



Shire of Roebourne

Karratha LIA Roads Upgrade

Multicriteria Assessment

DRAFT
July 2014

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1. Introduction

1.1 Background

The Karratha Light Industrial Area (LIA) is located off Karratha Road some 4 km south of Karratha towards the North West Coastal Highway. It has a road network of 18 roads totalling 16.4 km in length. The age of these roads varies from a few years to over 60 years.

Over time the use of these roads has been increasing in terms of heavy vehicle movements from what would have been originally planned. This has caused failure in some sections of roadwork which becomes more evident after rainfall. In addition to this delivery vehicles are longer and heavier than what would have been expected and some of the roads in the LIA, especially the older areas, are quite narrow. Trucks are frequently found travelling with their outer wheel path traversing the edge of the bitumen. These narrow roads do not adequately allow the turning of vehicles from intersections or from businesses and trucks can end up off the bitumen or on the wrong side of the road. This is an ongoing maintenance concern as the trucks cause edge failures and a rapid deterioration of the road surface but more importantly a traffic safety concern.

The Shire of Roebourne (SoR) recognises the importance of the LIA in supporting the local economy and is keen to ensure the longevity of the LIA road network by embarking on a programme of upgrades and renewal in a logically staged manner to ensure they continue to operate efficiently and safely.

1.2 Development of the LIA

It is assumed that the western side of the LIA, as outlined in green in Figure 1 was constructed first, then the purple and then the red area. Design drawings provided by SoR indicate the red area was constructed in 2008. Although maintenance on the road networks has been undertaken it is difficult to determine the extent of the works and when they were carried out as no records have been kept.

1.3 Purpose of this report

This report defines the recommended staging of works for SoR to upgrade the roads within the Karratha LIA, with consideration to future funding, pavement longevity, geometric deficiencies and drainage condition and upgrade requirements.

1.4 Identified Stakeholders

Key stakeholders in this project are as follows:

- Shire of Roebourne
- Main Roads Western Australia (MRWA)
- Businesses in the LIA

1.5 Standards

The following standards have been utilised throughout this investigation:

- Austroads Standards;
- MRWA standards and specifications;
- Australian Standards; and

- Shire of Roebourne standards and specifications.

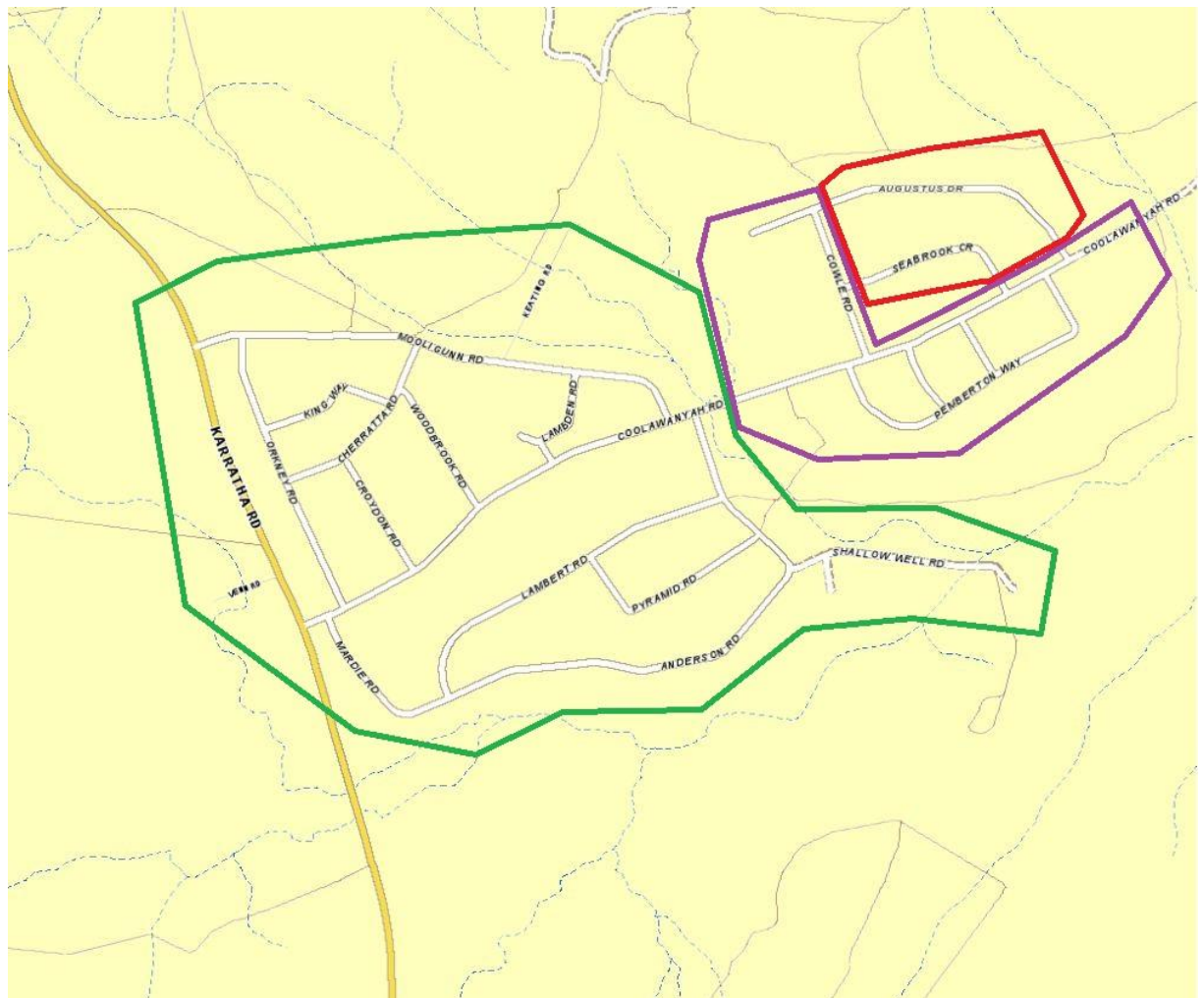


Figure 1 - Karratha LIA Aerial Image

1.6 Scope

The scope of this investigation was divided into various stages as follows:

1.6.1 Gap Analysis

The information provided was reviewed and assessed to determine if there were any gaps in crucial information that would restrict the progress of the project and affect the results of the multicriteria assessment. It was divided into three components as follows:

Pavement

The pavement data provided was used to determine the strength and remaining life of each section of road. This information was then compiled into an overall plan of the LIA, showing each section of road and the expected remaining life.

Road Geometry

Traffic data was reviewed and site inspections undertaken to confirm one-way/two-way operation, site issues and road geometry including road widths. Each intersection on the RAV network was tracked for a 53.5 m quad road train using aerial imaging to assess any intersection deficiencies. The same occurred on all other intersections using 19 m trucks.

Drainage

There are numerous open drains and culverts located throughout the LIA that collect and transport stormwater from the road and surrounding areas. GHD reviewed a drainage study undertaken by TME in 2008 and conducted site inspections to determine site condition changes since the report was written and identified any alterations in the drainage and road network

1.6.2 Site Inspections

Two site inspections were completed in May to answer any questions in regards to the data supplied and also to provide a physical assessment of the road conditions throughout the LIA. The first was completed on the 2nd May and the second was conducted after 107.4 mm of rainfall on the 6th May.

1.6.3 Workshop

At the conclusion of the gap analysis GHD and SoR workshopped the results of the gap study to discuss the impact these gaps would have on the multicriteria assessment. Criteria were established for the assessment and additional observations that may impact on detailed design noted for inclusion in the final report. A copy of the minutes from this meeting is included in Appendix A

1.6.4 Multicriteria Assessment

The information compiled as part of the gap analysis was then utilised to input into a multicriteria assessment to prioritise road upgrades throughout the LIA. A weighting was applied to each component as agreed at the workshop and additional scores given to sections of Coolawanyah Road and Mooligunn Road as SoR have indicated a preference to complete works along these roads as a priority as they are the only entries into the LIA and experience the most traffic and highest concentration of heavy vehicles. The intersections of Karratha Road with these two roads have the highest conflict between heavy and light vehicles.

1.6.5 Staging

On completion of the multicriteria assessment, GHD has determined a budget estimate for each of the priorities and suggested a possible staging option based on a budget of \$1.5 million for the first financial year, and \$730,000 worth of construction works for each consecutive stage. It has been assumed that this figure is GST exclusive and includes all aspects of the works (e.g. design)

2. Gap Analysis

The results of the gap analysis are divided up into the individual components as detailed in Section 1.6.1.

2.1 Pavements

2.1.1 Data Utilised

The road condition assessment was based on a desktop analysis of the following data:

- MetroCount traffic count data, Oct / Nov 2013
- ARRB Assessment, Dec 2013 / Jan 2014
- Pavement Management Services FWD Assessment
- Pavement core summary provided by Shire of Roebourne
- Site Inspections

2.1.2 Gaps Identified

There was insufficient information in the following areas:

- Pavement cores:
 - Logs are only available for Anderson Road and Coolawanyah Road.
 - One pavement core on Anderson Road indicated that Gilgai clays are present in the subgrade, the extent and reactivity of which has not been determined.
 - One pavement core on Coolawanyah Road indicated that Pindan clays are present in the subgrade, the extent and reactivity of which has not been determined.
 - The location of the pavement cores is not clearly identified.
- Laboratory test results:
 - No laboratory testing has been carried out on the base course or subgrade.
- Pavement surface condition assessment:
 - ARRB data not available for all roads.
 - No photographs.
- FWD data:
 - FWD data is missing for three road sections mentioned in the ARRB assessment.
- Traffic count data:
 - Traffic count data was only provided for 3 roads in the LIA.
- The pavement assessment indicates that some areas may only need localised rehabilitation; however a site assessment indicated that there is a possibility that the entire section of road should be improved.

2.1.3 Conclusion

GHD completed an analysis of the pavement data provided by combining the FWD testing data and the ARRB assessment to determine a pavement condition of each section of road. The results of this analysis differed only slightly from the original FWD data. Due to the gaps in the ARRB data, the multicriteria assessment only utilised the FWD data.

It was determined during this analysis that roads in the worst pavement condition, with less than five years remaining pavement life, include Anderson Road, Mardie Road, Coolawanyah Road from Karratha Road to Woodbrook Road and one section of Mooligunn Road from Karratha Road to Orkney Road. These roads are the major RAV roads within the LIA and have been allocated a priority in the multicriteria assessment (see section 0). A memo of the findings has been provided in Appendix B.

2.2 Geometrics

2.2.1 Data Utilised

The geometrics of the LIA were assessed using the following data:

- Intersection tracking
- Survey
- Site inspections
- Aerial Imaging
- MetroCount traffic count data, Oct / Nov 2013

2.2.2 Gaps Identified

There was insufficient information in the following areas:

- Traffic count data:
 - Traffic count data was only provided for 3 roads in the LIA.
- The Survey provided was lacking detail. Major features like edges of road, kerbing and drainage were provided however features including traffic islands, signage, lighting and property boundaries were not. In addition to this no survey was taken along Karratha Road.
- No geometrical standards have been adopted for industrial development (e.g. typical road cross sections).

2.2.3 Conclusion

GHD determined that the multicriteria assessment would apply to lengths of road and the width of the road would be the criteria used in the analysis. All intersection data was discounted from the evaluation criteria and intersections evaluated separately.

2.3 Drainage

2.3.1 Data Utilised

Drainage of the LIA was assessed using the Karratha Drainage Study commissioned by SoR and carried out by TME in 2008 (TME Study) and site inspections. The TME report prioritises culvert upgrades and provides a basis for determining culvert sizes for private driveway crossovers.

2.3.2 Gaps Identified

The TME Study is a comprehensive document and the only gap relates to the lack of information relating the performance of the floodway on Coolawanyah Road. Historic observations as discussed at the workshop with SoR indicate it is performing adequately so it has not been considered as part of this study.

A feature survey will be required in order to progress to detailed design.

2.3.3 Conclusion

Minimal changes have been implemented since the TME Study was completed. Site observations indicate that site conditions have changed little and not sufficiently to impact the results of the study. Any changes are noted on the plans provided in Appendix D.

2.4 Gap Impact

2.4.1 Multicriteria Assessment

It is not anticipated that including any of the information identified above would significantly impact the results of this study. Traffic count data was not included in the multicriteria assessment, however as it directly relates to both pavement life and RAV routes both of which have been considered, it is anticipated inclusion of this information will have minimal impact.

2.4.2 Intersections

The lack of traffic count data meant that any priority in intersection improvements would be based purely on turning templates. GHD do not believe that this is sufficient to adequately determine priorities for future works. Traffic count information taken on each arm of an intersection over the same time period is important to understanding the movements and volumes at each intersection.

2.4.3 Detailed Design

In order to progress to a detailed design of any road within the LIA the following information will be required:

- Geotechnical data – this relates to a majority of the gaps identified in section 2.1.2 and impacts the final pavement design.
- Traffic Count Data – Traffic count data is required for pavement design and intersection design.
- Feature Survey – This was identified as a gap in section 2.2.2 and will be required prior to undertaking any detailed design.

2.5 Additional Observations

Truck Breakdown Area

An additional safety concern identified during this investigation is the way in which trucks travel and park throughout the LIA. Trucks park haphazardly adjacent to internal roads within the LIA as businesses do not have sufficient turn around space on site and informal truck breakdown areas develop. The most common one located on Orkney Road, however trucks were also observed breaking down along Anderson Street. It is apparent from these observations that trucks utilise all roads in the LIA regardless of RAV restrictions. GHD believe this issue could be remedied by construction of a truck breakdown area within or in close proximity to the LIA, reducing safety concerns and prolonging expected remaining pavement life.

The lack of a truck breakdown area was discussed at the 29 April 2014 Shire of Roebourne Ordinary Council Meeting, and it is evident this is a growing concern to the Shire. Areas within the LIA used as informal truck breakdown areas are unallocated crown land and the Shire is unable to enforce laws for the illegal use of these areas. The Shire has had discussions with MRWA regarding this issue but has not yet found a suitable resolution. GHD recommends that

the Shire continue to approach them as the responsible authority for Road Train Assembly Areas in order to provide a safe and suitable area for drivers to reconfigure their vehicles according to RAV and permit restrictions. In recent times formal truck breakdown areas have been provided in other towns including Carnarvon, Exmouth and Broome

Crossovers

The TME Study concluded that the major concern with drainage in the LIA is not the road drainage network but crossovers constructed over the drainage network for property access. It is evident from our onsite observations that this remains the case today. Each crossover has a different pipe at a different height to the one downstream and upstream and water does not drain freely. As a result some businesses are flooded during periods of high rain.

TME recommended an area allowance be put in place in order that the crossovers throughout the LIA could be rectified improving the overall drainage of the LIA. Although flooding is localised and quickly dissipates, it will become a larger problem as the LIA develops. GHD recommends that the Shire investigate the possibility of businesses funding their crossover upgrades. It is noted that this will have to commence from the downstream end of the system and progress upstream.

Lighting

During the site investigation the inadequate lighting throughout the LIA was noted. Lights are generally located on transmission poles installed at the edge of the road reserve and the light arms do not extend over the road. As a result the road pavement and intersections are poorly lit.

It is understood that the Pilbara Underground Power Project (PUPP) includes lighting. We have discussed this project with the Horizon Power Project Manager Mr James Carney who confirmed that lighting will be provided in accordance with Australian Standard to all areas excepting the red area in Figure 1 which already has underground power. Mr Carney was unable to provide any indication of when this would occur as budgeting had not yet been provided for this aspect of the project. The SoR have had a further meeting where Mr Carney has indicated the designs are complete and works are expected to commence in November 2014. GHD recommends that this future project be considered when prioritising the upgrades of the roads and locations of lighting consider the ultimate road profile (as detailed in Figure 2).

3. Multicriteria Assessment

3.1 General

The multicriteria assessment considered each length of road individually in terms of four main components: pavement, geometrics, drainage and location within the road hierarchy. Turning movements for each intersection were not considered as part of this assessment and are discussed further in Section 4.

In order to determine the priority for future works each component was evaluated given a maximum score of 5 and this score weighted in accordance with the perceived priority of that component.

3.2 Evaluation Criteria

Each road section was evaluated as follows:

3.2.1 Pavements

Remaining Pavement Life

The expected remaining life of existing road pavements as determined by FWD testing was used with different scores for the following life expectancies:

- Five (5) years or less
- Six (6) to ten (10) years
- Greater than ten (10) years

RAV Network

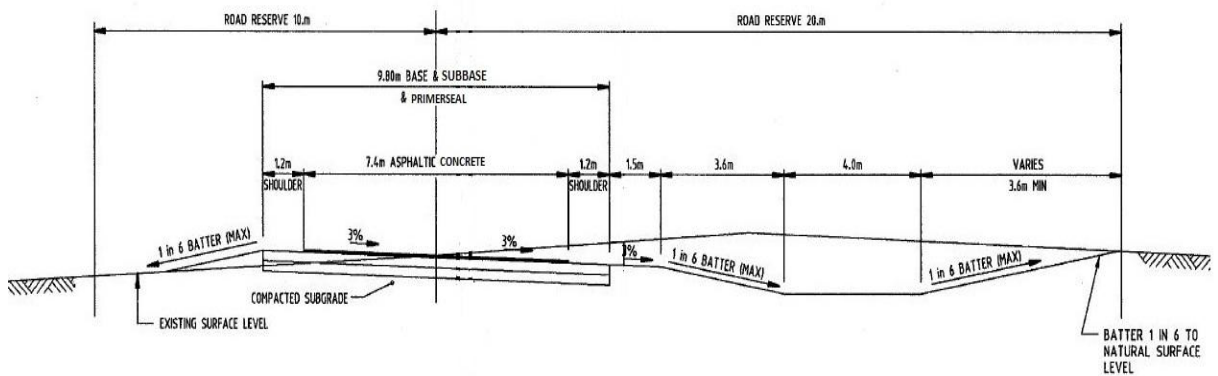
The existing RAV Network 10 route is considered to be more critical in terms of pavement performance due to the heavier loads travelling along them and more likely to deteriorate at a faster rate than the other roads in the LIA so were considered to be of the highest priority.

3.2.2 Geometrics

Pavement Width

In accordance with MRWA - Guidelines for Assessing the Suitability of Routes for Restricted Access Vehicles, town site roads with a speed of 60-70 km/h, must have a seal width of 7.2 m, providing there is no provision for cyclists or on road parking. No consideration is given to unsealed shoulders. Many of the roads in the LIA are below this standard including the most recently constructed roads Augustus Drive and Seabrook Crescent which were to be constructed at a 7.4 m seal width. We have therefore assumed that the original design criteria for this subdivision is the one that should be adopted for the entire LIA (see Figure 2). This will allow for some edge breakage of the seal and still meet MRWA design criteria.

