

University of Southern Queensland  
Faculty of Health, Engineering & Sciences

**The Economic Feasibility of Upgrading  
Moree's Light Industrial Area to Legally Cater  
for Restricted Access Vehicles**

A dissertation submitted by

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In fulfilment of the requirements of

**ENG4111/ENG4112 Research Project**

Towards the Degree of

**Bachelor of Engineering (Civil)**

Submitted: October 2013

## Abstract

The transport and freight industries of Australia are heavily reliant on the country's road network. Australia's road freight task is expected to double by 2020 and to increase efficiency vehicles are becoming larger and hence have the ability to carry heavier loads. Restricted Access Vehicles (RAVs) are those that exceed the dimensions of typical heavy vehicles and include B-Doubles, A-Doubles (road trains), AB-Triples and B-Triples. These are allowed to operate carrying a higher mass which allows more goods to be transported and productivity improved.

Due to their increased size these vehicles require a much wider area in order to safely and legally manoeuvre around intersections. Many towns and cities simply do not have adequate infrastructure to cater for such large vehicles. This is specifically the case of the Light Industrial Area of Moree, NSW which has caused Moree Plains Shire Council to commission the investigation of the implications into upgrading this area to cater for RAVs.

This investigation focusses on identifying the intersections in the Light Industrial Area which cannot legally cater for RAVs and the works required to ensure legal access could be approved by Council and the Roads and Maritime Services (RMS). These construction works and their associated costs were identified with varying levels of upgrade so expenses could be compared. As an alternative the costs of a breakdown facility have been determined but consideration is also given to constructing this to complement the upgrade of the Light Industrial Area.

Many considerations have been given to these alternatives including technical, social and economic. These produced recommendations to fully upgrade the Light Industrial Area for RAV access up to B-Triples and evaluate the possibility of constructing a breakdown facility in Moree. This study has developed a basic framework which can be used as a basis when this problem occurs in other parts of MPSC. It will help provide safe and legal RAV access to businesses and their customers which will assist Moree in maintaining their current stance as major agricultural producers.

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**Casey Spilsbury-Brinkmann**

**0050103424**

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Signature

**22/10/2013**

Date



## Acknowledgements

This research was carried out under the principle supervision of Mr Trevor Drysdale, University of Southern Queensland and Ms Lila Fisher, Project and Development Manager, Moree Plains Shire Council.

I would like to acknowledge Moree Plains Shire Council as my employer and for the opportunity to develop this project and design. I would also like to thank my supervisors Mr Trevor Drysdale and Ms Lila Fisher for their continuing support throughout this study.

# Table of Contents

Abstract .....	ii
Disclaimer .....	iii
Certification of Dissertation .....	iv
Acknowledgements .....	v
Table of Contents .....	vi
List of Figures .....	ix
List of Tables .....	x
Glossary of Terms .....	xi
1.0 Introduction .....	1
1.1 Project Statement.....	1
1.2 Project Aims .....	2
2.0 Background .....	3
2.1 Heavy Vehicle Fleet .....	3
2.1.1 Single Articulated Truck.....	3
2.1.2 B-Double.....	3
2.1.3 A-Doubles (Road Trains) .....	4
2.1.4 AB-Triples .....	4
2.1.5 B-Triples .....	5
2.2 Moree, NSW, 2400.....	5
2.2.1 Moree’s Current Restricted Access Vehicle Routes.....	6
2.2.2 Moree’s Light Industrial Area .....	6
2.2.3 Breakdown Facility Location .....	8
3.0 Literature Review .....	10
3.1 Austroads Guidelines.....	11
3.1.1 Austroads Design Vehicles and Turning Path Templates Guide.....	11
3.1.2 Guideline for Freight Routes in Urban and Rural Areas .....	11
3.1.3 Guidelines for Assessing Heavy Vehicle Access to Local Roads .....	12
3.2 Roads and Maritime Services NSW Guidelines.....	13
3.2.1 NSW Route Assessment Guide for Restricted Access Vehicles .....	13
3.2.2 NSW Route Assessment Guide – Freight Route Investigation Levels.....	14
3.3 National Heavy Vehicle Regulator.....	15
4.0 Background Material.....	16

