
				$ 50,000	0.79% of construction cost
Development Phase					
21100.01 Project Plan		$ -	$ -		
21101.01 Project Management		$ 100,000	$ 100,000		
21107.01 Survey		$ -	$ -		
21108.01 Geotechnical Investigations			$ -		
Work Management					
22100.01 Preliminary Design			$ -		
22200.01 Detailed Design		$ 450,000	$ 450,000		
Technical Advisor		$ 12,500	$ 12,500		
				$ 562,500	8.87% of construction cost
Implementation Phase					
Project Management		$ 100,000	$ 100,000		
31100 Plan Management			$ -		
Work Management					
		$ 465,000	$ 465,000		
				$ 565,000	8.91% of construction cost
Finalisation Phase					
41100 Finalisation Phase Project Management		$ 65,000	$ 65,000		
				$ 65,000	1.03% of construction cost
Principal's Obligations					
Roadworks Materials					
50107.01 Supply of bituminous material Prime, AMC0, from BP Brisbane		$ -	$ -		
50107.02 Supply of bituminous material Prime, AMC00, from BP Brisbane		$ -	$ -		
50107.03 Supply of bituminous material Class 170 from BP Brisbane		$ -	$ -		
50114.01 Supply and installation of Project signs		$ 15,000	$ 15,000		
Works					
9001.03S Post Construction Safety Audit		$ 12,000	$ 12,000		
50309.01 Service alterations		$ 450,000	$ 450,000		
Design of Water Service Relocations		$ 50,000	$ 50,000		
Other Payments and Costs					
50403.02 Compensation due to road infrastructure development (Property acquisitions)		$ -	$ -		
50403.03 Compensation due to road infrastructure development (Koala offsets)		$ -	$ -		
50405.01 Cultural Heritage payments (monitoring etc)		$ -	$ -		
50326.01 Accommodation works (Removal and demolition of buildings)		$ -	$ -		
50326.02 Accommodation works (Decontamination and remediation of service station) (Deleted)		$ -	$ -		
50406.01 Environmental fees and levies		$ -	$ -		
50407.01 Portable LSL levy and WHS fee 0.525% of project costs		$ 33,275	$ 33,275		
50408.01 Principal arranged insurance 0.65% of contract sum - allowance 0.70%		$ 44,367	$ 44,367		
				$ 604,643	9.54% of construction cost
Total Client Costs				**$ 1,847,143**	

Appendix D: Out - Turn Cost Calculation

This Appendix contains the Out-turn Cost Calculation.

This combines with the Project Cost including contingency to give the Out-turn Project Cost including contingency.

Input data

			Base	
Concept			$ 50,000	0.79%
Development			$ 562,500	8.87%
PUP			$ 450,000	
Property Acquisition				
Implementation			$ 719,643	11.35%
Finalisation			$ 65,000	1.03%
Construction Estimate			$ 6,338,186	$ 1,847,143 check
Construction Contingency P50 (Planned and Unplanned)			$ 303,258	
Construction Contingency P90 (Planned and Unplanned)			$ 467,504	
Client Contingency P50 (Planned and Unplanned)			$ 423,787	
Client Contingency P90 (Planned and Unplanned)			$ 707,027	

Output data

		2012 $	Escalation	Total		
Base Case	P90 and likely%	$ 9,359,860	$ 200,819	$ 9,560,679	Upper	5%
	P50 and likely%	$ 8,912,374	$ 193,070	$ 9,105,444	Likely	
Delay by 20% in time		$ 9,359,860	$ 263,342	$ 9,623,202		
	P90 and min%	$ 9,359,860	$ 134,480	$ 9,494,340		
	P90 and likely%	$ 9,359,860	$ 167,723	$ 9,527,583		
	P90 and max%	$ 9,359,860	$ 233,771	$ 9,593,631		

Monte Carlo Risk Profile

	Construction		Client		
	Transferred	Rate	Retained	Quantity	Client
P5	115,448	-	204,527	- 38,919	
P10	145,159	-	235,862	23,390	
P15	164,796	-	263,677	- 11,694	
P20	181,401		286,198	- 2,711	
P25	195,295		306,346	5,836	
P30	207,323		323,696	11,931	
P35	218,205		338,444	19,066	
P40	229,126		355,547	25,118	
P45	238,953		370,601	30,960	
P50	248,089		386,517	37,270	
P55	257,864		403,234	43,267	
P60	266,402		421,300	49,630	
P65	276,315		441,570	56,557	
P70	285,655		462,154	63,026	
P75	298,167		486,833	69,170	
P80	309,912		516,476	77,185	
P85	324,754		556,089	87,466	
P90	340,985		606,784	100,243	
P95	366,863		678,399	118,372	

Value of 20% delay in time	$ 62,523	
Diff from low to profile	-$ 66,339	
Diff from likely to profile	-$ 33,096	
Diff from high to profile	$ 32,952	

Construction cost	6,338,186	
P50 Risk Total	727,045	11%
P90 Risk Total	1,174,531	19%

Project cost	8,185,329	
P50 Risk Total	727,045	9%
P90 Risk Total	1,174,531	14%

	Base	Escalation	Out-turn
Concept	50,000	-	50,000
Development	562,500	-	562,500
PUP	450,000	2,637	452,637
Property Acquisition	-	-	-
Implementation	719,643	185,547	905,190
Finalisation	65,000	3,400	68,400
Construction Estimate	6,338,186	-	6,338,186
Construction Contingency P90 (Planned and Unplanned)	467,504	-	467,504
Client Contingency P90 (Planned and Unplanned)	707,027	9,235	716,261
Total risk adjusted Project Cost	9,359,860	200,819	9,560,679
Allowance for escalation	200,819		
Total Risk Adjusted Out-turn Cost	**9,560,679**		**9,560,679**

			Cash flows in September 2012 prices																		
			Client Costs									Contractor Costs									
			Concept	Development	PUP	Property	Implementation	Construction Rise and fall	Construction Contingency Rise and Fall	Finalisation	Client Contingency	Construction up to Award	Constuction Contingency up to Award	Total Cost per Month	Cumulative Total Project Cost	Assumed Inflation pa	Equivalent Monthly Rate	Inflation factor	Adjustment for inflation	Out-turn cost per Month	Cumulative Out-turn Cost
														-	-	0%	0.0000%	100%	-	-	-
Concept	1	Dec-11												-	-	0%	0.0000%	100%	-	-	-
	2	Jan-12	8,333								28,281			36,614	36,614	0%	0.0000%	100%	-	36,614	36,614
	3	Feb-12	8,333								28,281			36,614	73,229	0%	0.0000%	100%	-	36,614	73,229
	4	Mar-12	8,333								28,281			36,614	109,843	0%	0.0000%	100%	-	36,614	109,843
	5	Apr-12	8,333								28,281			36,614	146,458	0%	0.0000%	100%	-	36,614	146,458
	6	May-12	8,333								28,281			36,614	183,072	0%	0.0000%	100%	-	36,614	183,072
	7	Jun-12	8,333								28,281			36,614	219,686	0%	0.0000%	100%	-	36,614	219,686
Development	8	Jul-12		70,313							28,281			98,594	318,280	0%	0.0000%	100%	-	98,594	318,280
	9	Aug-12		70,313							28,281			98,594	416,874	0%	0.0000%	100%	-	98,594	416,874
	10	Sep-12		70,313							28,281			98,594	515,467	0%	0.0000%	100%	-	98,594	515,467
	11	Oct-12		70,313							28,281			98,594	614,061	0%	0.0000%	100%	-	98,594	614,061
	12	Nov-12		70,313							28,281			98,594	712,654	0%	0.0000%	100%	-	98,594	712,654
	13	Dec-12		70,313							28,281			98,594	811,248	0%	0.0000%	100%	-	98,594	811,248
	14	Jan-13		70,313	90,000						28,281			188,594	999,841	0%	0.0000%	100%	-	188,594	999,841
	15	Feb-13		70,313	90,000	-		- 6,338,186	- 467,504		28,281	6,338,186	467,504	188,594	1,188,435	0%	0.0000%	100%	-	188,594	1,188,435
Implementation	16	Mar-13			90,000		79,960	704,243	51,945		28,281			954,429	2,142,864	6%	0.4868%	100%	4,646	959,075	2,147,510
	17	Apr-13			90,000		79,960	704,243	51,945		28,281			954,429	3,097,293	6%	0.4868%	101%	9,314	963,743	3,111,253
	18	May-13			90,000		79,960	704,243	51,945		28,281			954,429	4,051,723	6%	0.4868%	101%	14,005	968,434	4,079,688
	19	Jun-13					79,960	704,243	51,945		28,281			864,429	4,916,152	6%	0.4868%	102%	16,954	881,383	4,961,071
	20	Jul-13					79,960	704,243	51,945		28,281			864,429	5,780,581	6%	0.4868%	102%	21,244	885,673	5,846,744
	21	Aug-13					79,960	704,243	51,945		28,281			864,429	6,645,010	6%	0.4868%	103%	25,555	889,984	6,736,728
	22	Sep-13					79,960	704,243	51,945		28,281			864,429	7,509,439	6%	0.4868%	103%	29,887	894,316	7,631,045
	23	Oct-13					79,960	704,243	51,945		28,281			864,429	8,373,869	6%	0.4868%	104%	34,240	898,670	8,529,714
	24	Nov-13					79,960	704,243	51,945		28,281			864,429	9,238,298	6%	0.4868%	104%	38,615	903,044	9,432,758
Fin	25	Dec-13								32,500	28,281			60,781	9,299,079	6%	0.4868%	105%	3,024	63,805	9,496,563
	26	Jan-14								32,500	28,281			60,781	9,359,860	6%	0.4868%	105%	3,335	64,116	9,560,679
		Check	-	-	2,637	-	17,744	156,277	11,527	3,400	9,235	-	-						200,819	9,560,679	
																		Check	9,560,679		

	Base	Escalation	Out-turn
Concept	50,000	-	50,000
Development	562,500	-	562,500
PUP	450,000	2,637	452,637
Property Acquisition	-	-	-
Implementation	719,643	181,498	901,141
Finalisation	65,000	3,400	68,400
Construction Estimate	6,338,186	-	6,338,186
Construction Contingency P50 (Planned and Unplanned)	303,258	-	303,258
Client Contingency P50 (Planned and Unplanned)	423,787	5,535	429,322
Total risk adjusted Project Cost	8,912,374	193,070	9,105,444
Allowance for escalation	193,070		
Total Risk Adjusted Out-turn Cost	**9,105,444**		**9,105,444**

			Cash flows in September 2012 prices																		
			Client Costs									Contractor Costs									
			Concept	Development	PUP	Property	Implementation	Construction Rise and fall	Construction Contingency Rise and Fall	Finalisation	Client Contingency	Construction up to Award	Constuction Contingency up to Award	Total Cost per Month	Cumulative Total Project Cost	Assumed Inflation pa	Equivalent Monthly Rate	Inflation factor	Adjustment for inflation	Out-turn cost per Month	Cumulative Out-turn Cost
														-	-	0%	0.0000%	100%	-	-	-
Concept	1	Dec-11												-	-	0%	0.0000%	100%	-	-	-
	2	Jan-12	8,333								16,951			25,285	25,285	0%	0.0000%	100%	-	25,285	25,285
	3	Feb-12	8,333								16,951			25,285	50,570	0%	0.0000%	100%	-	25,285	50,570
	4	Mar-12	8,333								16,951			25,285	75,854	0%	0.0000%	100%	-	25,285	75,854
	5	Apr-12	8,333								16,951			25,285	101,139	0%	0.0000%	100%	-	25,285	101,139
	6	May-12	8,333								16,951			25,285	126,424	0%	0.0000%	100%	-	25,285	126,424
	7	Jun-12	8,333								16,951			25,285	151,709	0%	0.0000%	100%	-	25,285	151,709
Development	8	Jul-12		70,313							16,951			87,264	238,973	0%	0.0000%	100%	-	87,264	238,973
	9	Aug-12		70,313							16,951			87,264	326,237	0%	0.0000%	100%	-	87,264	326,237
	10	Sep-12		70,313							16,951			87,264	413,501	0%	0.0000%	100%	-	87,264	413,501
	11	Oct-12		70,313							16,951			87,264	500,765	0%	0.0000%	100%	-	87,264	500,765
	12	Nov-12		70,313							16,951			87,264	588,029	0%	0.0000%	100%	-	87,264	588,029
	13	Dec-12		70,313							16,951			87,264	675,293	0%	0.0000%	100%	-	87,264	675,293
	14	Jan-13		70,313	90,000						16,951			177,264	852,557	0%	0.0000%	100%	-	177,264	852,557
	15	Feb-13		70,313	90,000	-		- 6,338,186	- 303,258		16,951	6,338,186	303,258	177,264	1,029,821	0%	0.0000%	100%	-	177,264	1,029,821
Implementation	16	Mar-13			90,000		79,960	704,243	33,695		16,951			924,850	1,954,671	6%	0.4868%	100%	4,502	929,352	1,959,173
	17	Apr-13			90,000		79,960	704,243	33,695		16,951			924,850	2,879,521	6%	0.4868%	101%	9,025	933,875	2,893,048
	18	May-13			90,000		79,960	704,243	33,695		16,951			924,850	3,804,371	6%	0.4868%	101%	13,571	938,421	3,831,469
	19	Jun-13					79,960	704,243	33,695		16,951			834,850	4,639,221	6%	0.4868%	102%	16,374	851,224	4,682,693
	20	Jul-13					79,960	704,243	33,695		16,951			834,850	5,474,071	6%	0.4868%	102%	20,517	855,367	5,538,060
	21	Aug-13					79,960	704,243	33,695		16,951			834,850	6,308,921	6%	0.4868%	103%	24,681	859,531	6,397,591
	22	Sep-13					79,960	704,243	33,695		16,951			834,850	7,143,771	6%	0.4868%	103%	28,864	863,715	7,261,306
	23	Oct-13					79,960	704,243	33,695		16,951			834,850	7,978,621	6%	0.4868%	104%	33,069	867,919	8,129,224
	24	Nov-13					79,960	704,243	33,695		16,951			834,850	8,813,471	6%	0.4868%	104%	37,293	872,143	9,001,368
Fin	25	Dec-13								32,500	16,951			49,451	8,862,923	6%	0.4868%	105%	2,460	51,912	9,053,280
	26	Jan-14								32,500	16,951			49,451	8,912,374	6%	0.4868%	105%	2,713	52,165	9,105,444
		Check	-	-	2,637	-	17,744	156,277	7,477	3,400	5,535	-	-						193,070	9,105,444	
																		Check	9,105,444		

Appendix E: Information Reviewed

This Appendix contains details of all documents and correspondence received and used in the preparation of this Report.

aQuenta

Project Number	412223
Project Title	Mooloolaba Rd Buderim Hill Upgrade
Client	AECOM

Document Ref:	Date	Incoming/ Outgoing	From	To	Client DT / Other Ref # Email Sub Hdr	Document Type	Document Description	Dwg / Sketch Details if applicable		
								Dwg Number	Rev	Format
412223_01							Attachments: 60250500-DD-4.pdf Mooloolaba_Road_50%_Design_issue_to_TMR.pdf	Mooloolaba_Road_50%_Design_issue_to_TMR.pdf	P1/P2	PDF
412223_02	05-Nov-12	Incoming	Michael Bannah	Neil King	AECOM/RE: Mooloolaba Road - Buderim Cost Schedule	Cost Related	Neil Excel version of the schedule attached. Regards Michael Attachment: 60250500 Detail Design Schedule REV 1.xls			
412223_03	06-Nov-12	Incoming	Michael Bannah	Neil King	AECOM/Mooloolaba Road Road Lighting drawings	Dwg	Neil Attached are the latest Road Lighting Drawings. Regards Michael Attachments: 60250500-1000-167000-RL-P1.pdf 60250500-1000-167001-RL-P3.pdf 60250500-1000-167002-RL-P3.pdf 60250500-1000-167003-RL-P3.pdf 60250500-1000-167004-RL-P3.pdf 60250500-1000-167006-RL-P3.pdf 60250500-1000-167007-RL-P3.pdf 60250500-1000-167008-RL-P1.pdf 60250500-1000-167009-RL-P1.pdf 60250500-1000-167010-RL-P1.pdf	60250500-1000-167000-RL-P1.pdf 60250500-1000-167001-RL-P3.pdf 60250500-1000-167002-RL-P3.pdf 60250500-1000-167003-RL-P3.pdf 60250500-1000-167004-RL-P3.pdf 60250500-1000-167006-RL-P3.pdf 60250500-1000-167007-RL-P3.pdf 60250500-1000-167008-RL-P1.pdf 60250500-1000-167009-RL-P1.pdf 60250500-1000-167010-RL-P1.pdf 60250500-1000-167005-RL-P3.pdf	P1 P3	PDF
412223_04	06-Nov-12	Incoming				Dwg	Attachments: Mooloolaba Rd 80% Design issue to TMR Disc received from AECOM	102001 DI-01 OF 2 P2 102002 DI-02 OF 2 P2 111001 TCS-01 OF 5 P2 111002 TCS-02 OF 5 P2 111003 TCS-03 OF 5 P2 111004 TCS-04 OF 5 P1 111005 TCS-05 OF 5 P1 112001 GD-01 OF 3 P2 112002 GD-02 OF 3 P2 112003 GD-03 OF 3 P2 121001 CL-01 OF 4 P2 121002 CL-02 OF 4 P2 121003 CL-03 OF 4 P2 121004 CL-04 OF 4 P1 131001 GA-01 OF 7 P3 131002 GA-02 OF 7 P3 131003 GA-03 OF 7 P3 131004 GA-04 OF 7 P3 131005 GA-05 OF 7 P3 131006 GA-06 OF 7 P3 131007 GA-07 OF 7 P3 135001 DS-01 OF 9 P2 135002 DS-02 OF 9 P2 135003 DS-03 OF 9 P2 135004 DS-04 OF 9 P2 135005 DS-05 OF 9 P2 135006 DS-06 OF 9 P2 135007 DS-07 OF 9 P2 135007 DS-OB OF 9 P2 135007 DS-09 OF 9 P2 137001 PA-01 OF 15 P1 137002 PA-02 OF 15 P1 137003 PA-03 OF 15 P1 137004 PA-04 OF 15 P1	P1/P2/P3	PDF

Document Ref:	Date	Incoming/ Outgoing	From	To	Client DT / Other Ref # Email Sub Hdr	Document Type	Document Description	Dwg / Sketch Details if applicable		
								Dwg Number	Rev	Format
								137005 PA-05 OF 15 P1		
								137006 PA-06 OF 15 P1		
								137007 PA-07 OF 15 P1		
								137008 PA-08 OF 15 P1		
								137009 PA-09 OF 15 P1		
								137010 PA-10 OF 15 P1		
								137011 PA-11 OF 15 P1		
								137012 PA-12 OF 15 P1		
								137013 PA-13 OF 15 P1		
								137014 PA-14 OF 15 P1		
								137015 PA-15 OF 15 P1		
								141001 DD-LD-01 OF 7 P3		
								141002 DD-LD-02 OF 7 P3		
								141003 DD-LD-03 OF 7 P3		
								141004 DD-LD-04 OF 7 P3		
								141005 DD-LD-05 OF 7 P3		
								141006 DD-LD-06 OF 7 P3		
								141007 DD-LD-07 OF 7 P3		
								142001 DD-LS-01 OF 5 P3		
								142002 DD-LS-02 OF 5 P3		
								142003 DD-LS-03 OF 5 P3		
								142004 DD-LS-04 OF 5 P3		
								142005 DD-LS-05 OF 5 P3		
								145001 DO-MD 01 OF 1 P1		
								149001 ES-01 OF 7 P2		
								149002 ES-02 OF 7 P2		
								149003 ES-03 OF 7 P2		
								149004 ES-04 OF 7 P2		
								149005 ES-05 OF 7 P2		
								149006 ES-06 OF 7 P2		
								149007 ES-07 OF 7 P2		
								151001 PD-01 OF 8 P2		
								151002 PD-02 OF 8 P2		
								151003 PD-03 OF 8 P2		
								151004 PD-04 OF 8 P2		
								151005 PD-05 OF 8 P2		
								151006 PD-06 OF 8 P2		
								151007 PD-07 OF 8 P2		
								151008 PD-08 OF 8 P2		
								161001 SL-01 OF 7 P2		
								161002 SL-02 OF 7 P2		
								161003 SL-03 OF 7 P2		
								161004 SL-04 OF 7 P2		
								161005 SL-05 OF 7 P2		
								161006 SL-06 OF 7 P2		
								161007 SL-07 OF 7 P2		
								167001 RL-01 OF 9 P3		
								167002 RL-02 OF 9 P3		
								167003 RL-03 OF 9 P3		
								167004 RL-04 OF 9 P3		
								167005 RL-05 OF 9 P3		
								167006 RL-06 OF 9 P3		
								167007 RL-07 OF 9 P3		
								167008 RL-08 OF 9 P3		
								167009 RL-09 OF 9 P3		
								181001 PU-01 OF 8 P2		
								181002 PU-02 OF 8 P2		
								181003 PU-03 OF 8 P2		
								181004 PU-04 OF 8 P2		
								181005 PU-05 OF 8 P2		
								181006 PU-06 OF 8 P2		
								181007 PU-07 OF 8 P2		
								181008 PU-08 OF 8 P2		
								191001 LS-01 OF 7 P3		
								191002 LS-02 OF 7 P3		
								191003 LS-03 OF 7 P3		
								191004 LS-04 OF 7 P3		
								191005 LS-05 OF 7 P3		
								191006 LS-06 OF 7 P3		
								191007 LS-07 OF 7 P3		

Document Ref:	Date	Incoming/ Outgoing	From	To	Client DT / Other Ref # Email Sub Hdr	Document Type	Document Description	Dwg / Sketch Details if applicable		
								Dwg Number	Rev	Format
								192001 XS-01 OF 29 P3 192002 XS-02 OF 29 P3 192003 XS-03 OF 29 P3 192004 XS-04 OF 29 P3 192005 XS-05 OF 29 P3 192006 XS-06 OF 29 P3 192007 XS-07 OF 29 P3 192008 XS-08 OF 29 P3 192009 XS-09 OF 29 P3 192010 XS-10 OF 29 P3 192011 XS-11 OF 29 P3 192012 XS-12 OF 29 P3 192013 XS-13 OF 29 P3 192014 XS-14 OF 29 P3 192015 XS-15 OF 29 P3 192016 XS-16 OF 29 P3 192017 XS-17 OF 29 P3 192018 XS-18 OF 29 P3 192019 XS-19 OF 29 P3 192020 XS-20 OF 29 P3 192021 XS-21 OF 29 P3 192022 XS-22 OF 29 P3 192023 XS-23 OF 29 P3 192024 XS-24 OF 29 P3 192025 XS-25 OF 29 P3 192026 XS-26 OF 29 P3 192027 XS-27 OF 29 P1 192028 XS-28 OF 29 P1 192029 XS-29 OF 29 P1		
412223_05	06-Nov-12	Incoming	Michael Bannah	Neil King	AECOM - Mooloolaba Road - Traffic Annexure	Misc	Neil / Stephen Please find attached Traffic Annexure for Mooloolaba Road, note that this is yet to be reviewed by TMR and RoadTek. Regards Michael Michael Bannah Files Attached: MRS02_1 MRTS02_1			
412223_06	14-Nov-12	Incoming	Michael Bannah	Neil King	FW: Mooloolaba Road - Buderim Cost Schedule	Specification	Neil Accommodation works Supp Spec as requested. Regards Michael Attachment: SuppSpec 7 - Accom Works.docx			

Appendix F: Construction Organisation Chart

Not Used

Appendix G: Construction Estimate Spread Analysis

This Appendix contains the spread analysis report for the Construction Estimate.

It shows the direct costs of the individual schedule items and amount of indirect cost and margin, applied to each item to give the sell amount.

Line No.	Item No.	Item Description	Qty	Unit	Direct Cost Rate	Direct Cost Total	Markup Mode	Controlled By	Indirect Spread	Margin Spread	Sell Rate	Sell Total	Effective Markup
1		**PRELIMINARY DESIGN ESTIMATE FOR PROJECT 263/134/480**											
2		Local Authority: Sunshine Coast Regional Council											
3		Road: 134											
4		Estimate Number: A - Preliminaries											
5		Estimate Location:											
6		Contract Number: NCHD 2543											
7													
8		NOTE: Estimate must be considered absolutely as the property of Main Roads until the acceptance of a tender, and must under no circumstances be divulged.											
9													
10													
11		Schedule A - Preliminaries											
12													
13		CONTRACTOR'S SITE FACILITIES AND CAMP (MRS28 Jun 09)											
14	1101.01	Contractor's site facilities (MRS28 Jun 09)	1	lump			Margin and overhead	125000.000 nominated as rate	89,312.99	35,687.01	125,000.00	125,000	
15													
16		PROVISION FOR TRAFFIC (MRS02 Oct 10)											
17	1201.01	Provision for traffic (MRS02 Oct 10)				322,063	Margin and		100,848.90	40,296.45	463,208.00	463,208	43.83
18	1202.01	Traffic Management Plan (MRS02 Oct 10)				10,404	Margin and		3,258.14	1,301.86	14,964.00	14,964	43.83
19	1203.01	Roadwork signing records (MRS02 Oct 10)				12,885	Margin and		4,034.76	1,612.18	18,532.00	18,532	43.83
20													
21		ENVIRONMENTAL MANAGEMENT (MRS51 Apr 11)											
22	1331.01	Develop Environmental Management Plan (Construction) (MRS51 Apr 11)				4,530	Margin and overhead		1,418.40	566.75	6,515.00	6,515	43.82
23	1332.01	Implement Environmental Management Plan (Construction) (MRS51 Apr 11)				30,530	Margin and overhead		9,559.61	3,819.76	43,909.00	43,909	43.82
24	1333.01	Environmental Licences, Permits and Approvals (MRS51 Apr 11)					Margin and overhead						
25	1351.01P	Cultural Heritage Management, if ordered (Provisional Quantity) (MRS51 Apr 11)					Margin and overhead						
26	1355.01P	Noise monitoring, if ordered (Provisional Quantity) (MRS51 Apr 11)				25,000	Margin and overhead		7,828.11	3,127.90	35,956.00	35,956	43.82
27	1361.01P	Condition survey and vibration monitoring, if ordered (Provisional Quantity) (MRS51 Apr 11)				50,000	Margin and overhead		15,656.92	6,256.08	71,913.00	71,913	43.83
28	1365.01P	Air quality monitoring, if ordered (Provisional Quantity) (MRS51 Apr 11)				25,000	Margin and overhead		7,828.11	3,127.90	35,956.00	35,956	43.82
29	1375.01P	Fauna management, if ordered (Provisional Quantity) (MRS51 Apr 11)				10,058	Margin and overhead		3,149.59	1,258.49	14,466.00	14,466	43.83
30	1381.01P	Pest Control, if ordered (Provisional Quantity) (MRS51 Apr 11)					Margin and overhead						
31	9000.01S	Erosion and Sedimentation Control (Refer to Supp Spec 2)				40,014	Margin and overhead		12,530.00	5,006.65	57,551.00	57,551	43.83

32	9001.01S	Provide As-Built Data (SCRSS901) (Refer to Supp Spec 3)	[redacted]	7,248	Margin and overhead		2,269.44	906.80	10,424.00	10,424	43.82
33	9003.01S	Liaison and Co-ordination of affected utilities work (Refer to Supp Spec 5)		5,000	Margin and overhead		1,565.48	625.52	7,191.00	7,191	43.82
34	9004.01S	Relationship Management (Refer to Supp Spec 6)		10,000	Margin and overhead		3,131.67	1,251.33	14,383.00	14,383	43.83
35	9005.01S	Accommodation Works to Lot 22 RP228644 (Refer to Supp Spec 7)		1,258	Margin and overhead		394.15	157.49	1,810.00	1,810	43.84
36	9005.02S	Accommodation Works to Lot 1 RP111424 (Refer to Supp Spec 7)		3,253	Margin and overhead		1,018.38	406.92	4,678.00	4,678	43.82
37	9005.03S	Accommodation Works to Lot 1 RP109329 (Refer to Supp Spec 7)		3,020	Margin and overhead		945.86	377.94	4,344.00	4,344	43.83
38	9005.04S	Accommodation Works to Lot 10 RP132410 (Refer to Supp Spec 7)		3,409	Margin and overhead		1,067.23	426.43	4,903.00	4,903	43.81
39	9005.05S	Accommodation Works to Lot 11 RP132410 (Refer to Supp Spec 7)		1,258	Margin and overhead		394.15	157.49	1,810.00	1,810	43.84
40	9005.06S	Accommodation Works to Lot 2 RP93588 (Refer to Supp Spec 7)		1,288	Margin and overhead		403.05	161.05	1,852.00	1,852	43.80
41	9005.07S	Accommodation Works to Lot 3 SP897856 (Refer to Supp Spec 7)		2,517	Margin and overhead		788.30	314.98	3,620.00	3,620	43.84
42	9005.08S	Accommodation Works to Lot 5 RP80359 (Refer to Supp Spec 7)		1,556	Margin and overhead		487.34	194.73	2,238.00	2,238	43.84
43	9005.09S	Accommodation Works to Lot 3 RP153972 (Refer to Supp Spec 7)			Margin and overhead						
44											
45		Schedule B - Drainage									
46											
47		REMOVAL/DEMOLITION (MRS03 Oct 10)									
48	2101.01	Removal or demolition of culverts, complete (MRS03 Oct 10)		1,320	Margin and overhead		413.52	165.23	1,899.00	1,899	43.84
49	2103.01	Removal or demolition of culverts excluding end structures (MRS03 Oct 10)		1,113	Margin and overhead		348.57	139.28	1,601.00	1,601	43.83
50	2106.01	Removal or demolition of concrete kerb and channel including kerb crossings (MRS03 Oct 10)		27,607	Margin and overhead		8,643.17	3,453.57	25.95	39,704	43.82
51	2108.01	Removal or demolition of gullies		3,000	Margin and		939.49	375.39	719.10	4,315	43.85
52	9015.01PS	Supply and place flowable fill in abandoned pipes and culverts (Provisional Quantity) (Refer to Supp Spec 4)		52,923	Margin and overhead		16,572.51	6,621.92	507.45	76,118	43.83
53											
54		SUPPLY AND INSTALLATION OF CULVERTS (MRS03 Oct 10)									
55	2241.01	Supply and installation of concrete pipe culvert components, Class 2, 375 mm diameter (MRS03 Oct 10)	[redacted]	38,868	Margin and overhead		12,171.13	4,863.25	576.31	55,902	43.83
56	2241.02	Supply and installation of concrete pipe culvert components, Class 3, 375 mm diameter (MRS03 Oct 10)		167,717	Margin and overhead		52,518.26	20,984.85	598.56	241,220	43.83
57	2241.03	Supply and installation of concrete pipe culvert components, Class 2, 450 mm diameter (MRS03 Oct 10)		31,843	Margin and overhead		9,970.94	3,984.11	683.55	45,798	43.83