Figure 2 – Recommended Road Cross Section



Note: street lights should be installed between 2.4 m and 3.0 m of the property boundary line in accordance with MRWA Utility Providers Code of Practice

3.2.3 Drainage

Culvert Upgrade Priorities

Each section of road was prioritised using the road culvert upgrade priorities set out in the TME Study for a 1:10 year ARI. Where multiple culverts are present along one section of road, the highest culvert priority has been used for scoring. No private driveway crossovers were considered.

3.2.4 Road Hierarchy

Each road was then given a score based on its importance in the road hierarchy as follows:

- Local distributor
- Access road

GHD notes that Mooligunn Road is listed as an access road within the hierarchy which does not reflect its importance in the road network as one of two entry roads to the LIA. GHD recommends reclassification of Mooligunn Road to reflect its importance in the LIA road network.

3.3 Scores and Weighting

3.3.1 Component Scoring

The scoring system applied to each component is detailed in Table 1

Table 1 - Scoring

Component	Criteria	Score
Pavements	Expected life left ≤5 years	4
	Expected life left 6-10 years	2
	Expected life left >10 years	0
	Is the intersection on a RAV route?	1
Geometrics	Is the road width adequate for RAV Network 10 route?	
	Yes	0
	No	5
Drainage	TME Karratha Drainage Study Priority 1	5
	TME Karratha Drainage Study Priority 2	3
	TME Karratha Drainage Study Priority 3	1
Road Hierarchy	Local Distributor	5
	Access Road	0

3.3.2 Weighting

The weighting applied to each component is detailed in Table 2.

Table 2 - Weighting

Component	Weighting
Pavements	35%
Geometrics	35%
Drainage	20%
Road Hierarchy	10%

3.3.3 Maximum Score

The maximum overall score using this system is 5 and a full table of all sections, showing individual scores can be seen in Appendix E .

3.4 Results

From the results show in Appendix E we have established a priority for future road upgrades. Each individual road is discussed below in order of priority, highest to lowest.

3.4.1 Coolawanyah Road

All sections of Coolawanyah Road produced the highest overall scores. Coolawanyah Road is a high priority for SoR as it is one of the two main entry roads into the LIA and also one of the main RAV routes.

The scores range from 2.9 to 4.3 out of a maximum 5, and the high scores are primarily due to the poor condition of the pavement with pavement failure being experienced in some areas, and the importance of the road within the LIA and the RAV network.

Coolawanyah Road is the most heavily trafficked road in the LIA in terms of heavy vehicle movements; with approximately 45 class 4 to 12 vehicle movements per day as determined by MetroCount data (refer to Appendix F for vehicle classes). The tracking data indicates these large vehicles must travel on the opposite side of the road in order to complete the turning movement. This is a critical safety risk which can be reduced by upgrading and widening the intersections at Karratha Road, Mardie Road, Mooligunn Road, Anderson Road and Pemberton Way. Refer to Appendix C for tracking data

3.4.2 Anderson Road and Mardie Road

Anderson and Mardie Roads have the lowest expected remaining pavement life after Coolawanyah Road. This is consistent with the large number of heavy vehicles that utilise both roads. MetroCount data indicates there are approximately 30 class 4 to 12 vehicle movements per day. This increases the importance of upgrading the intersections at Coolawanyah Road to encourage safe tracking of the heavy vehicles.

Anderson Road has the largest number of culverts; however they only have a moderate priority.

3.4.3 Mooligunn Road

Mooligunn Road generally has a longer expected remaining pavement life than Coolawanyah, Anderson and Mardie Roads, and wider road seal. It should be noted that only one section of Mooligunn road makes the top 15 highest scores, that being the section from Coolawanyah to Lambden Road. This is consistent with the overall road condition data and onsite observations which indicate that sections of Mooligunn Road are performing well. Despite this it is essential that the condition of the road be maintained due to its importance within the LIA and RAV network.

Tracking data of Mooligunn Road show evidence of larger vehicles travelling on the opposite side of the road in order to complete turning movements. This is a critical safety risk which can be reduced by upgrading and widening the intersections at Karratha Road and Coolawanyah Road.

It should be noted that the section of Mooligunn Road between Karratha Road and Orkney Road would experience high traffic flow as it is one of two entries on the LIA. However due to the low importance of the road within the road hierarchy, adequate road width and lack of culverts within this section, the final score of this section is quite low.

3.4.4 Lambert Road

Lambert Road is currently a one-way RAV route; however it is not defined on the MRWA Heavy Vehicle Operations RAV Network. There is no allowance for parking of RAV vehicles along the road and the seal width is not sufficient to allow for passing of two RAV vehicles travelling in opposite directions. This is considered to be a safety risk and it is recommended the road width be increased to RAV standard and both intersections with Anderson Road upgraded and widened.

3.4.5 Pemberton Way

Pemberton Way is located along the RAV Network 10 route within the LIA. It is located within the purple area in Figure 1, so the pavement has a higher expected remaining pavement life. Culverts along Pemberton Way have higher priority for upgrade. The upgrade of the culverts will reduce the degradation of the pavement as it will allow water to dissipate quickly from the pavement area.

Intersection upgrades with Coolawanyah Road at both ends of Pemberton Way should be upgraded and widened to allow adequate and safe turning movements of RAV vehicles. The

site visit indicated there are safety concerns with RAV vehicles turning into properties along Pemberton Way, especially at Centurion. Trucks travel off the edge of the seal in order to complete the turning movement into the property. This deteriorates the edge of the pavement and reduces pavement life expectancy. Widening of the seal will reduce this occurrence.

3.4.6 Cowle Road and Pyramid Road

Although not on the RAV network, these two roads are within the top 15 highest scores. Cowle Road has a number of companies serviced by heavy vehicles including Toll Ipec, the SoR Depot and Golden Hiabs. From on-site investigation on both roads it is apparent that the seal width is inadequate as there is evidence of vehicles travelling on the unsealed shoulder throughout the length of the road. This has adverse impacts on the longevity of the pavement.

3.4.7 Non-RAV Network Roads

The remaining roads within the LIA are not located along the RAV network. Currently they are less of a priority than the RAV routes since they are not considered main thoroughfare. The pavement on these roads is generally performing better than the pavements along the RAV routes due to the lighter traffic.

The Shire has indicated, and it has been consistent with site observations, that RAV vehicles do appear to travel along non-RAV network roads, and this is highly likely to continue. This is likely to cause the pavement to deteriorate at a quicker rate than would normally be the case due to the heavier loads and vehicles tracking off the seal to complete turning movements or avoid vehicles travelling in the opposite direction. Pavement widening will be needed along these roads. Similarly, intersections will require upgrading and widening if they are to provide full access for RAV vehicles.

There are minimal culvert upgrades required along these minor roads.

4. Intersections

4.1 Assessment

Each intersection on the RAV network was tracked for a 53.5 m quad road train for various turning movements using aerial imaging to assess any intersection deficiencies. The same occurred on all other intersections using 19 m trucks. Tracking sketches are provided in Appendix C for the RAV network only.

As detailed in Section 2.4.2 the data provided is not sufficient to confidently prioritise intersections works, however it is evident from the tracking data that many of the intersections have similar issues. We have therefore provided an overview of the issues encountered within the entire LIA and suggested possible solutions that can be applied to some or all of the intersections within the LIA network.

4.2 Issues

4.2.1 General

The issues associated with the current geometry and vehicle movements are as follows:

- **Road Safety** – It is evident from the tracking movements that RAV vehicles have some difficulty traversing the LIA intersections and are often unable to perform a complete turning movement without travelling on the opposite side of the road or off the edge of the pavement.

- if vehicles are traversing on the wrong side of the road, this means they head heading directly towards oncoming traffic , causing vehicles to veer away of stop completely until their turn is complete
- Infrastructure damage – as vehicles traverse off pavement, pavement breakage has occurred as well as kerb damage at intersections. This reduces the lifespan of the pavement and increases maintenance costs.

4.2.2 Traffic Flow

As the LIA has only two entry points, the intersections of Mooligunn and Coolawanyah Roads at Karratha Road can easily become congested, especially if a heavy vehicles wishes to turn onto Orkney or Mardie Roads.

In addition to this no slip lanes or turning lanes are provided anywhere throughout the estate so any time a vehicles turns, there is potential to stop free flowing traffic.

4.2.3 Additional Concerns

It should be noted that the same issues have been identified throughout the LIA at private driveway crossovers. Additional to what has been discussed above we have identified the following:

- Inadequate sizing of private driveway crossovers – this means trucks need to cross to the wrong side of the road in order to access the priorities, causing safety issues, pavement breakage and damage to the private driveway crossover.
- Insufficient space within properties – some properties do not have sufficient space to allow vehicles to turn and drive out of the property or to park. This means the vehicles back out onto the street or park on the street both of which restrict sight distance and create safety concerns for road users.

4.3 Identified Solutions

4.3.1 Intersection Layout

The layouts of all intersections should be revised and designed to accommodate the large vehicles travelling through the intersection. Options to improve the flow in and around each intersection would include traffic islands and slip lanes. In order to properly assess the needs of each intersection accurate traffic count data would be required.

4.3.2 Infrastructure

In order to reduce damage to road infrastructure, signs and lighting should be located far enough off the carriageway that they do not sustain any damage. If it is required that the infrastructure be located within the truck turning area then the design should take this into account (e.g. islands designed with truck run off areas, flush kerb instead of mountable kerb, flexible posts).

4.3.3 Traffic Congestion

Possible solutions to alleviate traffic congestion within the LIA are to install an additional access into the area from Karratha Road and/or formalise turning movements by installation of slip lanes at problem intersections.

4.4 Further Work

Prior to determining and prioritising intersection works, there needs to be a greater understanding of the traffic flow within the LIA and at each intersection. Crash data can be used to provide input in determining priorities for works and may also provide justification to apply for additional funding through the state and federal blackspot programmes. In addition to this, detailed traffic data will provide a greater understanding of how each intersection operates and what measures should be put into place to improve congestions and flow throughout the LIA network.

5. Cost Estimate

An indicative cost estimate has been developed for each section of road as separated by the pavement data. Where the cost estimate is above the anticipated budget, GHD have further divided the section based on a per metre rate, however we recommend that the estimates be revised once the proposed cross section and lengths of works are confirmed. The entire cost estimate report is provided in Appendix G and based on the following scope:

- Installation of new culverts to 1:10 year upgrades (please note this does not include private driveway crossovers)
- Widening of roads to standard Main Roads RAV cross section:
 - 7.4 m road carriageway and
 - 1.2 m unsealed shoulders
- Widening of intersections to provide lane correct turning movements
- Removal of existing kerb at intersections and installation of flush kerb
- Full reinstatement of pavement to RAV standard:
 - Road Carriageway
 - 200 mm sub-base
 - 200 mm base course
 - Prime coat
 - 7 mm Primer seal
 - Tack coat
 - 40 mm asphaltic concrete AC14
 - Shoulders
 - 200 mm sub-base
 - 200 mm base course
 - Prime coat
 - 7 mm Primer seal

For comparison purposes, it is assumed that all roads will be ultimately upgraded to full RAV standards. SoR have indicated that the adopted standard is likely to be less than this; however at this stage of the project, GHD believes that the maximum cost for upgrade must be determined in order to evaluate the long term impact on future budgets and resources. If the impact is substantial, then justification can be provided for adopting a lesser standard to reduce the overall timing and cost of the project. As the standard adopted is identical for all roads, then this provides a good basis for comparison for prioritising of works. The cost estimates do not take into account cost escalation, relocation of services, or street lighting. These costs assume full project costs as follows:

- 8% preliminaries contingency
- 10% design contingency
- 3% construction contingency
- 6% Professional fees and disbursements contingency

Contingencies are applied to the total of road section (section total net) to obtain the overall cost of construction (section total gross).

6. Staging Recommendations

The works have been staged in such a way to provide the most cost efficient options. SoR indicated that there is a \$1.325 M budget in the 2014/15 financial year and \$730,000 for all subsequent years. Consideration has been given to the following:

- Priority listing as determined by the multicriteria assessment,
- Cost of works to fit within SoR's budgetary constraints and
- Roads listed on the SoR's 10 year reseal programme

Each stage is detailed in the sections below and a summary provided in Table 3

6.1 Stages 1, 2 and 3

Coolawanyah Road – Karratha Road to Anderson Road

Total estimated cost: Stage 1 - \$1,325,000

Stage 2 - \$730,000

Stage 3 - \$87,709

Coolawanyah Road has received the highest priority scores from 2.9 to 4.3. Although the section of from Karratha Road to Croyden Road received a low priority score of 2.9, this was primarily due to the fact the pavement width is greater than 7.6 m and as such it receives a low geometry score. As the hierarchy scores and pavement scores are the same as the rest of the road, GHD believes it should be prioritised due to the low life expectancy of the pavement. As this is a main road into the estate it has a large number of vehicle movements which will impact significantly on the remaining pavement life. Considering its current condition it is highly recommended that this section of Coolawanyah Road be upgraded first. It is listed on the 10 year reseal program; however GHD recommend full reinstatement of the pavement as a reseal will not provide any long term benefit.

During the workshop the issue of congestion at the intersection of Karratha Road and Coolawanyah Road was discussed. It was suggested that the close proximity of the intersection of Coolawanyah Road and Mardie Road contribute to this congestion due to the large number of heavy vehicles turning at this intersection. It is recommended that SoR investigate what options can be provided for alleviating this congestion prior to upgrading the road (e.g. provision of turning lanes or installation of an additional access at Mardie Road). This has not been included as part of the scope of works for this project.

6.2 Stage 3 to 7

Anderson Road

Total estimated cost Stage 3 - \$642,291

Stage 4 - \$730,000

Stage 5 - \$730,000

Stage 6 - \$730,000

Stage 7 - \$240,709

Anderson Road received the next highest cumulative score with all sections at 4.1. While SoR have indicated that Mooligunn Road is a priority, GHD recommend Anderson Road be upgraded prior to Mooligunn due to the poor pavement condition of Anderson Road. This recommendation is consistent with the 10 year reseal program which places Anderson Road above Mooligunn Road. Anderson Road is located along a RAV route, and experiences a high concentration of heavy vehicle movements which will contribute to the pavement deterioration.

6.3 Stage 7

Mardie Road (partial)

Total estimated cost: \$489,291

Mardie Road has been prioritised above Mooligunn Road due to the poor expected pavement life. There is also a safety concern along Mardie Road as site inspection indicate heavy vehicles travel onto the wrong side of the road in order to access the businesses. It was also noted that the pavement is suffering from some edge failure due to vehicles traversing off the seal. This upgrade will tie in with the upgrades along Coolawanyah Road and Anderson Road.

6.4 Future Stages

GHD recommend SoR continue to upgrade the roads based on the priorities of the multicriteria assessment. After completion of Mardie Road, the next road recommended for upgrade would be Pyramid Road, followed by Lambert Road and Pemberton Way. Completion of these roads will ensure the current RAV routes are consistent across the LIA.

The other roads in the LIA have adequate pavement life remaining such that they are not expected to fail within the next 5 years, however they may be nearing the end of their life so will need to be reassessed. It is recommended that SoR revisit these as standards for the LIA will be established allowing for more accurate cost estimates.

Table 3 – Staging Recommendations

Road	Section	Score	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	Stage 7
Coolawanyah Road	Karratha Road to Croydon Road	2.9	\$455,000						
	Croydon Road to Woodbrook Road	4.0	\$579,000						
	Woodbrook Road to Lambden Road	4.3*	\$291,000	\$118,370					
	Lambden Road to Mooligunn Road	4.3*		\$585,626					
	Mooligunn Road to Anderson Road	4.3*		\$26,005	\$87,709				
Anderson Road	Mardie Road to Lambert Road	4.1			\$219,000				
	Lambert Road to Pyramid Road	4.1			\$423,291	\$730,000	\$730,000	\$239,709	
	Pyramid Road to Coolawanyah Road	4.1						\$490,291	\$240,709
Mardie Road	Coolawanyah Road to Anderson Road (Partial)	3.5							\$489,291
Total Expenditure			\$1,325,000	\$730,000	\$730,000	\$730,000	\$730,000	\$730,000	\$730,000

Notes:

* - Priority score for Coolawanyah Road from Woodbrook Road to Augustus Drive used for each part of the road along this section

7. Conclusion and Recommendations

GHD investigated the current pavement, geometric and drainage conditions of the Karratha LIA roads to determine required upgrades to ensure safe and efficient continued use of the road system. A cost estimate was completed in order to allocate packages of work according to prioritisation and SoR budgetary constraints. Many non-quantitative factors were taken into account when allocating works to certain packages, as described in Section 6 of this report.

7.1 Further Considerations

The following items, along with any gaps identified in Section 2 need to be considered prior to undertaking detailed design for any stage of works:

- Flush kerbing at intersections to strengthen edge of pavement and reduce edge cracking
- Typical cross section (i.e. carriageway width, pavement design) to be confirmed by SoR
- Traffic accident data, particularly for intersections along Karratha Road at Mooligunn Road and Coolawanyah Road
- Detailed traffic volume counts particularly at intersections to aid in both pavement and intersection design.
- Viability of a formal truck breakdown area within the LIA
- Intersection treatments for RAV network T-intersections, as recently released by MRWA
- Treatment of intersections in close proximity to Karratha Road
- Whether construction of a road with a one way crossfall should be considered to reduce both construction and maintenance costs (i.e. widening on one side of the road, filling in the open drain)
- Asset ownership of Karratha Road, currently owned by MRWA however there are works underway to hand over to SoR
- Implementation of PUPP
- Feasibility of additional entry into LIA

7.2 Detailed Design

7.2.1 Additional Data

In order to progress to detailed design the following will be required

1. Full feature survey – will be required to progress road and drainage design
2. Traffic count data – will be required to progress pavement design

In addition to the above, intersection traffic counts would assist in determining any intersection improvements and the design of the future lighting of the LIA would assist in refining both the road and lighting design layouts.

7.2.2 Road Design

Although each road is divided into sections for the purposes of evaluation and budgeting, GHD recommend road design be completed along the entire length of road. This will save on design costs and provide forward works for a number of years. For example, full design of Coolawanyah Road and Anderson Road will provide approximately six (6) years of work.

7.2.3 Pavement Design

Pavement design is an important consideration in the future and longevity of any road improvements. It is recommended that a detailed investigation be undertaken as follows:

1. Site Inspection – An experienced pavement engineer will spend approximately three (3) days evaluating, mapping and logging the entire LIA road network. Once complete, they will provide detailed information on where additional testing will be required, what pavement they believe can be rehabilitated or recycled and provide clarification on the previous test data. The added benefit is that any further testing will be targeted and specific and there may be some saving in construction costs.
2. Testing – once the site inspection has been completed, the testing identified can be undertaken. This can be completed for a portion of or the entire LIA road network and will provide additional clarity to the testing data, for instance the extent and severity of gilgai clays and whether any pindan clay is present in the subgrade or base of the road pavement.
3. The results from the site inspection and the testing are then combined with the traffic count data to provide a pavement design.