4.1 Assessment of Consequential Effects.....	16
4.1.1 Sustainability Aspects.....	16
4.1.2 Ethical Aspects .....	18
4.1.3 Safety Aspects .....	18
4.2 Resource Analysis .....	18
4.3 Project Timelines.....	19
4.4 Risk Assessment.....	20
4.4.1 Risks During Project Execution.....	20
4.4.2 Risks Beyond Project Completion.....	21
5.0 Methodology .....	22
5.1 Intersection Evaluation.....	23
5.1.1 B-Triples, AB-Triples and A-Doubles.....	23
5.1.2 B-Doubles .....	25
5.2 Determination of Order of Works .....	26
5.3 Cost Estimates .....	28
5.3.1 Road Rehabilitation .....	28
5.3.2 Kerb and Gutter .....	28
5.3.3 Pipe Culverts.....	29
5.3.4 Power Poles .....	29
5.3.5 Land Acquisitions .....	30
5.3.6 Labour.....	30
5.3.7 Survey and Design.....	30
5.4 Intersection Construction Costs.....	31
5.4.1 B-Triple, AB-Triple and A-Double Upgrade Costs.....	31
5.4.2 B-Double Upgrade Costs .....	33
5.5 Breakdown Facility Construction.....	35
6.0 Design Analysis .....	37
6.1 Economic Considerations.....	37
6.1.1 B-Triples, AB-Triples and A-Double Economic Considerations.....	37
6.1.2 B-Double Economic Considerations .....	38
6.1.3 Breakdown Area Economic Considerations.....	40
6.1.4 Moree's Economic Considerations .....	40
6.1.5 Alternative Funding .....	41

6.2 Technical Considerations .....	42
6.2.1 Technical Feasibility .....	42
6.2.2 Traffic Considerations .....	43
6.2.3 Safety Concerns .....	45
6.3 Social Considerations .....	47
7.0 Recommendations .....	50
8.0 Conclusion .....	51
9.0 Southern Moree Bypass .....	54
10.0 List of References .....	55
Appendix A – Project Specification.....	58
Appendix B – Moree Vehicle Routes for B-Doubles, A-Doubles, AB-Triples and B-Triples .....	60
Appendix C – RAV Template Overlays for Each Vehicle Class .....	62
Appendix D – Costing Spreadsheets for Various Levels of Upgrade.....	135

## List of Figures

Figure 1: Configuration and Maximum Allowable Mass (tonnes) of a Single Articulated Truck .....	3
Figure 2: Configuration and Maximum Allowable Mass (tonnes) of a 26m B-Double .....	4
Figure 3: Configuration and Maximum Allowable Mass (tonnes) of a Road Train....	4
Figure 4: Configuration and Maximum Allowable Mass (tonnes) of and AB-Triple .	5
Figure 5: Configuration and Maximum Allowable Mass (tonnes) of a B-Triple .....	5
Figure 6: Location of Moree, NSW, 2400 (RMS) .....	6
Figure 7: Businesses in Moree's Light Industrial Area .....	7
Figure 8: Businesses in Moree's Light Industrial Area .....	8
Figure 9: Proposed Location of Breakdown Facility .....	9
Figure 10: Upgrade Plan for B-Triples, AB-Triples and A-Doubles.....	25
Figure 11: Upgrade Plan for B-Doubles .....	26
Figure 12: RAV Access to Businesses.....	27
Figure 13: Kerb and Gutter Profile for Light Industrial Area.....	29
Figure 14: Full LIA Upgrade Plan for B-Triples, AB-Triples and A-Doubles.....	33
Figure 15: Full LIA Upgrade Plan for B-Doubles .....	34
Figure 16: Proposed Layout for the Breakdown Facility .....	36
Figure 17: A Typical B-Double (Mohr, 2010).....	39
Figure 18: Moree's Hot Artesian Spa Baths - A Major Economic Contributor (Swimplex Aquatics, 2010).....	41

# List of Tables

Table 1: Timeline of Project Objectives .....20

Table 2: Intersection Evaluation for B-Triples, AB-Triples and A-Doubles.....24

Table 3: Intersection Evaluation for B-Doubles .....26

Table 4: Intersection Priority .....27

Table 5: Unit Rates for Construction Works.....28

Table 6: Intersection Upgrade Costs for RAVs up to B-Triples.....32

Table 7: Full LIA Upgrade Costs for RAVs up to B-Triples.....33

Table 8: Intersection Upgrade Costs for B-Doubles .....34

Table 9: Full LIA Upgrade Costs for B-Doubles.....35

Table 10: Total Costs for Each Upgrade Level.....37

## Glossary of Terms

A-Double – A heavy vehicle consisting of two trailers with a 36.5 metre length with the second most severe turning path.