Line No.	Item No.	Item Description	Qty	Unit	Direct Cost Rate	Direct Cost Total	Markup Mode	Controlled By	Indirect Spread	Margin Spread	Sell Rate	Sell Total	Effective Markup
58	2241.04	Supply and installation of concrete pipe culvert components, Class 3, 450 mm diameter (MRS03 Oct 10)				52,153	Margin and overhead		16,331.24	6,525.52	714.38	75,010	43.83
59	2241.05	Supply and installation of concrete pipe culvert components, Class 3, 525 mm diameter (MRS03 Oct 10)				8,979	Margin and overhead		2,812.28	1,123.71	807.20	12,915	43.83
60	9006.01	Supply and installation of uPVC pipe culvert components, 150 mm diameter (MRS03 Oct 10) (refer Supp Spec 8)				2,811	Margin and overhead		879.68	351.50	192.50	4,043	43.81
61													
62		CONCRETE IN CULVERTS AND END STRUCTURES (MRS03 Oct 10)											
63	2317.01	Precast concrete end structures to culverts, 525 mm diameter (MRS03 Oct 10)				1,819	Margin and overhead		569.92	227.72	2,617.00	2,617	43.84
64													
65		PAVEMENT DRAINAGE (MRS03 Oct 10)											
66	2401.01	Concrete kerb, Type 1 (MRS03 Oct 10)				7,210	Margin and		2,257.23	901.93	102.66	10,369	43.82
67	2401.02	Concrete kerb, Type 5A (Modified kerb dowelled with grated drain, refer detail)				20,298	Margin and overhead		6,354.84	2,539.22	63.46	29,192	43.82
68	2401.03	Concrete kerb, Type 9 (MRS03 Oct 10)				5,286	Margin and		1,655.50	661.49	46.36	7,603	43.83
69	2401.04	Concrete kerb, Type 9A (Modified kerb dowelled with grated drain, refer detail)				30,328	Margin and overhead		9,494.33	3,793.67	52.36	43,616	43.81
70	2403.01	Concrete channel, Type 22 (MRS03 Oct 10)				2,367	Margin and		741.27	296.19	75.66	3,405	43.84
71	2403.02	Concrete channel, Vee drain, refer detail				4,457	Margin and		1,395.65	557.66	256.41	6,410	43.82
72	2404.01	Concrete kerb and channel, Type 7 (MRS03 Oct 10)				49,578	Margin and overhead		15,520.58	6,201.60	67.84	71,300	43.81
73	2404.02	Concrete kerb and channel, Type 15 (MRS03 Oct 10)				10,147	Margin and overhead		3,177.49	1,269.64	82.45	14,594	43.83
74	2405.01	Concrete channel, Type 17 (MRS03 Oct 10)				7,120	Margin and		2,229.71	890.93	74.21	10,241	43.83
75	2405.02	Concrete kerb and channel crossings, Pedestrian Ramp Type 2, (MRS03 Oct 10) Refer to TMR STD DRG 1446				500	Margin and overhead		157.20	62.81	360.00	720	44.00
76	2413.01	Concrete gullies, Field Inlet Type 1, single Gully, Std Drg 1309 (MRS03 Oct 10)				1,572	Margin and overhead		492.25	196.69	2,261.00	2,261	43.82
77	2416.01	Precast concrete side inlet gullies with 1050mm diameter precast shaft, "S" lintel, Kerb in Line, Inlet on Grade (MRS03 Oct 10)				30,494	Margin and overhead		9,548.90	3,815.48	4,873.10	43,858	43.83
78	2416.02	Precast concrete side inlet gullies with 1050mm diameter precast shaft, "S" lintel, Lip in Line, Inlet on Grade (MRS03 Oct 10)				91,481	Margin and overhead		28,645.94	11,446.13	4,873.06	131,573	43.83
79	2416.03	Precast concrete side inlet gullies with 2100mm diameter precast shaft, "S" lintel, Kerb in Line, Inlet on Grade (MRS03 Oct 10)				20,329	Margin and overhead		6,365.52	2,543.49	9,746.00	29,238	43.82
80	2416.04	Precast concrete side inlet gullies with 1500mm diameter precast shaft, "S" lintel, Kerb in Line, Inlet on Grade (MRS03 Oct 10)				19,026	Margin and overhead		5,957.40	2,380.42	6,841.00	27,364	43.82
81	2415.01	Precast concrete access chambers, 1050mm dia (MRS03 Oct 10)				9,236	Margin and overhead		2,892.50	1,155.76	4,428.00	13,284	43.83
82	9007.01S	Grated Drain, size 200mm wide x 360mm deep (Refer Supp Spec 9)				231,197	Margin and overhead		72,396.63	28,927.70	1,259.55	332,521	43.83

83	9007.02	Grated Drain, size 100mm wide x 200mm deep, driveways (Refer Supp Spec 9)			10,342	Margin and overhead		3,238.39	1,293.97	1,144.20	14,875	43.83
84	9007.03S	Grated Drain, size 200mm wide x 360mm deep special road crossing at Foote Ave (Refer Supp Spec 9)			15,814	Margin and overhead		4,951.75	1,978.58	1,421.50	22,744	43.82
85	9007.04S	Grated Drain, size 300mm wide x 360mm deep (Refer Supp Spec 9)			53,939	Margin and overhead		16,890.34	6,748.91	1,385.32	77,578	43.83
86	9007.05S	Grated Drain, size 300mm wide x 420mm deep (Refer Supp Spec 9)			111,714	Margin and overhead		34,981.59	13,977.68	1,501.62	160,673	43.83
87	9008.01S	Junction Pit to Grated Drain, size 360mm x 540mm x 877mm (including 150mm diameter uPVC pipe to gully) (Refer Supp Spec 10)			17,313	Margin and overhead		5,421.48	2,166.27	3,112.60	24,901	43.83
88	9008.02S	Junction Pit to Grated Drain, size 360mm x 540mm x 877mm (including 250mm diameter uPVC pipe to gully) (Refer Supp Spec 10)			13,732	Margin and overhead		4,299.84	1,718.10	3,291.70	19,750	43.82
89	9008.03S	Junction Pit to Grated Drain, size 300mm x 300mm x 450mm (Refer Supp Spec 10)			2,233	Margin and overhead		699.73	279.59	1,606.00	3,212	43.86
90	9009.01S	Modify existing gullies in Panorama Crescent, 2/D3 and 6/D1 to suit new kerb, kerb and channel levels (Refer Supp Spec 11)			6,422	Margin and overhead		2,010.85	803.48	1,847.20	9,236	43.83
91	9010.01S	Convert existing gully pit 9C1 and 10/C1 to access chamber (Refer Supp Spec 12)			1,766	Margin and overhead		553.06	220.99	1,270.00	2,540	43.83
92	9011.01S	Construct new gully pit over existing culvert at Ch45 MCD1 & 1/D2 (Refer Supp Spec 13)			5,379	Margin and overhead		1,684.25	672.98	3,868.00	7,736	43.82
93	9012.01S	Connect new culvert to existing pit at 2/D3 (Refer Supp Spec 14)			3,628	Margin and overhead		1,136.45	454.09	5,219.00	5,219	43.83
94												
95		PROTECTIVE TREATMENTS (MRS03 Jun 09)										
96	2631.01	Hand placed concrete paving to footpath, 100 mm thick (MRS03 Oct 10) reinforced concrete 25MPa/20 with SL62 mesh centrally located			57,101	Margin and overhead		17,879.26	7,144.06	134.19	82,124	43.82
97	2631.02	Hand placed concrete paving to driveway, 125 mm thick (MRS03 Oct 10) reinforced concrete 25MPa/20 with SL82 mesh centrally located			71,837	Margin and overhead		22,494.82	8,988.31	149.74	103,321	43.83
98	2631.03	Hand placed concrete paving to median, typically 100 mm thick (MRS03 Oct 10) unreinforced concrete 25MPa/20, finish to be terracotta with brick pattern with non slip long life			112,439	Margin and overhead		35,208.34	14,068.29	174.45	161,715	43.83
99												
100		PAVEMENT DRAINS (MRS38 Aug 11)										
101	2801.01	Pavement drain (MRS38 Aug 11)			32,199	Margin and		10,079.94	4,027.67	59.75	46,306	43.81
102	2802.01	Pavement drain outlets (MRS38 Aug 11)			878	Margin and		276.02	110.29	316.00	1,264	44.01
103	2802.02S	Pavement drain outlets (MRS38 Aug 11) (Refer Supp Spec 16)			2,743	Margin and overhead		858.99	343.23	394.50	3,945	43.83
104	2803.01	Pavement drain cleanout point (MRS38 Aug 11)			2,348	Margin and		735.08	293.72	337.70	3,377	43.81
105												
106		Schedule C - Earthworks										
107												
108		EARTHWORKS, PREPARATION (MRS04 Oct 10)										
109	3101.01	Clearing and grubbing (MRS04 Oct 10)			21,948	Margin and		6,892.48	2,754.05	5.49	31,595	43.95

110	3103.01P	Stripping of topsoil (Provisional Quantity as directed) (MRS04 Oct 10)	15,034	Margin and overhead		4,709.81	1,881.91	25.03	21,626	43.85
111	3104.01	Ground surface treatment under embankment, standard (MRS04 Oct 10)	3,962	Margin and overhead		1,239.58	495.30	4.14	5,697	43.80
112	3108.01P	Excavation and disposal of Unsuitable Material with individual excavation <= 10 m3 (Provisional Quantity as directed) (MRS04 Oct 10)	6,324	Margin and overhead		1,980.45	791.33	113.70	9,096	43.83
113	3304.01P	Supply and installation of geotextile, strength class C, filtration class V (Provisional Quantity) (MRS04 Oct 10) under embankment widening	9,920	Margin and overhead		3,112.19	1,243.54	8.30	14,276	43.91
114										
115		EARTHWORKS, EXCAVATION (MRS04 Oct								
116	3201.01	Road excavation, all materials (MRS04 Oct 10)	56,641	Margin and		17,744.81	7,090.34	25.39	81,477	43.85
117	3211.01P	Excavation of non-rippable material in road excavation, rate additional to rate for Work Item 3201 (Provisional Quantity)	4,803	Margin and overhead		1,503.77	600.87	88.56	6,908	43.83
118	3212.01P	Excavation of non-rippable material in confined excavation, rate additional to rates for Work Items 3203 to 3207 inclusive (Provisional Quantity) (MRS04 Oct 10)	8,621	Margin and overhead		2,699.57	1,078.68	177.13	12,399	43.83
119	3215.01P	Excavation and disposal of Unsuitable Material in and below confined excavations (Provisional Quantity as directed) (MRS04 Oct 10)	3,929	Margin and overhead		1,230.02	491.48	282.50	5,650	43.82
120										
121		EARTHWORKS, EMBANKMENT (MRS04 Oct 10)								
122	3301.01	Road embankment (MRS04 Oct 10)	126,011	Margin and		39,455.60	15,765.37	60.11	181,232	43.82
123	3306.01	Road verges using general fill material (Type 2.5) (MRS04 Oct 10)	172,110	Margin and overhead		53,894.91	21,534.92	160.74	247,540	43.83
124										
125		EARTHWORKS, SUBGRADE (MRS04 Oct 10)								
126	3401.01P	Testing of existing material below subgrade level in cuttings (Provisional Quantity if ordered) (MRS04 Oct 10)	1,993	Margin and overhead		623.76	249.24	1,433.00	2,866	43.80
127	3402.01P	Subgrade treatment Type A, in cuttings and embankments, (Provisional Quantity if ordered) (MRS04 Oct 10)	15,941	Margin and overhead		4,987.68	1,992.94	6.08	22,922	43.79
128	3403.01P	Subgrade in cuttings, subgrade treatment Type B, replace with subgrade fill material (Provisional Quantity if ordered) (MRS04 Oct 10)	2,881	Margin and overhead		902.32	360.54	207.20	4,144	43.83
129										
130		EARTHWORKS, BACKFILL (MRS04 Oct 10)								
131	3501.01P	Backfill with general backfill material to below subgrade treatment (Provisional Quantity) (MRS04 Oct 10)	5,362	Margin and overhead		1,678.92	670.85	154.23	7,712	43.83
132	9014.01P	Backfill with lean mix concrete to depth of existing pavement (Provisional Quantity) (MRS04 Oct 10) (refer Supp Spec 17)	3,950	Margin and overhead		1,236.68	494.14	568.10	5,681	43.82
133										
134		Schedule D - Pavements								
135										

Line No.	Item No.	Item Description	Qty	Unit	Direct Cost Rate	Direct Cost Total	Markup Mode	Controlled By	Indirect Spread	Margin Spread	Sell Rate	Sell Total	Effective Markup
136		UNBOUND PAVEMENTS (MRS05 Apr 11)											
137	4153	Subtype 2.3 Unbound pavement, Driveways (MRS05 Apr 11)				7,926	Margin and overhead		2,481.97	991.73	367.73	11,400	43.83
138													
139		PLANT MIXED STABILISED PAVEMENTS (MRS08 Apr 12)											
140	4301.01	Plant mixed stabilised pavement, Type 2.3 material with 1% GB Cement (75% cement, 25% fly ash), (MRS08 Apr 12) Pavement Type 2				36,992	Margin and overhead		11,584.54	4,628.86	190.02	53,206	43.83
141	4321.01	Supply of stabilising agent, GB Cement (75% cement, 25% fly ash) (MRS08 Apr 12) Pavement Type 2				1,966	Margin and overhead		615.85	246.08	471.40	2,828	43.81
142													
143		SUPPLY OF COVER AGGREGATE (MRS22 Oct 10)											
144	5011.01	Supply of cover aggregate precoated, 10 mm nominal size (MRS22 Oct 10)				11,652	Margin and overhead		3,648.91	1,458.01	137.37	16,759	43.83
145	5011.02	Supply of cover aggregate precoated, 10 mm nominal size, Driveways (MRS22 Oct 10)				430	Margin and overhead		134.47	53.73	309.00	618	43.79
146													
147		SPRAYED BITUMINOUS SURFACING (EXCLUDING EMULSION) (MRS11 Oct 10)											
148	5101.01	Prime, grade AMC0, spray rate 1.0L/m2, including supply of binder, Pavement Type 2 (MRS11 Oct 10)				2,240	Margin and overhead		707.01	282.50	1.73	3,230	44.17
149	5103.01S	Seal, class PMB (S4.5S), spray rate 1.8L/m2, including supply of binder, Pavement Types 1, 2, (MRS11 Oct 10)				40,099	Margin and overhead		12,483.54	4,988.08	2.01	57,570	43.57
150	5103.02	Seal, class C170, spray rate 1.2L/m2, including supply of binder, Pavement Type 2, (MRS11 Oct 10)				3,443	Margin and overhead		1,076.73	430.23	2.21	4,950	43.75
151	5103.03	Seal, class C170, spray rate 1.2L/m2, including supply of binder, Driveways, (MRS11 Oct 10)				450	Margin and overhead		140.84	56.28	2.21	648	43.87
152	5112.01S	Spreading cover aggregate 10mm, 130m2/m3, (MRS11 Oct 10) (Refer Supp Spec 18)				5,438	Margin and overhead		1,702.42	680.24	64.10	7,820	43.82
153	5112.02S	Spreading cover aggregate 10mm, 130m2/m3, Driveways (MRS11 Oct 10) (Refer Supp Spec 18)				401	Margin and overhead		124.95	49.93	288.00	576	43.59
154													
155		GEOTEXTILES FOR PAVING APPLICATIONS (MRS57 Jun 09)											
156	5151.01P	Supply of Geotextile grade >130g/m2 (Glasgrid 8550 or similar approved proprietary product) (MRS57 Jun 09) to Table 6.2 of MRTS57 (Provisional Quantity)				390	Margin and overhead		122.29	48.86	3.74	561	43.90
157	5153.01P	Placement of Paving Geotextile nominal weight g/m2 (MRS57 Jun 09) to Table 6.2 of MRTS57 (Provisional Quantity)				505	Margin and overhead		157.98	63.12	4.84	726	43.79
158													
159		PREPARATION OF THE EXISTING SURFACE (MRS30 Oct 10)											

160	5401.01	Preparation of the existing surface (MRS30 Oct 10)		1,777	Margin and overhead		577.18	230.62	0.16	2,585	45.46
161	5402.01P	Crack filling (Provisional Quantity) (MRS30 Oct 10)		6,370	Margin and overhead		1,993.47	796.53	18.32	9,160	43.80
162	5403.01P	Strain alleviating fabric strips (Provisional Quantity) (MRS30 Oct 10)		3,271	Margin and overhead		1,022.80	408.68	9.92	4,702	43.77
163	5404.01	Tack coat 0.2 litres/m2, residual bitumen (MRS30 Oct 10)		5,919	Margin and overhead		1,864.31	744.93	2.68	8,528	44.09
164	9115.01PS	Pavement Repairs (Asphalt) (Provisional Quantity, if ordered) (Refer Supp Spec 19) (Provisional Quantity)		1,925	Margin and overhead		603.76	241.24	2.77	2,770	43.90
165	9115.02PS	Pavement Repairs (Patch) (Provisional Quantity, if ordered) (Refer Supp Spec 19) (Provisional Quantity)		905	Margin and overhead		283.77	113.39	5.54	1,302	43.91
166											
167		DENSE GRADED ASPHALT (MRS30 Oct 10)									
168	5405.01	Dense graded asphalt corrector layer, DG14 (Class 320), Pavement Type 1		67,995	Margin and overhead		21,290.40	8,507.06	250.75	97,793	43.82
169	5405.02	Dense graded asphalt corrector layer, DG20 (Class 600), Pavement Type 1		113,788	Margin and overhead		35,630.76	14,237.07	246.47	163,656	43.83
170	5503.01	Dense graded asphalt, DG14 mix (MRS30 Oct 10) (Class 320), Wearing Course Pavement Type 1, 2		337,068	Margin and overhead		105,546.02	42,173.29	234.31	484,787	43.82
171	5503.02	Dense graded asphalt, DG14 mix (MRS30 Oct 10) (Class 170), Wearing Course Pavement, Driveways		26,079	Margin and overhead		8,166.26	3,263.01	1,172.12	37,508	43.83
172	5504.01	Dense graded asphalt, DG20 mix (MRS30 Oct 10) Class 600, Pavement Type 2		175,354	Margin and overhead		54,905.33	21,938.66	236.14	252,198	43.82
173	5543.01P	Open grade asphalt, OG14 mix (MRS30 Oct 10) (Provisional, If Ordered)		337,407	Margin and overhead		105,660.79	42,219.15	254.21	485,287	43.83
174	9116.01	Removal of existing Open Grade Asphalt wearing course, nominal 50mm (Refer Supp Spec 21)		43,949	Margin and overhead		13,763.60	5,499.55	4.43	63,212	43.83
175	9117.01P	Profile existing pavement below OGA, nominal 50mm (Refer Supp Spec 22) (Provisional Quantity)		5,401	Margin and overhead		1,691.94	676.05	10.40	7,769	43.85
176	9118.01S	Saw cut existing pavement (Refer to Supp Spec 23)		2,765	Margin and overhead		863.91	345.19	5.37	3,974	43.74
177	9118.02S	Saw cut existing pavement, driveway (Refer to Supp Spec 23)		869	Margin and overhead		271.97	108.67	29.75	1,250	43.87
178											
179											
180		Schedule E - Road Furniture & Linemarking									
181											
182		REMOVAL, DEMOLITION AND RE-ERECTION (MRS14 Jun 09)									
183	6101.01	Demolition of road furniture (traffic signs, guardrail, bench) (MRS14 Jun 09)		23,551	Margin and overhead		7,373.27	2,946.16	33,870.00	33,870	43.82
184	6104.01	Removal and re-erection of road furniture (electronic speed sign and equipment) (MRS14 Jun 09)		8,000	Margin and overhead		2,505.05	1,000.95	11,506.00	11,506	43.83

Line No.	Item No.	Item Description	Qty	Unit	Direct Cost Rate	Direct Cost Total	Markup Mode	Controlled By	Indirect Spread	Margin Spread	Sell Rate	Sell Total	Effective Markup
185													
186		ROADSIDE STRUCTURES (MRS14 Jun 09)											
187	6181.01	Fencing, 1320 mm high, galvanised welded mesh (TMR STD DRG 1604)				1,430	Margin and overhead		447.64	178.86	82.24	2,056	43.83
188													
189		GUIDANCE AND INFORMATION SYSTEMS (MRS14A Apr 11)											
190	6121.01	Supply of regulatory, warning and hazard sign faces, as listed in Clause 1.3 of Annexure MRS14A.1.				26,000	Margin and overhead		8,141.77	3,253.23	37,395.00	37,395	43.83
191	6131.01	Installation of regulatory, warning and hazard signs, as listed in Clause 1.3 of Annexure MRS14A.1.				20,757	Margin and overhead		6,500.02	2,597.23	29,854.00	29,854	43.83
192	6136.01	Supply, erection and installation of project signs				7,213	Margin and		2,258.41	902.40	10,374.00	10,374	43.82
193	9119.01S	Supply and installation of safety bollards (Refer Supp Spec 24)				9,000	Margin and overhead		2,818.12	1,126.04	359.56	12,944	43.82
194													
195		ROADSIDE STRUCTURES (MRS14A Apr 11)											
196	6161.01	Steel beam guardrail, w beam (MRS14A Apr 11)				38,840	Margin and		12,161.81	4,859.53	172.41	55,861	43.83
197	6163.01	Steel beam guardrail, terminal type A, SKT, ET2000 or approved equivalent (Design Speed 70km/h) (MRS14A Jun 09)				17,256	Margin and overhead		5,403.54	2,159.11	4,963.70	24,819	43.83
198	6163.02	Steel beam guardrail, terminal type A, (Type 1) Melt or approved equivalent in accordance with TMR STD DRG No. 1474 (MRS14A Apr 11)				4,172	Margin and overhead		1,306.61	522.08	6,001.00	6,001	43.83
199													
200		LINE MARKING (MRS45 Apr 11)											
201	6313.01	Barrier line, single, 100 mm wide (MRS45 Apr 11)				78	Margin and overhead		24.32	9.72	1.51	112	44.14
202	6314.01	Barrier line, one direction, 80 mm wide each line, 80 mm lateral gap between lines, 3000 mm line length and 9000 mm gap length on broken side, colour white, material paint (MRS45 Apr				9	Margin and overhead		2.74	1.10	1.60	13	45.09
203	6315.01	Barrier line, both directions, 80 mm wide each line, 80 mm lateral gap between lines, colour white, material paint (MRS45 Apr 11)				87	Margin and overhead		27.08	10.82	2.35	125	44.25
204	6318.01	Lane line, continuous, 100 mm wide, colour white, material paint (MRS45 Apr 11)				527	Margin and overhead		165.22	66.02	2.69	759	43.93
205	6319.01S	Edge line, 150 mm wide, colour white, material paint (Refer Supp Spec 25) (MRTS45 Apr 11)				7,549	Margin and overhead		2,374.14	948.64	3.37	10,872	44.02
206	6319.02S	Edge line, 150 mm wide, colour yellow, material paint (Refer Supp Spec 25) (MRTS45 Apr 11)				5,245	Margin and overhead		1,639.07	654.93	6.08	7,539	43.73
207	6321.01	Continuity line, 200 mm wide, 1000mm line length, 3000mm gap length, colour white, material paint (MRS45 Apr 11)				1,489	Margin and overhead		466.11	186.25	6.17	2,141	43.82
208	6322.01	Turn line, 100 mm wide, colour white, material paint (MRS45 Apr 11)				454	Margin and overhead		141.87	56.69	5.93	652	43.69
209	6323.01	Outline, 150 mm wide, colour white, material paint (MRS45 Apr 11)				3,173	Margin and overhead		991.37	396.13	6.08	4,560	43.74

Line No.	Item No.	Item Description	Qty	Unit	Direct Cost Rate	Direct Cost Total	Markup Mode	Controlled By	Indirect Spread	Margin Spread	Sell Rate	Sell Total	Effective Markup
210	6331.01	Transverse lines (stop lines, holding lines, markings at Stop and Give Way signs, pedestrian crosswalk lines, arrows,shapes, symbols and numerals), colour white, material paint (MRS45 Apr 11)				155	Margin and overhead		48.73	19.47	20.30	223	43.78
211	6332.01	Transverse lines (diagonal and chevron markings,parking areas and kerb markings), colour white, material paint (MRS45 Apr 11)				9,279	Margin and overhead		2,905.78	1,161.07	92.68	13,346	43.83
212													
213		RAISED PAVEMENT MARKERS (MRS45 Apr 11)											
214	6351.01	Retroreflective raised pavement markers (MRS45 Apr 11)				5,828	Margin and overhead		1,824.65	729.08	17.72	8,382	43.83
215													
216		Schedule F - Road Lighting											
217													
218		CONDUIT AND CONDUIT FITTINGS UNDERGROUND (MRS91 Jun 09)											
219	6507.02	Supply and installation of 2 of 100 mm, HDPVC, electrical conduit(s), in road (MRS91 Jun 09)				69,488	Margin and overhead		21,759.79	8,694.61	126.19	99,942	43.83
220	6507.03	Supply and installation of 1 of 100 mm, HDPVC, electrical conduit(s), in earth (MRS91 Jun 09)				38,560	Margin and overhead		12,072.06	4,823.66	63.09	55,456	43.82
221													
222		CABLE JOINTING PITS (MRS91 Jun 09)											
223	6554.03	Supply and installation of cable jointing pit Circular (MRS91 Jun 09)				35,275	Margin and overhead		11,045.92	4,413.65	805.31	50,735	43.83
224													
225		ROAD LIGHTING FOOTINGS (MRS92 Jun 09)											
226	6701.01	Road lighting pole footing, 350 mm diameter (MRS92 Jun 09)				36,477	Margin and overhead		11,422.26	4,564.02	1,543.04	52,463	43.82
227													
228		ROAD LIGHTING (MRS94 Jun 09)											
229	6771.01	Supply and installation of slip base road lighting pole, 8500 mm vertical height, 3000 mm long double outreach arm, without outreach arm extension with loop in loop out cabling (MRS94 Jun 09)				21,372	Margin and overhead		6,692.48	2,674.13	3,415.40	30,739	43.83
230	6771.02	Supply and installation of fixed base road lighting pole, 8500 mm vertical height, 3000 mm long single outreach arm, without outreach arm extension with loop in loop out cabling (MRS94 Jun 09)				23,059	Margin and overhead		7,220.67	2,885.18	3,316.50	33,165	43.83
231	6771.03	Supply and installation of slip base road lighting pole, 10000 mm vertical height, 4500 mm long single outreach arm, without outreach arm extension with loop in loop out cabling (MRS94 Jun 09)				17,309	Margin and overhead		5,420.19	2,165.76	4,979.00	24,895	43.83

Line No.	Item No.	Item Description	Qty	Unit	Direct Cost Rate	Direct Cost Total	Markup Mode	Controlled By	Indirect Spread	Margin Spread	Sell Rate	Sell Total	Effective Markup
232	6771.04	Supply and installation of fixed base road lighting pole, 10000 mm vertical height, 4500 mm long single outreach arm, without outreach arm extension with loop in loop out cabling (MRS94 Jun 09)				32,335	Margin and overhead		10,125.49	4,045.87	4,650.60	46,506	43.83
233	6776.01	Supply and installation of road lighting luminaire, rexel, Optispan aeroscreen S150 (MRS94 Jun 09)				9,680	Margin and overhead		3,031.73	1,211.40	732.80	13,923	43.83
234	6776.02	Supply and installation of road lighting luminaire, rexel, Optispan aeroscreen S250 (MRS94 Jun 09)				11,844	Margin and overhead		3,708.96	1,482.00	774.30	17,035	43.83
235	6776.03	Supply and installation of road lighting luminaire, rexel, Optispan aeroscreen S400 (MRS94 Jun 09)				1,241	Margin and overhead		388.17	155.10	892.00	1,784	43.79
236	6781.01	Removal of road lighting equipment for salvage, outreach and luminaire on existing timber poles (MRS94 Jun 09)				8,006	Margin and overhead		2,507.27	1,001.83	1,279.50	11,516	43.83
237	6781.012	Removal of road lighting equipment for salvage, outreach, luminaire and road lighting poles (MRS94 Jun 09)				7,497	Margin and overhead		2,347.57	938.03	1,797.10	10,783	43.83
238													
239		SWITCHBOARDS (MRS95 Jun 09)											
240	6801.01	Supply of URD pillar switchboard and ancillary components, post mounted (MRS95 Jun 09)				1,960	Margin and overhead		613.04	244.96	1,409.00	2,818	43.78
241	6803.01	Installation of URD pillar switchboard and ancillary components, post mounted (MRS95 Jun 09)				768	Margin and overhead		240.27	96.01	552.00	1,104	43.80
242													
243		ELECTRICAL CABLES (MRS95 Jun 09)											
244	6811.01	Supply of underground road lighting cable, 16mm, 4 cores, XLPE, PVC, Copper (MRS95 Jun 09)				24,032	Margin and overhead		7,526.54	3,007.40	17.91	34,566	43.83
245	6811.02	Supply of underground road lighting cable, 16mm, 2 cores, XLPE, PVC, Copper (MRS95 Jun 09)				388	Margin and overhead		121.50	48.55	12.40	558	43.83
246	6816.01	Supply of cable joint, fused (MRS95 Jun 09)				8,120	Margin and		2,542.71	1,016.00	307.34	11,679	43.83
247	6821.01	Installation, jointing and termination of underground road lighting cable, 4 cores (MRS95 Jun 09)				21,719	Margin and overhead		6,807.53	2,720.10	16.19	31,247	43.87
248	6821.02	Installation, jointing and termination of underground road lighting cable, 2 cores (MRS95 Jun 09)				610	Margin and overhead		190.92	76.29	19.49	877	43.81
249													
250		Schedule G - Landscaping											
251													
252		MONITORING AND CONTROL (MRS51 Apr 11)											
253	3713.01	Loading, haulage and placement of site planting media				11,574	Margin and overhead		3,613.73	1,443.95	2.89	16,632	43.70
254													
255		INPUT CONTROLLED SEEDING (MRS16C April12)											

Line No.	Item No.	Item Description	Qty	Unit	Direct Cost Rate	Direct Cost Total	Markup Mode	Controlled By	Indirect Spread	Margin Spread	Sell Rate	Sell Total	Effective Markup
256	3772.01	Hydromulching - single pass grass seed mix				6,071	Margin and		1,904.47	760.97	7.28	8,736	43.91
257													
258		TURFING (MRS16C April12)											
259	3782.01	Turf, A-Grade Green Couch				13,211	Margin and		4,142.94	1,655.40	6.67	19,010	43.89
260													
261		PREPARATION TREATMENTS (MRS16 Jun											
262	3811.01	Herbicide application (MRS16 Jun 09) allowance for application to 75% of total project landscape area prior to planting				4,160	Margin and overhead		1,306.83	522.17	2.03	5,989	43.98
		Total for all items				4,319,941			1,442,034.92	576,197.50		6,338,186	

Appendix H: Construction Estimate Resource Usage

This Appendix contains the Ranked Resource Usage Report for the Construction Estimate.