8. References

The findings and assumptions in this report are based on the following information:

- ARRB Group, April 2014, *LIA Road Condition Assessment Data and Report*
- Main Roads Western Australia (MRWA), Debbie Ford 26 July 2013, *Restricted Access Vehicle Route Assessment Report Karratha LIA – Network 10*,
- MRWA November 2009, *Guidelines for Assessing the Suitability of Routes for Restricted Access Vehicles*.
- MRWA, February 2012 *Utility Providers Code of Practice for Western Australia*
- Pavement Management Services, May 2014 *FWD Test Results*
- Shire of Roebourne (SoR), May 2014 *LIA Survey*
- SoR June 2013, *Karratha Light Industrial Subdivision Plan Set*
- SoR November 2013, *LIA Traffic Count Data*
- SoR, April 2014, *LIA Core Data*
- Thompson McRobert Edgeloe, July 2008, *Karratha LIA Drainage Study*
- Landgate, 9 July 2014, *SLIP Enabler*, viewed 05 June 2014
<https://www.slip.landgate.wa.gov.au>

Appendices

Appendix A – Workshop Meeting Minutes



Minutes

04 June 2014

Project	Karratha LIA Roads Upgrade	From	Fiona Kenyon
Subject	Gap Analysis Workshop Minutes	Tel	(08) 9186 0707
Venue/Date/Time	Shire of Roebourne Depot 8:30 am 23 May 2014	Job No	61/30841
Attendees	Craig Davey (SoR) Fiona Kenyon (GHD) Hayley Martin (GHD) Martin Waddington (SoR) Pragnesh Shah (SoR) Susan Batt (SoR)	Apologies	Nil

Minutes	Action
1. Gaps Analysis	
<ul style="list-style-type: none"> Truck Parking – apparent a breakdown area is needed. To be included in report with the suggestion of formalising the current informal breakdown area on Orkney 	GHD
<ul style="list-style-type: none"> Traffic data had significant gaps and locations were not clearly defined. CD to provide map of locations 	CD
<ul style="list-style-type: none"> Crash data at intersections to prioritise intersection works 	
<ul style="list-style-type: none"> Geotechnical gap identified a lack of coring data. This information will be required for detailed design. 	
2. Findings	
<ul style="list-style-type: none"> Pavement <ul style="list-style-type: none"> Priority sections are Coolawanyah Road, Mooligunn Road, Anderson Road, Marie Road, Anderson Road and RAV roads. Coolawanyah Floodway seems to be holding up well. There is a crack in the pavement, however it has been there for some time and little movement in the slab has been noticed Table 1 showing pavement analysis to be made clearer in regards to information received and analysis completed 	HM
<ul style="list-style-type: none"> Geometrics <ul style="list-style-type: none"> Minimum RAV cross section as defined by Main Roads not adopted throughout the LIA. New standards for RAV networks have been recently released 	

61/30841/2076

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Minutes	Action
<p>by Main Roads and will have a major impact if it is to be adopted in this area. HM to forward standards to SB)</p> <ul style="list-style-type: none"> – Costly to develop the entire estate to RAV standards and possible to adopt a lessor standard 	HM
<ul style="list-style-type: none"> • Drainage <ul style="list-style-type: none"> – TME report was never adopted by Council – Primary issue relates to crossovers and localised drainage of lots this needs to be rectified or it simply accepted there is an issue options are: <ul style="list-style-type: none"> ○ Replace all crossovers ○ Replace a portion of crossovers <p>However there needs to be awareness that if a portion of crossovers are replaced then it may not necessarily meet the requirements of the TME report due to minimum cover or levels adopted in the report.</p> – Deal breakers (if there are any) to be identified with priorities – Coolawanyah has limited drainage on one side which allows water to sit on the pavement so priority must be given to establishing drains where none currently exist 	
<p>3. Multicriteria Assessment</p> <ul style="list-style-type: none"> – Roads will be divided into sections – GHD to set a timeline of works assuming \$1.5 M spent next financial year and \$730,000 every year thereafter (all Regional Roads Group funding) – Road will be prioritised using a point and weighting system based on the following: <ul style="list-style-type: none"> ○ Coolawanyah and Mooligunn roads ○ Pavement data ○ Geometry / safety ○ RAV networks (SB to provide copy) – Priority for the drainage it to make sure the system works, accept flooding will happen, however if the system works it will dissipate. – Weighting to be 40% for pavement and geometry and 20% for drainage – GHD to discuss the impacts on long term maintenance as without upgrading of these roads, they will make up the majority of the reseal programme to little long term advantage. 	<p>HM</p> <p>SB</p>

Minutes	Action
4. Other Factors	
<ul style="list-style-type: none"> Changes to the road network <ul style="list-style-type: none"> Negotiations are currently underway for Main Roads to hand management of Karratha Road to the Shire. 	
<ul style="list-style-type: none"> Safety and Traffic Management <ul style="list-style-type: none"> There are safety and traffic management concerns at the intersections of Mooligunn Road with Karratha road and Coolawanyah road with Karratha road. This relates to queuing of traffic, parking and vehicles and trucks turning into Mardie and Orkney Roads. Lighting not assessed as part of this scope however should be noted for future work. Unsure how PUPP affects this. SB to forward details 	SB
<ul style="list-style-type: none"> Design considerations <ul style="list-style-type: none"> Constructability needs to be taken into account, especially detours and access to business. Gap Ridge Industrial estate has some examples of how intersections should be set out SoR recommends kerbing be removed around intersections and flush kerbing installed to strengthen the edge of the pavement and stop edge cracking If significant road widening is required, investigate the possibility of widening on one side with one way cross fall to the drain. This will reduce the amount of drainage maintenance required long term. 	
<ul style="list-style-type: none"> Management controls <ul style="list-style-type: none"> In terms of crossovers, the shire has very little control on how they get installed unless the owners wishes to apply for a crossover subsidy Vegetation management is also an important consideration in having a working drainage system. 	
5. Project timeline	HM
<ul style="list-style-type: none"> Currently behind original schedule. Timeframes to be reissued 	

Fiona Kenyon
Principal Civil Engineer

Appendix B – Pavement Assessment Memo



Memorandum

01 May 2014

To	Shire of Roebourne		
Copy to	Hayley Martin		
From	Caroline Maekivi	Tel	6222 8394
Subject	Karratha LIA – Pavement Assessment	Job no.	61/30841/02

1 Introduction

The Karratha Light Industrial Area (LIA) is located off Karratha Road some 4 km south of Karratha towards the North West Coastal Highway. It has a road network of 18 roads totalling 16.4 km in length. The age of these roads varies from a few years to over 60 years.

Over time the use of these roads has been increasing in terms of heavy vehicle movements from what would have been originally planned. This has caused failure in some sections of pavement which becomes more evident after rainfall. Further to this the delivery vehicles are longer and heavier than what would have been expected and these vehicles are finding negotiation of some of the network difficult due to the geometry of the roads.

The Shire of Roebourne (SoR) recognises the importance of the LIA in supporting the local economy and is keen to ensure the longevity of the LIA road network by embarking on a programme of upgrades and renewal in a logically staged manner to ensure they continue to operate efficiently and safely.

2 Traffic Assessment

An assessment of the provided traffic data was carried out. The available data consisted of MetroCount traffic volumes split into daily class by direction for six locations. The traffic survey was undertaken from 31st October to 21st November 2013.

Averaging the available daily traffic data through the LIA indicates that approximately 64 % (1244 vehicles) of traffic throughout the LIA is classified as light vehicles, 34 % (674 vehicles) of traffic consist of two axle trucks and 2 % (32 vehicles) of traffic are three axle trucks or larger.

The annual average daily traffic determined from the data available is 1950 with a heavy vehicle component of 36 %.

A summary of the MetroCount data is provided in Appendix A.

3 ARRB Assessment

An ARRB assessment of the majority of the main roads within the LIA has been provided by the Shire of Roebourne for use in the assessment of the road network condition. The ARRB assessment consists of ratings from 1 to 5 where 1 indicates that the pavement is brand new while 5 indicates that the pavement has failed. The overall condition index (OCI) has been used in the assessment to determine the overall condition of the road pavement.

As the date of the assessment has not been provided it is assumed that the ARRB pavement condition assessment is still a valid representation of the current pavement condition.

The ARRB data used in the assessment is provided in Appendix B.

4 FWD Assessment

An FWD pavement assessment was carried out by Pavement Management Services during August 2013. Pavement Management Services provided an assessment of the pavement life for each of the roads surveyed based on the FWD data and traffic data provided to Pavement Management Services by the Shire of Roebourne. The life expectancy data provided for each of the roads has been used in the assessment of the overall condition of the road.

A summary of the life expectancy data used in the assessment is provided in Appendix C.

5 Pavement Core

A summary of nine pavement cores has been provided by the Shire of Roebourne. The pavement cores are located on two of the major LIA roads, Coolawanyah Road and Anderson Road. The core logs have been used in the assessment of the road condition.

The core logs used in the assessment are provided in Appendix D.

6 Road Condition Assessment

The condition of each road was assessed in discrete sections (See Table 1). The section lengths were determined based on the available data. Where only FWD data exists for a road, the entire length of the road was treated as one section. Where more data was available, i.e. both an FWD and ARRB condition assessment for a section of the road, it was possible to analyse smaller sections. Gaps in Table 1 indicate that no data was available. The chainages given in Table 1 are based on those used in the FWD assessment (See Appendix C).

The road condition assessment identified four roads where significant sections are in poor condition and have less than five years design life remaining. The sections identified were located on:

- Anderson Road / Mardie Road –treated as a single road (Anderson Road) in the FWD assessment (approximately 2.5 km);
- Coolawanyah Road (approximately 0.7 km), and;
- Mooligunn Road (approximately 0.2 km).

Further details of the sections requiring rehabilitation works are given below in Table 1.

A number of discrete areas have also been identified in Table 1 where the design life at a particular point is less than five years based on the FWD data. In these areas localised rehabilitation/patching works may be required.

It is recommended that the road condition assessment is confirmed by an onsite visual inspection. The visual inspection should focus on those areas that have been identified as being in poor to average condition.

Locations identified as being in poor to average condition, including localised areas, should be monitored for further signs of deterioration.

Table 1 - Road Condition Assessment

Road	Seal	Lane	Ch. To	Ch. From	Remaining Life - Years (FWD)	ARRB Assessment (OCI)	Condition	Core	Recommended Options		Remaining Life (FWD)	ARRB Assessment
Mardie Road - Coolawanyah Road to Anderson Road		East	0	0.425	1		Poor	Subgrade identified as Gilgai clay in one core log	Rehabilitation recommended	Good	>10 years	< 2
		West	2.5	2.05	3		Poor		Rehabilitation recommended	OK	6 to 10 years	2 to 4
Anderson Road - Mardie Road LIA to Lambert Road	Asphalt	East	0.425	0.575	13	2	Poor / OK		Possible Rehabilitation required at Ch. 0.475, Estimated design life 0 years	Poor	≤ 5 years	> 4
	Asphalt	West	2.05	1.9	5	2	Poor					
Anderson Road - Lambert Road to Pyramid Road		East	0.575	2.025	1		Poor		Rehabilitation recommended			
		West	1.9	0.475	2		Poor		Rehabilitation recommended			
Anderson Road - Pyramid Road to Coolawanyah Road	Asphalt	East	2.025	2.5	2	2	Poor		Rehabilitation recommended			
	Asphalt	West	0.475	0	1	2	Poor		Rehabilitation recommended			
Augustus Drive - Coolawanyah Road to end	Chip Seal	East	0	1.3	19	2	Good					
	Chip Seal	West	1.15	0	18	2	Good					
Cherratta Road - Woodbrook Road to Mooligunn Road	Asphalt	North	0.7	0.5	13	2	Poor / OK		Possible Rehabilitation required at Ch. 0.65, Estimated design life 0 years			
	Asphalt	South	0	0.175	10	2	Poor / OK		Possible Rehabilitation required at Ch. 0.025 to 0.075, Estimated design life ≤ 1 years			
Cherratta Road - Woodbrook Road to Orkney		North	0.5	0	14		Poor / OK		Possible rehab required at Ch. 0.1 to 0.15 and 0.4, Estimated design life ≤ 2 years			
		South	0.7	0.175	19		Good					
Cherratta Road - Start of seal to Karratha - Tom Price Road	Asphalt	No FWD data				2	Good					
Coolawanyah Road - Karratha Road to Croydon Road		East	0	0.4	0		Poor	Basecourse poorly graded, sandy.	Rehabilitation recommended			
		West	2.8	2.35	2		Poor		Rehabilitation recommended			
Coolawanyah Road - Croydon Road to Woodbrook Road	Chip Seal	East	0.4	0.7	0	2	Poor		Rehabilitation recommended			
	Chip Seal	West	2.35	2.07	4	2	Poor	Subgrade identified as Pindan clay and cobbles in one core log	Rehabilitation recommended			
Coolawanyah Road - Woodbrook Road to Augustus Road		East	0.7	2.8	11		Poor / OK		Possible Rehabilitation required at Ch. 0.85-0.9, Ch. 1.1-1.85, Ch. 2.75, Estimated design life ≤ 1 years			
		West	2.07	0	9		Poor / OK		Possible Rehabilitation required at 0.175, 0.925 to 2.025, Estimated design life < 3 years			
Cowle Road - Augustus Road to Seabrook Crescent		North	0.525	0.25	20		Good					
		South	0	0.275	16		Good		Note: Ch. 0.075 to 0.125, Estimated design life 6 to 7 years			
Cowle Road - Coolawanyah Rod to Seabrook Crescent	Chip Seal	North	0.25	0	20	2	Good					
	Chip Seal	South	0.275	0.525	20	2	Good					
Croydon Road - Coolawanyah Road to Cherratta Road	Asphalt	North	0	0.475	10	3	Poor / OK		Possible Rehabilitation required at Ch. 0.025, 0.125, 0.275, Estimated desgin life ≤ 2 years			
	Asphalt	South	0.475	0	11	3	OK					
Fisher Way - Coolawanyah Road to Pemberton Way	Chip Seal	North	0.3	0	20	2	Good					
	Chip Seal	South	0	0.3	20	2	Good					
King Way - Orkney Road to Cherratta Road	Asphalt	East	0	0.45	20	3	OK					
	Asphalt	West	0.45	0	20	3	OK					
Lambden Road - Coolawanyah Road to Mooligunn Road	Asphalt	North	0.35	0	14	3	Poor / OK		Possible Rehabilitation required at Ch. 0.175 to 0.225, Estimated design life 2 years			
	Asphalt	South	0	0.35	17	3	Poor / OK		Possible Rehabilitation required at Ch. 0.35, Estimated design life 0 years			
Lambert Road - Anderson Road to Pyramid Road	Asphalt	East	1.2	0.775	17	2	Good		Note: at Ch. 0.825, 1.175 Estimated design life between 5 and 7 years			
	Asphalt	West	0	0.45	17	2	Poor / OK		Possible Rehabilitation required at 0.05, Estimated design life 1 year			
Lambert Road - Pyramid Road to Anderson Road		East	0.775	0	15		Poor / OK		Possible Rehabilitation required at Ch. 0.075 to 0.175, Estimated design life ≤ 3 years			
		West	0.45	1.2	11		Poor / OK		Possible Rehabilitation required at Ch. 0.9 to 1.1, Estimated design life ≤ 3 years			
McKay Street - Coolawanyah Road to Pemberton Way	Chip Seal	North	0.2	0	16	2	Poor / OK		Possible Rehabilitation required at 0.025, Estimated design life 5 years			
	Chip Seal	South	0	0.2	17	2	Good		Note: Ch. 0.2, Estimated design life 6 years			
Mooligunn Road - Orkney Road to Karratha Road	Asphalt	East	0	0.15	17	3	Good					
	Asphalt	West	1.6	1.475	3	3	Poor		Rehabilitation recommended			
Mooligunn Road - Cherratta Road to Orkney Road	Asphalt	East	0.15	0.725	19	3	OK					
	Asphalt	West	1.475	0.925	13	3	Poor / OK		Possible Rehabilitation required at Ch. 0.975, 1.125, 1.475, Estimated design life ≤ 2 years			
Mooligunn Road - Lambden Road to Cherratta Road	Asphalt	East	0.725	1.15	12	3	Poor / OK		Possible Rehabilitation required at Ch. 0.75, 0.85-0.9, Estimated design life ≤ 2 years			
	Asphalt	West	0.925	0.375	14	3	Poor / OK		Possible Rehabilitation required at 0.425, 0.725, 0.875, Estimated design life ≤ 2 years			
Mooligunn Road - Coolawanyah Road to Lambden Road	Asphalt	East	1.15	1.65	14	3	Poor / OK		Possible Rehabilitation required at Ch. 1.55, Estimated design life ≤ 2 years			
	Asphalt	West	0.375	0	10	3	Poor / OK		Possible Rehabilitation required at Ch. 0.225-0.375, Estimated design life ≤ 1 years			
Off Anderson-Anderson to end		East	0	0.65	10		Poor / OK		Possible Rehabilitation required at Ch. 0.15-0.2, 0.4-0.55, Estimated design life ≤ 2 years			
		West	0.65	0	8		Poor / OK		Possible Rehabilitation required at Ch. 0.425-0.525, 0.125, 0.225-0.275, Estimated design life ≤ 3 years			
Orkney Road - Mooligunn to Coolawanyah		North	1	0	17		Poor / OK		Possible Rehabilitation required at Ch. 0.075, 0.275-0.325, Estimated design life ≤ 3 years			
		South	0	1	11		Poor / OK		Possible Rehabilitation required at Ch. 0.05, 0.5, 0.7-0.75, 0.85, 0.95, Estimated design life ≤ 3 years			
Pemberton Way - McKay Street to Coolawanyah Road	Chip Seal	East	1.175	0.65	19	2	Good					
	Chip Seal	West	0	0.525	19	2	Poor / OK		Possible Rehabilitation required at Ch. 0.275, Estimated design life 4 years			
Pemberton Way - McKay Street to Fisher Way		East	0.65	0.45	20		Good					
		West	0.525	0.7	20		Good					
Pemberton Way - Coolawanyah Road to Fisher Way	Chip Seal	East	0.45	0	16	2	Poor / OK		Possible Rehabilitation required at Ch. 0.1, 0.2, Estimated design life 5 years			
	Chip Seal	West	0.7	1.175	13	2	Good					
Pyramid Road - Lambert Road to Anderson Road	Asphalt	East	0	0.7	10	2	Poor / OK		Possible Rehabilitation required at 0.125, 0.325, 0.525-0.675, Estimated design life ≤ 3 years			
	Chip Seal	West	0.7	0	8	2	Poor / OK		Possible Rehabilitation required at 0.05-0.25, Estimated design life ≤ 3 years			
Seabrook Crescent - Coolawanyah Road to Cowle Road		East	0	0.625	20		Good					
		West	0.625	0	20		Good					
Shallow Well Road - Anderson Road to End	Chip Seal	No FWD data				2	Good					
Woodbrook Road - Cherratta Road to Coolawanyah Road		North	0.475	0	14		Poor / OK		Possible Rehabilitation required at Ch. 0.025, Estimated design life 0 years			
		South	0	0.475	18		Poor / OK		Possible Rehabilitation required at Ch. 0.45, Estimated design life 1 year			
40 Mile Beach Access Road - NWCH to end of seal	Chip Seal	No FWD data				2	Good					

7 Gap Analysis

The gap analysis indicates that there is insufficient information in the following areas:

- Pavement cores;
 - Logs are only available for Anderson Road and Coolawanyah Road;
 - One pavement core on Anderson Road indicates that Gilgai clays are present in the subgrade. The extent of the Gilgai clay has not been determined, the reactivity of the Gilgai clay in the subgrade has not been determined;
 - One pavement core on Coolawanyah Road indicates that Pindan clays are present in the subgrade. The extent and reactivity of the Pindan clay has not been determined;
 - The location of the pavement cores is not clearly identified.
- Laboratory test results;
 - No laboratory testing has been carried out on the basecourse or subgrade;
- Pavement surface condition assessment;
 - ARRB data not available for all roads;
 - No photographs, and;
- FWD data;
 - FWD data is missing for three road sections mentioned in the ARRB report.