AB-Triple – A heavy vehicle consisting of 3 trailers with a 36.5 metre length that can carry the most weight. It has the second best turning path.

B-Double – A heavy vehicle consisting of two trailers with a 26 metre length and has the least severe turning path.

B-Triple – A heavy vehicle consisting of 3 trailers with a 36.5 metre length that has the most severe turning path.

Heavy Vehicle – Any vehicle that weighs more than 4.5 tonnes. Typically any class of truck.

Light Industrial Area (of Moree) – An area of Moree adjacent to the Newell Highway that is currently classed as light industrial where 7 businesses operate from offering goods and services primarily relating to agriculture.

Moree Plains Shire Council (MPSC) – A local council in Northern New South Wales with Moree as the major centre.

National Heavy Vehicle Regulator (NHVR) – A national regulator that monitors the approvals, accreditation and design of all heavy vehicles.

Turning path – The path a vehicle follows when making a turning manoeuvre that outlines the inner and outer wheel path based on a specified turning speed.

Restricted Access Vehicle (RAV) – A vehicle that exceeds width, height, length and/or some internal dimensions of vehicles as specified in Road Transport (Registration) Regulation 2007.

Roads and Maritime Services (RMS) – The NSW State Government agency that manages the road network. This includes testing and licensing drivers of all vehicles and registers and inspects all vehicles.

## 1.0 Introduction

Australia's road network is an integral element of the country's transport and freight industry. It is expected that by 2020 the road freight task within Australia will double with vehicles becoming larger in an attempt to increase productivity and reduce the risk of driver shortages.

Most freight vehicles operating within Australia's road network function under the term of restricted access vehicles (RAVs). RAVs include (but aren't limited to) B-Doubles, A-Doubles (road trains), AB-Triples and B-Triples of which B-Doubles, AB-Triples and B-Triples are all encompassed as higher productivity vehicles. Higher productivity vehicles operate at increased mass limits hence allowing larger loads to be transported and improving social and economic efficiency.

With increased sizes and loading also comes a difficulty with movements of RAVs throughout the road network. This is particularly problematic as RAVs move through towns and cities where infrastructure is often damaged and the safety of other road users is questionable as the vehicles move through areas unsuitable for such large vehicles.

The light industrial area of Moree, NSW currently has 7 businesses operating within it. However, this area is only approved for vehicles up to a single articulated truck (semi-trailer). Moree Plains Shire Council has commissioned an investigation into the feasibility and possible consequences of seeking approval for vehicles up to B-Triples in this area as a result of consistent pressure from the local businesses.

In conjunction with this research will be completed to determine the viability of a breakdown facility for heavy vehicles with more than one trailer so that they can disconnect trailers and move through Moree as a semi-trailer. This would provide an alternative to upgrading the Light Industrial Area.

### 1.1 Project Statement

The aim of this project is to investigate cost implications, technical feasibility and social effect of upgrading the light industrial area of Moree, NSW to legally cater for restricted access vehicles (RAVs) up to B-Triples and examine the viability of a



heavy vehicle breakdown area.

## 1.2 Project Aims

To ensure this research addresses the project aim five main objectives have been produced. These are as follows:

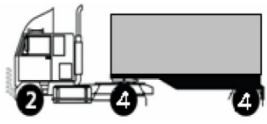
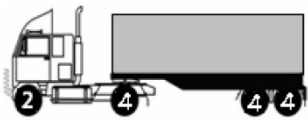




1. Utilise Austroads sweep path templates overlaid onto aerial photos of the light industrial area to determine which roads/intersections can already cater for RAVs.
2. Examine the construction required in the area and develop an order of works based on which initial construction benefits the most businesses.
3. Calculate the expense of upgrading and develop a spreadsheet showing all inclusive costs.
4. Investigate the social, economic and technical factors related to the feasibility and provide a dissertation based on these findings.
5. Calculate expenses and examine the potential of a breakdown facility for RAVs.