It lists all of the resources (plant, labour, materials and subcontractors) used in the preparation of the Construction Estimate ordered by value that each contributes to the Construction Estimate.

aQuenta CONSULTING

Resource Usage

Mooloolaba Road Upgrade Buderim

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Resource Name	Description	Use In Project Unit	Curr	Calculated Rate In AUD	Amount In AUD	% Proj	Major, Minor Sortcodes	Status
	Labour resources							
L.LA.GENERAL	GENERAL SKILLED CIVIL LABOUR				402,446	6.98	Labour, No Minor	Confirmed
L.LA.PF	PROJECT FOREMAN				136,481	2.37	Project Supervision, Construction	Confirmed
L.LA.SE	SITE ENGINEER				130,460	2.26	Engineering, Construction	Confirmed
L.LA.PM	PROJECT MANAGER				106,478	1.85	Manager, No Minor	Confirmed
L.LA.CA	CONTRACTS ADMINISTRATOR				84,297	1.46	Systems Management, No Minor	Confirmed
L.LA.CONCRETE	LABOUR CONCRETE WORKS				83,640	1.45	Labour, No Minor	Confirmed
L.LA.WET	WET WEATHER ALLOWANCE				82,094	1.42	Labour, No Minor	Confirmed
L.LA.QAE	QA ENGINEER				65,230	1.13	Systems Management, Quality	Confirmed
L.LA.TOOLBOX	TOOL BOX ALLOWANCE				62,110	1.08	Labour, No Minor	Confirmed
L.LA.SC	SAFETY COODINATOR				53,200	0.92	Manager, No Minor	Confirmed
L.TRADES.ELEC	ELECTRICAL TRADESMAN				50,550	0.88	Tradesman, No Minor	Confirmed
L.LA.CL	CLEANERS				19,443	0.34	Labour, No Minor	Confirmed
L.LA.SEC	SECURITY GUARD 18:00 TO 6:00				18,241	0.32	Security, No Minor	Confirmed
L.LA.SPE	SENIOR PROJECT ENGINEER				15,254	0.26	Engineering, Construction	Confirmed
L.LA.PE	PROJECT ENGINEER				12,885	0.22	Engineering, Construction	Confirmed
L.LA.EE	ENVORONMENTAL ENGINEER				11,778	0.20	Engineering, Environmental	Confirmed

Resource Usage

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Resource Name	Description	Use In Project	Unit	Curr	Calculated Rate In AUD	Amount In AUD	% Proj	Major, Minor Sortcodes	Status
L.TRADES.PLUMB	PLUMBING TRADESMAN					9,161	0.16	Tradesman, No Minor	Confirmed
L.LA.LHALLOW	LEADING HAND ALLOWANCE					7,704	0.13	Labour, No Minor	Confirmed
L.LA.INDUCTION	SITE INDUCTION ALLOWANCE					5,521	0.10	Labour, No Minor	Confirmed
L.TRADES.COMMS	COMMUNICATIONS TRADESMAN					679	0.01	Tradesman, No Minor	Confirmed
L.LA.ITT	IT TECHNICIAN					591	0.01	Systems Management, IT	Confirmed
L.LA.STEELFIXER	LABOUR STEEL FIXER					161		Labour, No Minor	Confirmed
L.LA.DOGMAN	CRANE DOGMAN					63		Labour, No Minor	Confirmed
L.LA.ITM	IT MANAGER							Systems Management, IT	Confirmed
L.LA.SAC	SENIOR ACCOUNTS CLERK							Systems Management, Accounts	Confirmed
L.LA.PRO	PUBLIC RELATIONS OFFICER							Systems Management, Public Relations	Confirmed
L.LA.PO	PROCURMENT OFFICER							Administration Management, Procurment	Confirmed
L.LA.CCC	COST CONTROL CLERK							Administration Management, Document Systems	Confirmed
L.LA.ACL	ACCOUNTS CLERK							Administration Management, Accounts	Confirmed
L.LA.PUP	PUBLIC UTILITY PLANT ENGINEER							Engineering, PUP	Confirmed
L.LA.TM	TRAFFIC MANAGEMENT							Engineering, Traffic	Confirmed
L.LA.GE	GRADUATE ENGINEER							Engineering, Construction	Confirmed
L.LA.CM	CONSTRUCTION MANAGER							Project Supervision, Construction	Confirmed
L.LA.PS	PROJECT SUPERVISOR							Project Supervision, Construction	Confirmed
L.LA.PRM	PROGRAMME MANAGER							Systems Management, Programme	Confirmed

Resource Usage

Resource Name	Description	Use In Project	Unit	Curr	Calculated Rate In AUD	Amount In AUD	% Proj	Major, Minor Sortcodes	Status
L.LA.SM	SYSTEMS MANAGER		week	AUD	3,233.6200			Systems Management, IT	Confirmed
L.LA.DSC	DOCUMENT AND SYSTEMS CONTROLLER		week	AUD	3,233.6200			Systems Management, Document & Systems	Confirmed
L.LA.AMA	ADMINISTRATION MANAGEMENT ASSISTANT		week	AUD	2,787.6100			Administration Management, No Minor	Confirmed
L.LA.AM	ADMINISTRATION MANAGER		week	AUD	1,895.5600			Administration Management, No Minor	Confirmed
	Total for Labour resources					***1,358,466***	***23.58***	***0.00% plugged, 0.00% unplugged***	
	<u>Material resources</u>								
MAC.OG14.EXBIN	OG14 ASPHALT EX-BIN					262,904	4.56	Road Surfacing, Asphalt Ex-Bin	Confirmed
MQM.DGB.CBR1525	DENSE GRADE BASE 2.5 CBR 15					153,269	2.66	Quarry Products, Road Base	Confirmed
MSWD.MONOHD.S200K	SUPPLY ACO S200K MONOLITHIC HEAVY DUTY DRAIN SYSTEM - 1,000mm long per section					146,880	2.55	Stormwater, ACO Drain	Plugged
MTC.TRITON.HIRE	Hire of Triton Barriers					114,168	1.98	Traffic Control, No Minor	Confirmed
MQM.NSPEC.CBR15	CBR 15 GENERAL FILL					96,480	1.67	Quarry Products, Fill	Confirmed
MQM.CRUAGG.0005	5mm SCREENINGS					73,074	1.27	Quarry Products, Aggregates	Confirmed
MSWD.MONOHD.S300KA	SUPPLY ACO S300KA MONOLITHIC HEAVY DUTY DRAIN SYSTEM - 1,000mm long per					71,690	1.24	Stormwater, ACO Drain	Plugged

Resource Name	Description	Use In Project	Unit	Curr	Calculated Rate In AUD	Amount In AUD	% Proj	Major, Minor Sortcodes	Status
MRM.CONNOR.N3220	32MPA / 20 CONCRETE					63,453	1.10	Concrete, No Minor	Confirmed
MRM.CONNOR.N3220KERB	32MPA / 20 KERBMIX					56,406	0.98	Concrete, No Minor	Confirmed
MOH.INSURE.EXCE	EXCESSES - INSURNACES					50,000	0.87	Overheads, Insurance	Confirmed
MTF.TIPFEE.CLEANFILL	CLEAN FILL TIP FEE					41,821	0.73	Tip Fees, No Minor	Confirmed
MSWD.PIPCO.03FJ0375	375ø CLASS 3 FLUSH JOINT RCP					37,981	0.66	Concrete Pipes, Class 3 - fj	Confirmed
MRM.CONNOR.N2520	25MPA / 20 CONCRETE					36,987	0.64	Concrete, No Minor	Confirmed
MSWD.MONOHD.S300K	SUPPLY ACO S300K MONOLITHIC HEAVY DUTY DRAIN SYSTEM - 1,000mm long per section					33,600	0.58	Stormwater, ACO Drain	Plugged
MQM.DGB.CBR4523	DENSE GRADE BASE 2.3 CBR 45					32,039	0.56	Quarry Products, Road Base	Confirmed
MLS.RWHSIGNS.GENERAL	REGULATORY, WARNING & HAZARD SIGNS GENERAL SUPPLY					32,000	0.56	Signs, No Minor	Confirmed
MSWD.PCGULLYWALL.1.2	PRECAST GULLY WALL SECTION 1.2M HIGH					28,693	0.50	Stormwater, Precast Gully	Confirmed
MRM.FLOWFILL.N2	2MPA FLOWABLE FILL					28,125	0.49	Concrete, No Minor	Plugged
MOH.INSURE.CAR PC	INSURANCE - PRINCIPAL CONTRACTORS ALL					25,100	0.44	Overheads, Insurance	Confirmed
MCBL.V90CIRC.4CE16MMPVC	25mm 4 C&E V90 CIRC PVC PVC					24,032	0.42	Signals - Streetlighting, Cable	Confirmed

Resource Name	Description	Use In Project	Unit	Curr	Calculated Rate In AUD	Amount In AUD	% Proj	Major, Minor Sortcodes	Status
MGEN.CONSUME.MISC	GENERAL CONSUMABLES					23,108	0.40	General, No Minor	Confirmed
MER.PVCON.0100HD	100ø HEAVY DUTY ELECTRICAL CONDUIT					22,662	0.39	Electrical, Conduit	Confirmed
MQM.BEDSAN.COARSE	COARSE BEDDING SAND					22,281	0.39	Quarry Products, Sand	Confirmed
MOH.PPE.GEN	PERSONNEL PROTECTION					20,860	0.36	Overheads, PPE	Confirmed
MSWD.MRDLIN.TS2400	2.4 TYPE SMALL MRD SPEC LINTEL					18,922	0.33	Stormwater, Lintel	Confirmed
MSWD.MRDPC.CHAMBER	MRD SPECIFICATION CHAMBER TO PRECAST SIDE					16,370	0.28	Stormwater, Precast Gully	Confirmed
MPLUG	MPLUG					15,924	0.28	No Major, No Minor	Confirmed
MSWD.MRDGULGRA.TAGAL	MRD SPEC TYPE A GALVANISED GULLY GRATE					15,215	0.26	Stormwater, Cover / Grate	Confirmed
MSGN.BPM.8500	8500 BASE POLE MOUNTED					15,171	0.26	Signals - Streetlighting, Timber Poles	Confirmed
MFRM.FORLVL.90X65	90 X 65 TRUFORM COST PER METER					14,626	0.25	Formworks, Structure Form	Confirmed
MSWD.PIPCO.03FJ0450	450ø CLASS 3 FLUSH JOINT RCP					14,236	0.25	Concrete Pipes, Class 3 - fj	Confirmed
MSA.SITEMESS.60002400	6000mm x 2400mm LUNCH ROOM / FURNISHED					14,040	0.24	Overheads, Site Accommodation	Confirmed
MSA.CP.LAPTOP	PURCHASE LAPTOP COMPUTER PACKAGE including relevant software					13,258	0.23	Communication, Computer	Confirmed
MER.PIT.ROUND06001000	ROUND ELECTRICAL PIT 600mm x 1000mm					12,866	0.22	Signals - Streetlighting, No Minor	Confirmed

Resource Usage

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Resource Name	Description	Use In Project	Unit	Curr	Calculated Rate In AUD	Amount In AUD	% Proj	Major, Minor Sortcodes	Status
MRS.STMESH.SL72	SL72 STEEL REO MESH					12,846	0.22	Reinforcing, Mesh	Confirmed
MOH.BF.GUARANTEE	BANK FEES - BANK GUARANTEE					12,568	0.22	Overheads, No Minor	Confirmed
MSWD.PCBASE.1050ø	PRECAST CONCRETE CHAMBER BASE -					12,008	0.21	Stormwater, Precast Chamber	Confirmed
MSGN.DOUOUT.3000	3000 DOUBLE OUTREACH					11,573	0.20	Signals - Streetlighting, Outreach Arm	Confirmed
MSGN.RLPF.0600	600mm DIA ROAD LIGHTING POLE FOOTING					10,937	0.19	Signals - Streetlighting, No Minor	Confirmed
MFRM.FORM.OIL	FORM OIL					10,715	0.19	Formworks, No Minor	Confirmed
MSGN.BPM.10000-F	10000 BASE POLE MOUNTED - Fixed					9,960	0.17	Signals - Streetlighting, Timber Poles	Confirmed
MSGN.LUMIN.S250	LUMINAIRE S250					9,529	0.17	Signals - Streetlighting, Luminaire	Confirmed
MRS.GADOBAR.R20150	GALVANISED DOWEL R20 x 150mm LONG					9,051	0.16	Reinforcing, Dowels	Plugged
MSA.SKIP.BIN	SKIP BINS					8,600	0.15	Overheads, Skip Bin	Confirmed
MOH.INSURE.PL	PUBLIC LIABILITY - INSURANCES					8,250	0.14	Overheads, Insurance	Confirmed
MSWD.MRDPC.TROUGH	MRD SPECIFICATION TROUGH TO PRECAST SIDE					8,185	0.14	Stormwater, Precast Gully	Confirmed
MRL.CABLEJOINT.FUSED	SUPPLY OF CABLE JOINT FUSED					8,120	0.14	Signals - Streetlighting, No Minor	Confirmed
MSWD.MRDASPRO.1050ID	1050mm ID MRD SPEC ASPRO					7,917	0.14	Stormwater, Aspro	Confirmed
MSD.MEGFLO.0450	450mm MEGAFLO DRAINAGE					7,834	0.14	Side Drains, No Minor	Confirmed
MSA.PETTY.CASH	PETTY CASH					7,789	0.14	Overheads, Petty Cash	Confirmed
MSGN.LUMIN.S150	LUMINAIRE S150					7,681	0.13	Signals - Streetlighting, Luminaire	Confirmed

Resource Usage

Resource Name	Description	Use In Project	Unit	Curr	Calculated Rate In AUD	Amount In AUD	% Proj	Major, Minor Sortcodes	Status
MSWD.PIPCO.02FJ0375	375ø CLASS 2 FLUSH JOINT RCP					7,635	0.13	Concrete Pipes, Class 2 - fj	Confirmed
MSWD.PIPCO.02FJ0450	450ø CLASS 2 FLUSH JOINT RCP					7,620	0.13	Concrete Pipes, Class 2 - fj	Confirmed
MTF.TIPFEE.DICON	DIRTY CONCRETE TIP FEE					7,589	0.13	Tip Fees, No Minor	Confirmed
MSWD.PCGULLYWALL.0.3	PRECAST GULLY WALL SECTION 0.3M HIGH					7,174	0.12	Stormwater, Precast Gully	Confirmed
MSGN.BPM.10000-S	10000 BASE POLE MOUNTED - Slip					6,850	0.12	Signals - Streetlighting, Timber Poles	Plugged
MRM.CONSUME.GEN	MISCELLANEOUS CONCRETE COSTS					6,667	0.12	Concrete, No Minor	Confirmed
MSWD.PCCHAMBER.WALL1500ø	PRECAST CONCRETE CHAMBER WALL -					6,372	0.11	Stormwater, Precast Chamber	Confirmed
MGEN.FAUNA.MANAGEMENT	FAUNA MANAGEMENT					6,100	0.11	General, No Minor	Confirmed
MGEN.SURV.PEG	SURVEY PEGS					5,240	0.09	General, No Minor	Confirmed
MTF.TIPFEE.GREEN	GENERAL GREEN WASTE					5,078	0.09	Tip Fees, No Minor	Confirmed
MLS.INFOSIGNS.GEN	INFORMATION SIGNS GENERAL SUPPLY					5,000	0.09	Signs, No Minor	Confirmed
MOH.MBILEPHONE.CHARGE	MOBILE PHONE CHARGES					4,986	0.09	Overheads, Communications	Confirmed
MSA.SITEOFFIC.60002400	6000mm x 2400mm PORTABLE OFFICE / FURNISHED					4,680	0.08	Overheads, Site Accommodation	Confirmed
MSA.PRINT.COST	PRINTING COSTS pages per person week					4,607	0.08	Overheads, consumables	Confirmed

Resource Name	Description	Use In Project	Unit	Curr	Calculated Rate In AUD	Amount In AUD	% Proj	Major, Minor Sortcodes	Status
MSWD.MONOHD.QK200AE	SUPPLY ACO QK200AE MONOLITHIC HEAVY DUTY ACCESS DRAIN FOR QK200A - 1,000mm					4,320	0.07	Stormwater, ACO Drain	Plugged
MSWD.MRDINFLCOVFRM.600CLB	600mm MRD SPEC CLASS B CONCRETE INFILL COVER & FRAME					4,236	0.07	Stormwater, Cover / Grate	Confirmed
MFC.TEMPFENCE.6MH	TEMPORARY FENCING HIRE UP TO 6 MONTHS					4,082	0.07	Fencing, No Minor	Confirmed
MSA.CHEM.TOI	CHEMICAL TOILET					3,960	0.07	Overheads, Site Accommodation	Confirmed
MSWD.MONOHD.Q100	SUPPLY ACO Q100 MONOLITHIC HEAVY DUTY DRAIN SYSTEM - 1,000mm long per section 155mm wide x 294mm deep DRAINAGE					3,900	0.07	Stormwater, ACO Drain	Plugged
MSEW.PIPPVC.SN08RRJ0100	100ø CLASS SN8 RR JOINT PVC PIPE					3,850	0.07	Sewer, PVC Pipe	Confirmed
MSA.TFC.CHARGES	TELEPHONE / FAX CALL CHARGES					3,600	0.06	Overheads, Communications	Confirmed
MSWD.PCCHAMBER.WALL1050ø	PRECAST CONCRETE CHAMBER WALL -					3,414	0.06	Stormwater, Precast Chamber	Confirmed
MFRM.FORPLYSTRUC.0007	7mm FORM PLY					3,272	0.06	Formworks, Structure Form	Plugged
MRS.GALDOBAR.R12450	GALVANISED DOWEL R12 x 450mm LONG					3,244	0.06	Reinforcing, Dowels	Confirmed
MLS.INFOSIGNS.INSTALL	INFORMATION SIGNS GENERAL INSTALLATION					3,000	0.05	Signs, No Minor	Confirmed

Resource Name	Description	Use In Project	Unit	Curr	Calculated Rate In AUD	Amount In AUD	% Proj	Major, Minor Sortcodes	Status
MCBL.CABLE.19C	CABLE 19 CORE					2,982	0.05	Signals - Streetlighting, Cable	Confirmed
MSWD.PIPCO.03FJ0525	525ø CLASS 3 FLUSH JOINT RCP					2,887	0.05	Concrete Pipes, Class 3 - fj	Confirmed
MSWD.PIPCO.02FJ0300	300ø CLASS 2 FLUSH JOINT RCP					2,878	0.05	Concrete Pipes, Class 2 - fj	Confirmed
MSA.MCT.SUP	MILK, COFFEE, TEA SUPPLY					2,873	0.05	Overheads, consumables	Confirmed
MSA.STAT.CONSUMP	STATIONARY CONSUMPTION per person week					2,736	0.05	Overheads, Stationary	Confirmed
MGF.GEOTEXT.CLCF240	GEOTEXTILE STRENGTH CLASS C FILTRATION CLASS					2,690	0.05	Geofabrics, Geotextile	Confirmed
MSA.CONTAINER.HIRE	SEA CONTAINER HIRE					2,519	0.04	Overheads, Site Accommodation	Confirmed
MFC.STAPICK.1800	1800mm STAR PICKET					2,504	0.04	Fencing, No Minor	Confirmed
MSWD.PCBASE.1500ø	PRECAST CONCRETE CHAMBER BASE -					2,486	0.04	Stormwater, Precast Chamber	Confirmed
MFRM.BOLT12ØX250	12ø x 250mm LONG CUPHEAD BOLT, NUT & WASHER					2,393	0.04	Formworks, Structure Form	Confirmed
MGF.GEOTEXT.BIDA34	BIDUM CALSS A34 GEOTEXTILE					2,259	0.04	Geofabrics, Geotextile	Confirmed
MSGN.SINOUT.3000	3000 SINGLE OUTREACH					2,250	0.04	Signals - Streetlighting, Outreach Arm	Confirmed
MCW.BCKGROD.0013	13ø FOAM BACKING ROD					2,169	0.04	Concrete Works, No Minor	Confirmed
MRM.LEANMIX.N10	10MPA LEAN MIX					2,145	0.04	Concrete, No Minor	Confirmed
MCW.CEMENT.BULK	BULK CEMENT CALC IN 25KG					1,966	0.03	Concrete Works, No Minor	Confirmed
MSGN.EXTENARM.1500	1500m LONG OUTREACH ARM EXTENSION					1,900	0.03	Signals - Streetlighting, Outreach Arm	Confirmed

Resource Name	Description	Use In Project	Unit	Curr	Calculated Rate In AUD	Amount In AUD	% Proj	Major, Minor Sortcodes	Status
MOH.WATSEW.INSTAL	WATER/SEWER INSTALLATION					1,890	0.03	Overheads, No Minor	Confirmed
MCW.GEN.CURE	CONCRETE CURING OIL $349.10 for 200litre					1,835	0.03	Concrete Works, Curing	Confirmed
MOH.MF.CARKIT	HANDS FREE CAR KIT FOR MOBILE PHONE					1,799	0.03	Overheads, Communications	Confirmed
MER.POLYMERIC.COVER	POLYMERIC PROTECTIVE TAPE - 300mm wide					1,759	0.03	Electrical, General	Confirmed
MSGN.SINOUT.4500	4500 SINGLE OUTREACH					1,750	0.03	Signals - Streetlighting, Outreach Arm	Plugged
MSWD.MRGALGRT.600900T2	TYPE 2 600mm x 900mm HEAVY DUTY GALVANISED					1,617	0.03	Stormwater, Cover / Grate	Confirmed
MSEW.STEPIRO.GEN	SEWER MANHOLE STEP IRON					1,602	0.03	Sewer, General	Confirmed
MCW.CEMENT.BAGGED	BAGGED CEMENT					1,551	0.03	Concrete Works, No Minor	Confirmed
MWR.PIPCOP.0032	32ø COPPER PIPE					1,230	0.02	Water, Copper Pipe	Confirmed
MWR.PIPMDPE.PN100050	50ø CLASS PN10 MD POLYETHYLENE PIPE					1,074	0.02	Water, PVC Pipe	Confirmed
MSGN.LUMIN.S400H	LUMINAIRE S400H					1,030	0.02	Signals - Streetlighting, Luminaire	Confirmed
MSWD.GD-JPIT.300x300x450	SUPPLY GRATED DRAIN JUNCTION PIT - 300mm x 300mm x 450mm including - Grate, topsection and					1,000	0.02	Stormwater, ACO Drain	Plugged
MRS.GEN.CHAIR	REINFORCING BAR CHAIRS					930	0.02	Reinforcing, General	Confirmed
MCW.ABELFLX.0125	125mm ABELFLEX COMPRESSIBLE FILLER					924	0.02	Concrete Works, No Minor	Confirmed

Resource Name	Description	Use In Project	Unit	Curr	Calculated Rate In AUD	Amount In AUD	% Proj	Major, Minor Sortcodes	Status
MSA.CLEAN.SUP	OFFICE CLEANING SUPPLIES					900	0.02	Overheads, Site Accommodation	Confirmed
MSEW.FITTING.MISC	MISCELLANEOUS SEWER FITTINGS					900	0.02	Sewer, General	Confirmed
MSA.COUR.BAG	COURIER BAGS					900	0.02	Overheads, Communications	Confirmed
MRW.PVCBND.SWJ015045	150ø x 45° PVC SW JOINT BEND					868	0.02	Roofwater, PVC Bend	Confirmed
MENV.BALED.HAY	HAY BALES SUPPLY					834	0.01	Environmental, General	Confirmed
MSA.FAX.RENTAL	FACSIMILE MACHINE RENTAL					812	0.01	Communication, No Minor	Confirmed
MSWD.PRECSTHW.0525	525ø PRECAST HEADWALL - QDMR Design					791	0.01	Stormwater, Precast Headwalls	Confirmed
MSA.EMAIL.CHARGE	EMAIL CHARGES					708	0.01	Communication, No Minor	Confirmed
MQM.CRURCK.00750150	75mm - 150mm CRUSHED ROCK					654	0.01	Quarry Products, Crushed Rock	Confirmed
MWR.FITTINGS.MISC	MISCELLANEOUS WATER FITTINGS					600	0.01	Water, General	Confirmed
MBDGE.M10x120BOLT	M10 x 120mm SS Bolt					600	0.01	Bridge Works, Bolts	Plugged
MSA.POWER.CONSUMP	ELECTRICITY CHARGES - GENERAL SITE CONSUMPTION per					585	0.01	Overheads, Electricity	Confirmed
MSWD.MAINMARK.POST	MAINTENANCE MARKER POST					509	0.01	Stormwater, General	Confirmed
MOH.MOB.PHONE	MOBILE PHONE PURCHASE on plan					500	0.01	Overheads, Communications	Confirmed
MENV.SANDBAG.SUPPLY	POLY SAND BAG WITH DRAW STRING - 840mm x					464	0.01	Environmental, No Minor	Confirmed
MSD.SUST.QTADAPT	QT STRIP DRAIN ADAPTOR					450	0.01	Side Drains, No Minor	Confirmed
MSA.OPTUSHAND.RENTAL	OPTUS HANDSET RENTAL					433	0.01	Communication, No Minor	Confirmed

Resource Name	Description	Use In Project	Unit	Curr	Calculated Rate In AUD	Amount In AUD	% Proj	Major, Minor Sortcodes	Status
MENV.GRSMAT.MAT	GRASS MATTING					410	0.01	Environmental, General	Confirmed
MER.GEN.POLYCOVER	POLYMERIC PROTECTIVE TAPE					408	0.01	Electrical, General	Confirmed
MSEW.PVCJUNC.01000090	100ø x 90° CLASS SN8 Y JUNCTION					408	0.01	Sewer, PVC Fittings	Confirmed
MGF.GEOTEXT.SEALMAC	GEOTEXTILE - SEALMAC POLYESTER					390	0.01	Geofabrics, Geotextile	Confirmed
MCBL.V90CIRC.2CE16MMPVC	16mm 2 C&E V90 CIRC PVC PVC					388	0.01	Signals - Streetlighting, Cable	Confirmed
MER.WARNING.TAPE	ELECTRICAL CONDUIT WARNING TAPE -					336	0.01	Electrical, General	Confirmed
MRW.PIPPVC.SN04SWJ0150	150ø CLASS SN4 SW JOINT PVC PIPE					328	0.01	Roofwater, PVC Pipe	Confirmed
MFRM.MHFORMOU.15001200225	1500ø x 1200mm x 225mm THICKNESS EXTERNAL MANHOLE FORM					312	0.01	Formworks, Manholes	Confirmed
MSD.CLEANOUT.AGG	CLEANOUT PIT & PVC CAP					304	0.01	Side Drains, No Minor	Confirmed
MWR.HYD.MARKER	HYDRANT MARKER					299	0.01	Water, Hydrants	Confirmed
MSWD.SLFSUPGALGRT.600900H	600mm x 900mm HEAVY DUTY GALVANISED					295	0.01	Stormwater, Cover / Grate	Confirmed
MFRM.MHFORMIN.10501200	1050ø x 1200mm INTERNAL MANHOLE FORM					270		Formworks, Manholes	Confirmed
MSWD.MONOHD.Q100EC	SUPPLY END CAP TO SUIT ACO Q100 MONOLITHIC HEAVY DUTY DRAIN SYSTEM					264		Stormwater, ACO Drain	Plugged

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Resource Name	Description	Use In Project	Unit	Curr	Calculated Rate In AUD	Amount In AUD	% Proj	Major, Minor Sortcodes	Status
MFC.MARKERTAPE	FLURO MARKER TAPE 100 M ROLL					262		Fencing, No Minor	Confirmed
MER.GEN.DRAWWIRE	DRAW WIRE					255		Electrical, General	Confirmed
MSEW.PVCCOU.SN100100	100ø CLASS SN10 PVC SLIP COUPLING					165		Sewer, PVC Fittings	Confirmed
MENV.SILTFEN.SF2000	SF2000 SILT FENCING					154		Environmental, Silt Fence	Confirmed
MTC.ROADSIGN.TEMP	TEMPORARY ROAD SIGNS					138		Traffic Control, No Minor	Confirmed
MRW.PIPPVC.SN06SWJ0100	100ø CLASS SN6 SW JOINT PVC PIPE					137		Roofwater, PVC Pipe	Confirmed
MRS.GEN.TWIRE	TIE WIRE					135		Reinforcing, General	Confirmed
MFRM.GPFORMIN.09300835120	930mm x 835mm x 1200mm INTERNAL GULLY PIT FORM					107		Formworks, Manholes	Confirmed
MSWD.MONOHD.S200KEC	SUPPLY ACO S200K END CAP TO SUIT S200K MONOLITHIC HEAVY DUTY DRAIN SYSTEM					100		Stormwater, ACO Drain	Plugged
MFRM.GPFORMOU.1.2x0.9x1.2	1200mm x 900mm x 1200mm EXTERNAL GULLY PIT FORM HIRE					99		Formworks, Manholes	Confirmed
MFRM.NAILS75X375	COST FOR 25kg 75 x 3.75 BULLET HEAD NAILS##CRLF##					91		Formworks, Structure Form	Confirmed
MSWD.MONOHD.S300KECA	SUPPLY ACO S300K END CAP TO SUIT S300KA MONOLITHIC HEAVY DUTY					88		Stormwater, ACO Drain	Plugged

Resource Name	Description	Use In Project	Unit	Curr	Calculated Rate In AUD	Amount In AUD	% Proj	Major, Minor Sortcodes	Status
MSWD.MONOHD.S300KEC	SUPPLY ACO S300K END CAP TO SUIT S300K MONOLITHIC HEAVY DUTY DRAIN SYSTEM					75		Stormwater, ACO Drain	Plugged
MFRM.FORPLYSTRUC.0019	19mm FORM PLY					68		Formworks, Structure Form	Confirmed
MRS.STMESH.SL82	SL82 STEEL REO MESH					62		Reinforcing, Mesh	Confirmed
MFRM.CONSUM.GEN	FORMWORK CONSUMABLES					48		Formworks, No Minor	Confirmed
MFRM.FORTIMBRSTRUC.F7O	F7 OREGON FORMWORK					39		Formworks, Structure Form	Confirmed
MGF.GEOTEXT.CL3F1	GEOTEXTILE STRENGTH CLASS C FILTRATION CLASS					36		Geofabrics, Geotextile	Confirmed
MFRM.GPFRMIN.093008351200	930mm x 835mm x 1200mm INTERNAL GULLY PIT FORM					35		Formworks, Manholes	Confirmed
MRS.STMESH.SL818	SL818 STEEL REO MESH					34		Reinforcing, Mesh	Confirmed
MRS.DEFBAR.GRADE500	DEFORMED REINFORCING BAR including 2.5% Rolling					32		Reinforcing, Bar	Confirmed
MGEN.MATT.PIN	EROSION CONTROL MATTING PINS					32		Environmental, No Minor	Confirmed
MRM.NOFINES.CON	NO FINES CONCRETE					16		Concrete, No Minor	Confirmed
MER.ENDCAP.100MMø	SUPPLY END CAP FOR 100mm ø ELECTRICAL					7		Electrical, Fittings	Confirmed
MRS.REINFORCE.COMSUME	REINFORCING CONSUMABLES					3		Reinforcing, No Minor	Confirmed
MRS.STMESH.SL52	SL52 STEEL REO MESH					3		Reinforcing, Mesh	Confirmed
MRM.LEANMIX.N5	5MPA LEAN MIX							Concrete, No Minor	Confirmed