8 Reliability of Data

The proceeding road condition assessment has been based solely on the data provided by the Shire of Roebourne without any onsite visual assessment.

9 Conclusion

The road condition assessment is based on a desktop analysis of data gathered by others. The age of the data is not defined for the ARRB condition assessment or pavement cores. It should be noted that further deterioration may have occurred since the assessment.

A visual verification assessment by an experienced pavement engineer is recommended to confirm the desktop assessment is correct, and to identify suitable rehabilitation options/patching before commencing the Phase 2 design work.

Some sections of roads have been identified as needing rehabilitation/patching but an onsite assessment may suggest the full road should be improved. Further sections may require rehabilitation in areas where upgrade works are required to ensure levels and alignments work.

As there is normally a delay between assessment, preparation of contract documents and awarding the contract a further allowance for deterioration and increased rehabilitation should be allowed for.

It is recommended that if rehabilitation is to be undertaken, the type, quality and thickness of the pavement should be logged, sampled and tested to assess possible recycling options.

Regards

A handwritten signature in blue ink, consisting of a stylized 'C' followed by a long horizontal stroke.

Caroline Maekivi
Geotechnical Engineer

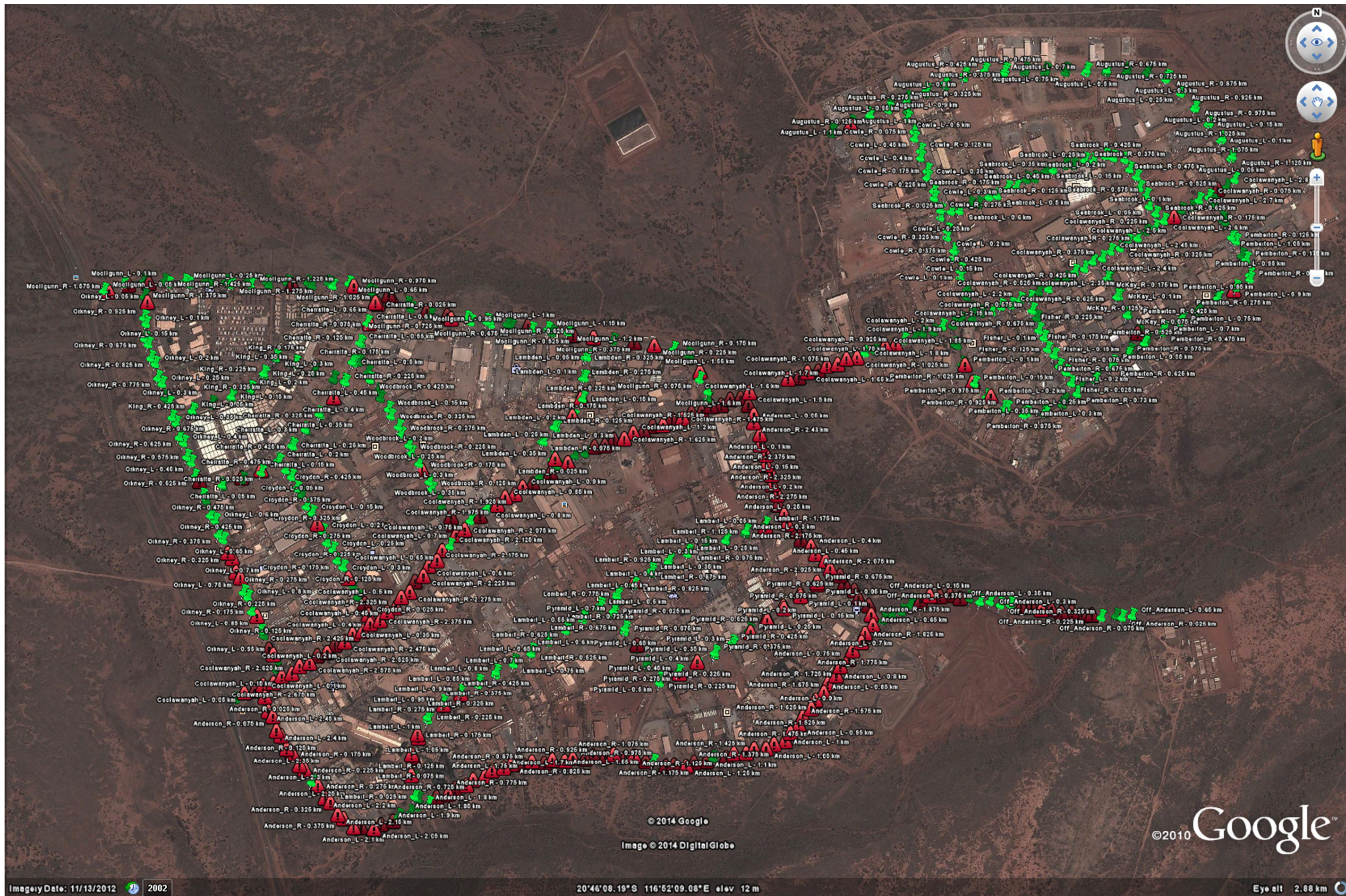
Appendix A – MetroCount Summary of Traffic Volume by Class

Road	Vehicle Class	Lane direction	Average daily traffic
Anderson Road	Class 1 and 2	Total	713
		South	367
		North	345
	Class 3	Total	355
		South	152
		North	203
	Class 4 to 12	Total	30
		South	16
		North	16
Coolawanya Road	Class 1 and 2	Total	1492
		East	737
		West	756
	Class 3	Total	440
		East	212
		West	221
	Class 4 to 12	Total	45
		East	23
		West	22
Mooliguun Road	Class 1 and 2	Total	1528
		East	598
		West	930
	Class 3	Total	1226
		East	1099
		West	127
	Class 4 to 12	Total	20
		East	12
		West	8

Appendix B – ARRB Assessment

Unique Asset ID	Asset Name		Network Measure	Degradation Ranking	Treatment Name	Linear Cracking	Local Surface Defects	Stripping	Flushing or Bleeding	Crocodile Cracking	Rutting	Roughness	Surface Condition Index	Base Condition Index	OCI (Service Index)
RD8140492-1	40 MILE BEACH ACCESS ROAD - NORTH WEST COASTAL HIGHWAY TO END OF SEAL	LIA	7081	671	Chip Seal	2	1	2	3	1	2	2	2	2	2
RD8140082-8	ANDERSON ROAD - MARDIE ROAD - LIA TO LAMBERT ROAD	LIA	1035	120	Asphalt	2	2	1	1	2	2	2	2	2	2
RD8140082-11	ANDERSON ROAD - PYRAMID ROAD TO COOLAWANYAH ROAD	LIA	2160	119	Asphalt	2	2	1	1	2	1	2	2	2	2
RD8140077-237	CHERRATTA ROAD - WOODBROOK ROAD TO MOOLIGUNN ROAD	LIA	1088	114	Asphalt	2	2	1	1	3	2	2	2	2	2
RD8140079-264	COOLAWANYAH ROAD - CROYDON ROAD TO WOODBROOK ROAD	LIA	2760	1008	Chip Seal	3	2	2	3	2	2	2	3	2	2
RD8140084-643	LAMBERT ROAD - ANDERSON ROAD TO PYRAMID ROAD	LIA	5106	123	Asphalt	1	2	2	1	2	2	2	2	2	2
RD8140083-896	PYRAMID ROAD - LAMBERT ROAD TO ANDERSON ROAD	LIA	5396	122	Asphalt	3	2	1	1	2	2	2	2	2	2
RD8140493-988	SHALLOW WELL ROAD - ANDERSON ROAD TO END	LIA	4148	672	Chip Seal	2	1	2	3	1	2	2	2	2	2
RD8140075-782	MOOLIGUNN ROAD - COOLAWANYAH ROAD TO LAMDEN ROAD	LIA	3700	102	Asphalt	3	2	2	3	3	3	3	3	3	3
RD8140075-785	MOOLIGUNN ROAD - ORKNEY ROAD TO KARRATHA ROAD	LIA	1350	105	Asphalt	3	2	2	2	4	3	3	2	3	3
RD8140121-642	LAMDEN ROAD - COOLAWANYAH ROAD TO MOOLIGUNN ROAD	LIA	2448	207	Asphalt	3	2	2	2	3	3	3	2	3	3
RD8140075-783	MOOLIGUNN ROAD - LAMDEN ROAD TO CHERRATTA ROAD	LIA	4680	103	Asphalt	3	2	2	5	2	3	3	3	3	3
RD8140006-230	CHERRATHA ROAD - START OF SEAL TO KARRATHA - TOM PRICE RD	LIA	243.6	5	Asphalt	2	2	4	2	2	3	2	3	2	2
RD8140075-784	MOOLIGUNN ROAD - CHERRATTA ROAD TO ORKNEY ROAD	LIA	5130	104	Asphalt	3	2	2	3	3	3	3	3	3	3
RD8140078-621	KING WAY - ORKNEY ROAD TO CHERRATTA ROAD	LIA	3082	115	Asphalt	3	3	2	3	2	3	3	3	3	3
RD8140081-301	CROYDON ROAD - COOLAWANYAH ROAD TO CHERRATTA ROAD	LIA	2948	117	Asphalt	3	2	2	2	3	3	3	2	3	3
RD8140303-287	COWLE ROAD - COOLAWANYAH ROAD TO SEABROOK CRESCENT	LIA	1560	461	Chip Seal	3	2	2	2	2	2	2	2	2	2
RD8140304-32	AUGUSTUS DRIVE - COOLAWANYAH ROAD TO COWLE DRIVE	LIA	7790	463	Chip Seal	2	2	2	2	1	1	2	2	1	2
RD8140305-950	SEABROOK CRESCENT - COOLAWANYAH ROAD TO COWLE ROAD	LIA	4851	465	Chip Seal	2	2	2	2	1	1	2	2	1	2
RD8140306-867	PEMBERTON WAY - COOLAWANYAH RD TO FISHER WAY	LIA	2924	466	Chip Seal	2	2	2	2	1	1	2	2	1	2
RD8140306-869	PEMBERTON WAY - MCKAY STREET TO COOLAWANYAH ROAD	LIA	3536	468	Chip Seal	2	2	2	2	1	1	2	2	1	2
RD8140307-409	FISHER WAY - COOLAWANYAH ROAD TO PEMBERTON WAY	LIA	1748	469	Chip Seal	2	2	2	2	1	1	2	2	1	2
RD8140308-753	MCKAY STREET - COOLAWANYAH ROAD TO PEMBERTON WAY	LIA	1449	470	Chip Seal	2	2	2	2	1	1	2	2	1	2

Appendix C – Summary of FWD Remaining Life Data



Appendix D – Pavement Core

Road name	Offset	Location	Core #	Depth to (mm)					Notes
				Asphalt	Basecourse	Subbase	Subgrade	Refusal	
Coolawanyah Road	300mm from edgeline, Sth side	Opposite Karratha Building	1	18	80	70			Poorly graded and quality basecourse, sandy clay and fines subbase, subgrade pindan clay with some cobbles
Coolawanyah Road	400mm from edgeling, Nth side	Opposite Freo Cranes	2	20	100	50			Poorly graded quality granite 12mm sand basecourse
Coolawanyah Road	750mm from edge of seal, Sth side	Opposite Noble & sons	3	15	100	-			Very poorly graded, lots of fines basecourse.
Coolawanyah Road	1.3m from edge of seal, Nth side	opposite joyce cranes	4	10	120	100			basecourse road base type material low grade, sandy gravel subbase, no moisture observed
Anderson Road	1.15m from edge of seal, East side	opposite Force access	5	25	150	-			basecourse calcrete gravel, little moisture, natural surface thereon
Anderson Road	1.6m from edge of seal, Sth side	Opposite access hire	6	20	140	-			basecourse imported gravel sandy clay with cobbles and then natural surface sand with slight moisture content
Anderson Road	1.7m from edge of seal, Sth side	opposite viking moorings	7	20	140	-			basecourse clayey gravel, natural surface gilgai clay
Coolawanyah Road	2.4m from edgeling, Nth side	Opposite Raw Hire	8	15	130	-			basecourse poorly graded sandy, sandy gravel with some form of cobble
Coolawanyah Road	2.8m from edgeline, nth side	Opposite Mitre 10	9	25	140				basecourse sand gravel slight moisture, fine sand with cobbles natural surface

Appendix C – RAV Network Tracking



PRELIMINARY

A	INITIAL ISSUE		
rev	description	app'd	date

KARRATHA LIA
RAV NETWORK
GENERAL ARRANGMENT



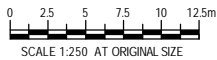
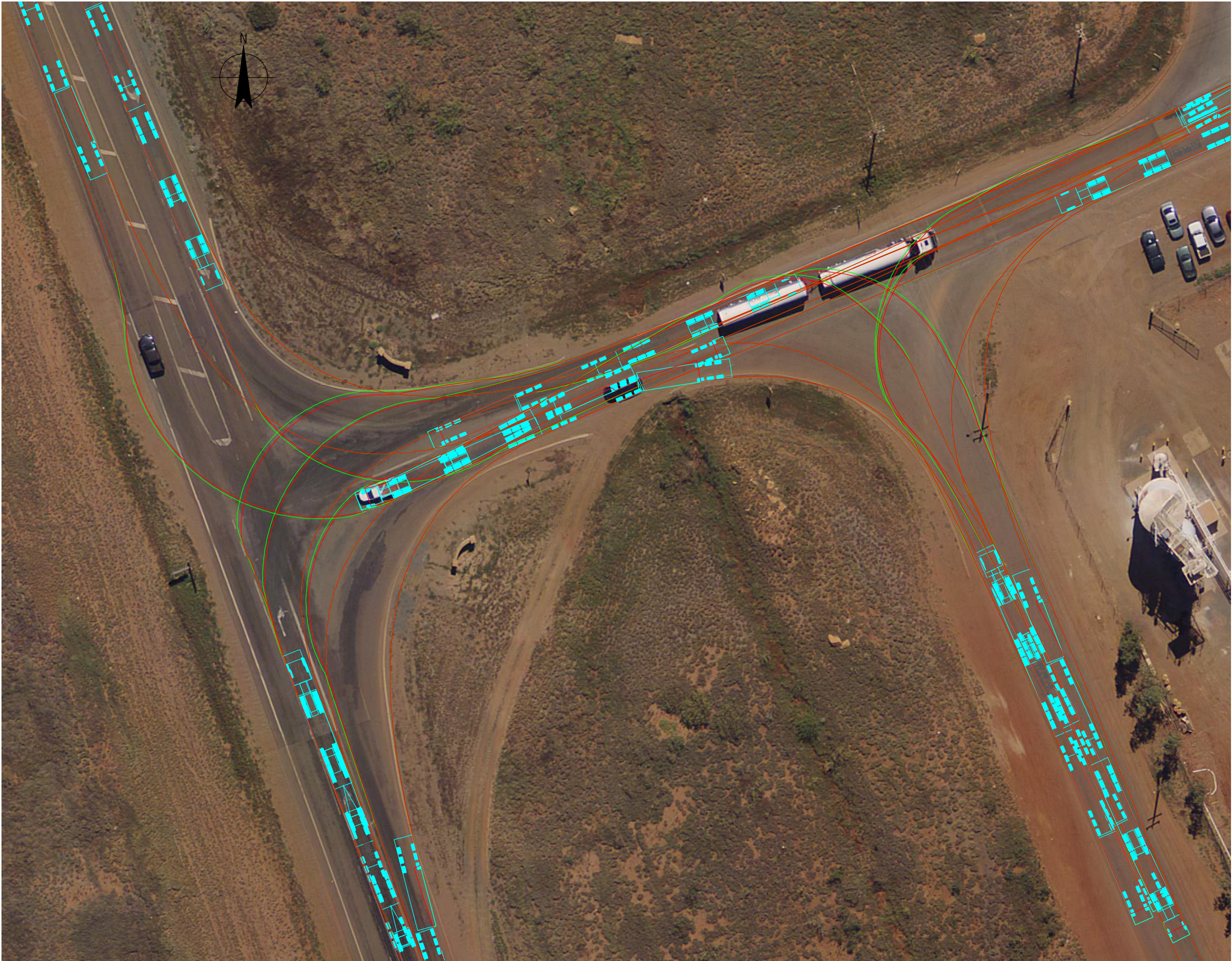
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date	MAY 2014		rev no.	A

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PRELIMINARY

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KARRATHA LIA
RAV NETWORK
VEHICLE TURN PATHS

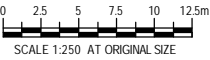


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RAV NETWORK
VEHICLE TURN PATHS

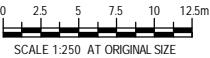


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RAV NETWORK
VEHICLE TURN PATHS