## 2.0 Background

### 2.1 Heavy Vehicle Fleet

#### 2.1.1 Single Articulated Truck

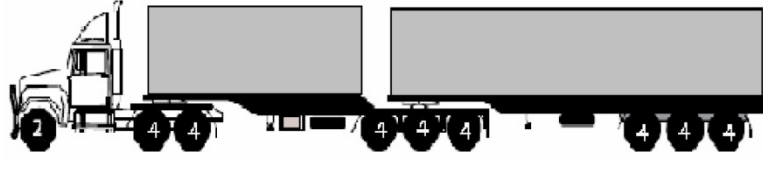
A single articulated truck (semi-trailer) is the combination of a prime mover and trailer where the trailer has no front axle. These are general access vehicles and are typically less than 19 metres in length. In NSW the gross vehicle mass is restricted to 42.5 tonnes for a 19m single articulated truck.

			
GML	6      9      9	24t	
CML	N/A		
			
GML	6    16.5    16.5	39t	
CML	6    17      17	40t	
HML	N/A		
			
GML	6    16.5      20	42.5t	
CML	6    17      21	43.5t	∅
HML	6    17      22.5	45.5t	1AP <sup>j</sup>

**Figure 1: Configuration and Maximum Allowable Mass (tonnes) of a Single Articulated Truck**

#### 2.1.2 B-Double

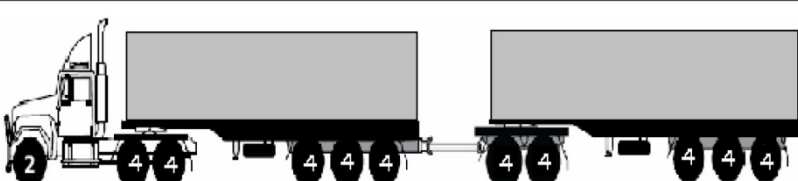
A B-Double is the combination of a prime mover and two trailers which are linked by a B-coupling. This B-coupling is located at the rear of the initial trailer and improves stability as well as increasing simplicity when adding or removing the second trailer. The B-Double is the first of the restricted access vehicles and ranges from 19-26 metres in length. When completing route assessments it is typical for a 26 metre vehicle to be considered as it is worst case scenario. This project therefore will only investigate 26 metre B-Doubles. The 26 metre B-Double gross vehicle mass is limited to 62.5 tonnes.

					
GML	6	16.5	20	20	62.5t <sup>(7) (8)</sup>
CML	6	17	21	21	64.5t <sup>(7) (8) d</sup>
HML	6	17	22.5	22.5	68t IAP <sup>(7) (8) f</sup>

**Figure 2: Configuration and Maximum Allowable Mass (tonnes) of a 26m B-Double**

### 2.1.3 A-Doubles (Road Trains)

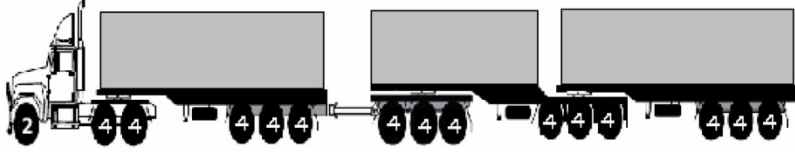
An A-Double (Road Train) is similar to a B-Double as it is a combination of a prime mover and two trailers however it can be up to 36.5 metres long. When assessing routes for A-Doubles a typical Type 1 A-Double vehicle combination is used. In NSW the gross vehicle mass of road trains is restricted to 79 tonnes.

						
GML	6	16.5	20	16.5	20	79t <sup>(9)</sup>
CML	6	17	21	17	21	81t <sup>(9) d</sup>
HML	6	17	22.5	17	22.5	85t IAP <sup>(9) f</sup>

**Figure 3: Configuration and Maximum Allowable Mass (tonnes) of a Road Train**

### 2.1.4 AB-Triples


AB-Triples are a combination of a single articulated truck and a B-Double. They consist of a prime mover, semi-trailer, converter dolly and a B-Double. As with A-Doubles and B-Triples they are limited to 36.5 metres in length and in NSW are restricted to having a gross vehicle mass of 102.5 tonnes.

							
GML	6	16.5	20	20	20	20	102.5t IAP <sup>(9)</sup>
CML	6	17	21	21	21	21	104.5t IAP <sup>(9)δ</sup>
HML	6	17	22.5	22.5	22.5	22.5	113t IAP <sup>(9)†</sup>

**Figure 4: Configuration and Maximum Allowable Mass (tonnes) of and AB-Triple**

### 2.1.5 B-Triples

A B-Triple is a vehicle with a combination of a prime mover towing three trailers which are linked by B-couplings. There is a large push for B-Triples to be used more often than road trains due to their increased efficiency and reduced pavement wear. B-Triples are limited to 36.5 metres in length and have a limiting gross vehicle mass of 82.5 tonnes in NSW.