Resource Name	Description	Use In Project	Unit	Curr	Calculated Rate In AUD	Amount In AUD	% Proj	Major, Minor Sortcodes	Status
MSA.ABLUTION.BLOCK	ABLUTION BLOCK							Overheads, Site Accommodation	Confirmed
MOH.2WAY.RF	REPEATER FREQUENCY ESTABHLISHMENT							Overheads, Communications	Confirmed
MTC.IRONMAN.HIRE	STEEL BARRIER HIRE							Traffic Control, No Minor	Confirmed
MOH.LNDLNE.CONN	LANDLINE CONNECTION FEE							Overheads, Communications	Confirmed
MOH.2WAY.RS	2 WAY REPEATER STATION							Overheads, Communications	Confirmed
MOH.2WAY.SF	SIMPLEX FREQUENCY ESTABHLISHMENT							Overheads, Communications	Confirmed
MOH.2WAY.RADIO	2 WAY RADIO UNITS							Overheads, Communications	Confirmed
MOH.2WAY.MAST	2 WAY MAIN ANTENNA							Overheads, Communications	Confirmed
MOH.2WAY.BS	2 WAY BASE STATION							Overheads, Communications	Confirmed
	Total for Material resources					***2,016,052***	***34.99***	***15.45% plugged, 0.00% unplugged***	
	<u>Plant resources</u>								
PBA.CASE480.4WD	BACKHOE 4WD HIRE					119,765	2.08	Backhoes, No Minor	Confirmed
PTRU.HIAB.TRUCK	HIRE HIAB CRANE TRUCK 25t Capacity					78,084	1.36	Trucks, No Minor	Confirmed
PVEH.ENGSUP.UTE	ENGINEERS / SUPERVISORS					75,551	1.31	Vehicle, No Minor	Confirmed
PTRU.TIPPER.10M3	TRUCK HIRE / 10m³					67,712	1.18	Trucks, No Minor	Confirmed
PGR.GRAD.CAT140M	GRADER CAT 140M					56,763	0.99	Graders, No Minor	Confirmed
PTRU.WATCAR.12KL	12 KILOLITRE WATER CART					47,897	0.83	Water Cart, No Minor	Confirmed

Resource Name	Description	Use In Project	Unit	Curr	Calculated Rate In AUD	Amount In AUD	% Proj	Major, Minor Sortcodes	Status
PTRU.T&SDOG.18M3	TRUCK & SUPERDOG HIRE /					45,935	0.80	Trucks, No Minor	Confirmed
PEXC.20T.GEN	20T EXCAVATOR HIRE					42,605	0.74	Excavators, No Minor	Confirmed
PTRU.ACTIPPER.10M3	ASPHALT CARTAGE TRUCK HIRE / $10m^3$					27,486	0.48	Trucks, No Minor	Confirmed
PEXC.30T.GEN	30T EXCAVATOR HIRE					26,917	0.47	Excavators, No Minor	Confirmed
VMS.BOARDS>6MONTHS	HIRE OF VARRIABLE MESSAGE BOARD					26,114	0.45	VMS, No Minor	Confirmed
PROLL.PADFOOT.10T	PAD FOOT ROLLER 10T					21,426	0.37	Rollers, No Minor	Confirmed
PEXC.30T.HAMMER	30T EXCAVATOR / HAMMER HIRE					18,119	0.31	Excavators, No Minor	Confirmed
PGEN.MIS.GEN	MISCELLANEOUS PLANT					18,000	0.31	Plant- General, No Minor	Confirmed
PTRU.TRUCK.6T	TRUCK 6T CAPACITY					12,321	0.21	Trucks, No Minor	Confirmed
PER.ELECTVAN.TRAD	ELECTRICAL TRADERS VAN					11,197	0.19	Electrical, No Minor	Confirmed
PROLL.SMOOTH.10T	SMOOTH DRUM ROLLER 10T					10,367	0.18	Rollers, No Minor	Confirmed
PVEH.PM.SEDAN	PROJECT MANAGER SEDAN					10,109	0.18	Vehicle, No Minor	Confirmed
PBOB.BOBCAT.GENERAL	BOBCAT					8,195	0.14	Bobcats, No Minor	Confirmed
PBA.CASE480.BORE	BACKHOE POST HOLE BORER HIRE					7,382	0.13	Backhoes, No Minor	Confirmed
PSML.SMALL.TOOLS	SMALL TOOLS, GRINDERS, DRILLS, SAWS ETC					6,912	0.12	Small Plant, No Minor	Confirmed
PDOZ.CAT.D6N	DOZER CAT D6N					6,709	0.12	Dozers, No Minor	Confirmed
PTRU.TILT.GEN	TILT TRAY TRUCK					6,497	0.11	Low Loaders, No Minor	Confirmed

Resource Name	Description	Use In Project	Unit	Curr	Calculated Rate In AUD	Amount In AUD	% Proj	Major, Minor Sortcodes	Status
PBOB.BOBCAT.COMBO	BOBCAT 6 TONNE EXCAVATOR COMBO					6,406	0.11	Bobcats, No Minor	Confirmed
PGEN.WHEELWASH.GEN	HIRE OF WHEEL WASH					5,128	0.09	Wheel wash, No Minor	Confirmed
PSML.SCISLIFT.15240	15.24M SCISSOR LIFT					4,516	0.08	Small Plant, No Minor	Confirmed
PSML.TRNCHR.0100	100mm TRENCHER					4,318	0.07	Small Plant, No Minor	Confirmed
PCR.FRANNA.18T	18T FRANNA					4,080	0.07	Cranes, Franna	Confirmed
PGEN.SKIP.2M3	2M3 RUBBISH SKIP INCLUDING FORTNIGHTLY					3,676	0.06	Plant- General, Small Plant	Confirmed
MSA.COLPRINT.HIRE	COLOUR PRINTER HIRE					3,308	0.06	Site Accommodation, Printers	Confirmed
PSML.SHOR.30001500MDB	3000mm x 1500mm MINI DRAG BOX					2,609	0.05	Small Plant, No Minor	Confirmed
PROLL.PADFOOT.12T	PAD FOOT ROLLER 12T					1,896	0.03	Rollers, No Minor	Confirmed
PSML.TRCHROLL.1250	1250KG TRENCH ROLLER					1,648	0.03	Small Plant, No Minor	Confirmed
PSML.VIBPLATE.ST	VIBRATION PLATE SHORT TERM HIRE					1,461	0.03	Small Plant, No Minor	Confirmed
MSA.B&WPRINT.HIRE	BLACK & WHITE PRINTER HIRE					1,241	0.02	Site Accommodation, Printers	Confirmed
PSML.WACKER.HIRE	WACKER PACKER HIRE					830	0.01	Small Plant, No Minor	Confirmed
PCP.BOOM.36M	36M CONCRETE BOOM PUMP					360	0.01	Concrete Pumps, No Minor	Confirmed
PROLL.MULWHE.12T	MULTI WHEEL ROLLER 12T					190		Rollers, No Minor	Confirmed
PLD.LOADER.CAT950	LOADER CAT 950					186		Loaders, No Minor	Confirmed
PCR.FRANNA.20T	20T FRANNA					142		Cranes, Franna	Confirmed
PSML.QCKCUT.0300	300mm QUICK CUT SAW					64		Small Plant, No Minor	Confirmed
PSML.RAMR.WACKER	WACKER PACKER					61		Small Plant, No Minor	Confirmed

Resource Name	Description	Use In Project	Unit	Curr	Calculated Rate In AUD	Amount In AUD	% Proj	Major, Minor Sortcodes	Status
PSML.SHOR.25002400DBRE	2500mm x 2400mm DRAG BOX REAR EXIT					49		Small Plant, No Minor	Confirmed
PSML.COMP.285LS	COMPRESSOR 285 LITRES/SECOND					33		Small Plant, No Minor	Confirmed
PROLL.SMOOTH.15T	SMOOTH DRUM ROLLER 15T					26		Rollers, No Minor	Confirmed
PROLL.SMOOTH.CC10	CC10 ROLLER					10		Rollers, No Minor	Confirmed
PCP.SURCH.M3	CONCRETE PUMP SURCHARGE					8		Concrete Pumps, No Minor	Confirmed
PSML.VIBPLATMED.ST	VIBRATION PLATE SHORT TERM HIRE					6		Small Plant, No Minor	Confirmed
PSML.SCABBLE.GUN	SCABBLE GUN					4		Small Plant, No Minor	Confirmed
	Total for Plant resources					***794,318***	***13.79***	***0.00% plugged, 0.00% unplugged***	
	Subcontract resources								
SCON.ASPHALT.DG14	14mm DENSE GRADE ASPHALT SUPPLY/LAY					357,517	6.20	Road Surfacing, Dense Grade Asphalt	Confirmed
SCON.ASPHALT.DG20	20mm DENSE GRADE ASPHALT SUPPLY/LAY					172,539	2.99	Road Surfacing, Dense Grade Asphalt	Confirmed
SCON.TRAFCON.06001800MF	TRAFFIC CONTROLLER 06:00 TO 18:00 MONDAY TO FRIDAY					128,880	2.24	Traffic Control, Traffic Controllers	Confirmed
SCON.ENVIRON.MGNT	GENERAL ENVIRONMENTAL MANAGEMENT					115,000	2.00	Environmental, No Minor	Confirmed

Resource Name	Description	Use In Project	Unit	Curr	Calculated Rate In AUD	Amount In AUD	% Proj	Major, Minor Sortcodes	Status
SCON.ASPHALT.DG20CC	20mm DENSE GRADE ASPHALT CORRECTOR COURSE					110,973	1.93	Road Surfacing, Dense Grade Asphalt	Confirmed
SCON.SURV.TEAM	HIRED SURVEY TEAM					100,040	1.74	Survey, No Minor	Confirmed
SCON.ASPHALT.DG14CC	14mm DENSE GRADE ASPHALT CORRECTOR COURSE					65,180	1.13	Road Surfacing, Dense Grade Asphalt	Confirmed
SCON.TEST.QA	QA TESTING					50,000	0.87	Testing, No Minor	Confirmed
SCON.PROFILE.60mm>1000m²	PROFILING 0-60mm DEPTH GREATER THAN 1000m²					43,949	0.76	Profiling, No Minor	Confirmed
SCON.FRP.EDGE0100	SUPPLY AND PLACE 100mm HIGH EDGE FORMWORK					43,701	0.76	Concrete, Formwork	Confirmed
SCON.PMB-S45S.18L/M2-IB	SEAL CLASS PMB (S4.5S) SPRAY RATE 1.8litre/m² INCLUDING BINDER					40,099	0.70	Road Surfacing, Seal	Plugged
SCON.ACPLACE.CREW	ASPHALT PAVER AND CREW					35,234	0.61	Road Surfacing, Paver Crew	Confirmed
SCON.GUARDRAIL.WBEAM	W-BEAM GUEARDRAIL					33,378	0.58	Guardrailing, No Minor	Confirmed
SCON.TRAFCON.VEHSGN	TRAFFIC CONTROL VEHICLE & SIGNS ALL HOURS					27,585	0.48	Traffic Control, Traffic Controllers	Confirmed
SCON.FRP.EDGE0125	SUPPLY AND PLACE 125mm HIGH EDGE FORMWORK					19,176	0.33	Concrete, Formwork	Confirmed
SCON.GUARDRAIL.TERM1	STEEL BEAM GUARDRAIL TERMINAL TYPE 1					17,256	0.30	Guardrailing, No Minor	Confirmed

Resource Name	Description	Use In Project	Unit	Curr	Calculated Rate In AUD	Amount In AUD	% Proj	Major, Minor Sortcodes	Status
SCON.ASPHALT.ESTABLISH	ESTABLISHMENT ASPHALT SUBCONTRACT					16,890	0.29	Road Surfacing, Establish	Confirmed
SCON.KERBLAY.TYPE9	SUBCONTRACT CONCRETE KERB PLACE - TYPE 9					15,254	0.26	Kerb and Channel, Kerb	Confirmed
SCON.K&CLAY.TYPE7	SUBCONTRACT CONCRETE KERB AND CHANNEL PLACE - TYPE 7 KERB AND					12,864	0.22	Kerb and Channel, Kerb & Channel	Confirmed
SCON.COVERAGGPC.0010	SUPPLY PRECOATED 10mm COVER					12,082	0.21	Road Surfacing, Aggregate	Confirmed
SCON.TURF.GRADEA	GRADE A TURF SUBCONTRACT					11,400	0.20	Landscaping, Turf	Confirmed
SCON.TRAFFIC.CONSULT	TRAFFIC CONSULTANT					10,404	0.18	Traffic Control, Traffic Controllers	Confirmed
SCON.TREEMULCH.CREW	TREE MULCHING CREW					9,631	0.17	Clearing, No Minor	Confirmed
MLS.THERMO.CHEVRON	TRANSVERSE LINES THERMO					9,279	0.16	Linemarking, No Minor	Confirmed
SCON.CONBOLLARDS	SUPPLY AND INSTALL CONCRETE					9,000	0.16	Concrete, General	Plugged
SCON.ACPLACE.SHUTTLEBUGGY	SHUTTLE BUGGY & CREW					8,969	0.16	Road Surfacing, Paver Crew	Confirmed
SCON.KERBLAY.TYPE5	SUBCONTRACT CONCRETE KERB PLACE - TYPE 5					8,446	0.15	Kerb and Channel, Kerb	Confirmed
SLM.OUTLINE.150WTH	OUTLINE - 150mm WIDE - WHITE - THERMOPLASTIC					8,418	0.15	Linemarking, No Minor	Confirmed
SLM.EDGELINE.150WTH	EDGE LINE - 150mm WIDE - WHITE - THERMOPLASTIC					7,549	0.13	Linemarking, No Minor	Confirmed

Resource Name	Description	Use In Project	Unit	Curr	Calculated Rate In AUD	Amount In AUD	% Proj	Major, Minor Sortcodes	Status
SCON.ASPHALT.CRACKFILL	SUBCONTRSCT CRACK FILLING					6,370	0.11	Road Surfacing, Crack Filling	Confirmed
SCON.SAW.0050AC	50mm DEEP AC SAWCUT SUBCONTRACT					6,358	0.11	Saw cutting, Asphalt	Confirmed
SCON.ROADSURF.TC02/M2	TACK COAT 0.2L/M2 SUPPLY AND PLACE					5,919	0.10	Road Surfacing, Tack Coat	Confirmed
SCON.COVERAGG.0010SPREAD	SPREADING PRIME COVER MATERIAL 10MM 180M2/M3					5,839	0.10	Road Surfacing, Aggregate	Confirmed
SCON.GUARDRAIL.CTB	DRIVE POSTS THROUGH CTB - extra over cost					5,461	0.09	Guardrailing, No Minor	Confirmed
SCON.PROFILE.60mm<1000m^2	PROFILING 0-60mm DEPTH LESS THAN 1000m^2					5,401	0.09	Profiling, No Minor	Confirmed
SCON.ASPHALT.PREPARE	PREPARE EXISITING SURFACE FOR ASPHALT					4,607	0.08	Road Surfacing, Prepare	Confirmed
SLM.LINES.1958677	LONG PAINT 100mm EDGE LINE					4,308	0.07	Linemarking, No Minor	Confirmed
SCON.ENDTREAT.MELT	BARRIER END TREATMENT MELT					4,172	0.07	Guardrailing, No Minor	Confirmed
SCON.MANHERBICIDE.KNOCK-S	SUBCONTRACT MANUAL HERBICIDE APPLICATION - KNOCK-DOWN -					4,160	0.07	Landscaping, Herbicide	Confirmed
SCON.ASPHALT.SAFS	STRESS ABSORBING FABRIC STRIPS					3,271	0.06	Road Surfacing, Fabric Strips	Confirmed
SCON.TRAFCON.18000600MF	TRAFFIC CONTROLLER 18:00 TO 6:00 MONDAY					3,237	0.06	Traffic Control, Traffic Controllers	Confirmed

Resource Name	Description	Use In Project	Unit	Curr	Calculated Rate In AUD	Amount In AUD	% Proj	Major, Minor Sortcodes	Status
SCON.KERBLAY.TYPE1	SUBCONTRACT CONCRETE KERB PLACE - TYPE 1					3,091	0.05	Kerb and Channel, Kerb	Confirmed
SCON.BITUMENSURF.BINDER	BINDER/ADDITIVES TO BITUMINOUS SURFACING					2,886	0.05	Road Surfacing, Additives	Confirmed
SCON.K&CLAY.TYPE15	SUBCONTRACT CONCRETE KERB AND CHANNEL PLACE - TYPE 15 KERB AND					2,708	0.05	Kerb and Channel, Kerb & Channel	Confirmed
MSA.CHEMTOI.PUMP	CHEMICAL TOILET PUMP OUT					2,636	0.05	Overhead, Site Accommodation	Confirmed
SCON.SIGNAL.CONST	ELECTRICAL SIGNALS					2,560	0.04	Electrical, No Minor	Confirmed
MLS.RPM.REFLECTIVE	RRPM DOUBLE					2,516	0.04	Linemarking, No Minor	Confirmed
SCON.PRIMEAMCO.1/M2	PRIME AMCO SPRAY RATE					2,240	0.04	Road Surfacing, Prime	Confirmed
SCON.CHANNELLAY.TYPE22	SUBCONTRACT CONCRETE CHANNEL PLACE - TYPE 22 CHANNEL					2,240	0.04	Kerb and Channel, Channel	Confirmed
SCON.SAW.ESTABLISH	SAWCUT SUBCONTRACT					1,827	0.03	Saw cutting, No Minor	Confirmed
SCON.HYDROMULCH.GRASS-S1	HYDROMULCHING GRASS SEED MIX SINGLE PASS - SMALL AREAS					1,800	0.03	Landscaping, Mulch	Confirmed
SLM.CONTINUITY.200WTH	SUBCONTRACT CONTINUITY LINE - 200mm WIDE - WHITE - THERMOPLASTIC					1,489	0.03	Linemarking, No Minor	Confirmed
SCON.FENCING.1800CW	1800 HIGH CHAINWIRE FENCE SUPPLIED AND					1,430	0.02	Fencing, No Minor	Confirmed

Resource Usage

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Resource Name	Description	Use In Project	Unit	Curr	Calculated Rate In AUD	Amount In AUD	% Proj	Major, Minor Sortcodes	Status
SCON.CONSUME.GEN	GENERAL CONCRETOR CONSUMABLES					1,321	0.02	Concrete, General	Confirmed
SCON.SEAL170.12L/M2	SEAL CLASS 170 SPRAY RATE					1,008	0.02	Road Surfacing, Seal	Confirmed
SCON.TEST.Q104A	Q104A LIQUID LIMIT TEST					784	0.01	Testing, No Minor	Confirmed
SCON.TEST.Q205C	Q205C WET/DRY STRENGTH VARIATION TEST					727	0.01	Testing, No Minor	Confirmed
SLM.LANE-CONT.100WTH	LANE LINE - CONTINUOUS - 100mm WIDE - WHITE -					527	0.01	Linemarking, No Minor	Confirmed
SLM.TURN.100WTH	TURN LINE - 100mm WIDE - WHITE - THERMOPLASTIC					454	0.01	Linemarking, No Minor	Confirmed
SCON.TEST.Q103A	PARTICLE SIZE DISTRIBUTION					218		Testing, No Minor	Confirmed
SCON.GRASSSEEDING.SMALL	SEEDING & FERTILISER - SMALL AREAS					168		Landscaping, Seeding	Confirmed
SCON.TEST.Q105	Q105 PLASTICITY INDEX TEST					164		Testing, No Minor	Confirmed
SLM.THERMO.TRANSVERSE	THERMOPLASTIC TRANSVERSE LINES					155		Linemarking, No Minor	Confirmed
SCON.FRP.EDGE0210	SUPPLY AND PLACE 210mm HIGH EDGE FORMWORK					125		Concrete, Formwork	Confirmed
SCON.TEST.VISIT	TESTER SITE VISIT					100		Testing, No Minor	Confirmed

Resource Name	Description	Use In Project	Unit	Curr	Calculated Rate In AUD	Amount In AUD	% Proj	Major, Minor Sortcodes	Status
SLM.BARRIER-2.80WTH	BARRIER LINE BOTH DIRECTIONS - 80mm WIDE EACH LINE - 80mm LATERAL GAP BETWEEN LINES - WHITE -					87		Linemarking, No Minor	Confirmed
SLM.BARRIER-S.100WTH	BARRIER LINE - SINGLE - 100mm WIDE - WHITE - THERMOPLASTIC					78		Linemarking, No Minor	Confirmed
SLM.BARRIER-1.80WTH	BARRIER LINE ONE DIRECTION - 80mm WIDE EACH LINE - 80mm LATERAL GAP BETWEEN LINES - 3000mm LINE LENGTH AND 9000mm GAP LENGTH ON BROKEN SIDE -					9		Linemarking, No Minor	Confirmed
SCON.MANUALSEED.GRASS-S	MANUAL SEEDING AND FERTILISER GRASS SEED MIX - SMALL AREAS SUBCONTRACT							Landscaping, Seeding	Confirmed
SCON.MAINS.CONNECT20M	INSTALLATION OF MAINS CONNECTION EQUIPMENT 20M							Electrical, No Minor	Confirmed
MOH.FIBOPT.ESTAB	FIBRE OPTIC ESTABLISHMENT TO OFFICES per							Overhead, Communication	Confirmed
	Total for Subcontract resources					***1,593,139***	***27.65***	***3.08% plugged, 0.00% unplugged***	

Resource Usage

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Resource Name	Description	Use In Project	Unit	Curr	Calculated Rate In AUD	Amount In AUD	% Proj	Major, Minor Sortcodes	Status

Appendix I: Plugged Rates

This Appendix contains the following major items that have not undergone a First Principles Estimate and have been plugged at Direct Cost Level.

These items will require further detailed estimating later in the preconstruction phase.

Plugged Rates

aQuenta CONSULTING

Item	Description	Amount at Direct Cost	
9119.01	Supply Bollards	$	9,000
9007.05	Supply 300 ACO Drain 300 x 420	$	73,700
9007.04	Supply 300 ACO Drain 300 x 360	$	35,400
9007.01 to 9007.03	Supply 200 ACO Drain 200 x 360	$	159,300
9007.01 to 9007.03	Supply 200 ACO Drain 200 x 360	$	6,480
	Total	**$**	**283,880**

Amounts are at Direct Cost level. Indirects are spread on these values to give the sell amounts.

Appendix J: Peer Review Report

This Appendix contains the details of the Internal Review of the estimate carried out and the subsequent actions taken.

This review was carried out by an internal Aquenta Consulting resource.

Peer Review Report

aQuenta CONSULTING

Project	Mooloolaba Road Upgrade Buderim Hill
Estimator	Stephen Bullent
Reviewer	NK
Date of review	15-Nov-12
Guidance	Check construction methods, quantities, suppliers information, rates, overheads, organisation chart.

Item	Issue Description	Action/Mitigation
Direct Costs		
1101.01	Contractor's Site facilities	Nominate say $125,000 (approx 2% of Contract Value)
1341.01	Water Quality Monitoring	No water courses so delete costs
1351.01	Cultural Heritage Management	Urban environment with no clearing so delete costs
9002.01	Liaison of Principal's Materials	Inluded in overheads staffing. Nominate $5,000
9003.01	Liaison of Utilities work	Inluded in overheads staffing. Nominate $5,000
9004.01	Relationship management	Inluded in overheads staffing. Nominate $10,000
	Type A Subgrade	ADD new item
2241.02	Concrete Pipe Culvert Class 3 375mm dia	Change pipe class from 2 to 3
2241.04	Concrete Pipe Culvert Class 3 450mm dia	Change pipe class from 2 to 3
2241.05	Concrete Pipe Culvert Class 3 525mm dia	Change pipe class from 2 to 3
2401.01	Concrete Kerb Type 1	Double rate as small quantity
2401.02	Concrete Kerb Type 5	Allow for dowels
3301.01	Road Embankment	Allow for imported material as excavted material is spoiled
3306.01	Road Verges	Allow for imported material as excavted material is spoiled
4301.01	Plant Mixed Stabilised Pavement	Adjust resource to Type 2.3 material (Not CTB) as cement is a separate item
6181.01	Fencing 1320m high	Increase rate to
Overheads	Project Duration	Increase Global define to 36 weeks
	Engineer	Allow for full time site engineer rather than SPE
	Project Supervision	Allow for additional Supervisor
	Wet Weather	Increase to 4 week allowance
	Vehicles	Adjust for extra Supervisor
	Site Sheds	Increase for more staff
	Construction Water	Allow $2.50/KL based on water cart hours at

Appendix K: Independent Review Report

Not Used

Appendix L: Planned Risk

This Appendix contains the Planned Risk Calculations which contribute to the Construction Contingency (Risk on Rate) and to the Project Contingency (Risk on Quantity).

Construction Estimate - Schedule Item Contingency

											Quantity: 0.6% Planned Risk On Quantity 37,952						Rate: 0.9% Planned Risk On Rate 55,433
				Total	6,338,186					Total	6,376,138					Total	6,393,619
						Quantity						Rate					
Item No	Description	Unit	Estimated Qty	Unit Rate $c	Amount	% Range Low	% Range High	Sampled %	Comment Correlation	Sampled Qty	Sampled Amount	% Range Low	% Range High	Sampled %	Comment Correlation	Sampled Rate	Sampled Amount
	PRELIMINARY DESIGN ESTIMATE FOR PROJECT 263/134/480																
	Local Authority: Sunshine Coast Regional Council Road: 134 Estimate Number: A - Preliminaries Estimate Location: Contract Number: NCHD 2543																
	NOTE: Estimate must be considered absolutely as the property of Main Roads until the acceptance of a tender, and must under no circumstances be divulged.																
	Schedule A - Preliminaries																
	CONTRACTOR'S SITE FACILITIES AND CAMP (MRS28 Jun 09)																
1101.01	Contractor's site facilities (MRS28 Jun 09)	lump			125,000	100%	100%	100%		1	125,000	90%	120%	103%		129,167	129,167
	PROVISION FOR TRAFFIC (MRS02 Oct 10)																
1201.01	Provision for traffic (MRS02 Oct 10)	lump			463,208	100%	100%	100%		1	463,208	90%	120%	103%		478,648	478,648
1202.01	Traffic Management Plan (MRS02 Oct 10)	lump			14,964	100%	100%	100%		1	14,964	90%	120%	103%		15,463	15,463
1203.01	Roadwork signing records (MRS02 Oct 10)	lump			18,532	100%	100%	100%		1	18,532	90%	120%	103%		19,150	19,150
	ENVIRONMENTAL MANAGEMENT (MRS51 Apr 11)																
1331.01	Develop Environmental Management Plan (Construction) (MRS51 Apr 11)	lump			6,515	100%	100%	100%		1	6,515	90%	110%	100%		6,515	6,515
1332.01	Implement Environmental Management Plan (Construction) (MRS51 Apr 11)	lump			43,909	100%	100%	100%		1	43,909	90%	110%	100%		43,909	43,909
1333.01	Environmental Licences, Permits and Approvals (MRS51 Apr 11)	lump															
1351.01P	Cultural Heritage Management, if ordered (Provisional Quantity) (MRS51 Apr 11)	lump															
1355.01P	Noise monitoring, if ordered (Provisional Quantity) (MRS51 Apr 11)	lump			35,956	100%	100%	100%		1	35,956	90%	110%	100%		35,956	35,956
1361.01P	Condition survey and vibration monitoring, if ordered (Provisional Quantity) (MRS51 Apr 11)	lump			71,913	100%	100%	100%		1	71,913	90%	110%	100%		71,913	71,913
1365.01P	Air quality monitoring, if ordered (Provisional Quantity) (MRS51 Apr 11)	lump			35,956	100%	100%	100%		1	35,956	90%	110%	100%		35,956	35,956
1375.01P	Fauna management, if ordered (Provisional Quantity) (MRS51 Apr 11)	lump			14,466	100%	100%	100%		1	14,466	90%	110%	100%		14,466	14,466
1381.01P	Pest Control, if ordered (Provisional Quantity) (MRS51 Apr 11)	lump															
9000.01S	Erosion and Sedimentation Control (Refer to Supp Spec 2)	lump			57,551	100%	100%	100%		1	57,551	90%	110%	100%		57,551	57,551
9001.01S	Provide As-Built Data (SCRSS901) (Refer to Supp Spec 3)	lump			10,424	100%	100%	100%		1	10,424	90%	110%	100%		10,424	10,424
9003.01S	Liaison and Co-ordination of affected utilities work (Refer to Supp Spec 5)	lump			7,191	100%	100%	100%		1	7,191	90%	110%	100%		7,191	7,191
9004.01S	Relationship Management (Refer to Supp Spec 6)	lump			14,383	100%	100%	100%		1	14,383	90%	110%	100%		14,383	14,383
9005.01S	Accommodation Works to Lot 22 RP228644 (Refer to Supp Spec 7)	lump			1,810	100%	100%	100%		1	1,810	90%	110%	100%		1,810	1,810
9005.02S	Accommodation Works to Lot 1 RP111424 (Refer to Supp Spec 7)	lump			4,678	100%	100%	100%		1	4,678	90%	110%	100%		4,678	4,678
9005.03S	Accommodation Works to Lot 1 RP109329 (Refer to Supp Spec 7)	lump			4,344	100%	100%	100%		1	4,344	90%	110%	100%		4,344	4,344
9005.04S	Accommodation Works to Lot 10 RP132410 (Refer to Supp Spec 7)	lump			4,903	100%	100%	100%		1	4,903	90%	110%	100%		4,903	4,903
9005.05S	Accommodation Works to Lot 11 RP132410 (Refer to Supp Spec 7)	lump			1,810	100%	100%	100%		1	1,810	90%	110%	100%		1,810	1,810
9005.06S	Accommodation Works to Lot 2 RP93508 (Refer to Supp Spec 7)	lump			1,852	100%	100%	100%		1	1,852	90%	110%	100%		1,852	1,852
9005.07S	Accommodation Works to Lot 3 SP897856 (Refer to Supp Spec 7)	lump			3,620	100%	100%	100%		1	3,620	90%	110%	100%		3,620	3,620
9005.08S	Accommodation Works to Lot 5 RP80359 (Refer to Supp Spec 7)	lump			2,238	100%	100%	100%		1	2,238	90%	110%	100%		2,238	2,238
9005.09S	Accommodation Works to Lot 3 RP153972 (Refer to Supp Spec 7)	lump															
	Schedule B - Drainage																
	REMOVAL/DEMOLITION (MRS03 Oct 10)																