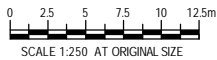
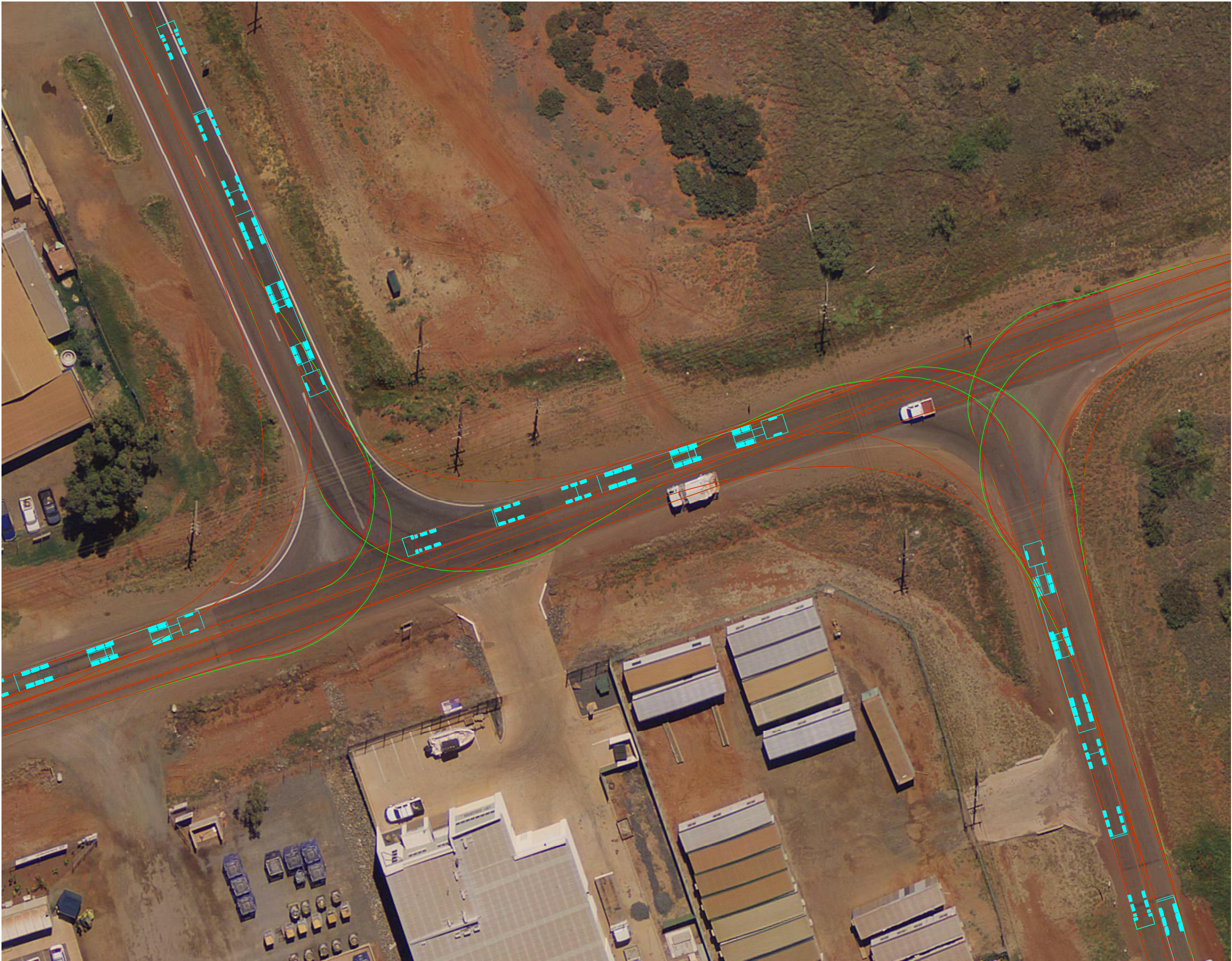


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VEHICLE TURN PATHS

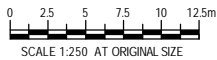


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RAV NETWORK
VEHICLE TURN PATHS

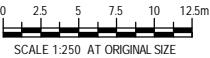
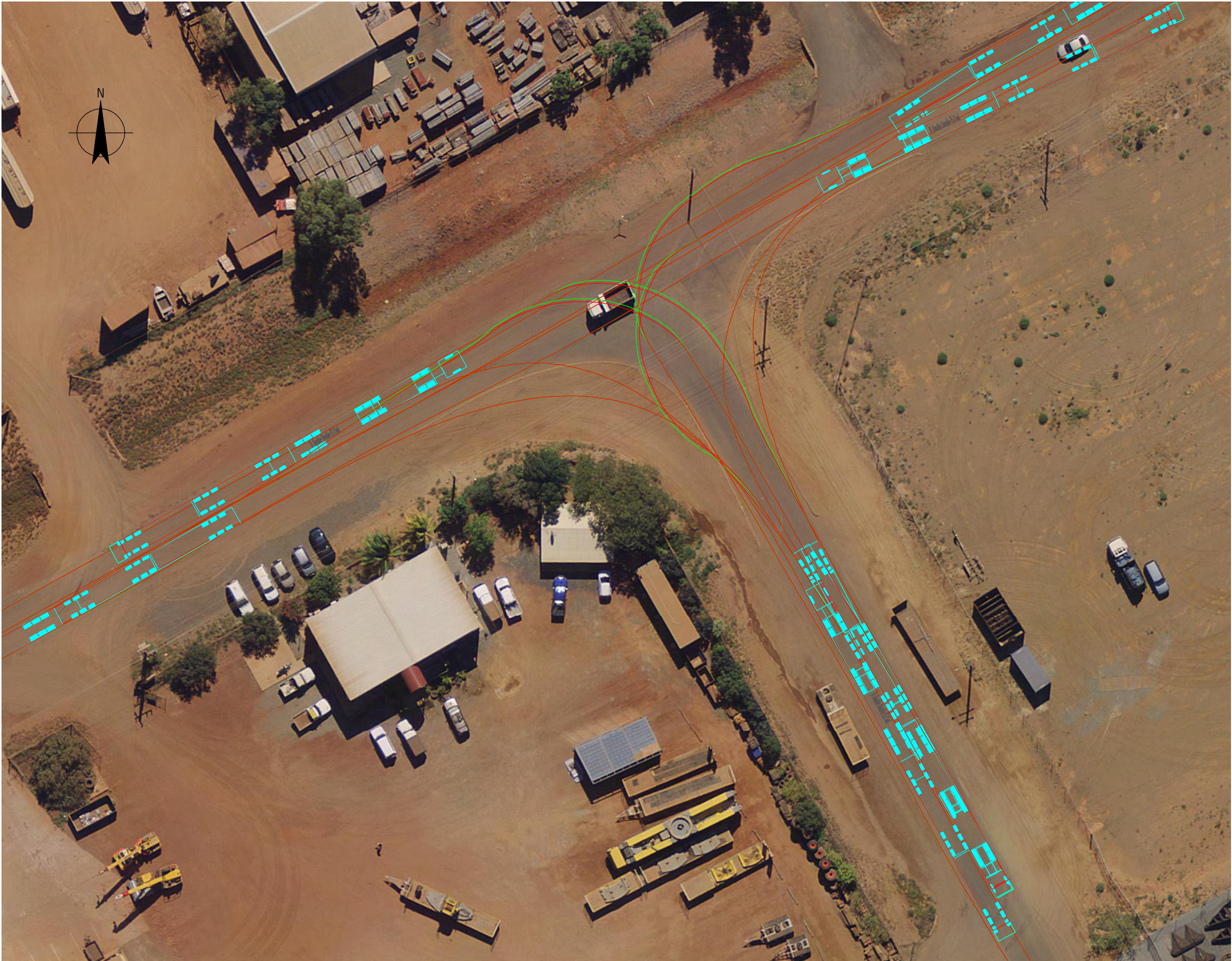


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VEHICLE TURN PATHS

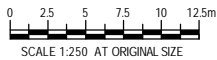
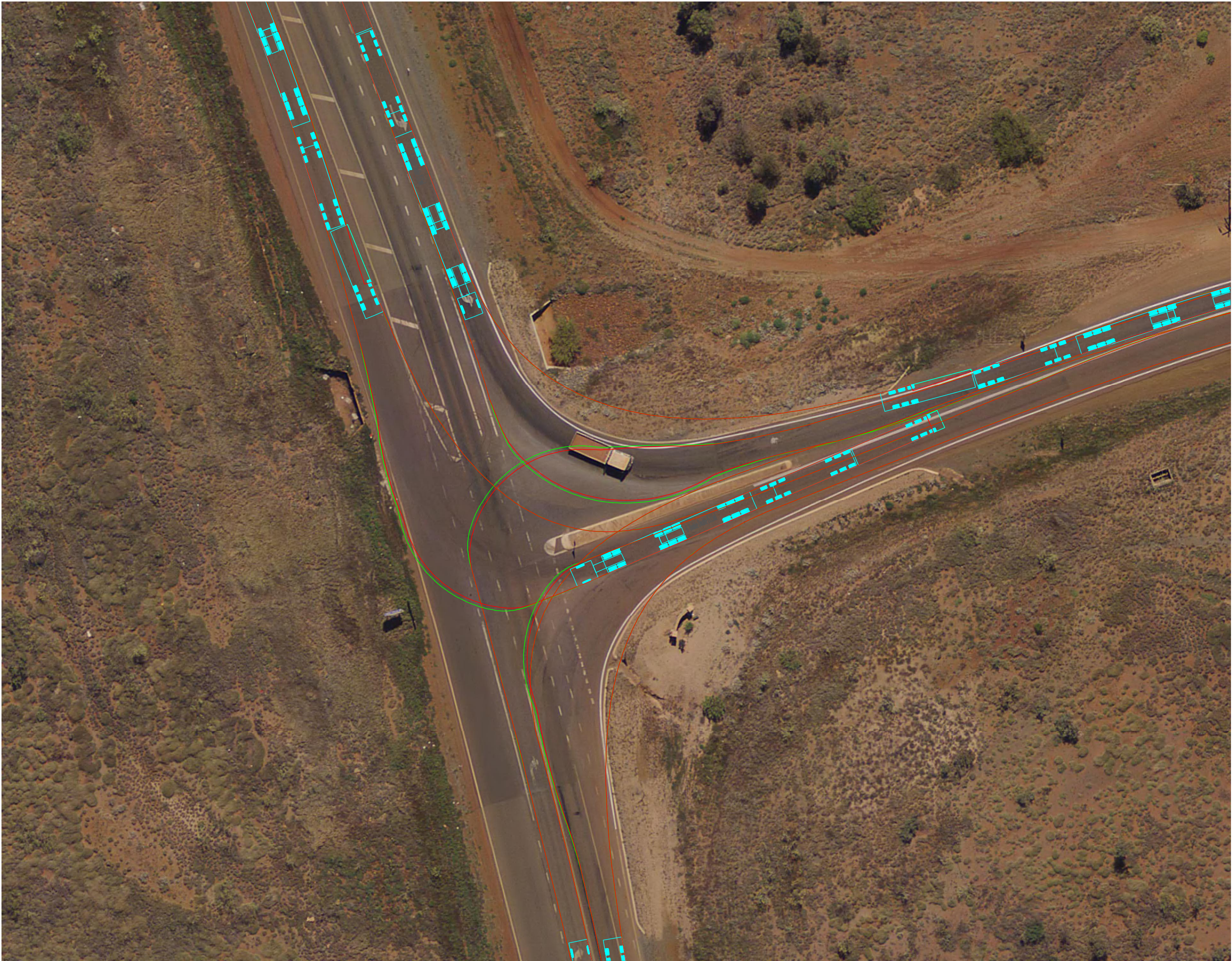


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VEHICLE TURN PATHS



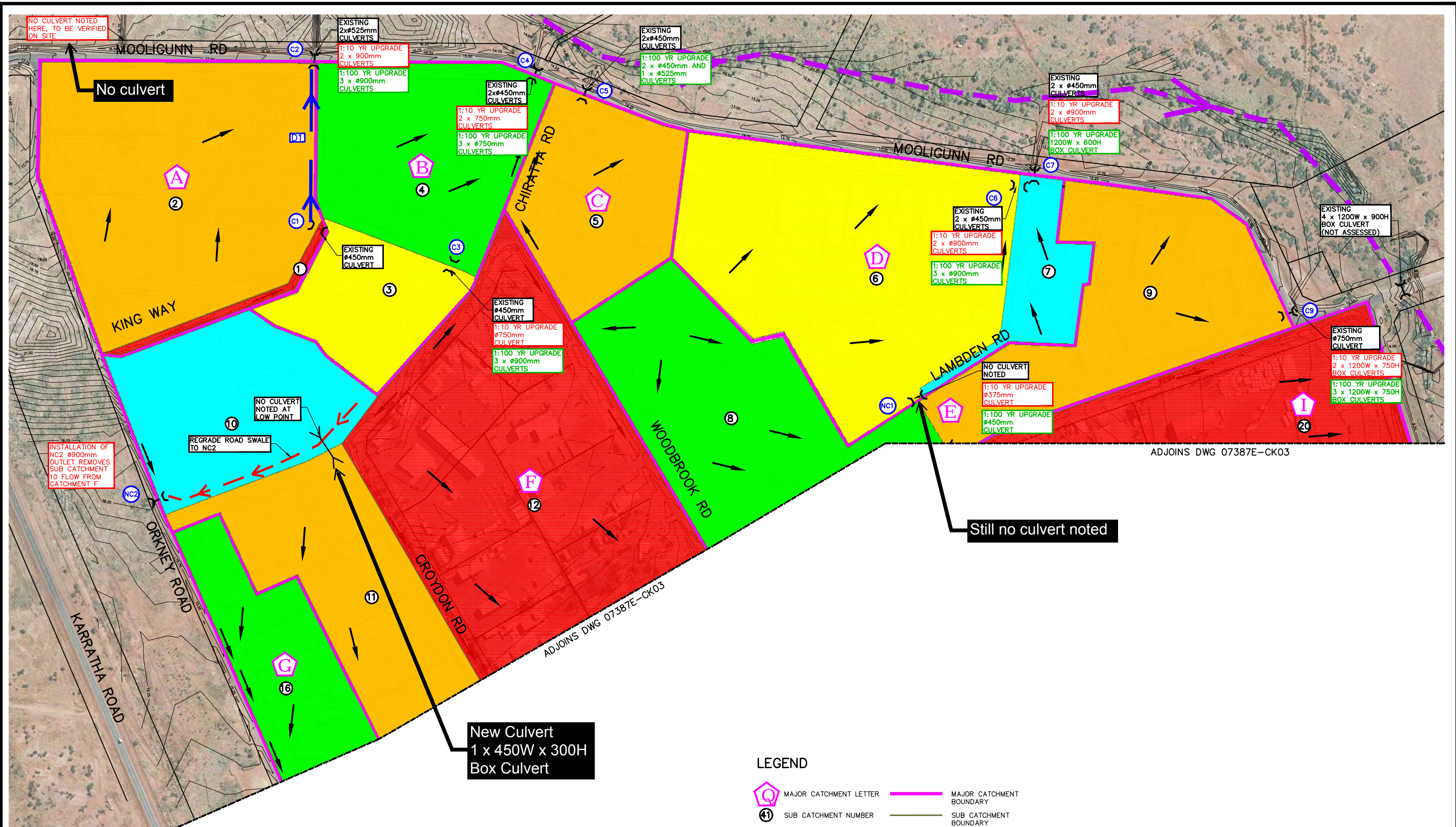
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Appendix D – Marked-up TME Drainage Plans



LEGEND

- MAJOR CATCHMENT LETTER
- SUB CATCHMENT NUMBER
- OPEN DRAIN NUMBER
- CULVERT NUMBER
- NEW CULVERT NUMBER
- EXISTING DRAINAGE
- PROPOSED UPGRADES 1:10 YEAR
- PROPOSED UPGRADES 1:100 YEAR
- MAJOR CATCHMENT BOUNDARY
- SUB CATCHMENT BOUNDARY
- FLOW DIRECTION
- OPEN DRAIN
- SWALE DRAIN
- NON PERENNIAL DRAIN

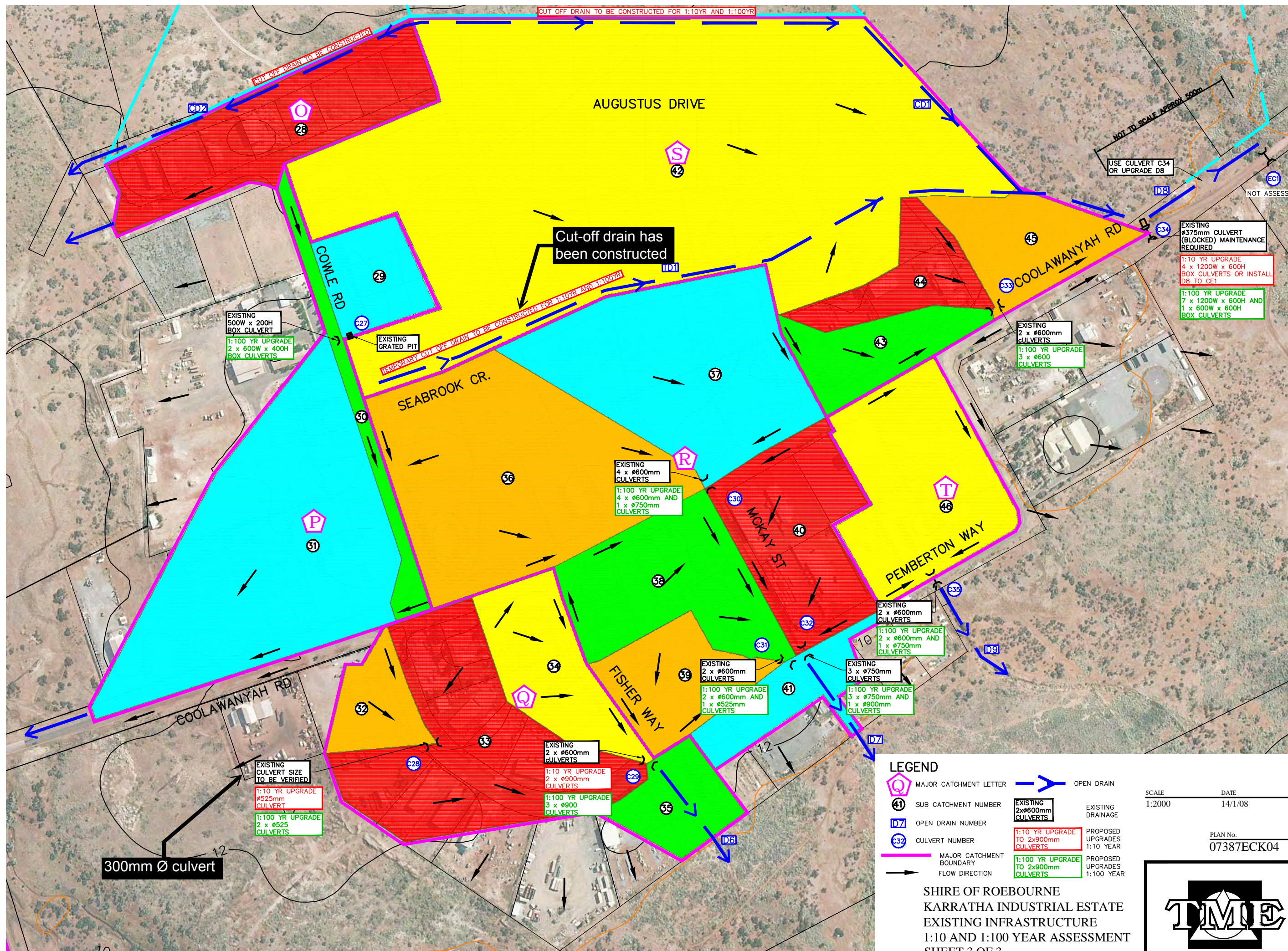
SCALE 1:2000 DATE 14/1/08

PLAN No. 07387ECK02



SHIRE OF ROEBOURNE
KARRATHA INDUSTRIAL ESTATE
EXISTING INFRASTRUCTURE
1:10 YEAR AND 1:100 YEAR ASSESMENT
SHEET 1 OF 3





LEGEND

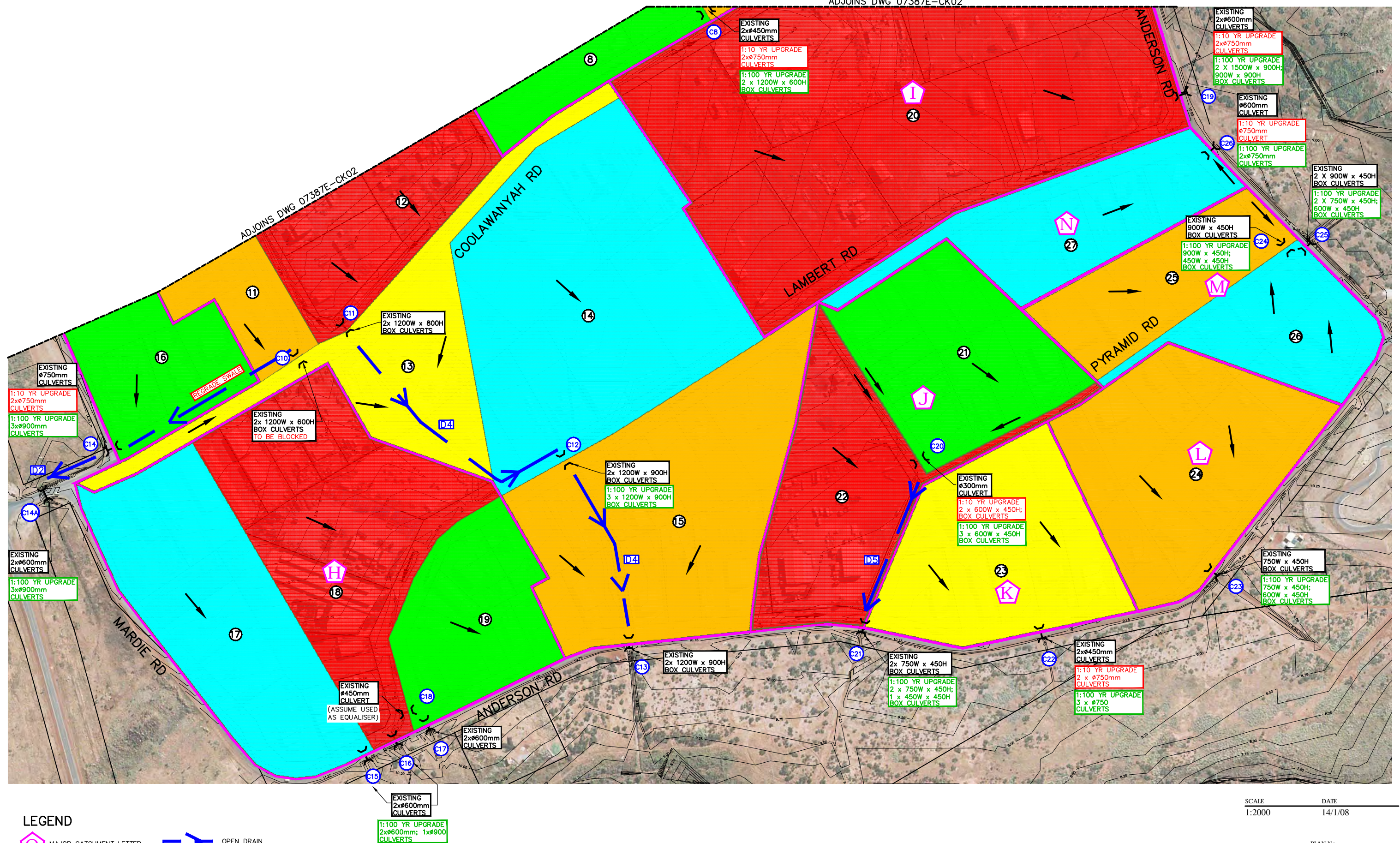
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	SUB CATCHMENT NUMBER		EXISTING DRAINAGE
	OPEN DRAIN NUMBER		PROPOSED UPGRADES 1:10 YEAR
	CULVERT NUMBER		PROPOSED UPGRADES 1:100 YEAR
	MAJOR CATCHMENT BOUNDARY		
	FLOW DIRECTION		

SHIRE OF ROEBOURNE
KARRATHA INDUSTRIAL ESTATE
EXISTING INFRASTRUCTURE
1:10 AND 1:100 YEAR ASSESSMENT
SHEET 3 OF 3

SCALE 1:2000 DATE 14/1/08

PLAN No.
07387ECK04





LEGEND

- MAJOR CATCHMENT LETTER
 SUB CATCHMENT NUMBER
 OPEN DRAIN NUMBER
 CULVERT NUMBER
 MAJOR CATCHMENT BOUNDARY
 SUB CATCHMENT BOUNDARY
 FLOW DIRECTION
- OPEN DRAIN
 EXISTING DRAINAGE
 PROPOSED UPGRADES 1:10 YEAR
 PROPOSED UPGRADES 1:100 YEAR

SCALE 1:2000 DATE 14/1/08

PLAN No.
07387ECK03



SHIRE OF ROEBOURNE
KARRATHA INDUSTRIAL ESTATE
EXISTING INFRASTRUCTURE
1:10 YEAR AND 1:100 YEAR ASSESSMENT
SHEET 2 OF 3



Appendix E – Multicriteria Assessment Spreadsheet

	Pavements			Drainage			Geometrics		Heirarchy	Weighted Scores				
Road	Min Expected Pavement Life	RAV Route?	Pavements Score	Culverts	Culvert Priority	Drainage Score	Existing Sealed Road Widths	Geometrics Score	Heirarchy Score	Pavements	Drainage	Geometrics	Heirarchy	Total Score
Coolawanyah Road - Woodbrook Road to Augustus Road	9	Yes	3	C30	1	5	7	5	5	1.05	1	1.75	0.5	4.3
Coolawanyah Road - Croydon Road to Woodbrook Road	0	Yes	5	-	-	0	7	5	5	1.75	0	1.75	0.5	4.0
Coolawanyah Road - Karratha Road to Croydon Road	0	Yes	5	C14A	2	3	8	0	5	1.75	0.6	0	0.5	2.9
Anderson Road - Lambert Road to Pyramid Road	1	Yes	5	C17, C13, C21, C22, C23, C25	2	3	7	5	0	1.75	0.6	1.75	0	4.1
Anderson Road - Mardie Road LIA to Lambert Road	5	Yes	5	C15, C16	2	3	7	5	0	1.75	0.6	1.75	0	4.1
Anderson Road - Pyramid Road to Coolawanyah Road	1	Yes	5	C26, C19	2	3	7	5	0	1.75	0.6	1.75	0	4.1
Mooligunn Road - Orkney Road to Karratha Road	3	Yes	5	-	-	0	7.6	0	5	1.75	0	0	0.5	2.3
Mardie Road - Coolawanyah Road to Anderson Road	1	Yes	5	-	-	0	7.4	0	0	1.75	0	0	0	1.8
Mooligunn Road - Coolawanyah Road to Lambden Road	10	Yes	3	C7, C9	2	3	7.6	0	5	1.05	0.6	0	0.5	2.2
Pyramid Road - Lambert Road to Anderson Road	8	No	2	C24, C20	1	5	7	5	0	0.7	1	1.75	0	3.5
Lambert Road - Anderson Road to Pyramid Road	17	Yes	1	C12	1	5	6.6	5	0	0.35	1	1.75	0	3.1
Pemberton Way - Coolawanyah Road to Fisher Way	13	Yes	1	C28, C29	1	5	6.6	5	0	0.35	1	1.75	0	3.1
Pemberton Way - McKay Street to Coolawanyah Road	19	Yes	1	C32, C35	1	5	6.6	5	0	0.35	1	1.75	0	3.1
Pemberton Way - McKay Street to Fisher Way	20	Yes	1	C31	1	5	6.6	5	0	0.35	1	1.75	0	3.1
Cowle Road - Augustus Road to Seabrook Crescent	16	No	0	C27	1	5	7	5	0	0	1	1.75	0	2.8
King Way - Orkney Road to Cherratta Road	20	No	0	C3	1	5	6	5	0	0	1	1.75	0	2.8
Lambden Road - Coolawanyah Road to Mooligunn Road	14	No	0	NC1, C6, C8	1	5	6.5	5	0	0	1	1.75	0	2.8
Orkney Road - Mooligunn to Coolawanyah	11	No	0	NC2, C14	1	5	6.5	5	0	0	1	1.75	0	2.8
Cherratta Road - Woodbrook Road to Mooligunn Road	10	No	2	-	-	0	6.3	5	0	0.7	0	1.75	0	2.5
Croydon Road - Coolawanyah Road to Cherratta Road	10	No	2	-	-	0	6.2	5	0	0.7	0	1.75	0	2.5
Off Anderson-Anderson to end	8	No	2	-	-	0		5	0	0.7	0	1.75	0	2.5
Mooligunn Road - Cherratta Road to Orkney Road	13	Yes	1	C2, C4	3	1	7.6	0	5	0.35	0.2	0	0.5	1.1
Mooligunn Road - Lambden Road to Cherratta Road	12	Yes	1	C5	3	1	7.6	0	0	0.35	0.2	0	0	0.6
Lambert Road - Pyramid Road to Anderson Road	11	Yes	1	-	-	0	6.6	5	0	0.35	0	1.75	0	2.1
Cherratta Road - Woodbrook Road to Orkney	14	No	0	-	-	0	6.3	5	0	0	0	1.75	0	1.8
Cowle Road - Coolawanyah Rod to Seabrook Crescent	20	No	0	-	-	0	7	5	0	0	0	1.75	0	1.8
Fisher Way - Coolawanyah Road to Pemberton Way	20	No	0	-	-	0	6.7	5	0	0	0	1.75	0	1.8
McKay Street - Coolawanyah Road to Pemberton Way	16	No	0	-	-	0	6.7	5	0	0	0	1.75	0	1.8
Woodbrook Road - Cherratta Road to Coolawanyah Road	14	No	0	-	-	0	6.2	5	0	0	0	1.75	0	1.8
Augustus Drive - Coolawanyah Road to end	18	No	0	C33	3	1	8.2	0	0	0	0.2	0	0	0.2
Seabrook Crescent - Coolawanyah Road to Cowle Road	20	No	0	-	-	0	8	0	0	0	0	0	0	0.0

Appendix F – Vehicle Classes

Prime Mover, Trailer Combinations

VEHICLE DESCRIPTION AND CONFIGURATION CHART (RAV) – PRIME MOVER, TRAILER COMBINATIONS EXAMPLES							Axle Spacing Table	Length (m)	Mass (T) Maximum Permitted Mass	Height (m) (i = see NOTES)	Axle Groups	RAV Network
Category 1	(A) PRIME MOVER, SEMI TRAILER TOWING A PIG TRAILER 	(B) PRIME MOVER TOWING AN OVERHEIGHT SEMI TRAILER 	(C) SHORT B-DOUBLE 	(D) TWINSTEER PRIME MOVER TOWING SEMI TRAILER 		(A) (B) (C) (D)	A A A A	≤20 ≤19 ≤20 ≤19	50 42.5 50 47.5	≤4.6 (4) ≤3.5 (5) ≤4.6 (4) ≤4.6 (4)	4 3 4 3	Network 1
Category 2	(A) PRIME MOVER, SEMI TRAILER TOWING A PIG TRAILER 	(B) PRIME MOVER TOWING SEMI TRAILER 	(C) B-DOUBLE 	(D) SHORT B-TRIPLE 	(E) CAR CARRIER SEMI TRAILER 	(A) (B) (C) (D) (E)	A A A A A	≤27.5 ≤20 ≤27.5 ≤27.5 ≤25	65.5 42.5 67.5 87.5 42.5	≤4.6 (4) ≤3.5 (5) ≤4.6 (4) ≤4.6 (4) ≤4.6 (4)	4 3 4 5 3	Network 2
Category 3	(A) PRIME MOVER, SEMI TRAILER TOWING A DOG TRAILER 											Network 3
Category 4	(A) PRIME MOVER, SEMI TRAILER TOWING 6 AXLE DOG TRAILER 											Network 4
Category 5	(A) PRIME MOVER, SEMI TRAILER TOWING A DOG TRAILER 	(B) PRIME MOVER, SEMI TRAILER TOWING A DOG TRAILER AND CONVERTER DOLLY 	(C) B-DOUBLE TOWING A CONVERTER DOLLY 	(D) B-TRIPLE 		(A) (B) (C) (D)	B B A A	>27.5, ≤36.5 >27.5, ≤36.5 >27.5, ≤36.5 >27.5, ≤36.5	84 84+d 67.5+d 84	≤4.6 (4) ≤4.6 (4) ≤4.6 (4) ≤4.6 (4)	5 6 5 5	Network 5
Category 6	(A) PRIME MOVER, SEMI TRAILER TOWING 6 AXLE DOG TRAILER 	(B) B-TRIPLE 	(C) PRIME MOVER SEMI TRAILER TOWING A 6 AXLE TRAILER & CONVERTER DOLLY 			(A) (B) (C)	A A A	>27.5, ≤36.5 >27.5, ≤36.5 >27.5, ≤36.5	87.5 87.5 87.5+d	≤4.6 (4) ≤4.6 (4) ≤4.6 (4)	5 5 6	Network 6
Category 7	(A) PRIME MOVER, TOWING SEMI TRAILER AND B DOUBLE 	(B) B-DOUBLE TOWING A DOG TRAILER 				(A) (B)	A A	>27.5, ≤36.5 >27.5, ≤36.5	107.5 107.5	≤4.6 (4) ≤4.6 (4)	6 6	Network 7
Category 9	(A) PRIME MOVER, SEMI TRAILER TOWING 2 X DOG TRAILERS 	(B) PRIME MOVER, SEMI TRAILER TOWING A DOG TRAILER AND CONVERTER DOLLY 	(C) B DOUBLE TOWING A DOG TRAILER 	(D) PRIME MOVER, SEMI TRAILER TOWING A B-DOUBLE 		(A) (B) (C) (D)	B B B A	>36.5, ≤53.5 >36.5, ≤53.5 >36.5, ≤45 >36.5, ≤45	120.5 84+d 107.5 107.5	≤4.6 (4) ≤4.6 (4) ≤4.6 (4) ≤4.6 (4)	7 6 6 6	Network 9
Category 10	(A) PRIME MOVER, SEMI TRAILER TOWING 2 X 6 AXLE DOG TRAILERS 	(B) B-DOUBLE TOWING A CONVERTER DOLLY CONNECTED TO 2 SEMI TRAILERS 	(C) PRIME MOVER, SEMI TRAILER TOWING B TRIPLE 	(D) B-DOUBLE TOWING 2 DOG TRAILERS 	(E) DOUBLE ROAD TRAIN TOWING B-DOUBLE TRAILERS 	(A) (B) (C) (D) (E) (F)	A A A A A A	>36.5, ≤53.5 >36.5, ≤53.5 >36.5, ≤53.5 >36.5, ≤53.5 >36.5, ≤53.5 >36.5, ≤53.5	127.5 127.5 127.5 147.5 147.5 87.5+d	≤4.6 (4) ≤4.6 (4) ≤4.6 (4) ≤4.6 (4) ≤4.6 (4) ≤4.6 (4)	7 7 7 8 8 6	Network 10

- Operators using a category of RAV outlined in this document must operate that RAV in accordance with the OPERATING CONDITIONS and only on the network specified.
- These diagrams are a visual indication of the vehicle only.
- Operators must refer to the OPERATING CONDITIONS for the full vehicle description.

- The height of the vehicle can exceed 4.3 m but MUST NOT exceed 4.6 m when it is:
 - built to carry livestock or;
 - carrying a crate to carry livestock or;
 - carrying vehicles on more than one deck or;
 - carrying a multi modal container or;
 - carrying a large indivisible item or;
 - When operating with an appropriately licenced over height curtain side or pantechon trailer.
- Maximum height of Pig Trailer only.

Heavy Vehicle Operations
Tel: 138 HVO (138 486)
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Appendix G – Cost Estimates

KARRATHA LIA ROADS UPGRADE

CONCEPT ESTIMATE

COST PLAN No. 1

FOR



04-Jun-14

**KARRATHA LIA ROADS UPGRADE
CONCEPT ESTIMATE**

04/06/2014

NOTES, ASSUMPTIONS & EXCLUSIONS

- 1 This estimate is based on preliminary information and should be considered indicative only.
- 2 This estimate is based on the following information:
- 3 GHD Road Schedule and scope of works email dated 29 May 2014
- 4 The costs included herein are based on rates current at the time of the estimates. No allowance has been allowed for cost escalation.
- 5 No allowance has been made for relocation of electrical, communications, water, sewer or pipes storm water services
- 6 No allowance has been made for relocation of street lights or the addition of new street lights
- 7 The estimate includes allowances for main contractor preliminaries and margins, design and construction contingencies, design and administration fees.
- 8 No allowance has been made for Shire costs.
- 9 The estimate breaks the work into work packages aligned to the schedule. These packages can be used to balance work flows against budgets and priorities as necessary.
- 10 This estimate is deemed to have a level of confidence of +/- of 30%.