						Quantity						Rate					
										Planned Risk On Quantity	0.6% 37,952					Planned Risk On Rate	0.9% 55,433
			Total		6,338,186					Total	6,376,138					Total	6,393,619
						% Range Low	% Range High	Sampled %	Comment Correlation	Sampled Qty	Sampled Amount	% Range Low	% Range High	Sampled %	Comment Correlation	Sampled Rate	Sampled Amount
2101.01	Removal or demolition of culverts, complete (MRS03 Oct 10)	lump		$	1,899	100%	100%	100%		1	1,899	90%	110%	100%		1,899	1,899
2103.01	Removal or demolition of culverts excluding end structures (MRS03 Oct 10)	lump		$	1,601	100%	100%	100%		1	1,601	90%	110%	100%		1,601	1,601
2106.01	Removal or demolition of concrete kerb and channel including kerb crossings (MRS03 Oct 10)	m	Sch.4 Part 4 s.7(1)(c)	$	39,704	90%	110%	100%		1,530	39,704	90%	110%	100%		26	39,704
2108.01	Removal or demolition of gullies	each		$	4,315	90%	110%	100%		6	4,315	90%	110%	100%		719	4,315
9015.01PS	Supply and place flowable fill in abandoned pipes and culverts (Provisional Quantity) (Refer to Supp Spec 4)	m3		$	76,118	90%	150%	100%		150	76,118	90%	120%	100%		507	76,118
	SUPPLY AND INSTALLATION OF CULVERTS (MRS03 Oct 10)																
2241.01	Supply and installation of concrete pipe culvert components, Class 2, 375 mm diameter (MRS03 Oct 10)	m		$	55,902	90%	110%	100%		97	55,902	90%	110%	100%		576	55,902
2241.02	Supply and installation of concrete pipe culvert components, Class 3, 375 mm diameter (MRS03 Oct 10)	m		$	241,220	90%	110%	100%		403	241,220	90%	110%	100%		599	241,220
2241.03	Supply and installation of concrete pipe culvert components, Class 2, 450 mm diameter (MRS03 Oct 10)	m		$	45,798	90%	110%	100%		67	45,798	90%	110%	100%		684	45,798
2241.04	Supply and installation of concrete pipe culvert components, Class 3, 450 mm diameter (MRS03 Oct 10)	m		$	75,010	90%	110%	100%		105	75,010	90%	110%	100%		714	75,010
2241.05	Supply and installation of concrete pipe culvert components, Class 3, 525 mm diameter (MRS03 Oct 10)	m		$	12,915	90%	110%	100%		16	12,915	90%	110%	100%		807	12,915
9006.01	Supply and installation of uPVC pipe culvert components, 150 mm diameter (MRS03 Oct 10) (refer Supp Spec 8)	m		$	4,043	90%	110%	100%		21	4,043	90%	110%	100%		193	4,043
	CONCRETE IN CULVERTS AND END STRUCTURES (MRS03 Oct 10)																
2317.01	Precast concrete end structures to culverts, 525 mm diameter (MRS03 Oct 10)	each			2,617	90%	110%	100%		1	2,617	90%	110%	100%		2,617	2,617
	PAVEMENT DRAINAGE (MRS03 Oct 10)																
2401.01	Concrete kerb, Type 1 (MRS03 Oct 10)	m			10,369	90%	110%	100%		101	10,369	90%	110%	100%		103	10,369
2401.02	Concrete kerb, Type 5A (Modified kerb dowelled with grated drain, refer detail)	m			29,192	90%	110%	100%		460	29,192	90%	110%	100%		63	29,192
2401.03	Concrete kerb, Type 9 (MRS03 Oct 10)	m			7,603	90%	110%	100%		164	7,603	90%	110%	100%		46	7,603
2401.04	Concrete kerb, Type 9A (Modified kerb dowelled with grated drain, refer detail)	m			43,616	90%	110%	100%		833	43,616	90%	110%	100%		52	43,616
2403.01	Concrete channel, Type 22 (MRS03 Oct 10)	m			3,405	90%	110%	100%		45	3,405	90%	110%	100%		76	3,405
2403.02	Concrete channel, Vee drain, refer detail	m			6,410	90%	110%	100%		25	6,410	90%	110%	100%		256	6,410
2404.01	Concrete kerb and channel, Type 7 (MRS03 Oct 10)	m			71,300	90%	110%	100%		1,051	71,300	90%	110%	100%		68	71,300
2404.02	Concrete kerb and channel, Type 15 (MRS03 Oct 10)	m			14,594	90%	110%	100%		177	14,594	90%	110%	100%		82	14,594
2405.01	Concrete channel, Type 17 (MRS03 Oct 10)	m			10,241	90%	110%	100%		138	10,241	90%	110%	100%		74	10,241
2405.02	Concrete kerb and channel crossings, Pedestrian Ramp Type 2, (MRS03 Oct 10) Refer to TMR STD DRG 1446	each			720	90%	110%	100%		2	720	90%	110%	100%		360	720
2413.01	Concrete gullies, Field Inlet Type 1, single Gully, Std Drg 1309 (MRS03 Oct 10)	each			2,261	90%	110%	100%		1	2,261	90%	110%	100%		2,261	2,261
2416.01	Precast concrete side inlet gullies with 1050mm diameter precast shaft, "S" lintel, Kerb in Line, Inlet on Grade (MRS03 Oct 10)	each			43,858	90%	110%	100%		9	43,858	90%	110%	100%		4,873	43,858
2416.02	Precast concrete side inlet gullies with 1050mm diameter precast shaft, "S" lintel, Lip in Line, Inlet on Grade (MRS03 Oct 10)	each			131,573	90%	110%	100%		27	131,573	90%	110%	100%		4,873	131,573
2416.03	Precast concrete side inlet gullies with 2100mm diameter precast shaft, "S" lintel, Kerb in Line, Inlet on Grade (MRS03 Oct 10)	each			29,238	90%	110%	100%		3	29,238	90%	110%	100%		9,746	29,238
2416.04	Precast concrete side inlet gullies with 1500mm diameter precast shaft, "S" lintel, Kerb in Line, Inlet on Grade (MRS03 Oct 10)	each			27,364	90%	110%	100%		4	27,364	90%	110%	100%		6,841	27,364
2415.01	Precast concrete access chambers, 1050mm dia (MRS03 Oct 10)	each			13,284	90%	110%	100%		3	13,284	90%	110%	100%		4,428	13,284
9007.01S	Grated Drain, size 200mm wide x 360mm deep (Refer Supp Spec 9)	m			332,521	90%	120%	103%		273	343,605	90%	120%	103%		1,302	343,605
9007.02	Grated Drain, size 100mm wide x 200mm deep, driveways (Refer Supp Spec 9)	m			14,875	90%	120%	103%		13	15,370	90%	120%	103%		1,182	15,370
9007.03S	Grated Drain, size 200mm wide x 360mm deep special road crossing at Foote Ave (Refer Supp Spec 9)	m			22,744	90%	120%	103%		17	23,502	90%	120%	103%		1,469	23,502
9007.04S	Grated Drain, size 300mm wide x 360mm deep (Refer Supp Spec 9)	m			77,578	90%	120%	103%		58	80,164	90%	120%	103%		1,431	80,164
9007.05S	Grated Drain, size 300mm wide x 420mm deep (Refer Supp Spec 9)	m			160,673	90%	120%	103%		111	166,029	90%	120%	103%		1,552	166,029

Item No	Description	Unit	Estimated Qty	Unit Rate $c	Amount	Quantity % Range Low	Quantity % Range High	Quantity Sampled %	Quantity Comment Correlation	Sampled Qty	Sampled Amount	Rate % Range Low	Rate % Range High	Rate Sampled %	Rate Comment Correlation	Sampled Rate	Sampled Amount
									Planned Risk On Quantity		0.6% 37,952				Planned Risk On Rate		0.9% 55,433
				Total	6,338,186					Total	6,376,138					Total	6,393,619
9008.01S	Junction Pit to Grated Drain, size 360mm x 540mm x 877mm (including 150mm diameter uPVC pipe to gully) (Refer Supp Spec 10)	each	[redacted]		$ 24,901	90%	110%	100%		8	24,901	90%	110%	100%		3,113	24,901
9008.02S	Junction Pit to Grated Drain, size 360mm x 540mm x 877mm (including 250mm diameter uPVC pipe to gully) (Refer Supp Spec 10)	each			$ 19,750	90%	110%	100%		6	19,750	90%	110%	100%		3,292	19,750
9008.03S	Junction Pit to Grated Drain, size 300mm x 300mm x 450mm (Refer Supp Spec 10)	each			$ 3,212	90%	110%	100%		2	3,212	90%	110%	100%		1,606	3,212
9009.01S	Modify existing gullies in Panorama Crescent, 2/D3 and 6/D1 to suit new kerb, kerb and channel levels (Refer Supp Spec 11)	each			$ 9,236	90%	110%	100%		5	9,236	90%	110%	100%		1,847	9,236
9010.01S	Convert existing gully pit 9C1 and 10/C1 to access chamber (Refer Supp Spec 12)	each			$ 2,540	90%	110%	100%		2	2,540	90%	110%	100%		1,270	2,540
9011.01S	Construct new gully pit over existing culvert at Ch45 MCD1 & 1/D2 (Refer Supp Spec 13)	each			$ 7,736	90%	110%	100%		2	7,736	90%	110%	100%		3,868	7,736
9012.01S	Connect new culvert to existing pit at 2/D3 (Refer Supp Spec 14)	each	[redacted]		5,219	90%	110%	100%		1	5,219	90%	110%	100%		5,219	5,219
	PROTECTIVE TREATMENTS (MRS03 Jun 09)		Sch.4 Part 4 s.7(1)(c)														
2631.01	Hand placed concrete paving to footpath, 100 mm thick (MRS03 Oct 10) reinforced concrete 25MPa/20 with SL62 mesh centrally located	m2			82,124	90%	110%	100%		612	82,124	90%	110%	100%		134	82,124
2631.02	Hand placed concrete paving to driveway, 125 mm thick (MRS03 Oct 10) reinforced concrete 25MPa/20 with SL82 mesh centrally located	m2			103,321	90%	110%	100%		690	103,321	90%	110%	100%		150	103,321
2631.03	Hand placed concrete paving to median, typically 100 mm thick (MRS03 Oct 10) unreinforced concrete 25MPa/20, finish to be terracotta with brick pattern with non slip long life seal coat	m2			161,715	90%	110%	100%		927	161,715	90%	110%	100%		174	161,715
	PAVEMENT DRAINS (MRS38 Aug 11)																
2801.01	Pavement drain (MRS38 Aug 11)	m			46,306	90%	110%	100%		775	46,306	90%	110%	100%		60	46,306
2802.01	Pavement drain outlets (MRS38 Aug 11)	each			1,264	90%	110%	100%		4	1,264	90%	110%	100%		316	1,264
2802.02S	Pavement drain outlets (MRS38 Aug 11) (Refer Supp Spec 16)	each			3,945	90%	110%	100%		10	3,945	90%	120%	103%		408	4,076
2803.01	Pavement drain cleanout point (MRS38 Aug 11)	each			3,377	90%	110%	100%		10	3,377	90%	110%	100%		338	3,377
	Schedule C - Earthworks																
	EARTHWORKS, PREPARATION (MRS04 Oct 10)																
3101.01	Clearing and grubbing (MRS04 Oct 10)	m2			31,595	90%	110%	100%		5,755	31,595	90%	110%	100%		5	31,595
3103.01P	Stripping of topsoil (Provisional Quantity as directed) (MRS04 Oct 10)	m3			21,626	90%	110%	100%		864	21,626	90%	110%	100%		25	21,626
3104.01	Ground surface treatment under embankment, standard (MRS04 Oct 10)	m2			5,697	90%	110%	100%		1,376	5,697	90%	110%	100%		4	5,697
3108.01P	Excavation and disposal of Unsuitable Material with individual excavation <= 10 m3 (Provisional Quantity as directed) (MRS04 Oct 10)	m3			9,096	90%	110%	100%		80	9,096	90%	110%	100%		114	9,096
3304.01P	Supply and installation of geotextile, strength class C, filtration class V (Provisional Quantity) (MRS04 Oct 10) under embankment widening	m2			14,276	90%	110%	100%		1,720	14,276	90%	110%	100%		8	14,276
	EARTHWORKS, EXCAVATION (MRS04 Oct 10)																
3201.01	Road excavation, all materials (MRS04 Oct 10)	m3			81,477	90%	120%	103%		3,316	84,192	90%	110%	100%		25	81,477
3211.01P	Excavation of non-rippable material in road excavation, rate additional to rate for Work Item 3201 (Provisional Quantity)	m3			6,908	90%	120%	103%		81	7,138	90%	110%	100%		89	6,908
3212.01P	Excavation of non-rippable material in confined excavation, rate additional to rates for Work Items 3203 to 3207 inclusive (Provisional Quantity) (MRS04 Oct 10)	m3			12,399	90%	110%	100%		70	12,399	90%	110%	100%		177	12,399
3215.01P	Excavation and disposal of Unsuitable Material in and below confined excavations (Provisional Quantity as directed) (MRS04 Oct 10)	m3			5,650	90%	110%	100%		20	5,650	90%	110%	100%		283	5,650
	EARTHWORKS, EMBANKMENT (MRS04 Oct 10)																
3301.01	Road embankment (MRS04 Oct 10)	m3			181,232	90%	120%	103%		3,115	187,273	90%	110%	100%		60	181,232
3306.01	Road verges using general fill material (Type 2.5) (MRS04 Oct 10)	m3			247,540	90%	120%	103%		1,591	255,791	90%	110%	100%		161	247,540
	EARTHWORKS, SUBGRADE (MRS04 Oct 10)																
3401.01P	Testing of existing material below subgrade level in cuttings (Provisional Quantity if ordered) (MRS04 Oct 10)	per s			2,866	90%	110%	100%		2	2,866	90%	110%	100%		1,433	2,866

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						Planned Risk On Quantity					0.6% 37,952	Planned Risk On Rate					0.9% 55,433
			Total		6,338,186					Total	6,376,138					Total	6,393,619
						Quantity					Sampled Amount	Rate					Sampled Amount
						% Range		Sampled %	Comment	Sampled		% Range		Sampled %	Comment	Sampled	
						Low	High		Correlation	Qty		Low	High		Correlation	Rate	
3402.01P	Subgrade treatment Type A, in cuttings and embankments, (Provisional Quantity if ordered) (MRS04 Oct 10)	m2	Sch.4 Part 4 s.7(1)(c)	$	22,922	90%	110%	100%		3,770	22,922	90%	110%	100%		6	22,922
3403.01P	Subgrade in cuttings, subgrade treatment Type B, replace with subgrade fill material (Provisional Quantity if ordered) (MRS04 Oct 10)	m2		$	4,144	90%	110%	100%		20	4,144	90%	110%	100%		207	4,144
	EARTHWORKS, BACKFILL (MRS04 Oct 10)																
3501.01P	Backfill with general backfill material to below subgrade treatment (Provisional Quantity) (MRS04 Oct 10)	m3		$	7,712	90%	120%	103%		52	7,969	90%	110%	100%		154	7,712
9014.01P	Backfill with lean mix concrete to depth of existing pavement (Provisional Quantity) (MRS04 Oct 10) (refer Supp Spec 17)	m3		$	5,681	90%	120%	103%		10	5,870	90%	110%	100%		568	5,681
	Schedule D - Pavements																
	UNBOUND PAVEMENTS (MRS05 Apr 11)																
4153.00	Subtype 2.3 Unbound pavement, Driveways (MRS05 Apr 11)	m3		$	11,400	90%	110%	100%		31	11,400	90%	110%	100%		368	11,400
	PLANT MIXED STABILISED PAVEMENTS (MRS08 Apr 12)																
4301.01	Plant mixed stabilised pavement, Type 2.3 material with 1% GB Cement (75% cement, 25% fly ash), (MRS08 Apr 12) Pavement Type 2	m3		$	53,206	90%	110%	100%		280	53,206	90%	110%	100%		190	53,206
4321.01	Supply of stabilising agent, GB Cement (75% cement, 25% fly ash) (MRS08 Apr 12) Pavement Type 2	tonne		$	2,828	90%	110%	100%		6	2,828	90%	110%	100%		471	2,828
	SUPPLY OF COVER AGGREGATE (MRS22 Oct 10)																
5011.01	Supply of cover aggregate precoated, 10 mm nominal size (MRS22 Oct 10)	m3		$	16,759	90%	110%	100%		122	16,759	90%	110%	100%		137	16,759
5011.02	Supply of cover aggregate precoated, 10 mm nominal size, Driveways (MRS22 Oct 10)	m3		$	618	90%	110%	100%		2	618	90%	110%	100%		309	618
	SPRAYED BITUMINOUS SURFACING (EXCLUDING EMULSION) (MRS11 Oct 10)																
5101.01	Prime, grade AMC0, spray rate 1.0L/m2, including supply of binder, Pavement Type 2 (MRS11 Oct 10)	litre		$	3,230	90%	110%	100%		1,867	3,230	90%	110%	100%		2	3,230
5103.01S	Seal, class PMB (S4.5S), spray rate 1.8L/m2, including supply of binder, Pavement Types 1, 2, (MRS11 Oct 10)	litre		$	57,570	90%	110%	100%		28,642	57,570	90%	110%	100%		2	57,570
5103.02	Seal, class C170, spray rate 1.2L/m2, including supply of binder, Pavement Type 2, (MRS11 Oct 10)	litre		$	4,950	90%	110%	100%		2,240	4,950	90%	110%	100%		2	4,950
5103.03	Seal, class C170, spray rate 1.2L/m2, including supply of binder, Driveways, (MRS11 Oct 10)	litre		$	648	90%	110%	100%		293	648	90%	110%	100%		2	648
5112.01S	Spreading cover aggregate 10mm, 130m2/m3, (MRS11 Oct 10) (Refer Supp Spec 18)	m3		$	7,820	90%	110%	100%		122	7,820	90%	110%	100%		64	7,820
5112.02S	Spreading cover aggregate 10mm, 130m2/m3, Driveways (MRS11 Oct 10) (Refer Supp Spec 18)	m3		$	576	90%	110%	100%		2	576	90%	110%	100%		288	576
	GEOTEXTILES FOR PAVING APPLICATIONS (MRS57 Jun 09)																
5151.01P	Supply of Geotextile grade >130g/m2 (Glasgrid 8550 or similar approved proprietary product) (MRS57 Jun 09) to Table 6.2 of MRTS57 (Provisional Quantity)	m2		$	561	90%	110%	100%		150	561	90%	110%	100%		4	561
5153.01P	Placement of Paving Geotextile nominal weight g/m2 (MRS57 Jun 09) to Table 6.2 of MRTS57 (Provisional Quantity)	m2		$	726	90%	110%	100%		150	726	90%	110%	100%		5	726
	PREPARATION OF THE EXISTING SURFACE (MRS30 Oct 10)																
5401.01	Preparation of the existing surface (MRS30 Oct 10)	m2		$	2,585	90%	110%	100%		16,156	2,585	90%	110%	100%		0	2,585
5402.01P	Crack filling (Provisional Quantity) (MRS30 Oct 10)	m		$	9,160	90%	110%	100%		500	9,160	90%	110%	100%		18	9,160
5403.01P	Strain alleviating fabric strips (Provisional Quantity) (MRS30 Oct 10)	m		$	4,702	90%	110%	100%		474	4,702	90%	110%	100%		10	4,702
5404.01	Tack coat 0.2 litres/m2, residual bitumen (MRS30 Oct 10)	litre		$	8,528	90%	110%	100%		3,182	8,528	90%	110%	100%		3	8,528
9115.01PS	Pavement Repairs (Asphalt) (Provisional Quantity, if ordered) (Refer Supp Spec 19) (Provisional Quantity)	m2		$	2,770	90%	110%	100%		1,000	2,770	90%	120%	103%		3	2,862
9115.02PS	Pavement Repairs (Patch) (Provisional Quantity, if ordered) (Refer Supp Spec 19) (Provisional Quantity)	m2		$	1,302	90%	110%	100%		235	1,302	90%	120%	103%		6	1,345
	DENSE GRADED ASPHALT (MRS30 Oct 10)																
5405.01	Dense graded asphalt corrector layer, DG14 (Class 320), Pavement Type 1	tonne		$	97,793	90%	110%	100%		390	97,793	90%	110%	100%		251	97,793
5405.02	Dense graded asphalt corrector layer, DG20 (Class 600), Pavement Type 1	tonne		$	163,656	90%	110%	100%		664	163,656	90%	110%	100%		246	163,656

										Planned Risk On Quantity	0.6% 37,952					Planned Risk On Rate	0.9% 55,433
			Total		6,338,186					Total	6,376,138					Total	6,393,619
						Quantity					Sampled Amount	Rate					Sampled Amount
						% Range Low	% Range High	Sampled %	Comment Correlation	Sampled Qty		% Range Low	% Range High	Sampled %	Comment Correlation	Sampled Rate	
5503.01	Dense graded asphalt, DG14 mix (MRS30 Oct 10) (Class 320), Wearing Course Pavement Type 1, 2	tonne	Sch.4 Part 4 s.7(1)(c)	$	484,787	90%	110%	100%		2,069	484,787	90%	110%	100%		234	484,787
5503.02	Dense graded asphalt, DG14 mix (MRS30 Oct 10) (Class 170), Wearing Course Pavement, Driveways	tonne		$	37,508	90%	110%	100%		32	37,508	90%	110%	100%		1,172	37,508
5504.01	Dense graded asphalt, DG20 mix (MRS30 Oct 10) Class 600, Pavement Type 2	tonne		$	252,198	90%	110%	100%		1,068	252,198	90%	110%	100%		236	252,198
5543.01P	Open grade asphalt, OG14 mix (MRS30 Oct 10) (Provisional, If Ordered)	tonne		$	485,287	90%	110%	100%		1,909	485,287	90%	110%	100%		254	485,287
9116.01	Removal of existing Open Grade Asphalt wearing course, nominal 50mm (Refer Supp Spec 21)	m2		$	63,212	90%	110%	100%		14,269	63,212	90%	110%	100%		4	63,212
9117.01P	Profile existing pavement below OGA, nominal 50mm (Refer Supp Spec 22) (Provisional Quantity)	m2		$	7,769	90%	110%	100%		747	7,769	90%	110%	100%		10	7,769
9118.01S	Saw cut existing pavement (Refer to Supp Spec 23)	m		$	3,974	90%	110%	100%		740	3,974	90%	110%	100%		5	3,974
9118.02S	Saw cut existing pavement, driveway (Refer to Supp Spec 23)	m		$	1,250	90%	110%	100%		42	1,250	90%	110%	100%		30	1,250
	Schedule E - Road Furniture & Linemarking																
	REMOVAL, DEMOLITION AND RE-ERECTION (MRS14 Jun 09)																
6101.01	Demolition of road furniture (traffic signs, guardrail, bench) (MRS14 Jun 09)	lump			33,870	100%	100%	100%		1	33,870	90%	110%	100%		33,870	33,870
6104.01	Removal and re-erection of road furniture (electronic speed sign and equipment) (MRS14 Jun 09)	lump			11,506	100%	100%	100%		1	11,506	90%	110%	100%		11,506	11,506
	ROADSIDE STRUCTURES (MRS14 Jun 09)																
6181.01	Fencing, 1320 mm high, galvanised welded mesh (TMR STD DRG 1604)	m		$	2,056	90%	110%	100%		25	2,056	90%	110%	100%		82	2,056
	GUIDANCE AND INFORMATION SYSTEMS (MRS14A Apr 11)																
6121.01	Supply of regulatory, warning and hazard sign faces, as listed in Clause 1.3 of Annexure MRS14A.1.	lump			37,395	100%	100%	100%		1	37,395	90%	110%	100%		37,395	37,395
6131.01	Installation of regulatory, warning and hazard signs, as listed in Clause 1.3 of Annexure MRS14A.1.	lump			29,854	100%	100%	100%		1	29,854	90%	110%	100%		29,854	29,854
6136.01	Supply, erection and installation of project signs	lump			10,374	100%	100%	100%		1	10,374	90%	110%	100%		10,374	10,374
9119.01S	Supply and installation of safety bollards (Refer Supp Spec 24)	each		$	12,944	90%	110%	100%		36	12,944	90%	110%	100%		360	12,944
	ROADSIDE STRUCTURES (MRS14A Apr 11)																
6161.01	Steel beam guardrail, w beam (MRS14A Apr 11)	m		$	55,861	90%	110%	100%		324	55,861	90%	110%	100%		172	55,861
6163.01	Steel beam guardrail, terminal type A, SKT, ET2000 or approved equivalent (Design Speed 70km/h) (MRS14A Jun 09)	each		$	24,819	90%	110%	100%		5	24,819	90%	110%	100%		4,964	24,819
6163.02	Steel beam guardrail, terminal type A, (Type 1) Melt or approved equivalent in accordance with TMR STD DRG No. 1474 (MRS14A Apr 11)	each			6,001	90%	110%	100%		1	6,001	90%	110%	100%		6,001	6,001
	LINE MARKING (MRS45 Apr 11)																
6313.01	Barrier line, single, 100 mm wide (MRS45 Apr 11)	m	1.51	$	112	90%	110%	100%		74	112	90%	110%	100%		2	112
6314.01	Barrier line, one direction, 80 mm wide each line, 80 mm lateral gap between lines, 3000 mm line length and 9000 mm gap length on broken side, colour white, material paint (MRS45 Apr 11)	m		$	13	90%	110%	100%		8	13	90%	110%	100%		2	13
6315.01	Barrier line, both directions, 80 mm wide each line, 80 mm lateral gap between lines, colour white, material paint (MRS45 Apr 11)	m	2.35	$	125	90%	110%	100%		53	125	90%	110%	100%		2	125
6318.01	Lane line, continuous, 100 mm wide, colour white, material paint (MRS45 Apr 11)	m		$	759	90%	110%	100%		282	759	90%	110%	100%		3	759
6319.01S	Edge line, 150 mm wide, colour white, material paint (Refer Supp Spec 25) (MRTS45 Apr 11)	m		$	10,872	90%	110%	100%		3,226	10,872	90%	110%	100%		3	10,872
6319.02S	Edge line, 150 mm wide, colour yellow, material paint (Refer Supp Spec 25) (MRTS45 Apr 11)	m		$	7,539	90%	110%	100%		1,240	7,539	90%	110%	100%		6	7,539
6321.01	Continuity line, 200 mm wide, 1000mm line length, 3000mm gap length, colour white, material paint (MRS45 Apr 11)	m		$	2,141	90%	110%	100%		347	2,141	90%	110%	100%		6	2,141
6322.01	Turn line, 100 mm wide, colour white, material paint (MRS45 Apr 11)	m		$	652	90%	110%	100%		110	652	90%	110%	100%		6	652
6323.01	Outline, 150 mm wide, colour white, material paint (MRS45 Apr 11)	m		$	4,560	90%	110%	100%		750	4,560	90%	110%	100%		6	4,560
6331.01	Transverse lines (stop lines, holding lines, markings at Stop and Give Way signs, pedestrian crosswalk lines, arrows,shapes, symbols and numerals), colour white, material paint (MRS45 Apr 11)	m2		$	223	90%	110%	100%		11	223	90%	110%	100%		20	223