KARRATHA LIA ROADS UPGRADE
CONCEPT ESTIMATE

04/06/2014

Ref	Scope	Unit	Qty	Rate	Total	Section Total Net	Section Total Gross
				\$	\$	\$	\$
	Coolawanyah Road - Karratha Road to Croydon Road						
	<u>Roads:</u>						
1	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	2,400	24.38	58,500.00		
2	200mm thick sub-base	m2	2,400	21.00	50,400.00		
3	200mm thick base	m2	2,400	24.00	57,600.00		
4	Prime coat	m2	2,400		included		
5	Prime sealer 7mm thick	m2	2,400		included		
6	Tack coat	m2	2,400		included		
7	40mm asphalt concrete AC14	m2	2,400	45.00	108,000.00		
8	Line marking	Item	1	480.00	480.00		
	<u>Shoulders:</u>						
9	Excavate and remove for new shoulders approx. 410 thick	m2	900	22.88	20,587.50		
10	200mm thick sub-base	m2	900	21.00	18,900.00		
11	200mm thick base	m2	900	24.00	21,600.00		
12	Prime coat	m2	900	15.00	13,500.00		
13	Prime sealer 7mm thick	m2	900		included		
14	Flush kerbs	m	80	45.00	3,600.00		
15	Signage	Item	1	480.00	480.00	353,647.50	455,000.00
	Coolawanyah Road - Croydon Road to Woodbrook Road						
	<u>Roads:</u>						
16	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	3,040	24.38	74,100.00		
17	200mm thick sub-base	m2	3,040	21.00	63,840.00		
18	200mm thick base	m2	3,040	24.00	72,960.00		
19	Prime coat	m2	3,040		included		
20	Prime sealer 7mm thick	m2	3,040		included		
21	Tack coat	m2	3,040		included		
22	40mm asphalt concrete AC14	m2	3,040	45.00	136,800.00		
23	Line marking	Item	1	600.00	600.00		
	<u>Shoulders:</u>						
24	Excavate and remove for new shoulders approx. 410 thick	m2	1,200	22.88	27,450.00		
25	200mm thick sub-base	m2	1,200	21.00	25,200.00		
26	200mm thick base	m2	1,200	24.00	28,800.00		
27	Prime coat	m2	1,200	15.00	18,000.00		
28	Prime sealer 7mm thick	m2	1,200		included		
29	Flush kerbs	m	40	45.00	1,800.00		
30	Signage	Item	1	600.00	600.00	450,150.00	579,000.00
	Coolawanyah Road - Woodbrook Road to Augustus Road						
	<u>Roads:</u>						
31	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	15,960	24.38	389,025.00		
32	200mm thick sub-base	m2	15,960	21.00	335,160.00		
33	200mm thick base	m2	15,960	24.00	383,040.00		
34	Prime coat	m2	15,960		included		
35	Prime sealer 7mm thick	m2	15,960		included		
36	Tack coat	m2	15,960		included		
37	40mm asphalt concrete AC14	m2	15,960	45.00	718,200.00		
38	Line marking	Item	1	3,150.00	3,150.00		
	<u>Shoulders:</u>						
39	Excavate and remove for new shoulders approx. 410 thick	m2	6,300	22.88	144,112.50		
40	200mm thick sub-base	m2	6,300	21.00	132,300.00		
41	200mm thick base	m2	6,300	24.00	151,200.00		
42	Prime coat	m2	6,300	15.00	94,500.00		
43	Prime sealer 7mm thick	m2	6,300		included		
44	Flush kerbs	m	220	45.00	9,900.00		
45	Signage	Item	1	3,150.00	3,150.00	2,363,737.50	3,039,000.00

KARRATHA LIA ROADS UPGRADE
CONCEPT ESTIMATE

04/06/2014

Ref	Scope	Unit	Qty	Rate	Total	Section Total Net	Section Total Gross
				\$	\$	\$	\$
	Mooligunn Road - Cherratta Road to Orkney Road						
	<u>Roads:</u>						
46	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	4,370	24.38	106,518.75		
47	200mm thick sub-base	m2	4,370	21.00	91,770.00		
48	200mm thick base	m2	4,370	24.00	104,880.00		
49	Prime coat	m2	4,370		included		
50	Prime sealer 7mm thick	m2	4,370		included		
51	Tack coat	m2	4,370		included		
52	40mm asphalt concrete AC14	m2	4,370	45.00	196,650.00		
53	Line marking	Item	1	862.50	862.50		
	<u>Shoulders:</u>						
54	Excavate and remove for new shoulders approx. 410 thick	m2	1,725	22.88	39,459.38		
55	200mm thick sub-base	m2	1,725	21.00	36,225.00		
56	200mm thick base	m2	1,725	24.00	41,400.00		
57	Prime coat	m2	1,725	15.00	25,875.00		
58	Prime sealer 7mm thick	m2	1,725		included		
59	Flush kerbs	m	40	45.00	1,800.00		
60	Signage	Item	1	862.50	862.50		
61	Culvert 750 dia	m	40	675.00	27,270.00		
62	Culvert 900 dia	m	40	900.00	36,360.00		
63	Headwall to suit 750 dia culvert	No	4	1,650.00	6,600.00		
64	Headwall to suit 900 dia culvert	No	2	1,800.00	3,600.00	720,133.13	926,000.00
	Mooligunn Road - Coolawanyah Road to Lambden Road						
	<u>Roads:</u>						
65	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	3,800	24.38	92,625.00		
66	200mm thick sub-base	m2	3,800	21.00	79,800.00		
67	200mm thick base	m2	3,800	24.00	91,200.00		
68	Prime coat	m2	3,800		included		
69	Prime sealer 7mm thick	m2	3,800		included		
70	Tack coat	m2	3,800		included		
71	40mm asphalt concrete AC14	m2	3,800	45.00	171,000.00		
72	Line marking	Item	1	750.00	750.00		
	<u>Shoulders:</u>						
73	Excavate and remove for new shoulders approx. 410 thick	m2	1,500	22.88	34,312.50		
74	200mm thick sub-base	m2	1,500	21.00	31,500.00		
75	200mm thick base	m2	1,500	24.00	36,000.00		
76	Prime coat	m2	1,500	15.00	22,500.00		
77	Prime sealer 7mm thick	m2	1,500		included		
78	Flush kerbs	m	40	45.00	1,800.00		
79	Signage	Item	1	750.00	750.00		
80	Culvert 900 dia	m	25	900.00	22,680.00		
81	Culvert 1200 wide x 750 high	m	25	1,350.00	34,020.00		
82	Headwall to suit 900 dia culvert	No	4	1,800.00	7,200.00		
83	Headwall to suit 1200 wide x 750 high culvert	No	4	1,800.00	7,200.00	633,337.50	814,000.00

KARRATHA LIA ROADS UPGRADE
CONCEPT ESTIMATE

04/06/2014

Ref	Scope	Unit	Qty	Rate	Total	Section Total Net	Section Total Gross
				\$	\$	\$	\$
	Mooligunn Road - Lambden Road to Cherratta Road						
	<u>Roads:</u>						
84	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	3,230	24.38	78,731.25		
85	200mm thick sub-base	m2	3,230	21.00	67,830.00		
86	200mm thick base	m2	3,230	24.00	77,520.00		
87	Prime coat	m2	3,230		included		
88	Prime sealer 7mm thick	m2	3,230		included		
89	Tack coat	m2	3,230		included		
90	40mm asphalt concrete AC14	m2	3,230	45.00	145,350.00		
91	Line marking	Item	1	637.50	637.50		
	<u>Shoulders:</u>						
92	Excavate and remove for new shoulders approx. 410 thick	m2	1,275	22.88	29,165.63		
93	200mm thick sub-base	m2	1,275	21.00	26,775.00		
94	200mm thick base	m2	1,275	24.00	30,600.00		
95	Prime coat	m2	1,275	15.00	19,125.00		
96	Prime sealer 7mm thick	m2	1,275		included		
97	Flush kerbs	m	40	45.00	1,800.00		
98	Signage	Item	1	637.50	637.50	478,171.88	615,000.00
	Mooligunn Road - Orkney Road to Karratha Road						
	<u>Roads:</u>						
99	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	1,140	24.38	27,787.50		
100	200mm thick sub-base	m2	1,140	21.00	23,940.00		
101	200mm thick base	m2	1,140	24.00	27,360.00		
102	Prime coat	m2	1,140		included		
103	Prime sealer 7mm thick	m2	1,140		included		
104	Tack coat	m2	1,140		included		
105	40mm asphalt concrete AC14	m2	1,140	45.00	51,300.00		
106	Line marking	Item	1	225.00	225.00		
	<u>Shoulders:</u>						
107	Excavate and remove for new shoulders approx. 410 thick	m2	450	22.88	10,293.75		
108	200mm thick sub-base	m2	450	21.00	9,450.00		
109	200mm thick base	m2	450	24.00	10,800.00		
110	Prime coat	m2	450	15.00	6,750.00		
111	Prime sealer 7mm thick	m2	450		included		
112	Flush kerbs	m	40	45.00	1,800.00		
113	Signage	Item	1	225.00	225.00	169,931.25	219,000.00
	Anderson Road - Lambert Road to Pyramid Road						
	<u>Roads:</u>						
114	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	11,020	24.38	268,612.50		
115	200mm thick sub-base	m2	11,020	21.00	231,420.00		
116	200mm thick base	m2	11,020	24.00	264,480.00		
117	Prime coat	m2	11,020		included		
118	Prime sealer 7mm thick	m2	11,020		included		
119	Tack coat	m2	11,020		included		
120	40mm asphalt concrete AC14	m2	11,020	45.00	495,900.00		
121	Line marking	Item	1	2,175.00	2,175.00		
	<u>Shoulders:</u>						
122	Excavate and remove for new shoulders approx. 410 thick	m2	4,350	22.88	99,506.25		
123	200mm thick sub-base	m2	4,350	21.00	91,350.00		
124	200mm thick base	m2	4,350	24.00	104,400.00		
125	Prime coat	m2	4,350	15.00	65,250.00		
126	Prime sealer 7mm thick	m2	4,350		included		
127	Flush kerbs	m	40	45.00	1,800.00		
128	Signage	Item	1	2,175.00	2,175.00		
129	Culvert 750 dia	m	25	675.00	17,010.00		
130	Headwall to suit 750 dia culvert	No	4	1,650.00	6,600.00	1,650,678.75	2,123,000.00

KARRATHA LIA ROADS UPGRADE
CONCEPT ESTIMATE

04/06/2014

Ref	Scope	Unit	Qty	Rate	Total	Section Total Net	Section Total Gross
				\$	\$	\$	\$
	Anderson Road - Mardie Road LIA to Lambert Road						
	<u>Roads:</u>						
131	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	1,140	24.38	27,787.50		
132	200mm thick sub-base	m2	1,140	21.00	23,940.00		
133	200mm thick base	m2	1,140	24.00	27,360.00		
134	Prime coat	m2	1,140		included		
135	Prime sealer 7mm thick	m2	1,140		included		
136	Tack coat	m2	1,140		included		
137	40mm asphalt concrete AC14	m2	1,140	45.00	51,300.00		
138	Line marking	Item	1	225.00	225.00		
	<u>Shoulders:</u>						
139	Excavate and remove for new shoulders approx. 410 thick	m2	450	22.88	10,293.75		
140	200mm thick sub-base	m2	450	21.00	9,450.00		
141	200mm thick base	m2	450	24.00	10,800.00		
142	Prime coat	m2	450	15.00	6,750.00		
143	Prime sealer 7mm thick	m2	450		included		
144	Flush kerbs	m	40	45.00	1,800.00		
145	Signage	Item	1	225.00	225.00	169,931.25	219,000.00
	Anderson Road - Pyramid Road to Coolawanyah Road						
	<u>Roads:</u>						
146	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	3,610	24.38	87,993.75		
147	200mm thick sub-base	m2	3,610	21.00	75,810.00		
148	200mm thick base	m2	3,610	24.00	86,640.00		
149	Prime coat	m2	3,610		included		
150	Prime sealer 7mm thick	m2	3,610		included		
151	Tack coat	m2	3,610		included		
152	40mm asphalt concrete AC14	m2	3,610	45.00	162,450.00		
153	Line marking	Item	1	712.50	712.50		
	<u>Shoulders:</u>						
154	Excavate and remove for new shoulders approx. 410 thick	m2	1,425	22.88	32,596.88		
155	200mm thick sub-base	m2	1,425	21.00	29,925.00		
156	200mm thick base	m2	1,425	24.00	34,200.00		
157	Prime coat	m2	1,425	15.00	21,375.00		
158	Prime sealer 7mm thick	m2	1,425		included		
159	Flush kerbs	m	40	45.00	1,800.00		
160	Signage	Item	1	712.50	712.50		
161	Culvert 750 dia	m	36	675.00	24,300.00		
162	Headwall to suit 750 dia culvert	No	6	1,650.00	9,900.00	568,415.63	731,000.00
	Lambert Road - Anderson Road to Pyramid Road						
	<u>Roads:</u>						
163	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	3,230	24.38	78,731.25		
164	200mm thick sub-base	m2	3,230	21.00	67,830.00		
165	200mm thick base	m2	3,230	24.00	77,520.00		
166	Prime coat	m2	3,230		included		
167	Prime sealer 7mm thick	m2	3,230		included		
168	Tack coat	m2	3,230		included		
169	40mm asphalt concrete AC14	m2	3,230	45.00	145,350.00		
170	Line marking	Item	1	637.50	637.50		
	<u>Shoulders:</u>						
171	Excavate and remove for new shoulders approx. 410 thick	m2	1,275	22.88	29,165.63		
172	200mm thick sub-base	m2	1,275	21.00	26,775.00		
173	200mm thick base	m2	1,275	24.00	30,600.00		
174	Prime coat	m2	1,275	15.00	19,125.00		
175	Prime sealer 7mm thick	m2	1,275		included		
176	Flush kerbs	m	40	45.00	1,800.00		
177	Signage	Item	1	637.50	637.50	478,171.88	615,000.00

KARRATHA LIA ROADS UPGRADE
CONCEPT ESTIMATE

04/06/2014

Ref	Scope	Unit	Qty	Rate	Total	Section Total Net	Section Total Gross
				\$	\$	\$	\$
	Lambert Road - Pyramid Road to Anderson Road						
	<u>Roads:</u>						
178	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	5,890	24.38	143,568.75		
179	200mm thick sub-base	m2	5,890	21.00	123,690.00		
180	200mm thick base	m2	5,890	24.00	141,360.00		
181	Prime coat	m2	5,890		included		
182	Prime sealer 7mm thick	m2	5,890		included		
183	Tack coat	m2	5,890		included		
184	40mm asphalt concrete AC14	m2	5,890	45.00	265,050.00		
185	Line marking	Item	1	1,162.50	1,162.50		
	<u>Shoulders:</u>						
186	Excavate and remove for new shoulders approx. 410 thick	m2	2,325	22.88	53,184.38		
187	200mm thick sub-base	m2	2,325	21.00	48,825.00		
188	200mm thick base	m2	2,325	24.00	55,800.00		
189	Prime coat	m2	2,325	15.00	34,875.00		
190	Prime sealer 7mm thick	m2	2,325		included		
191	Flush kerbs	m	40	45.00	1,800.00		
192	Signage	Item	1	1,162.50	1,162.50	870,478.13	1,119,000.00
	Pemberton Way - Coolawanyah Road to Fisher Way						
	<u>Roads:</u>						
193	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	3,420	24.38	83,362.50		
194	200mm thick sub-base	m2	3,420	21.00	71,820.00		
195	200mm thick base	m2	3,420	24.00	82,080.00		
196	Prime coat	m2	3,420		included		
197	Prime sealer 7mm thick	m2	3,420		included		
198	Tack coat	m2	3,420		included		
199	40mm asphalt concrete AC14	m2	3,420	45.00	153,900.00		
200	Line marking	Item	1	675.00	675.00		
	<u>Shoulders:</u>						
201	Excavate and remove for new shoulders approx. 410 thick	m2	1,080	22.88	24,705.00		
202	200mm thick sub-base	m2	1,080	21.00	22,680.00		
203	200mm thick base	m2	1,080	24.00	25,920.00		
204	Prime coat	m2	1,080	15.00	16,200.00		
205	Prime sealer 7mm thick	m2	1,080		included		
206	Flush kerbs	m	40	45.00	1,800.00		
207	Signage	Item	1	675.00	675.00		
208	Culvert 525 dia	m	13	525.00	6,615.00		
209	Culvert 900 dia	m	25	900.00	22,680.00		
210	Headwall to suit 525 dia culvert	No	2	900.00	1,800.00		
211	Headwall to suit 900 dia culvert	No	4	1,800.00	7,200.00	522,112.50	671,000.00
	Pemberton Way - McKay Street to Coolawanyah Road						
	<u>Roads:</u>						
212	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	3,990	24.38	97,256.25		
213	200mm thick sub-base	m2	3,990	21.00	83,790.00		
214	200mm thick base	m2	3,990	24.00	95,760.00		
215	Prime coat	m2	3,990		included		
216	Prime sealer 7mm thick	m2	3,990		included		
217	Tack coat	m2	3,990		included		
218	40mm asphalt concrete AC14	m2	3,990	45.00	179,550.00		
219	Line marking	Item	1	787.50	787.50		
	<u>Shoulders:</u>						
220	Excavate and remove for new shoulders approx. 410 thick	m2	1,575	22.88	36,028.13		
221	200mm thick sub-base	m2	1,575	21.00	33,075.00		
222	200mm thick base	m2	1,575	24.00	37,800.00		
223	Prime coat	m2	1,575	15.00	23,625.00		
224	Prime sealer 7mm thick	m2	1,575		included		
225	Flush kerbs	m	40	45.00	1,800.00		
226	Signage	Item	1	787.50	787.50	590,259.38	759,000.00

KARRATHA LIA ROADS UPGRADE
CONCEPT ESTIMATE

04/06/2014

Ref	Scope	Unit	Qty	Rate	Total	Section Total Net \$	Section Total Gross \$
				\$	\$		
	Pemberton Way - McKay Street to Fisher Way						
	<u>Roads:</u>						
227	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	1,520	24.38	37,050.00		
228	200mm thick sub-base	m2	1,520	21.00	31,920.00		
229	200mm thick base	m2	1,520	24.00	36,480.00		
230	Prime coat	m2	1,520		included		
231	Prime sealer 7mm thick	m2	1,520		included		
232	Tack coat	m2	1,520		included		
233	40mm asphalt concrete AC14	m2	1,520	45.00	68,400.00		
234	Line marking	Item	1	300.00	300.00		
	<u>Shoulders:</u>						
235	Excavate and remove for new shoulders approx. 410 thick	m2	600	22.88	13,725.00		
236	200mm thick sub-base	m2	600	21.00	12,600.00		
237	200mm thick base	m2	600	24.00	14,400.00		
238	Prime coat	m2	600	15.00	9,000.00		
239	Prime sealer 7mm thick	m2	600		included		
240	Flush kerbs	m	40	45.00	1,800.00		
241	Signage	Item	1	300.00	300.00	225,975.00	291,000.00
	Pyramid Road - Lambert Road to Anderson Road						
	<u>Roads:</u>						
242	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	5,320	24.38	129,675.00		
243	200mm thick sub-base	m2	5,320	21.00	111,720.00		
244	200mm thick base	m2	5,320	24.00	127,680.00		
245	Prime coat	m2	5,320		included		
246	Prime sealer 7mm thick	m2	5,320		included		
247	Tack coat	m2	5,320		included		
248	40mm asphalt concrete AC14	m2	5,320	45.00	239,400.00		
249	Line marking	Item	1	1,050.00	1,050.00		
	<u>Shoulders:</u>						
250	Excavate and remove for new shoulders approx. 410 thick	m2	2,100	22.88	48,037.50		
251	200mm thick sub-base	m2	2,100	21.00	44,100.00		
252	200mm thick base	m2	2,100	24.00	50,400.00		
253	Prime coat	m2	2,100	15.00	31,500.00		
254	Prime sealer 7mm thick	m2	2,100		included		
255	Flush kerbs	m	40	45.00	1,800.00		
256	Signage	Item	1	1,050.00	1,050.00		
257	Culvert 600 wide x 450 high	m	25	750.00	18,900.00		
258	Headwall to suit 600 wide x 450 high culvert	No	4	1,050.00	4,200.00	809,512.50	1,041,000.00
	King Way - Orkney Road to Cherratta Road						
	<u>Roads:</u>						
259	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	3,420	24.38	83,362.50		
260	200mm thick sub-base	m2	3,420	21.00	71,820.00		
261	200mm thick base	m2	3,420	24.00	82,080.00		
262	Prime coat	m2	3,420		included		
263	Prime sealer 7mm thick	m2	3,420		included		
264	Tack coat	m2	3,420		included		
265	40mm asphalt concrete AC14	m2	3,420	45.00	153,900.00		
266	Line marking	Item	1	675.00	675.00		
	<u>Shoulders:</u>						
267	Excavate and remove for new shoulders approx. 410 thick	m2	1,350	22.88	30,881.25		
268	200mm thick sub-base	m2	1,350	21.00	28,350.00		
269	200mm thick base	m2	1,350	24.00	32,400.00		
270	Prime coat	m2	1,350	15.00	20,250.00		
271	Prime sealer 7mm thick	m2	1,350		included		
272	Flush kerbs	m	40	45.00	1,800.00		
273	Signage	Item	1	675.00	675.00		
274	Culvert 750 dia	m	13	675.00	8,505.00		
275	Headwall to suit 750 dia culvert	No	2	1,650.00	3,300.00	517,998.75	666,000.00