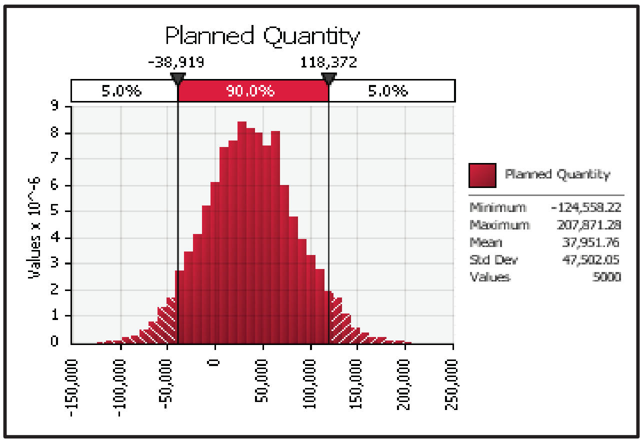
						Quantity						Rate					
										Planned Risk On Quantity	0.6% 37,952					Planned Risk On Rate	0.9% 55,433
			Total		6,338,186					Total	6,376,138					Total	6,393,619
						% Range Low	% Range High	Sampled %	Comment Correlation	Sampled Qty	Sampled Amount	% Range Low	% Range High	Sampled %	Comment Correlation	Sampled Rate	Sampled Amount
6332.01	Transverse lines (diagonal and chevron markings,parking areas and kerb markings), colour white, material paint (MRS45 Apr 11)	m2	Sch.4 Part 4 s.7(1)(c)	$	13,346	90%	110%	100%		144	13,346	90%	110%	100%		93	13,346
	RAISED PAVEMENT MARKERS (MRS45 Apr 11)																
6351.01	Retroreflective raised pavement markers (MRS45 Apr 11)	each		$	8,382	90%	110%	100%		473	8,382	90%	110%	100%		18	8,382
	Schedule F - Road Lighting																
	CONDUIT AND CONDUIT FITTINGS UNDERGROUND (MRS91 Jun 09)																
6507.02	Supply and installation of 2 of 100 mm, HDPVC, electrical conduit(s), in road (MRS91 Jun 09)	m		$	99,942	90%	110%	100%		792	99,942	90%	125%	105%		132	104,940
6507.03	Supply and installation of 1 of 100 mm, HDPVC, electrical conduit(s), in earth (MRS91 Jun 09)	m		$	55,456	90%	110%	100%		879	55,456	90%	125%	105%		66	58,229
	CABLE JOINTING PITS (MRS91 Jun 09)																
6554.03	Supply and installation of cable jointing pit Circular (MRS91 Jun 09)	each		$	50,735	90%	110%	100%		63	50,735	90%	125%	105%		846	53,271
	ROAD LIGHTING FOOTINGS (MRS92 Jun 09)																
6701.01	Road lighting pole footing, 350 mm diameter (MRS92 Jun 09)	each		$	52,463	90%	110%	100%		34	52,463	90%	125%	105%		1,620	55,087
	ROAD LIGHTING (MRS94 Jun 09)																
6771.01	Supply and installation of slip base road lighting pole, 8500 mm vertical height, 3000 mm long double outreach arm, without outreach arm extension with loop in loop out cabling (MRS94 Jun 09)	each		$	30,739	90%	110%	100%		9	30,739	90%	110%	100%		3,415	30,739
6771.02	Supply and installation of fixed base road lighting pole, 8500 mm vertical height, 3000 mm long single outreach arm, without outreach arm extension with loop in loop out cabling (MRS94 Jun 09)	each		$	33,165	90%	110%	100%		10	33,165	90%	110%	100%		3,317	33,165
6771.03	Supply and installation of slip base road lighting pole, 10000 mm vertical height, 4500 mm long single outreach arm, without outreach arm extension with loop in loop out cabling (MRS94 Jun 09)	each		$	24,895	90%	110%	100%		5	24,895	90%	110%	100%		4,979	24,895
6771.04	Supply and installation of fixed base road lighting pole, 10000 mm vertical height, 4500 mm long single outreach arm, without outreach arm extension with loop in loop out cabling (MRS94 Jun 09)	each		$	46,506	90%	110%	100%		10	46,506	90%	110%	100%		4,651	46,506
6776.01	Supply and installation of road lighting luminaire, rexel, Optispan aeroscreen S150 (MRS94 Jun 09)	each		$	13,923	90%	110%	100%		19	13,923	90%	110%	100%		733	13,923
6776.02	Supply and installation of road lighting luminaire, rexel, Optispan aeroscreen S250 (MRS94 Jun 09)	each		$	17,035	90%	110%	100%		22	17,035	90%	110%	100%		774	17,035
6776.03	Supply and installation of road lighting luminaire, rexel, Optispan aeroscreen S400 (MRS94 Jun 09)	each		$	1,784	90%	110%	100%		2	1,784	90%	110%	100%		892	1,784
6781.01	Removal of road lighting equipment for salvage, outreach and luminaire on existing timber poles (MRS94 Jun 09)	each		$	11,516	90%	110%	100%		9	11,516	90%	125%	105%		1,343	12,091
6781.01	Removal of road lighting equipment for salvage, outreach, luminaire and road lighting poles (MRS94 Jun 09)	each		$	10,783	90%	110%	100%		6	10,783	90%	125%	105%		1,887	11,322
	SWITCHBOARDS (MRS95 Jun 09)																
6801.01	Supply of URD pillar switchboard and ancillary components, post mounted (MRS95 Jun 09)	each		$	2,818	90%	110%	100%		2	2,818	90%	120%	103%		1,456	2,912
6803.01	Installation of URD pillar switchboard and ancillary components, post mounted (MRS95 Jun 09)	each		$	1,104	90%	110%	100%		2	1,104	90%	120%	103%		570	1,141
	ELECTRICAL CABLES (MRS95 Jun 09)																
6811.01	Supply of underground road lighting cable, 16mm, 4 cores, XLPE, PVC, Copper (MRS95 Jun 09)	m		$	34,566	90%	110%	100%		1,930	34,566	90%	110%	100%		18	34,566
6811.02	Supply of underground road lighting cable, 16mm, 2 cores, XLPE, PVC, Copper (MRS95 Jun 09)	m		$	558	90%	110%	100%		45	558	90%	110%	100%		12	558
6816.01	Supply of cable joint, fused (MRS95 Jun 09)	each		$	11,679	90%	110%	100%		38	11,679	90%	110%	100%		307	11,679
6821.01	Installation, jointing and termination of underground road lighting cable, 4 cores (MRS95 Jun 09)	m		$	31,247	90%	110%	100%		1,930	31,247	90%	110%	100%		16	31,247
6821.02	Installation, jointing and termination of underground road lighting cable, 2 cores (MRS95 Jun 09)	m		$	877	90%	110%	100%		45	877	90%	110%	100%		19	877
	Schedule G - Landscaping																

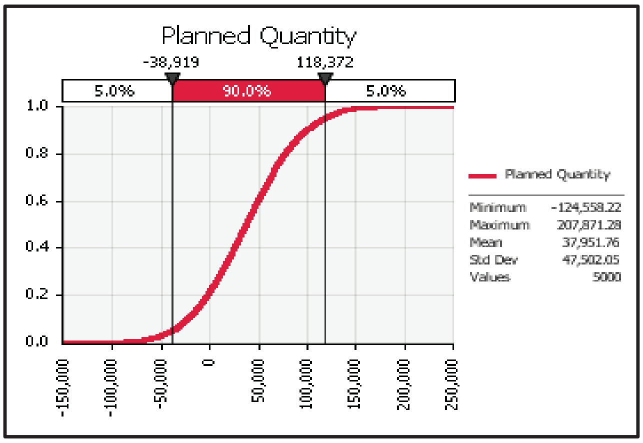
						Quantity						Rate					
									Planned Risk On Quantity	0.6% 37,952					Planned Risk On Rate	0.9% 55,433	
				Total	6,338,186					Total	6,376,138					Total	6,393,619
Item No	Description	Unit	Estimated Qty	Unit Rate $c	Amount	% Range Low	% Range High	Sampled %	Comment Correlation	Sampled Qty	Sampled Amount	% Range Low	% Range High	Sampled %	Comment Correlation	Sampled Rate	Sampled Amount
3713.01	MONITORING AND CONTROL (MRS51 Apr 11) Loading, haulage and placement of site planting media	m2	Sch.4 Part 4 s.7(1)(c)		$ 16,632	90%	110%	100%		5,755	16,632	90%	110%	100%		3	16,632
3772.01	INPUT CONTROLLED SEEDING (MRS16C April12) Hydromulching - single pass grass seed mix	m2			$ 8,736	90%	110%	100%		1,200	8,736	90%	110%	100%		7	8,736
3782.01	TURFING (MRS16C April12) Turf, A-Grade Green Couch	m2			$ 19,010	90%	110%	100%		2,850	19,010	90%	110%	100%		7	19,010
3811.01	PREPARATION TREATMENTS (MRS16 Jun 09) Herbicide application (MRS16 Jun 09) allowance for application to 75% of total project landscape area prior to planting	m2			$ 5,989	90%	110%	100%		2,950	5,989	90%	110%	100%		2	5,989

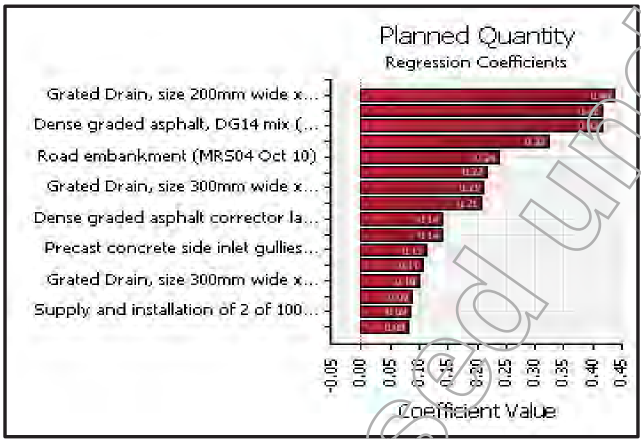
@RISK Output Report for Planned Quantity

Performed By: neil.king

Date: Monday, 21 January 2013 1:21:40 PM







Simulation Summary Information	
Workbook Name	412223 - L Planned Risk Register v0.2.xlsx
Number of Simulations	1
Number of Iterations	5000
Number of Inputs	314
Number of Outputs	2
Sampling Type	Latin Hypercube
Simulation Start Time	1/21/13 13:21:13
Simulation Duration	00:00:18
Random # Generator	Mersenne Twister
Random Seed	1

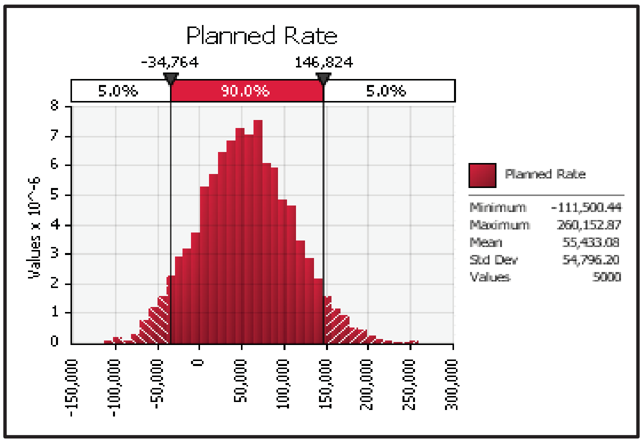
Summary Statistics for Planned Quantity

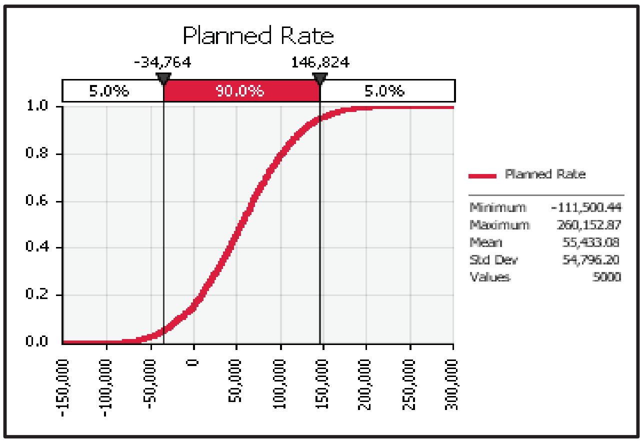
Statistics		**Percentile**	
Minimum	- 124,558	**5%**	- 38,919
Maximum	207,871	**10%**	- 23,390
Mean	37,952	**15%**	- 11,694
Std Dev	47,502	**20%**	- 2,711
Variance	2256444686	**25%**	5,836
Skewness	0.068760635	**30%**	11,931
Kurtosis	2.885662343	**35%**	19,066
Median	37,270	**40%**	25,118
Mode	7,716	**45%**	30,960
Left X	- 38,919	**50%**	37,270
Left P	5%	**55%**	43,267
Right X	118,372	**60%**	49,630
Right P	95%	**65%**	56,557
Diff X	157,291	**70%**	63,026
Diff P	90%	**75%**	69,170
#Errors	0	**80%**	77,185
Filter Min	Off	**85%**	87,466
Filter Max	Off	**90%**	100,243
#Filtered	0	**95%**	118,372

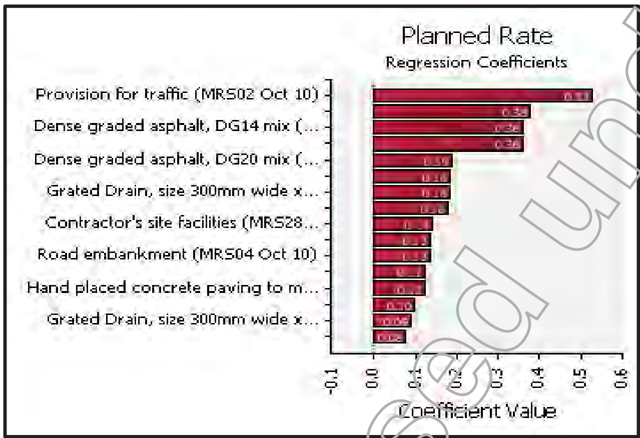
@RISK Output Report for Planned Rate

Performed By: neil.king

Date: Monday, 21 January 2013 1:22:13 PM







Simulation Summary Information	
Workbook Name	412223 - L Planned Risk Register v0.2.xlsx
Number of Simulations	1
Number of Iterations	5000
Number of Inputs	314
Number of Outputs	2
Sampling Type	Latin Hypercube
Simulation Start Time	1/21/13 13:21:13
Simulation Duration	00:00:18
Random # Generator	Mersenne Twister
Random Seed	1

Summary Statistics for Planned Rate			
Statistics		**Percentile**	
Minimum	- 111,500	**5%**	- 34,764
Maximum	260,153	**10%**	- 16,817
Mean	55,433	**15%**	- 1,296
Std Dev	54,796	**20%**	8,792
Variance	3002623843	**25%**	17,379
Skewness	0.070194413	**30%**	25,985
Kurtosis	2.834109837	**35%**	33,879
Median	55,169	**40%**	41,230
Mode	73,637	**45%**	47,958
Left X	- 34,764	**50%**	55,169
Left P	5%	**55%**	62,077
Right X	146,824	**60%**	68,720
Right P	95%	**65%**	75,624
Diff X	181,587	**70%**	83,918
Diff P	90%	**75%**	92,404
#Errors	0	**80%**	101,865
Filter Min	Off	**85%**	113,234
Filter Max	Off	**90%**	126,519
#Filtered	0	**95%**	146,824

Appendix M: Unplanned Risk

This Appendix contains the Unplanned Project Risk Register for Contractor and Client Owned Risks. The output from the Monte Carlo Analysis is added to the construct Estimate or the Project Cost to give the Project Cost including contingency.

MOOLOOLABA ROAD UPGRADE BUDERIM HILL			Quantitative Analysis - Monte Carlo Analysis									Allocation of Risk			
Risk Definition				Cost				Probability		Amount	Amount	Retained by Client		Transferred to Contractor	
Ref	Risk Description	Consequence of risk	Proposed method of valuation	Min	Likely	Max	Calculated by @Risk	% Likelihood	Calculated by @Risk	Calculated by @Risk	Mean Value	% of amount	Amount	% of amount	Amount
Client Risks / Site Risks / Approval Risks															
Client budgeting															
CB01a	Client resource budgeting pre award	- actual expenditure is different to planned resulting in shortfall in client budget (assuming same delivery method as budget is based on ECI)	Allow % of unexpended budget includes staff, consultants, excludes land (0% min, 2.5% likely, 5% max)($0.6million)	-	15,313	30,625	15,313	100%	1	15,313	15,313	100%	15,313	0%	-
CB01b	Client resource budgeting post award	- actual expenditure is different to planned resulting in shortfall in client budget (assuming same delivery method as budget is based on)	Allow % of unexpended budget includes staff, consultants, excludes land (-5% min, 0% likely, 20% max)($0.8million)	- 39,232	-	156,929	39,232	100%	1	39,232	39,232	100%	39,232	0%	-
CB02	Uncertainty in delivery method - Govt. may make decision to force delivery model. Eg ECI, Alliance, D& C.	- change in assumed delivery method (RCC) may result in delays and additional costs not currently allowed for in estimate	Not an issue with this project												
Property acquisition															
PA01	Land costs are different to those allowed in budget	- additional costs	No land to be acquired												
PA02	More land is required than originally allowed	- additional costs and possible delays - currently based on the preliminary design.	Not an issue with this project												
Environmental															
EN01	Contaminated land	- increase in cost to treat the contaminated land - cost to manage the contamination process - delay to project delivery	Not an issue with this project												
EN03	Expectation that noise amelioration will be implemented in more homes than is actually warranted	- public criticism - pressure to ameliorate more homes against noise than is required - extra cost if additional amelioration is installed	Allow for noise barriers as possible "compensation", say $100,000	-	100,000	100,000	66,667	20%	-	-	13,333	100%	-	0%	-
EN06	Environmental offset planting is required	Additional costs to contribute to land bank	Not an issue with this project												
EN07	Other environmental mitigation measures are required	Additional costs to install fauna crossings	Not an Issue for this project												
Approvals															
AP01	Cultural heritage , extinguishing Native Title	Possible delay	Not an issue with this project												
AP02	Environmental approvals - An EIS is required though not currently planned	Possible delay	Not an issue with this project												
Other															
Design development															
Design detail development															
DD01	Increase in **DRAINAGE** detail as more detailed design is undertaken - Note this is not changes to the functionality of the project just the detail of the current project	- additional costs as more detail developed - currently at Concept level.	Allow 0%, 5%, 10% of drainage costs $2.17m	-	104,460	208,921	104,460	100%	1	104,460	104,460	0%	-	100%	104,460
DD02	Increase in **EARTHWORKS/GEOTECH** detail as more detailed design is undertaken - Note this is not changes to the functionality of the project just the detail of the current project	- additional costs as more detail developed - currently at Concept level.	Allow 0%, 5%, 10% of earthworks costs $0.7m	-	33,041	66,082	33,041	100%	1	33,041	33,041	0%	-	100%	33,041
DD03	Increase in **PAVEMENT** detail as more detailed design is undertaken - Note this is not changes to the functionality of the project just the detail of the current project	- additional costs as more detail developed - currently at Concept level.	Allow 0%, 2.5%, 5% of pavement costs $1.8m	-	44,684	89,369	44,684	100%	1	44,684	44,684	0%	-	100%	44,684

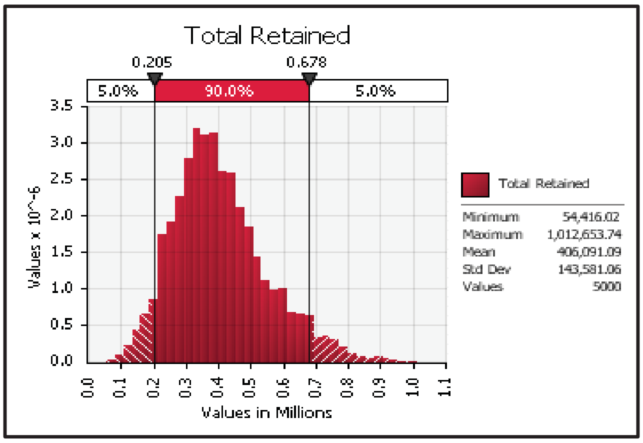
MOOLOOLABA ROAD UPGRADE BUDERIM HILL			Quantitative Analysis - Monte Carlo Analysis									Allocation of Risk			
Risk Definition				Cost				Probability		Amount	Amount	Retained by Client		Transferred to Contractor	
Ref	Risk Description	Consequence of risk	Proposed method of valuation	Min	Likely	Max	Calculated by @Risk	% Likelihood	Calculated by @Risk	Calculated by @Risk	Mean Value	% of amount	Amount	% of amount	Amount
DD05	Increase in **Other** detail as more detailed design is undertaken - Note this is not changes to the functionality of the project just the detail of the current project	- change in costs as more detail developed - currently at Concept level.	Allow -5% min, 5% likely, 10% max of Other elements not noted above from Preliminary to Detailed design. $1.8m.	- 90,039	90,039	180,079	60,026	100%	1	60,026	60,026	0%	-	100%	60,026
Standards change															
SC01	Standards change prior to contract award	- additional costs to project that will be contained in the contractors submission.	Not an Issue												
SC02	Standards change post to contract award	- additional costs to upgrade design to new standards during construction	Allow 2%-4% per year during contract period	76,058	114,087	152,116	114,087	10%	-	-	11,409	100%	-	0%	-
Change in functionality															
CF01	Scope change ordered by client during construction (this excludes standards changes post award that are ordered by client, covered separately)	- additional costs and delays during construction - for items that add new functionality to the project.	Allow 0% min 2.5% likely 5% max of the construction costs.	-	158,455	316,909	158,455	100%	1	158,455	158,455	100%	158,455	0%	-
Other															
3rd party influences															
PUP delays and additional costs															
PU01	Unknown services discovered on site during construction	- potential for delay costs - cost to repair damaged services - possible irrigation services on location	Allow 0% min, 20% likely, 50% max of the utilities costs ($0.45M)	-	90,000	225,000	105,000	100%	1	105,000	105,000	100%	105,000	0%	-
PU03	Delays by service authorities in carrying out relocation work, causes disruption to Construction Contractor	- potential disruption and for increased costs to the Contractor working around relocation work	Allow max of 12 weeks of overhead recurring costs	-	210,000	420,000	210,000	25%	-	-	52,500	100%	-	0%	-
Community and Stakeholders															
Political issues															
Construction risk															
Latent conditions															
C1	Geotechnical issues. (Ground conditions and suitability, additional sampling and analysis).	Delays in project, increase in pavement/or replacement, increased cost.	Planned risk allowance for unsuitable. Variations during construction CF01												
Methodology															
Other															
OT01	Inclement weather and effects more than allowed in current program	- delays in project delivery	Allow 3wks (in 30 wks) in estimate, allow -50% min and +33% max.	- 30,000	-	80,000	16,667	20%	-	-	3,333	0%	-	100%	-
Financial risk (escalation rate, additional costs due to prolongation, market pressures)															
Esclation / Market pressures															
ES01	Cost escalation different to that allowed	- greater out-turn dollars - public criticism	Allow for rate going from best profile min, likely profile likely, worst profile max and assume MR pay rise and fall	- 66,000	- 30,000	33,000	- 21,000	100%	1	- 21,000	- 21,000	100%	- 21,000	0%	-
ES02	Labour Rates pressure due to LNG labour demand	- potential for increased costs	Not an issue with this project												
Delay															
DE01	Funding, property acquisition, political, technical, community, environmental impacts delays planning and delivery of project	- additional costs due to escalation - delay in project delivery - public criticism	Allow additional 0% min, 10% likely, 20% max delay in duration over whole project cycle	-	32,500	65,000	32,500	100%	1	32,500	32,500	100%	32,500	0%	-
DE02	Delay due to funding availability	- additional costs due to escalation - delay in project delivery - public criticism	Funding available												
Funding															

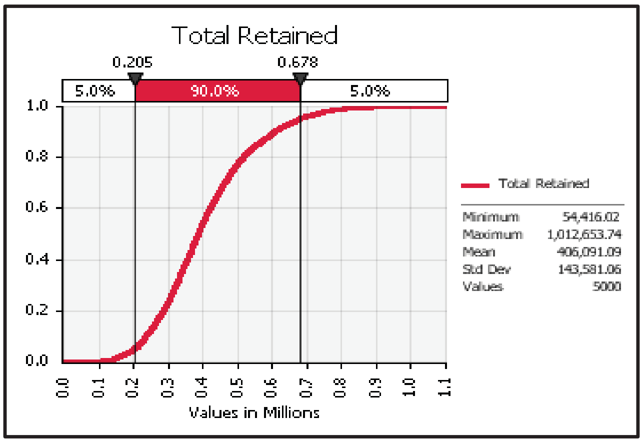
MOOLOOLABA ROAD UPGRADE BUDERIM HILL			Quantitative Analysis - Monte Carlo Analysis									Allocation of Risk			
Risk Definition			Cost					Probability		Amount	Amount	Retained by Client		Transferred to Contractor	
Ref	Risk Description	Consequence of risk	Proposed method of valuation	Min	Likely	Max	Calculated by @Risk	% Likelihood	Calculated by @Risk	Calculated by @Risk	Mean Value	% of amount	Amount	% of amount	Amount
F1	Inaccurate construction estimates - omissions and errors.	Cost over-runs and need for variations. Errors or omissions in quantities/rates etc will increase project cost. Refunding.	Covered elsewhere within this risk register under Client Budgeting, escalation and project delays.												
F2	Inability to manage within Total Fixed Budget	Costs may exceed imposed budget	Covered elsewhere within this risk register under Client Budgeting, escalation and project delays.												
F3	Change to project funding priority (lower priority) and/or restricted cash flow	Decreased project priority after the award of the construction contract, Suspension claim for delay or prolongation of construction contract.	Covered elsewhere within this risk register under Client Budgeting, escalation and project delays.												
												Total Retained	329,499	Total Transferred	242,212

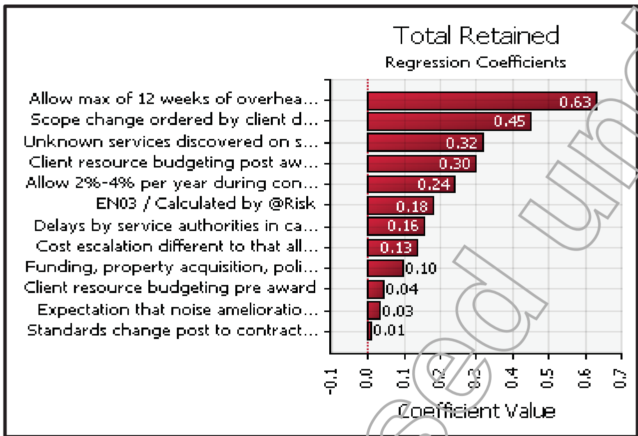
@RISK Output Report for Total Retained

Performed By: neil.king

Date: Monday, 21 January 2013 1:26:29 PM







Simulation Summary Information	
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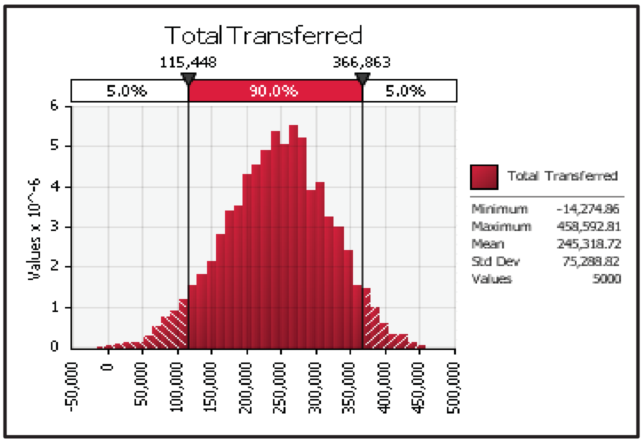
Number of Iterations	5000
Number of Inputs	28
Number of Outputs	2
Sampling Type	Latin Hypercube
Simulation Start Time	1/21/13 13:26:09
Simulation Duration	00:00:07
Random # Generator	Mersenne Twister
Random Seed	1

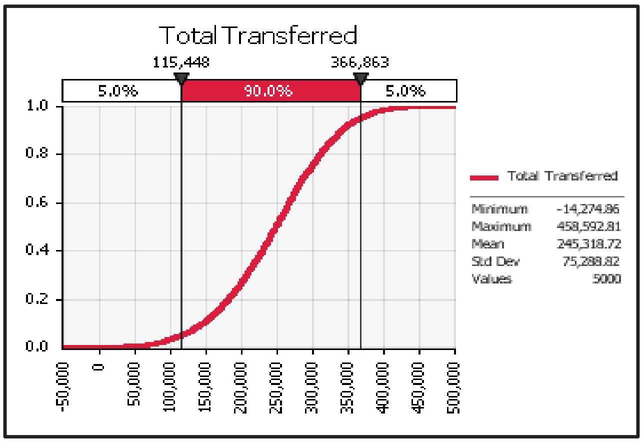
Summary Statistics for Total Retained			
Statistics		**Percentile**	
Minimum	54,416	**5%**	204,527
Maximum	1,012,654	**10%**	235,862
Mean	406,091	**15%**	263,677
Std Dev	143,581	**20%**	286,198
Variance	20615521088	**25%**	306,346
Skewness	0.666890194	**30%**	323,696
Kurtosis	3.423346911	**35%**	338,444
Median	386,517	**40%**	355,547
Mode	331,729	**45%**	370,601
Left X	204,527	**50%**	386,517
Left P	5%	**55%**	403,234
Right X	678,399	**60%**	421,300
Right P	95%	**65%**	441,570
Diff X	473,871	**70%**	462,154
Diff P	90%	**75%**	486,833
#Errors	0	**80%**	516,476
Filter Min	Off	**85%**	556,089
Filter Max	Off	**90%**	606,784
#Filtered	0	**95%**	678,399

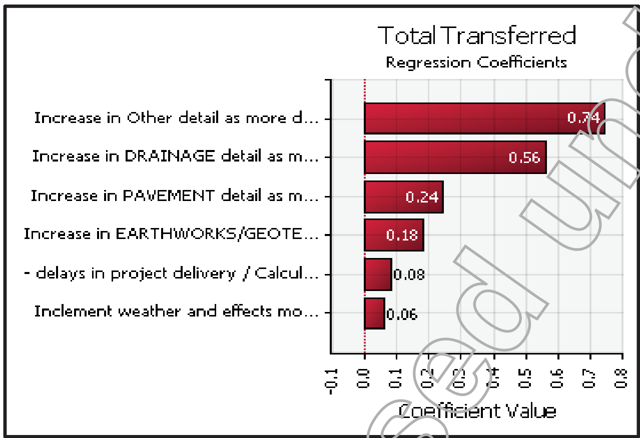
@RISK Output Report for Total Transferred

Performed By: neil.king

Date: Monday, 21 January 2013 1:27:02 PM







Simulation Summary Information	
Workbook Name	412223 - M Project Risk Register v0.2.xlsx
Number of Simulations	1
Number of Iterations	5000
Number of Inputs	28
Number of Outputs	2
Sampling Type	Latin Hypercube
Simulation Start Time	1/21/13 13:26:09
Simulation Duration	00:00:07
Random # Generator	Mersenne Twister
Random Seed	1

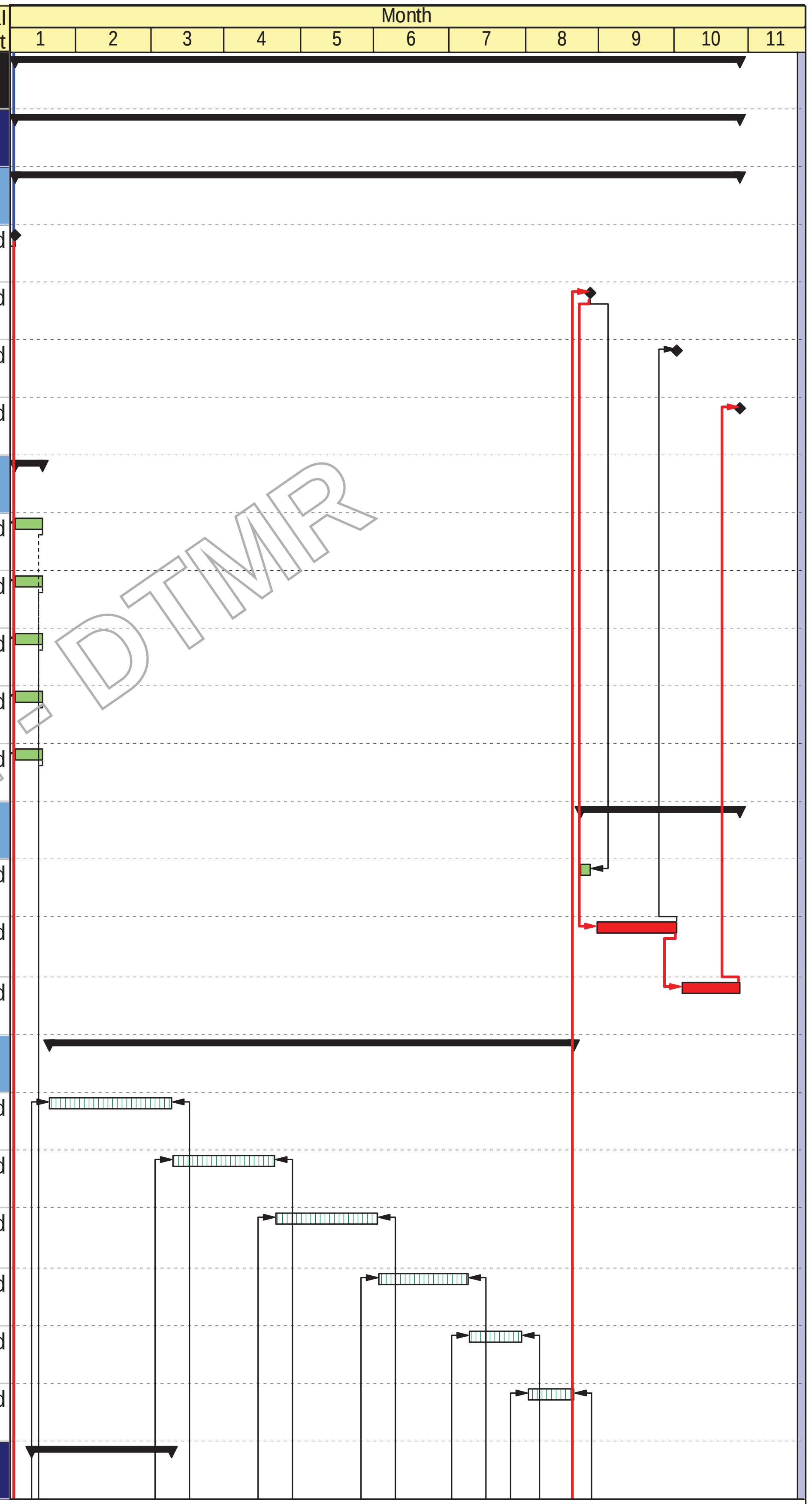
Summary Statistics for Total Transferred

Statistics		**Percentile**	
Minimum	- 14,275	**5%**	115,448
Maximum	458,593	**10%**	145,159
Mean	245,319	**15%**	164,796
Std Dev	75,289	**20%**	181,401
Variance	5668406840	**25%**	195,295
Skewness	-0.161401529	**30%**	207,323
Kurtosis	2.794630387	**35%**	218,205
Median	248,089	**40%**	229,126
Mode	239,595	**45%**	238,953
Left X	115,448	**50%**	248,089
Left P	5%	**55%**	257,864
Right X	366,863	**60%**	266,402
Right P	95%	**65%**	276,315
Diff X	251,416	**70%**	285,655
Diff P	90%	**75%**	298,167
#Errors	0	**80%**	309,912
Filter Min	Off	**85%**	324,754
Filter Max	Off	**90%**	340,985
#Filtered	0	**95%**	366,863

Appendix N: Construction Programme

This Appendix contains the Construction Programme developed based on the constructability review and inputs to the Construction Estimate contained in Appendix A.

Activity ID	Activity Name	Qty	Rate	Dur	Early Start	Early Finish	Total Float
MOOLOOLABA ROAD UPGRADE - Ver-0 (07-Nov-2012) - six phases							
GENERAL							
KEY DATES							
0010	Target Date for Contract Award (TBC)			0d	04-Feb-13		0d
0020	Earliest Completion of Works (Practical Completion - Dry Days)			0d		27-Sep-13	0d
0030	Forecast Completion of Works (Practical Completion - Wet Days)			0d		01-Nov-13	18d
0040	Forecast Completion of Works (With 10% Contingency for Unforseen Items)			0d		27-Nov-13	0d
PRELIMINARIES							
0100	Prepare Project Plan			10d	04-Feb-13	15-Feb-13	4d
0110	Prepare CEMP (Construction Environmental Management Plan)			10d	04-Feb-13	15-Feb-13	4d
0120	Prepare SSMP (Site Safety Management Plan)			10d	04-Feb-13	15-Feb-13	4d
0130	Prepare Traffic Management Plan			10d	04-Feb-13	15-Feb-13	4d
0140	Prepare Construction Programme			10d	04-Feb-13	15-Feb-13	4d
COMPLETION AND CONTINGENCY							
0500	Prepare As-Built Drawings			5d	23-Sep-13	27-Sep-13	42d
0510	Contingency for Wet Weather (at 3 days per month)			24d	30-Sep-13	01-Nov-13	0d
0520	Project Contingency for Variations and Unforeseen (at 10%)			18d	04-Nov-13	27-Nov-13	0d
TRAFFIC SWITCHES / DIVERSIONS							
0600	1st Traffic Switch - Top Section Uphill Lane (close to traffic)			35d	18-Feb-13	09-Apr-13	0d
0610	2nd Traffic Switch - Top Section Downhill Lane (close to traffic)			28d	10-Apr-13	21-May-13	0d
0620	3rd Traffic Switch - Middle Section Uphill Lane (close to traffic)			30d	22-May-13	02-Jul-13	0d
0630	4th Traffic Switch - Middle Section Downhill Lane (close to traffic)			27d	03-Jul-13	08-Aug-13	0d
0640	5th Traffic Switch - Bottom Section Uphill Lane (close to traffic)			16d	09-Aug-13	30-Aug-13	0d
0650	6th Traffic Switch - Bottom Section Downhill Lane (close to traffic)			15d	02-Sep-13	20-Sep-13	0d
CONSTRUCTION - PHASE 1a Uphill Lane (ch 6595 to 6950m)							



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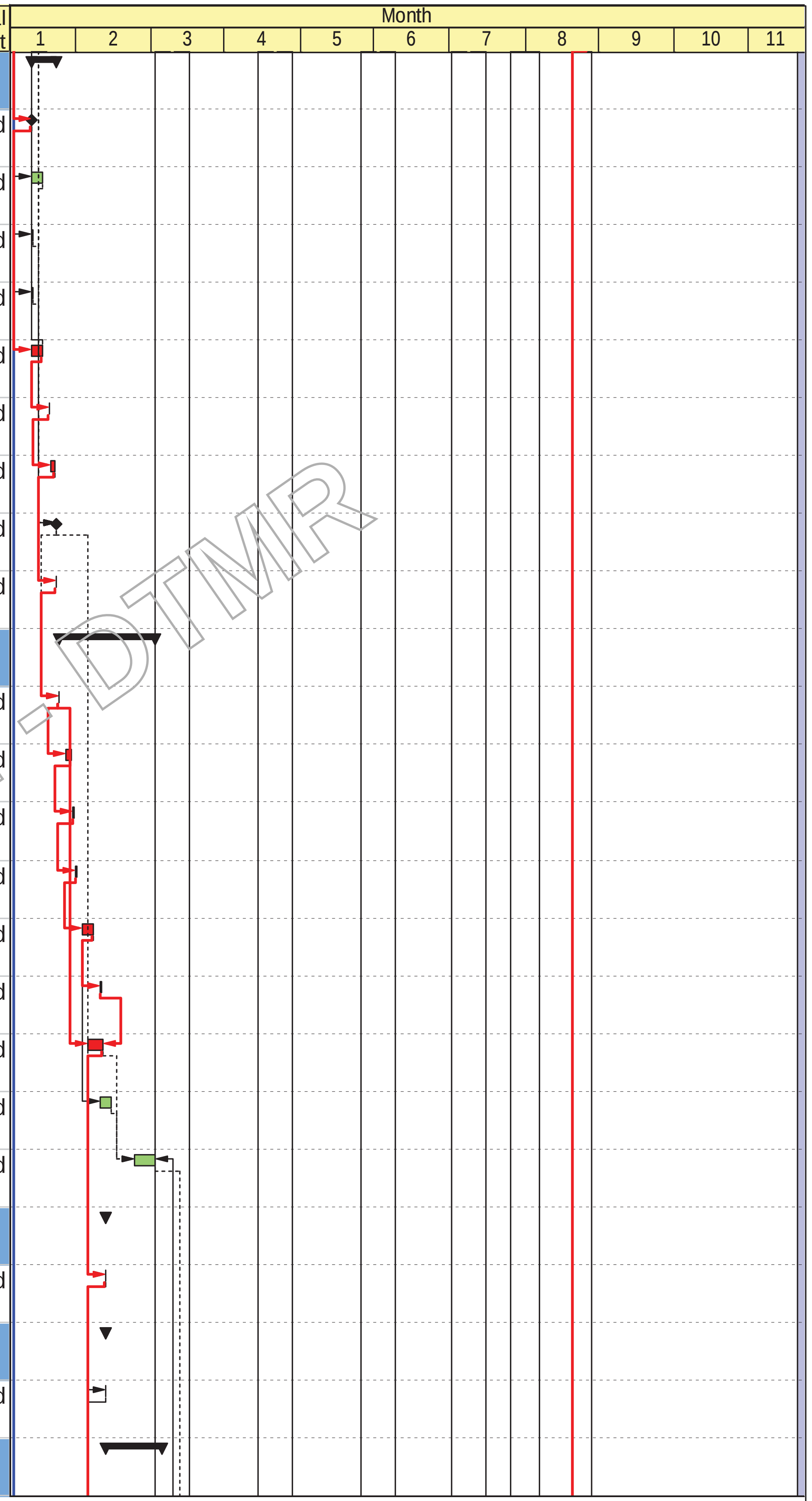
MOOLOOLABA ROAD UPGRADE - Ver-0 (07-Nov-2012) - six phases

Level 3 Programme based on 80% Design Dwgs and Bill of Quantities

Prepared by: Colin Smith 09-Nov-12 Page 1 of 9 Layout Name: CS - Barchart 2 (with Qty, Rate, Float)

- Remaining Level of Effort
- Remaining Work
- Critical
- Milestones
- Summary

Activity ID	Activity Name	Qty	Rate	Dur	Early Start	Early Finish	Total Float
PRELIMINARIES							
1A-0010	Take Possession / Start on Site (allow 1 wk after Award of Contract)			0d	11-Feb-13		0d
1A-0020	Setup Site Offices and Amenities			5d	11-Feb-13	15-Feb-13	4d
1A-0030	Manage PUP (Public Utilities / Services)			1d	11-Feb-13	11-Feb-13	8d
1A-0040	Establish Environmental Controls			1d	11-Feb-13	11-Feb-13	8d
1A-0050	Establish Traffic Management Plan (Barriers, Traffic Control)			5d	11-Feb-13	15-Feb-13	0d
1A-0060	Form Safe Working Areas			1d	18-Feb-13	18-Feb-13	0d
1A-0070	Set-out the Works			2d	19-Feb-13	20-Feb-13	0d
1A-0080	Complete Site Mobilisation and Setup			0d	21-Feb-13		1d
1A-0090	Remove Existing (Redundant) Street Furniture			1d	21-Feb-13	21-Feb-13	0d
STORMWATER DRAINAGE							
1A-2000	New Cross Drain on Both Lanes - ch 6935m	14m		1d	22-Feb-13	22-Feb-13	0d
1A-2010	New Longitudinal Drain on Uphill Lane - ch 6800 to 6935m	135m		3d	25-Feb-13	27-Feb-13	0d
1A-2020	New Cross Drain on Uphill Lane - ch 6880m	7m		1d	28-Feb-13	28-Feb-13	0d
1A-2030	New Cross Drain on Both Lanes - ch 6830m	14m		1d	01-Mar-13	01-Mar-13	0d
1A-2040	New Cross Drain on Uphill Lane - ch 6680m	7m		5d	04-Mar-13	08-Mar-13	0d
1A-2050	New Longitudinal Drain on Uphill Lane - ch 6710 to 6680m	30m		1d	11-Mar-13	11-Mar-13	0d
1A-2060	Construct Bases for 8No Access Chambers & Gully Pits - ch 6680 to 6935m	8No		5d	06-Mar-13	12-Mar-13	0d
1A-2070	Construct Drain & Base for Median Longitudinal Grated Drain	110m		5d	11-Mar-13	15-Mar-13	7d
1A-2080	Complete Drainage Structures (with kerbs)			5d	25-Mar-13	02-Apr-13	2d
EARTHWORKS							
1A-1000	No Bulk Earthworks in this Phase 1A - ch 9595 to 6950m	0m³		0d	13-Mar-13	13-Mar-13	0d
SIDE ROADS							
1A-1500	Earthworks and Tie- in to Side Roads - none in this Phase 1A	nil		0d	13-Mar-13	13-Mar-13	1d
PAVEMENTS							



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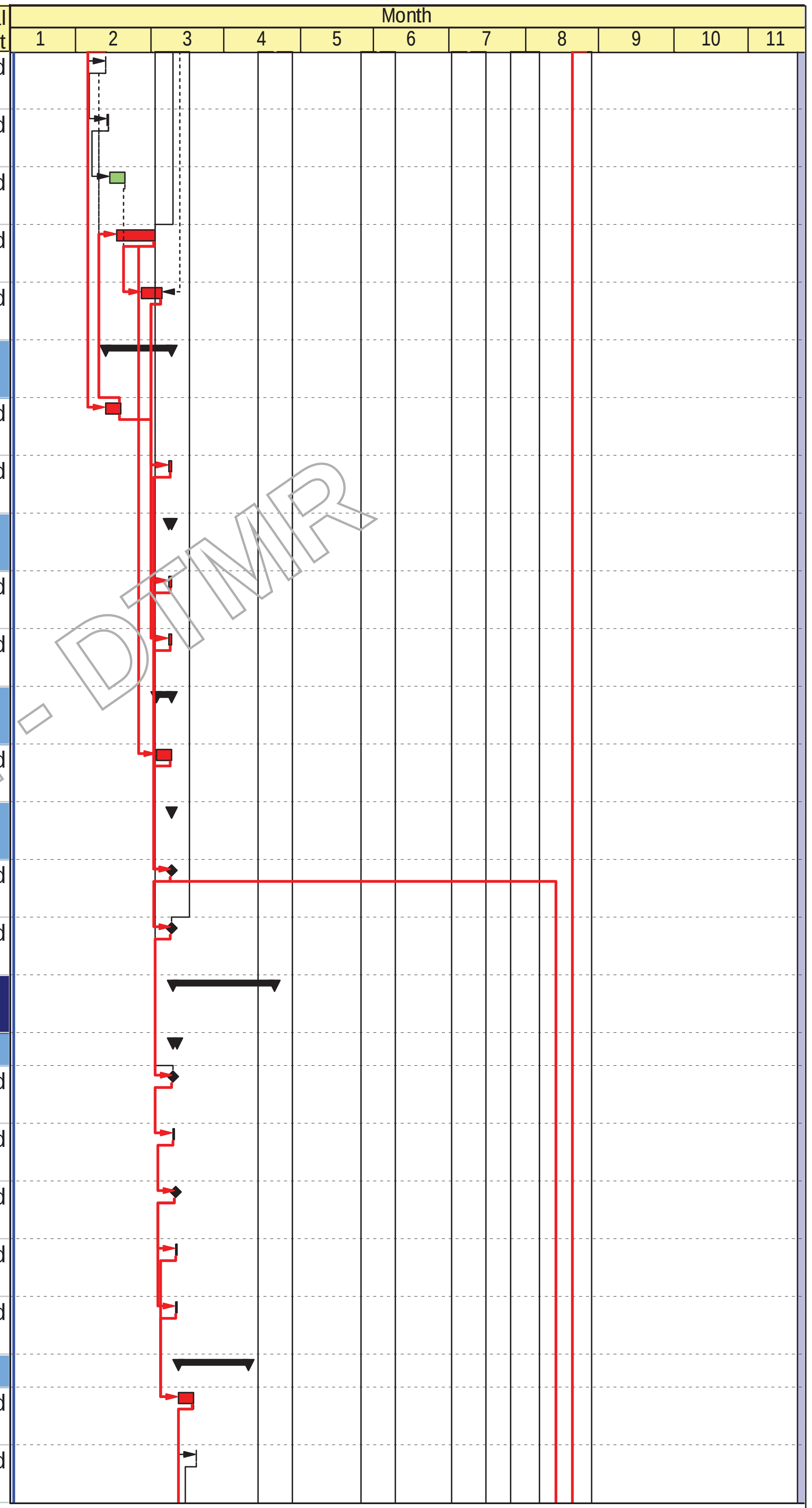
MOOLOOLABA ROAD UPGRADE - Ver-0 (07-Nov-2012) - six phases

Level 3 Programme based on 80% Design Dwgs and Bill of Quantities

Prepared by: Colin Smith 09-Nov-12 Page 2 of 9 Layout Name: CS - Barchart 2 (with Qty, Rate, Float)

Remaining Level of Effort
Remaining Work
Critical
◆ Milestones
Summary

Activity ID	Activity Name	Qty	Rate	Dur	Early Start	Early Finish	Total Float
1A-5000	Remove Existing Road Surface (saw cuts and cold plane off)			1d	13-Mar-13	13-Mar-13	1d
1A-5010	Remove Existing Kerbs and Channels (whats left after installing new drainage)			1d	14-Mar-13	14-Mar-13	1d
1A-5020	Digout and Rebuild Sections of Bad Road Pavement			5d	15-Mar-13	21-Mar-13	4d
1A-5030	Construct New Kerbs, Channels, Medians & Property Cross-overs / Entrances	355m		10d	18-Mar-13	02-Apr-13	0d
1A-5040	New Pavement and Re-surfacing			5d	28-Mar-13	05-Apr-13	0d
ELECTRICAL							
1A-6000	Trenches and Cabling for Street Lighting			5d	13-Mar-13	19-Mar-13	0d
1A-6010	Erect Street Lighting Poles, Test and Commission	check		2d	08-Apr-13	09-Apr-13	0d
ROAD FURNITURE							
1A-7000	Erect Road Signs and Guard Rails			2d	08-Apr-13	09-Apr-13	0d
1A-7010	Road Line Markings and Reflective Studs			2d	08-Apr-13	09-Apr-13	0d
LANDSCAPING							
1A-8000	Topsoil, Matting, Hydroseed, Turfing, Plants, etc			5d	03-Apr-13	09-Apr-13	0d
COMPLETION AND TRAFFIC SWITCH							
1A-9000	Complete Phase 1a - Top Section Uphill Lane			0d		09-Apr-13	0d
1A-9010	Open New Phase 1a - Top Section Uphill Lane to Traffic			0d		09-Apr-13	0d
CONSTRUCTION - PHASE 1b Downhill Lane (ch 6595 to 6950m)							
PRELIMINARIES							
1B-0010	Switch Traffic to Uphill Lane, Close Downhill Lane			0d	10-Apr-13		0d
1B-0020	Form Safe Working Areas			1d	10-Apr-13	10-Apr-13	0d
1B-0030	Commence Phase 1b - Downhill Lane			0d	11-Apr-13		0d
1B-0070	Set-out the Works			1d	11-Apr-13	11-Apr-13	0d
1B-0090	Remove Existing (Redundant) Street Furniture			1d	11-Apr-13	11-Apr-13	0d
STORMWATER DRAINAGE							
1B-2000	Construct Drain & Base for Longitudinal Grated Drain - ch 6710 to 6830m	120m		5d	12-Apr-13	18-Apr-13	0d
1B-2010	New Cross Drain on Downhill Lane - ch 6770m	7m		1d	19-Apr-13	19-Apr-13	1d



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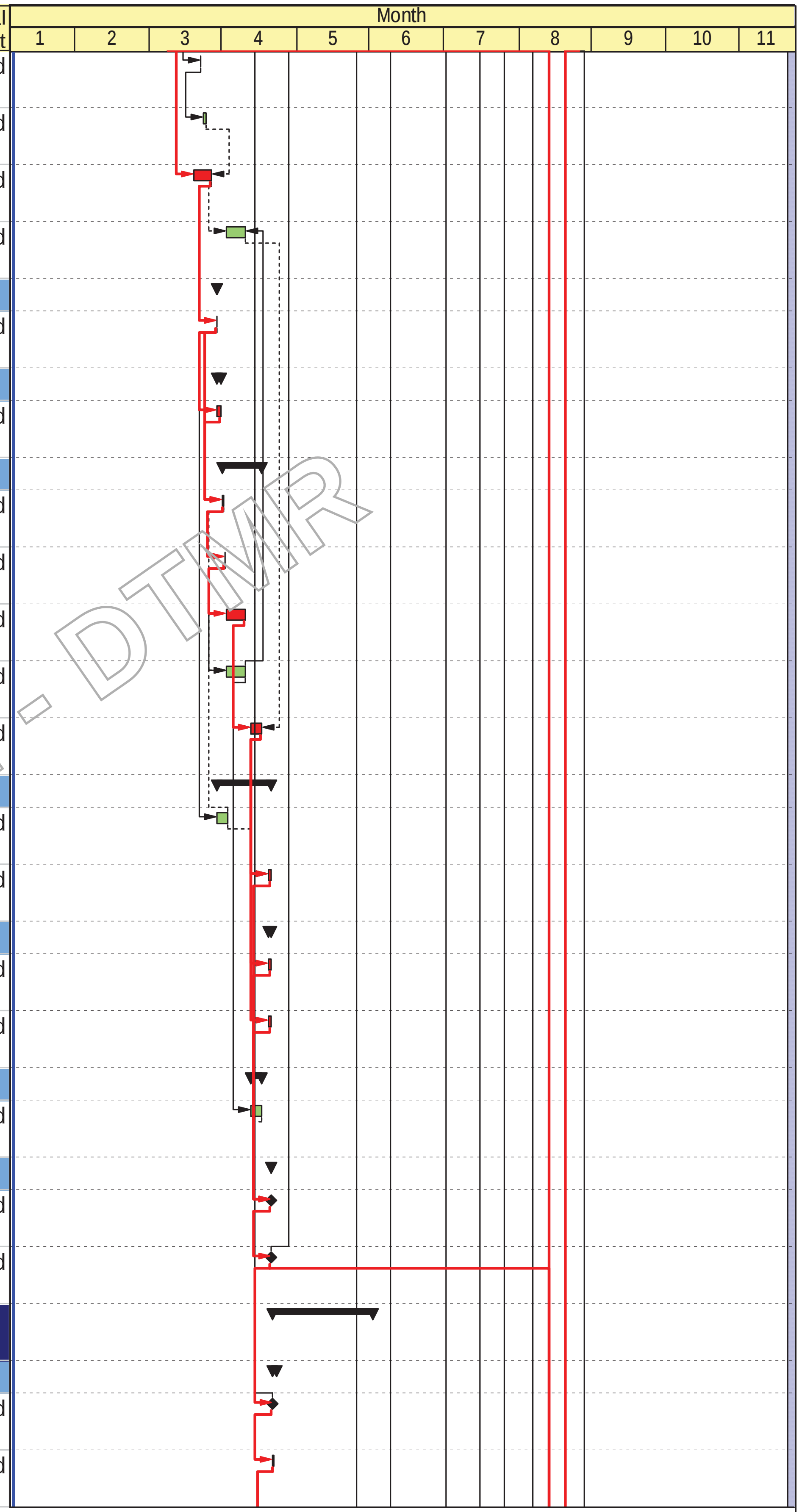
MOOLOOLABA ROAD UPGRADE - Ver-0 (07-Nov-2012) - six phases

Level 3 Programme based on 80% Design Dwgs and Bill of Quantities

Prepared by: Colin Smith 09-Nov-12 Page 3 of 9 Layout Name: CS - Barchart 2 (with Qty, Rate, Float)

Remaining Level of Effort
Remaining Work
Critical
Milestones
Summary

Activity ID	Activity Name	Qty	Rate	Dur	Early Start	Early Finish	Total Float
1B-2020	Construct Drain & Base for Median Longitudinal Grated Drain - ch 6770m	10m		1d	22-Apr-13	22-Apr-13	1d
1B-2030	New Longitudinal Drain on Foote Ave	20m		2d	23-Apr-13	24-Apr-13	1d
1B-2040	Construct Bases for 7No Access Chambers & Gully Pits - ch 6680 to 6935m	7No		5d	19-Apr-13	26-Apr-13	0d
1B-2060	Complete Drainage Structures (with kerbs)			5d	03-May-13	10-May-13	4d
EARTHWORKS							
1B-1000	No Bulk Earthworks in this Phase 1B - ch 9595 to 6950m	0m³		0d	29-Apr-13	29-Apr-13	0d
SIDE ROADS							
1B-1500	Earthworks and Tie- in to Foote Ave Side Road			2d	29-Apr-13	30-Apr-13	0d
PAVEMENTS							
1B-5000	Remove Existing Road Surface (saw cuts and cold plane off)			1d	01-May-13	01-May-13	0d
1B-5010	Remove Existing Kerbs and Channels (whats left after installing new drainage)			1d	02-May-13	02-May-13	0d
1B-5020	Digout and Rebuild Sections of Bad Road Pavement			5d	03-May-13	10-May-13	0d
1B-5030	Construct New Kerbs, Channels & Property Cross-overs / Entrances	355m		5d	03-May-13	10-May-13	2d
1B-5040	New Pavement and Re-surfacing			5d	13-May-13	17-May-13	0d
ELECTRICAL							
1B-6000	Trenches and Cabling for Street Lighting			5d	29-Apr-13	03-May-13	3d
1B-6010	Erect Street Lighting Poles, Test and Commission	check		2d	20-May-13	21-May-13	0d
ROAD FURNITURE							
1B-7000	Erect Road Signs and Guard Rails			2d	20-May-13	21-May-13	0d
1B-7010	Road Line Markings and Reflective Studs			2d	20-May-13	21-May-13	0d
LANDSCAPING							
1B-8000	Topsoil, Matting, Hydroseed, Turfing, Plants, etc			5d	13-May-13	17-May-13	2d
COMPLETION AND TRAFFIC SWITCH							
1B-9000	Complete Phase 1b - Top Section Uphill Lane			0d		21-May-13	0d
1B-9010	Open New Phase 1b - Top Section Uphill Lane to Traffic			0d		21-May-13	0d
CONSTRUCTION - PHASE 2A Uphill Lane (ch 6950 to 7400m)							
PRELIMINARIES							
2A-0010	Switch Traffic to Downhill Lane, Close Uphill Lane - ch 6950 to 7400m			0d	22-May-13		0d
2A-0020	Form Safe Working Areas			1d	22-May-13	22-May-13	0d



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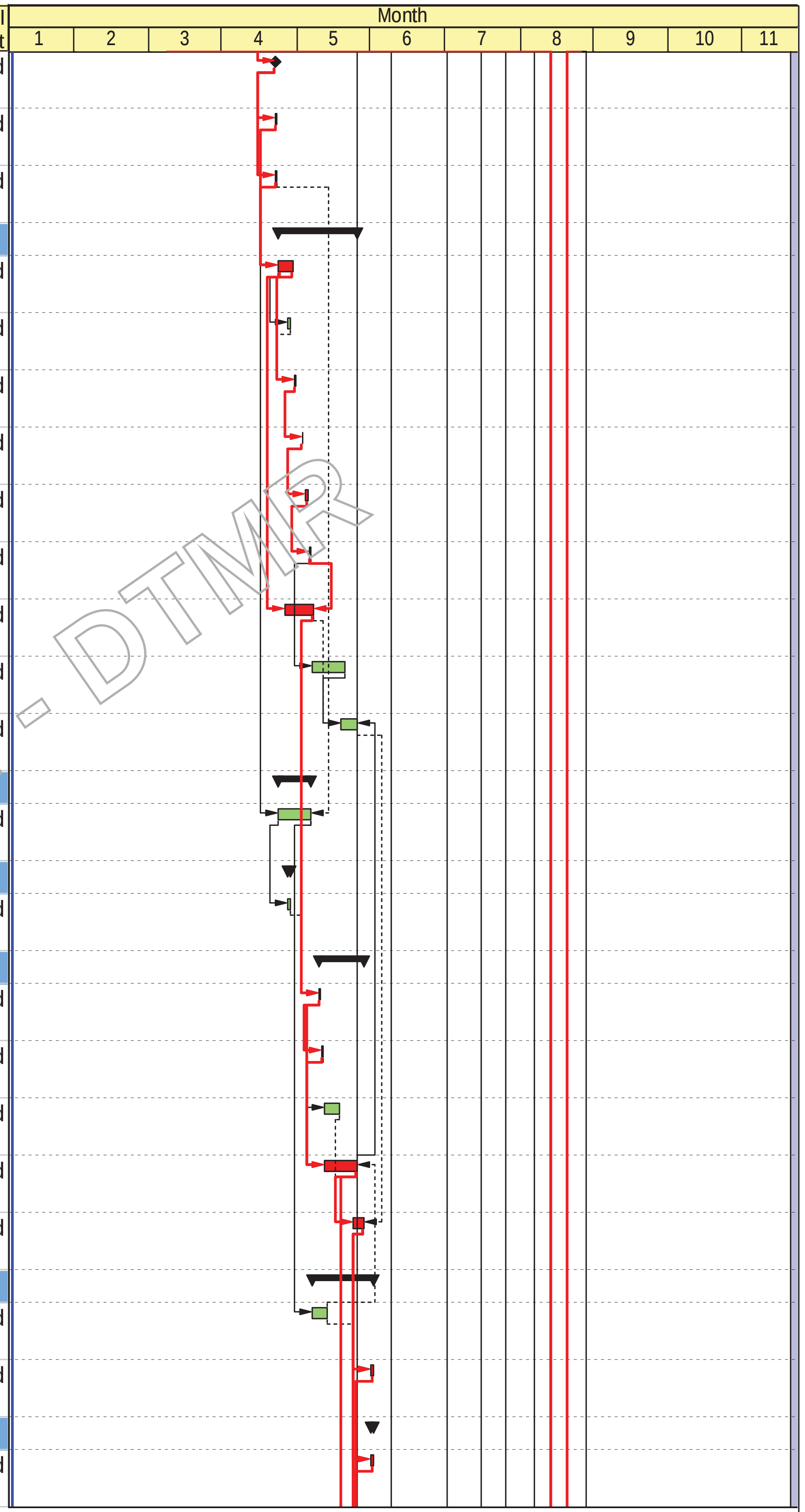
MOOLOOLABA ROAD UPGRADE - Ver-0 (07-Nov-2012) - six phases

Level 3 Programme based on 80% Design Dwgs and Bill of Quantities

Prepared by: Colin Smith 09-Nov-12 Page 4 of 9 Layout Name: CS - Barchart 2 (with Qty, Rate, Float)