KARRATHA LIA ROADS UPGRADE
CONCEPT ESTIMATE

04/06/2014

Ref	Scope	Unit	Qty	Rate	Total	Section Total Net	Section Total Gross
				\$	\$	\$	\$
	Lambden Road - Coolawanyah Road to Mooligunn Road						
	<u>Roads:</u>						
276	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	2,660	24.38	64,837.50		
277	200mm thick sub-base	m2	2,660	21.00	55,860.00		
278	200mm thick base	m2	2,660	24.00	63,840.00		
279	Prime coat	m2	2,660		included		
280	Prime sealer 7mm thick	m2	2,660		included		
281	Tack coat	m2	2,660		included		
282	40mm asphalt concrete AC14	m2	2,660	45.00	119,700.00		
283	Line marking	Item	1	525.00	525.00		
	<u>Shoulders:</u>						
284	Excavate and remove for new shoulders approx. 410 thick	m2	1,050	22.88	24,018.75		
285	200mm thick sub-base	m2	1,050	21.00	22,050.00		
286	200mm thick base	m2	1,050	24.00	25,200.00		
287	Prime coat	m2	1,050	15.00	15,750.00		
288	Prime sealer 7mm thick	m2	1,050		included		
289	Flush kerbs	m	60	45.00	2,700.00		
290	Signage	Item	1	525.00	525.00		
291	Culvert 375 dia	m	13	330.00	4,158.00		
292	Culvert 750 dia	m	25	675.00	17,010.00		
293	Culvert 900 dia	m	25	900.00	22,680.00		
294	Headwall to suit 375 dia culvert	No	2	900.00	1,800.00		
295	Headwall to suit 750 dia culvert	No	4	1,650.00	6,600.00		
296	Headwall to suit 900 dia culvert	No	4	1,800.00	7,200.00	454,454.25	584,000.00
	Orkney Road - Mooligunn to Coolawanyah						
	<u>Roads:</u>						
297	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	7,600	24.38	185,250.00		
298	200mm thick sub-base	m2	7,600	21.00	159,600.00		
299	200mm thick base	m2	7,600	24.00	182,400.00		
300	Prime coat	m2	7,600		included		
301	Prime sealer 7mm thick	m2	7,600		included		
302	Tack coat	m2	7,600		included		
303	40mm asphalt concrete AC14	m2	7,600	45.00	342,000.00		
304	Line marking	Item	1	1,500.00	1,500.00		
	<u>Shoulders:</u>						
305	Excavate and remove for new shoulders approx. 410 thick	m2	3,000	22.88	68,625.00		
306	200mm thick sub-base	m2	3,000	21.00	63,000.00		
307	200mm thick base	m2	3,000	24.00	72,000.00		
308	Prime coat	m2	3,000	15.00	45,000.00		
309	Prime sealer 7mm thick	m2	3,000		included		
310	Flush kerbs	m	80	45.00	3,600.00		
311	Signage	Item	1	1,500.00	1,500.00		
312	Culvert 750 dia	m	25	675.00	17,010.00		
313	Headwall to suit 750 dia culvert	No	4	1,650.00	6,600.00	1,148,085.00	1,476,000.00

KARRATHA LIA ROADS UPGRADE
CONCEPT ESTIMATE

04/06/2014

Ref	Scope	Unit	Qty	Rate	Total	Section Total Net	Section Total Gross
				\$	\$	\$	\$
	Cherratta Road - Woodbrook Road to Mooligunn Road						
	<u>Roads:</u>						
314	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	1,520	24.38	37,050.00		
315	200mm thick sub-base	m2	1,520	21.00	31,920.00		
316	200mm thick base	m2	1,520	24.00	36,480.00		
317	Prime coat	m2	1,520		included		
318	Prime sealer 7mm thick	m2	1,520		included		
319	Tack coat	m2	1,520		included		
320	40mm asphalt concrete AC14	m2	1,520	45.00	68,400.00		
321	Line marking	Item	1	300.00	300.00		
	<u>Shoulders:</u>						
322	Excavate and remove for new shoulders approx. 410 thick	m2	600	22.88	13,725.00		
323	200mm thick sub-base	m2	600	21.00	12,600.00		
324	200mm thick base	m2	600	24.00	14,400.00		
325	Prime coat	m2	600	15.00	9,000.00		
326	Prime sealer 7mm thick	m2	600		included		
327	Flush kerbs	m	40	45.00	1,800.00		
328	Signage	Item	1	300.00	300.00	225,975.00	291,000.00
	Cherratta Road - Woodbrook Road to Orkney						
	<u>Roads:</u>						
329	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	3,800	24.38	92,625.00		
330	200mm thick sub-base	m2	3,800	21.00	79,800.00		
331	200mm thick base	m2	3,800	24.00	91,200.00		
332	Prime coat	m2	3,800		included		
333	Prime sealer 7mm thick	m2	3,800		included		
334	Tack coat	m2	3,800		included		
335	40mm asphalt concrete AC14	m2	3,800	45.00	171,000.00		
336	Line marking	Item	1	750.00	750.00		
	<u>Shoulders:</u>						
337	Excavate and remove for new shoulders approx. 410 thick	m2	1,500	22.88	34,312.50		
338	200mm thick sub-base	m2	1,500	21.00	31,500.00		
339	200mm thick base	m2	1,500	24.00	36,000.00		
340	Prime coat	m2	1,500	15.00	22,500.00		
341	Prime sealer 7mm thick	m2	1,500		included		
342	Flush kerbs	m	60	45.00	2,700.00		
343	Signage	Item	1	750.00	750.00	563,137.50	724,000.00
	Croydon Road - Coolawanyah Road to Cherratta Road						
	<u>Roads:</u>						
344	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	3,610	24.38	87,993.75		
345	200mm thick sub-base	m2	3,610	21.00	75,810.00		
346	200mm thick base	m2	3,610	24.00	86,640.00		
347	Prime coat	m2	3,610		included		
348	Prime sealer 7mm thick	m2	3,610		included		
349	Tack coat	m2	3,610		included		
350	40mm asphalt concrete AC14	m2	3,610	45.00	162,450.00		
351	Line marking	Item	1	712.50	712.50		
	<u>Shoulders:</u>						
352	Excavate and remove for new shoulders approx. 410 thick	m2	1,425	22.88	32,596.88		
353	200mm thick sub-base	m2	1,425	21.00	29,925.00		
354	200mm thick base	m2	1,425	24.00	34,200.00		
355	Prime coat	m2	1,425	15.00	21,375.00		
356	Prime sealer 7mm thick	m2	1,425		included		
357	Flush kerbs	m	40	45.00	1,800.00		
358	Signage	Item	1	712.50	712.50	534,215.63	687,000.00

KARRATHA LIA ROADS UPGRADE
CONCEPT ESTIMATE

04/06/2014

Ref	Scope	Unit	Qty	Rate	Total	Section Total Net	Section Total Gross
				\$	\$	\$	\$
	Woodbrook Road - Cherratta Road to Coolawanyah Road						
	<u>Roads:</u>						
359	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	3,610	24.38	87,993.75		
360	200mm thick sub-base	m2	3,610	21.00	75,810.00		
361	200mm thick base	m2	3,610	24.00	86,640.00		
362	Prime coat	m2	3,610		included		
363	Prime sealer 7mm thick	m2	3,610		included		
364	Tack coat	m2	3,610		included		
365	40mm asphalt concrete AC14	m2	3,610	45.00	162,450.00		
366	Line marking	Item	1	712.50	712.50		
	<u>Shoulders:</u>						
367	Excavate and remove for new shoulders approx. 410 thick	m2	1,425	22.88	32,596.88		
368	200mm thick sub-base	m2	1,425	21.00	29,925.00		
369	200mm thick base	m2	1,425	24.00	34,200.00		
370	Prime coat	m2	1,425	15.00	21,375.00		
371	Prime sealer 7mm thick	m2	1,425		included		
372	Flush kerbs	m	40	45.00	1,800.00		
373	Signage	Item	1	712.50	712.50	534,215.63	687,000.00
	Augustus Drive - Coolawanyah Road to end						
	<u>Roads:</u>						
374	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	10,660	24.38	259,837.50		
375	200mm thick sub-base	m2	10,660	21.00	223,860.00		
376	200mm thick base	m2	10,660	24.00	255,840.00		
377	Prime coat	m2	10,660		included		
378	Prime sealer 7mm thick	m2	10,660		included		
379	Tack coat	m2	10,660		included		
380	40mm asphalt concrete AC14	m2	10,660	45.00	479,700.00		
381	Line marking	Item	1	1,950.00	1,950.00		
	<u>Shoulders:</u>						
382	Excavate and remove for new shoulders approx. 410 thick	m2	3,900	22.88	89,212.50		
383	200mm thick sub-base	m2	3,900	21.00	81,900.00		
384	200mm thick base	m2	3,900	24.00	93,600.00		
385	Prime coat	m2	3,900	15.00	58,500.00		
386	Prime sealer 7mm thick	m2	3,900		included		
387	Flush kerbs	m	40	45.00	1,800.00		
388	Signage	Item	1	1,950.00	1,950.00	1,548,150.00	1,991,000.00
	Cowle Road - Augustus Road to Seabrook Crescent						
	<u>Roads:</u>						
389	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	2,090	24.38	50,943.75		
390	200mm thick sub-base	m2	2,090	21.00	43,890.00		
391	200mm thick base	m2	2,090	24.00	50,160.00		
392	Prime coat	m2	2,090		included		
393	Prime sealer 7mm thick	m2	2,090		included		
394	Tack coat	m2	2,090		included		
395	40mm asphalt concrete AC14	m2	2,090	45.00	94,050.00		
396	Line marking	Item	1	412.50	412.50		
	<u>Shoulders:</u>						
397	Excavate and remove for new shoulders approx. 410 thick	m2	825	22.88	18,871.88		
398	200mm thick sub-base	m2	825	21.00	17,325.00		
399	200mm thick base	m2	825	24.00	19,800.00		
400	Prime coat	m2	825	15.00	12,375.00		
401	Prime sealer 7mm thick	m2	825		included		
402	Flush kerbs	m	40	45.00	1,800.00		
403	Signage	Item	1	412.50	412.50	310,040.63	399,000.00

KARRATHA LIA ROADS UPGRADE
CONCEPT ESTIMATE

04/06/2014

Ref	Scope	Unit	Qty	Rate	Total	Section Total Net	Section Total Gross
				\$	\$	\$	\$
	Cowle Road - Coolawanyah Rod to Seabrook Crescent Roads:						
404	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	1,900	24.38	46,312.50		
405	200mm thick sub-base	m2	1,900	21.00	39,900.00		
406	200mm thick base	m2	1,900	24.00	45,600.00		
407	Prime coat	m2	1,900		included		
408	Prime sealer 7mm thick	m2	1,900		included		
409	Tack coat	m2	1,900		included		
410	40mm asphalt concrete AC14	m2	1,900	45.00	85,500.00		
411	Line marking	Item	1	375.00	375.00		
	Shoulders:						
412	Excavate and remove for new shoulders approx. 410 thick	m2	750	22.88	17,156.25		
413	200mm thick sub-base	m2	750	21.00	15,750.00		
414	200mm thick base	m2	750	24.00	18,000.00		
415	Prime coat	m2	750	15.00	11,250.00		
416	Prime sealer 7mm thick	m2	750		included		
417	Flush kerbs	m	40	45.00	1,800.00		
418	Signage	Item	1	375.00	375.00	282,018.75	363,000.00
	Fisher Way - Coolawanyah Road to Pemberton Way Roads:						
419	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	2,280	24.38	55,575.00		
420	200mm thick sub-base	m2	2,280	21.00	47,880.00		
421	200mm thick base	m2	2,280	24.00	54,720.00		
422	Prime coat	m2	2,280		included		
423	Prime sealer 7mm thick	m2	2,280		included		
424	Tack coat	m2	2,280		included		
425	40mm asphalt concrete AC14	m2	2,280	45.00	102,600.00		
426	Line marking	Item	1	450.00	450.00		
	Shoulders:						
427	Excavate and remove for new shoulders approx. 410 thick	m2	600	22.88	13,725.00		
428	200mm thick sub-base	m2	600	21.00	12,600.00		
429	200mm thick base	m2	600	24.00	14,400.00		
430	Prime coat	m2	600	15.00	9,000.00		
431	Prime sealer 7mm thick	m2	600		included		
432	Flush kerbs	m	40	45.00	1,800.00		
433	Signage	Item	1	450.00	450.00	313,200.00	403,000.00
	Mardie Road - Coolawanyah Road to Anderson Road Roads:						
434	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	3,230	24.38	78,731.25		
435	200mm thick sub-base	m2	3,230	21.00	67,830.00		
436	200mm thick base	m2	3,230	24.00	77,520.00		
437	Prime coat	m2	3,230		included		
438	Prime sealer 7mm thick	m2	3,230		included		
439	Tack coat	m2	3,230		included		
440	40mm asphalt concrete AC14	m2	3,230	45.00	145,350.00		
441	Line marking	Item	1	637.50	637.50		
	Shoulders:						
442	Excavate and remove for new shoulders approx. 410 thick	m2	1,275	22.88	29,165.63		
443	200mm thick sub-base	m2	1,275	21.00	26,775.00		
444	200mm thick base	m2	1,275	24.00	30,600.00		
445	Prime coat	m2	1,275	15.00	19,125.00		
446	Prime sealer 7mm thick	m2	1,275		included		
447	Flush kerbs	m	20	45.00	900.00		
448	Signage	Item	1	637.50	637.50	477,271.88	614,000.00

KARRATHA LIA ROADS UPGRADE
CONCEPT ESTIMATE

04/06/2014

Ref	Scope	Unit	Qty	Rate	Total	Section Total Net	Section Total Gross
				\$	\$	\$	\$
	McKay Street - Coolawanyah Road to Pemberton Way						
	<u>Roads:</u>						
449	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	1,520	24.38	37,050.00		
450	200mm thick sub-base	m2	1,520	21.00	31,920.00		
451	200mm thick base	m2	1,520	24.00	36,480.00		
452	Prime coat	m2	1,520		included		
453	Prime sealer 7mm thick	m2	1,520		included		
454	Tack coat	m2	1,520		included		
455	40mm asphalt concrete AC14	m2	1,520	45.00	68,400.00		
456	Line marking	Item	1	300.00	300.00		
	<u>Shoulders:</u>						
457	Excavate and remove for new shoulders approx. 410 thick	m2	600	22.88	13,725.00		
458	200mm thick sub-base	m2	600	21.00	12,600.00		
459	200mm thick base	m2	600	24.00	14,400.00		
460	Prime coat	m2	600	15.00	9,000.00		
461	Prime sealer 7mm thick	m2	600		included		
462	Flush kerbs	m	40	45.00	1,800.00		
463	Signage	Item	1	300.00	300.00	225,975.00	291,000.00
	Off Anderson-Anderson to end						
	<u>Roads:</u>						
464	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	4,940	24.38	120,412.50		
465	200mm thick sub-base	m2	4,940	21.00	103,740.00		
466	200mm thick base	m2	4,940	24.00	118,560.00		
467	Prime coat	m2	4,940		included		
468	Prime sealer 7mm thick	m2	4,940		included		
469	Tack coat	m2	4,940		included		
470	40mm asphalt concrete AC14	m2	4,940	45.00	222,300.00		
471	Line marking	Item	1	975.00	975.00		
	<u>Shoulders:</u>						
472	Excavate and remove for new shoulders approx. 410 thick	m2	1,950	22.88	44,606.25		
473	200mm thick sub-base	m2	1,950	21.00	40,950.00		
474	200mm thick base	m2	1,950	24.00	46,800.00		
475	Prime coat	m2	1,950	15.00	29,250.00		
476	Prime sealer 7mm thick	m2	1,950		included		
477	Flush kerbs	m	20	45.00	900.00		
478	Signage	Item	1	975.00	975.00	729,468.75	938,000.00
	Seabrook Crescent - Coolawanyah Road to Cowle Road						
	<u>Roads:</u>						
479	Excavate and remove roads, base course and sub-base approx. 450mm thick	m2	4,750	24.38	115,781.25		
480	200mm thick sub-base	m2	4,750	21.00	99,750.00		
481	200mm thick base	m2	4,750	24.00	114,000.00		
482	Prime coat	m2	4,750		included		
483	Prime sealer 7mm thick	m2	4,750		included		
484	Tack coat	m2	4,750		included		
485	40mm asphalt concrete AC14	m2	4,750	45.00	213,750.00		
486	Line marking	Item	1	937.50	937.50		
	<u>Shoulders:</u>						
487	Excavate and remove for new shoulders approx. 410 thick	m2	1,875	22.88	42,890.63		
488	200mm thick sub-base	m2	1,875	21.00	39,375.00		
489	200mm thick base	m2	1,875	24.00	45,000.00		
490	Prime coat	m2	1,875	15.00	28,125.00		
491	Prime sealer 7mm thick	m2	1,875		included		
492	Flush kerbs	m	40	45.00	1,800.00		
493	Signage	Item	1	937.50	937.50	702,346.88	900,000.00

KARRATHA LIA ROADS UPGRADE
CONCEPT ESTIMATE

04/06/2014

Ref	Scope	Unit	Qty	Rate	Total	Section Total Net \$	Section Total Gross \$
				\$	\$		
494	Sub-Total				19,621,197.38	19,621,197.38	25,230,000.00
495	Preliminaries	8%				1,578,802.62	included
496	Total Construction Cost					21,200,000.00	included
497	Design Contingency	10%				2,120,000.00	included
498	Construction Contingency	3%				640,000.00	included
499	Professional Fees & Disbursements	6%				1,270,000.00	included
500	Shire Management Costs					excluded	included
501	Total (at current prices)					25,230,000.00	25,230,000.00
502	Escalation to Tender					excluded	excluded
503	Total (excluding GST)					25,230,000.00	25,230,000.00
504	GST					2,523,000.00	2,523,000.00
505	Total					27,753,000.00	27,753,000.00

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