- Remaining Level of Effort
- Remaining Work
- Critical
- Milestones
- Summary

Activity ID	Activity Name	Qty	Rate	Dur	Early Start	Early Finish	Total Float
2A-0030	Commence Phase 2a - Uphill Lane			0d	23-May-13		0d
2A-0070	Set-out the Works			1d	23-May-13	23-May-13	0d
2A-0090	Remove Existing (Redundant) Street Furniture			1d	23-May-13	23-May-13	0d
STORMWATER DRAINAGE							
2A-2000	New Longitudinal Drain ch 7180m to 7000m	180m		5d	24-May-13	30-May-13	0d
2A-2010	New Longitudinal Drain Crossing Myes Crescent (with ch 7180-7000m)	40m		2d	28-May-13	29-May-13	1d
2A-2020	New Cross Drain on Uphill Lane - ch 7180m	7m		1d	31-May-13	31-May-13	0d
2A-2030	New Cross Drain on Uphill Lane - ch 7140m	7m		1d	03-Jun-13	03-Jun-13	0d
2A-2040	New Cross Drain on Both Lanes - ch 7060m	7m		2d	04-Jun-13	05-Jun-13	0d
2A-2050	New Cross Drain on Uphill Lane - ch 7030m	7m		1d	06-Jun-13	06-Jun-13	0d
2A-2060	Construct Bases for 13No Access Chambers & Gully Pits - ch 6950 to 7400m	13No		10d	27-May-13	07-Jun-13	0d
2A-2070	Construct Drain & Base for Median Longitudinal Grated Drain	180m		10d	07-Jun-13	20-Jun-13	2d
2A-2090	Complete Drainage Structures (with kerbs)			5d	19-Jun-13	25-Jun-13	2d
EARTHWORKS							
2A-1000	Earthworks Fill to Edge of Road (Embankment) Phase 2a - ch 6950 to7400m	check 5000m³	500m³/day	10d	24-May-13	06-Jun-13	1d
SIDE ROADS							
2A-1500	Earthworks and Tie- in to Myes Crescent Side Road			2d	28-May-13	29-May-13	7d
PAVEMENTS							
2A-5000	Remove Existing Road Surface (saw cuts and cold plane off)			1d	10-Jun-13	10-Jun-13	0d
2A-5010	Remove Existing Kerbs and Channels (whats left after installing new drainage)			1d	11-Jun-13	11-Jun-13	0d
2A-5020	Digout and Rebuild Sections of Bad Road Pavement			5d	12-Jun-13	18-Jun-13	3d
2A-5030	Construct New Kerbs, Channels, Medians & Property Cross-overs / Entrances	450m		10d	12-Jun-13	25-Jun-13	0d
2A-5040	New Pavement and Re-surfacing			5d	24-Jun-13	28-Jun-13	0d
ELECTRICAL							
2A-6000	Trenches and Cabling for Street Lighting			5d	07-Jun-13	13-Jun-13	3d
2A-6010	Erect Street Lighting Poles, Test and Commission	check		2d	01-Jul-13	02-Jul-13	0d
ROAD FURNITURE							
2A-7000	Erect Road Signs and Guard Rails			2d	01-Jul-13	02-Jul-13	0d



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MOOLOOLABA ROAD UPGRADE - Ver-0 (07-Nov-2012) - six phases

Level 3 Programme based on 80% Design Dwgs and Bill of Quantities

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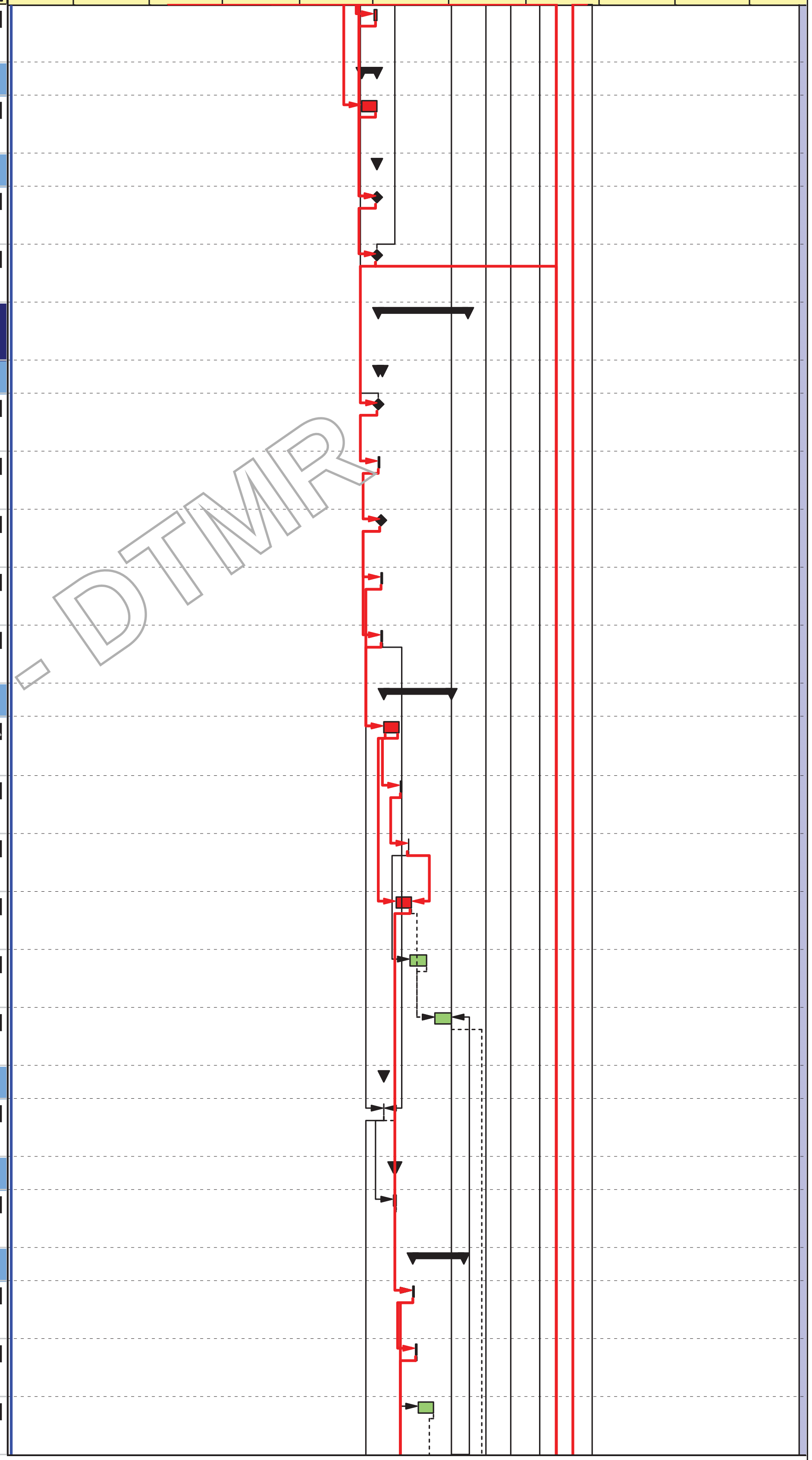
Remaining Level of Effort
Remaining Work
Critical
Milestones
Summary

Activity ID	Activity Name	Qty	Rate	Dur	Early Start	Early Finish	Total Float
2A-7010	Road Line Markings and Reflective Studs			2d	01-Jul-13	02-Jul-13	0d
LANDSCAPING							
2A-8000	Topsoil, Matting, Hydroseed, Turfing, Plants, etc			5d	26-Jun-13	02-Jul-13	0d
COMPLETION AND TRAFFIC SWITCH							
2A-9000	Complete Phase 2a - Top Section Uphill Lane			0d		02-Jul-13	0d
2A-9010	Open New Phase 2a - Top Section Uphill Lane to Traffic			0d		02-Jul-13	0d
CONSTRUCTION - PHASE 2B Downhill Lane (ch 6950 to 7400m)							
PRELIMINARIES							
2B-0010	Switch Traffic to Uphill Lane, Close Downhill Lane - ch 6950 to 7400m			0d	03-Jul-13		0d
2B-0020	Form Safe Working Areas			1d	03-Jul-13	03-Jul-13	0d
2B-0030	Commence Phase 2b - Downhill Lane			0d	04-Jul-13		0d
2B-0070	Set-out the Works			1d	04-Jul-13	04-Jul-13	0d
2B-0090	Remove Existing (Redundant) Street Furniture			1d	04-Jul-13	04-Jul-13	0d
STORMWATER DRAINAGE							
2B-2000	New Longitudinal Drain ch 7140m to 7060m	80m		5d	05-Jul-13	11-Jul-13	0d
2B-2030	New Cross Drain on Downhill Lane - ch 7140m	7m		1d	12-Jul-13	12-Jul-13	0d
2B-2050	New Cross Drain on Uphill Lane - ch 7030m	7m		1d	15-Jul-13	15-Jul-13	0d
2B-2060	Construct Bases for 5No Access Chambers & Gully Pits - ch 6950 to 7400m	5No		5d	10-Jul-13	16-Jul-13	0d
2B-2070	Construct Drain & Base for Longitudinal Grated Drain - ch 6950 to 7030m	80m		5d	16-Jul-13	22-Jul-13	7d
2B-2090	Complete Drainage Structures (with kerbs)			5d	26-Jul-13	01-Aug-13	2d
EARTHWORKS							
2B-1000	No Bulk Earthworks in this Phase 2B - ch 6950 to7400m	$0m^3$		0d	05-Jul-13	05-Jul-13	4d
SIDE ROADS							
2B-1500	Earthworks and Tie- in to Thomsen Terrace Side Road			2d	09-Jul-13	10-Jul-13	4d
PAVEMENTS							
2B-5000	Remove Existing Road Surface (saw cuts and cold plane off)			1d	17-Jul-13	17-Jul-13	0d
2B-5010	Remove Existing Kerbs and Channels (whats left after installing new drainage)			1d	18-Jul-13	18-Jul-13	0d
2B-5020	Digout and Rebuild Sections of Bad Road Pavement			5d	19-Jul-13	25-Jul-13	3d

Month: 1 2 3 4 5 6 7 8 9 10 11



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MOOLOOLABA ROAD UPGRADE - Ver-0 (07-Nov-2012) - six phases

Level 3 Programme based on 80% Design Dwgs and Bill of Quantities

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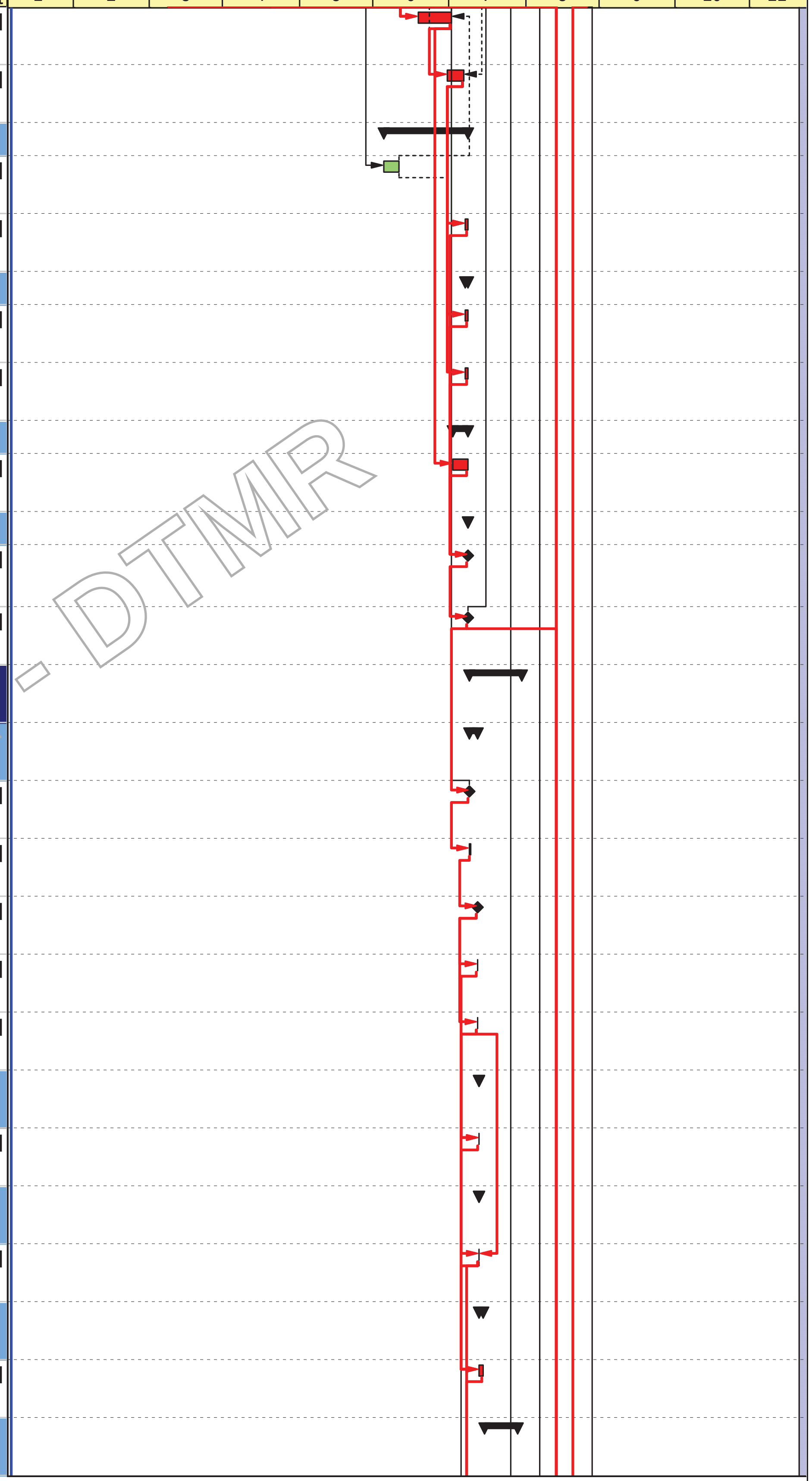
Remaining Level of Effort
Remaining Work
Critical
Milestones
Summary

Activity ID	Activity Name	Qty	Rate	Dur	Early Start	Early Finish	Total Float
2B-5030	Construct New Kerbs, Channels, Medians & Property Cross-overs / Entrances	450m		10d	19-Jul-13	01-Aug-13	0d
2B-5040	New Pavement and Re-surfacing			5d	31-Jul-13	06-Aug-13	0d
ELECTRICAL							
2B-6000	Trenches and Cabling for Street Lighting			5d	05-Jul-13	11-Jul-13	10d
2B-6010	Erect Street Lighting Poles, Test and Commission	check		2d	07-Aug-13	08-Aug-13	0d
ROAD FURNITURE							
2B-7000	Erect Road Signs and Guard Rails			2d	07-Aug-13	08-Aug-13	0d
2B-7010	Road Line Markings and Reflective Studs			2d	07-Aug-13	08-Aug-13	0d
LANDSCAPING							
2B-8000	Topsoil, Matting, Hydroseed, Turfing, Plants, etc			5d	02-Aug-13	08-Aug-13	0d
COMPLETION AND TRAFFIC SWITCH							
2B-9000	Complete Phase 2b - Middle Section Downhill Lane			0d		08-Aug-13	0d
2B-9010	Open New Phase 2b - Middle Section Downhill Lane			0d		08-Aug-13	0d
CONSTRUCTION - PHASE 3A Uphill Lane (ch 7400 to 7619m)							
PRELIMINARIES							
3A-0010	Switch Traffic to Downhill Lane, Close Uphill Lane - ch 7400 to 7619m			0d	09-Aug-13		0d
3A-0020	Form Safe Working Areas			1d	09-Aug-13	09-Aug-13	0d
3A-0030	Commence Phase 3a - Uphill Lane			0d	12-Aug-13		0d
3A-0070	Set-out the Works			1d	12-Aug-13	12-Aug-13	0d
3A-0090	Remove Existing (Redundant) Street Furniture			1d	12-Aug-13	12-Aug-13	0d
STORMWATER DRAINAGE							
3A-2000	No Drainage in this Phase 3A - ch 7400 to 7619m	nil		0d	13-Aug-13	13-Aug-13	0d
EARTHWORKS							
3A-1000	No Bulk Earthworks in this Phase 3a - ch 7400 to 7619m	0m³		0d	13-Aug-13	13-Aug-13	0d
SIDE ROADS							
3A-1500	Earthworks and Tie- in to Buderim Pines (Side) Road			2d	13-Aug-13	14-Aug-13	0d
PAVEMENTS							

Month: 1 2 3 4 5 6 7 8 9 10 11



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Level 3 Programme based on 80% Design Dwgs and Bill of Quantities

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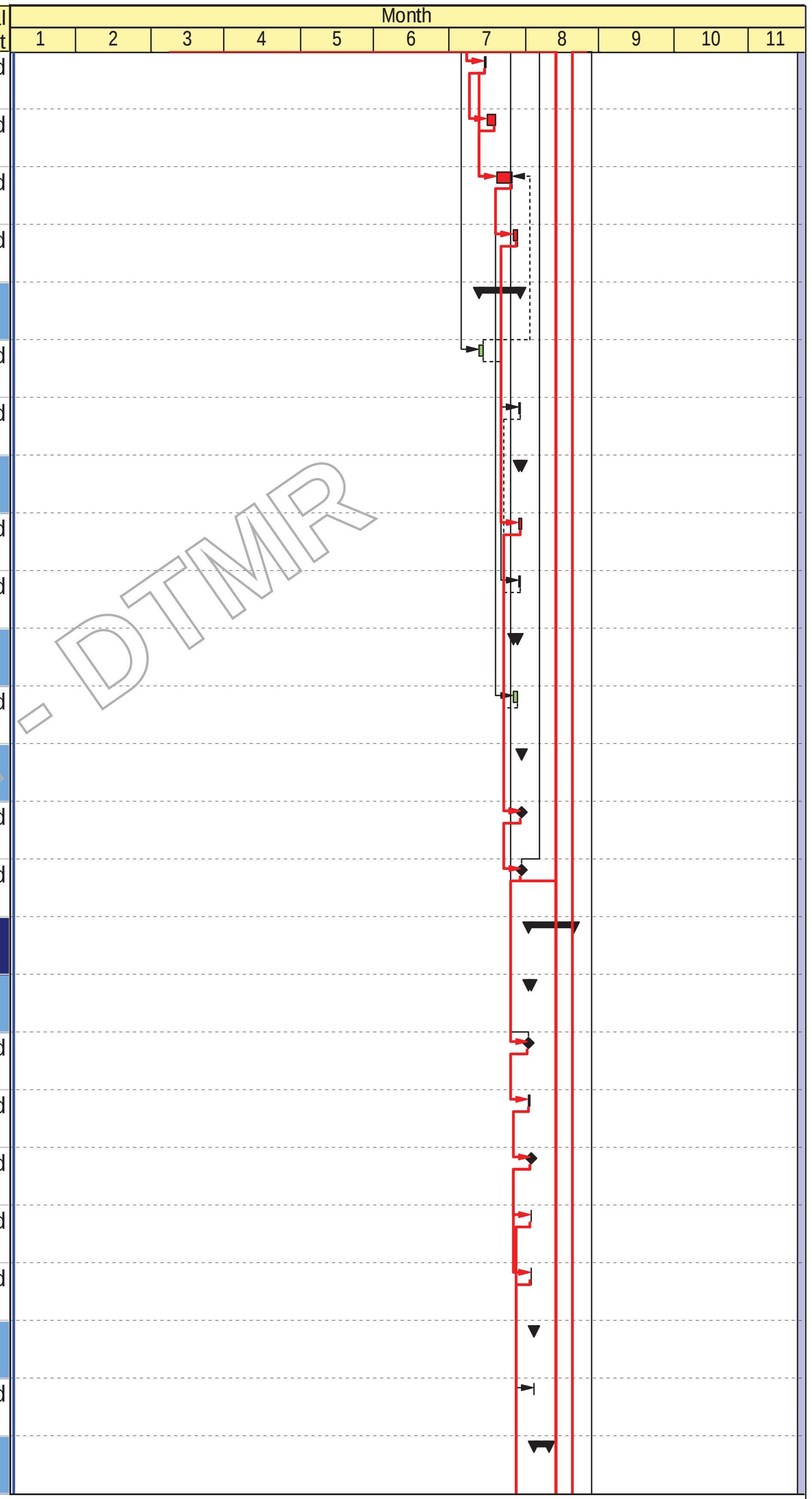
Remaining Level of Effort
Remaining Work
Critical
Milestones
Summary

Activity ID	Activity Name	Qty	Rate	Dur	Early Start	Early Finish	Total Float
3A-5000	Remove Existing Road Surface (saw cuts and cold plane off)			1d	15-Aug-13	15-Aug-13	0d
3A-5010	Partial Removal of Existing Kerbs and Medians			2d	16-Aug-13	19-Aug-13	0d
3A-5030	Construct New Kerbs and Medians	100m		5d	20-Aug-13	26-Aug-13	0d
3A-5040	New Pavement and Re-surfacing			2d	27-Aug-13	28-Aug-13	0d
ELECTRICAL							
3A-6000	Trenches and Cabling for Street Lighting			2d	13-Aug-13	14-Aug-13	6d
3A-6010	Erect Street Lighting Poles, Test and Commission	check		1d	29-Aug-13	29-Aug-13	1d
ROAD FURNITURE							
3A-7000	Erect Road Signs and Guard Rails			2d	29-Aug-13	30-Aug-13	0d
3A-7010	Road Line Markings and Reflective Studs			1d	29-Aug-13	29-Aug-13	1d
LANDSCAPING							
3A-8000	Topsoil, Matting, Hydroseed, Turfing, Plants, etc			2d	27-Aug-13	28-Aug-13	2d
COMPLETION AND TRAFFIC SWITCH							
3A-9000	Complete Phase 3a - Bottom Section Uphill Lane			0d		30-Aug-13	0d
3A-9010	Open New Phase 3a - Bottom Section Uphill Lane to Traffic			0d		30-Aug-13	0d
CONSTRUCTION - PHASE 3B Downhill Lane (ch 7400 to 7619m)							
PRELIMINARIES							
3B-0010	Switch Traffic to Uphill Lane, Close Downhill Lane - ch 7400 to 7619m			0d	02-Sep-13		0d
3B-0020	Form Safe Working Areas			1d	02-Sep-13	02-Sep-13	0d
3B-0030	Commence Phase 3b - Downhill Lane			0d	03-Sep-13		0d
3B-0070	Set-out the Works			1d	03-Sep-13	03-Sep-13	0d
3B-0090	Remove Existing (Redundant) Street Furniture			1d	03-Sep-13	03-Sep-13	0d
STORMWATER DRAINAGE							
3B-2000	No Drainage in this Phase 3B - ch 7400 to 7619m	nil		0d	04-Sep-13	04-Sep-13	60d
EARTHWORKS							



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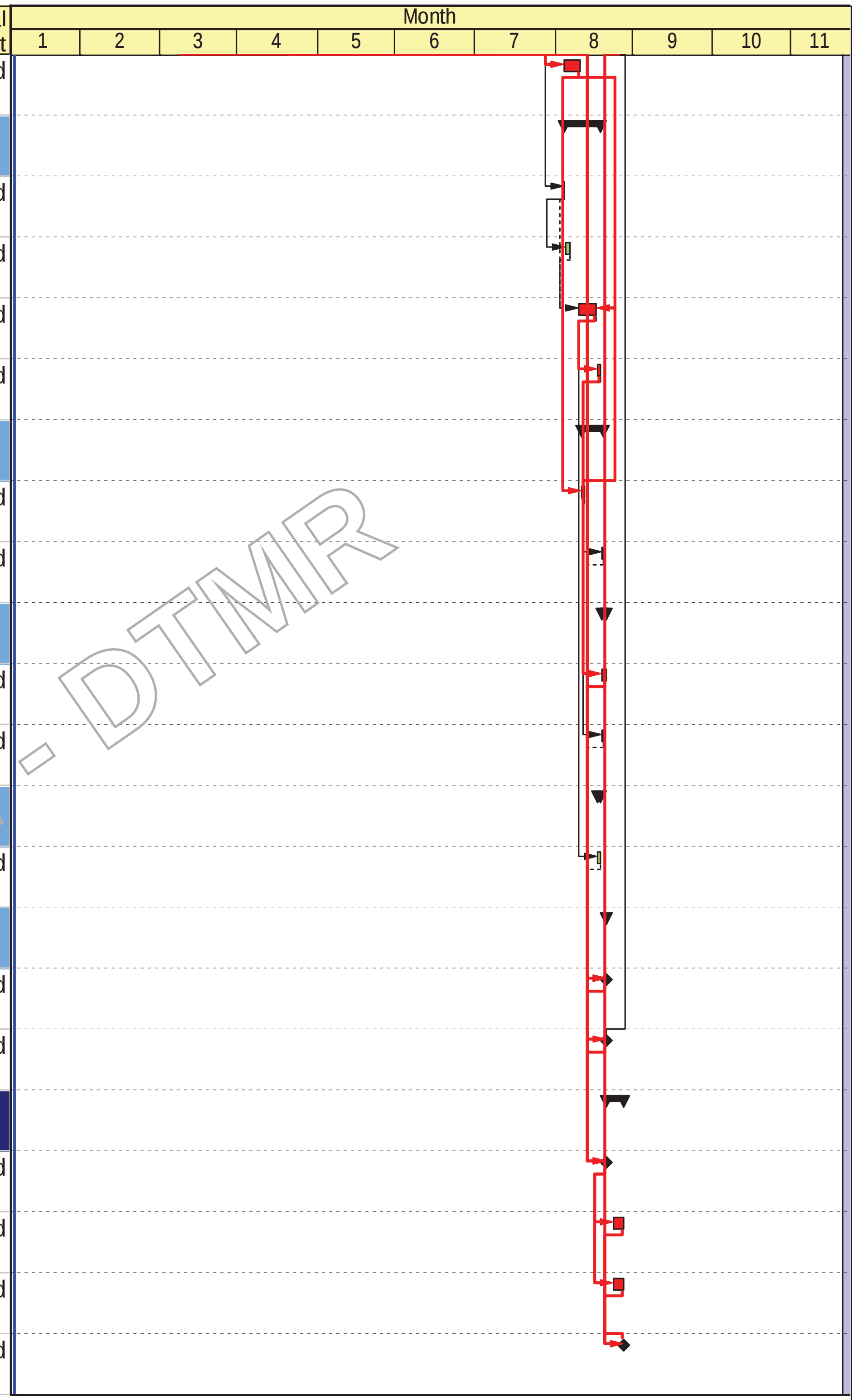
Remaining Level of Effort
Remaining Work
Critical
Milestones
Summary

Activity ID	Activity Name	Qty	Rate	Dur	Early Start	Early Finish	Total Float
3B-1000	Bulk Earthworks - Trim Back Rock Face	check 200m³		5d	04-Sep-13	10-Sep-13	0d
PAVEMENTS							
3B-5000	Remove Existing Road Surface (saw cuts and cold plane off)			1d	04-Sep-13	04-Sep-13	1d
3B-5010	Partial Removal of Existing Kerbs and Medians			2d	05-Sep-13	06-Sep-13	1d
3B-5030	Construct New Kerbs & Property Cross-overs / Entrances	200m		5d	10-Sep-13	16-Sep-13	0d
3B-5040	New Pavement and Re-surfacing			2d	17-Sep-13	18-Sep-13	0d
ELECTRICAL							
3B-6000	Trenches and Cabling for Street Lighting			2d	11-Sep-13	12-Sep-13	0d
3B-6010	Erect Street Lighting Poles, Test and Commission	check		1d	19-Sep-13	19-Sep-13	1d
ROAD FURNITURE							
3B-7000	Erect Road Signs and Guard Rails			2d	19-Sep-13	20-Sep-13	0d
3B-7010	Road Line Markings and Reflective Studs			1d	19-Sep-13	19-Sep-13	1d
LANDSCAPING							
3B-8000	Topsoil, Matting, Hydroseed, Turfing, Plants, etc			2d	17-Sep-13	18-Sep-13	2d
COMPLETION AND TRAFFIC SWITCH							
3B-9000	Complete Phase 3b - Bottom Section Downhill Lane			0d		20-Sep-13	0d
3B-9010	Open New Phase 3b - Bottom Section Downhill Lane to Traffic			0d		20-Sep-13	0d
DEMOBILISE AND CLEAR SITE							
1-9040	Complete All Works			0d		20-Sep-13	0d
1-9050	Defects and Minor Omissions			5d	23-Sep-13	27-Sep-13	0d
1-9060	Clear Site, Demobilise.			5d	23-Sep-13	27-Sep-13	0d
1-9070	Practical Completion & Handover to Client			0d		27-Sep-13	0d



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Level 3 Programme based on 80% Design Dwgs and Bill of Quantities

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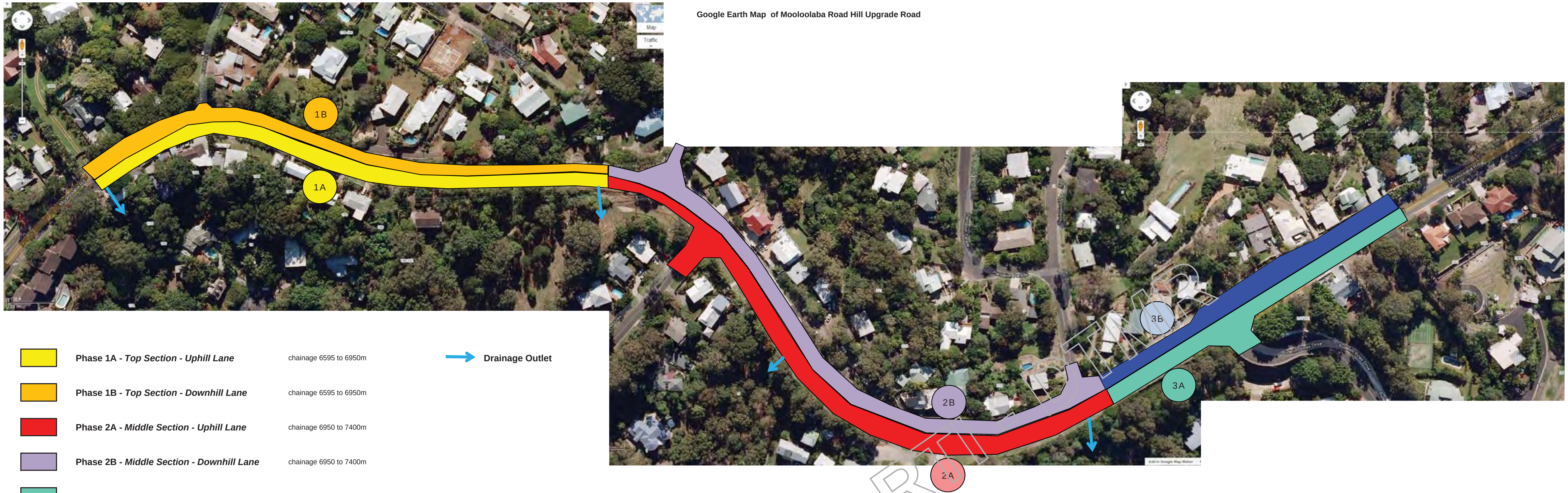
Remaining Level of Effort
Remaining Work
Critical
Milestones
Summary

Appendix O: Construction Methodology

This Appendix contains the Constructability Report.

Google Earth Map of Mooloolaba Road Hill Upgrade Road



Phase 1A - *Top Section - Uphill Lane*	chainage 6595 to 6950m	
Phase 1B - *Top Section - Downhill Lane*	chainage 6595 to 6950m	
Phase 2A - *Middle Section - Uphill Lane*	chainage 6950 to 7400m	
Phase 2B - *Middle Section - Downhill Lane*	chainage 6950 to 7400m	
Phase 3A - *Bottom Section - Uphill Lane*	chainage 7400 to 7619m	
Phase 3B - *Bottom Section - Downhill Lane*	chainage 7400 to 7619m	

→ **Drainage Outlet**

Appendix P: Estimate Approval Form

Not Used

Appendix Q: Out-turn Investment Cost Table

Not Used