							
GML	6	16.5	20	20	20	20	82.5t IAP <sup>(9)</sup>
CML	6	17	21	21	21	21	84.5t IAP <sup>(9)δ</sup>
HML	6	17	22.5	22.5	22.5	22.5	90.5t IAP <sup>(9)†</sup>

**Figure 5: Configuration and Maximum Allowable Mass (tonnes) of a B-Triple**

## 2.2 Moree, NSW, 2400

Moree was first established as a settlement in 1844 and gazetted as a town in 1862. Its location is shown in Figure 6 and currently has a population of approximately 7,800 with 13,400 in the whole of Moree Plains Shire. Moree is a strong agricultural town with large amounts of production. The items produced in the shire include (but aren't limited to) cotton, wheat, pecans, olives and cattle. Moree is well known for its' hot artesian baths and is currently progressing with vast plans for future economic development.



Figure 6: Location of Moree, NSW, 2400 (RMS)

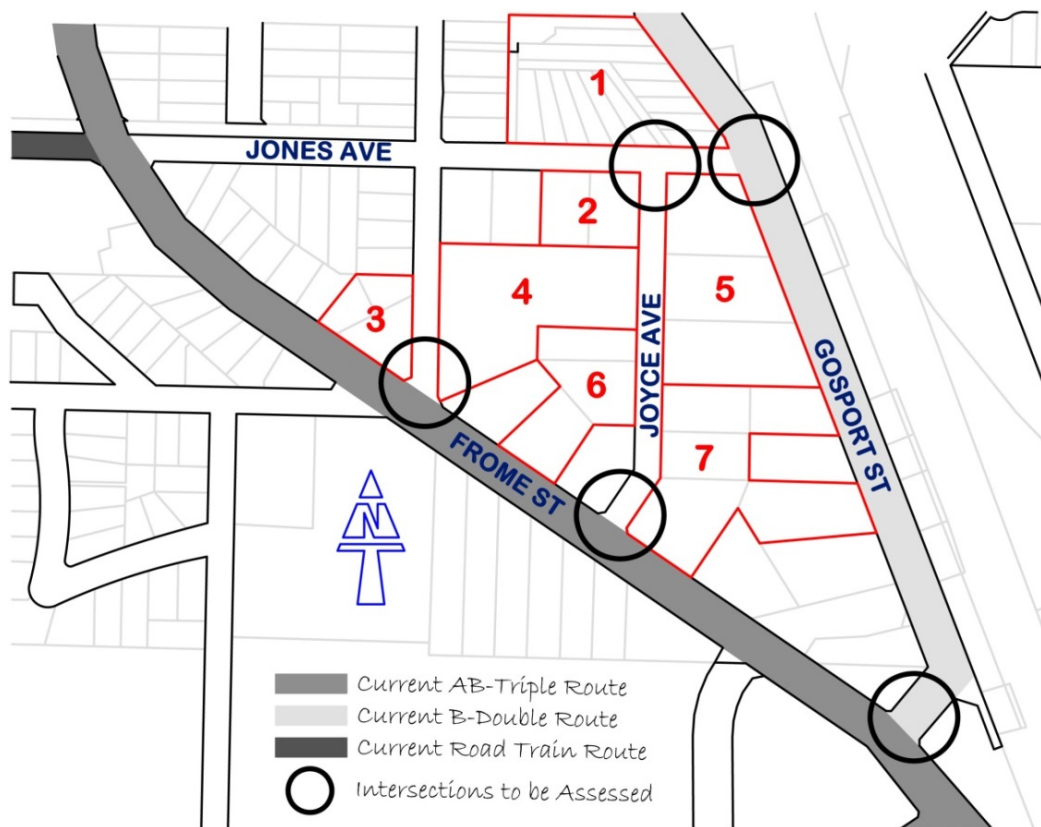
### 2.2.1 Moree's Current Restricted Access Vehicle Routes

All highways through or around Moree (Carnarvon, Gwydir and Newell) are currently approved for vehicles up to AB-Triples. B-Triples are not approved East of Moree. Through the township of Moree the Gwydir Highway is only approved for Road Trains. There are several other areas of Moree also approved and all the current RAV routes can be seen in Appendix B.

### 2.2.2 Moree's Light Industrial Area

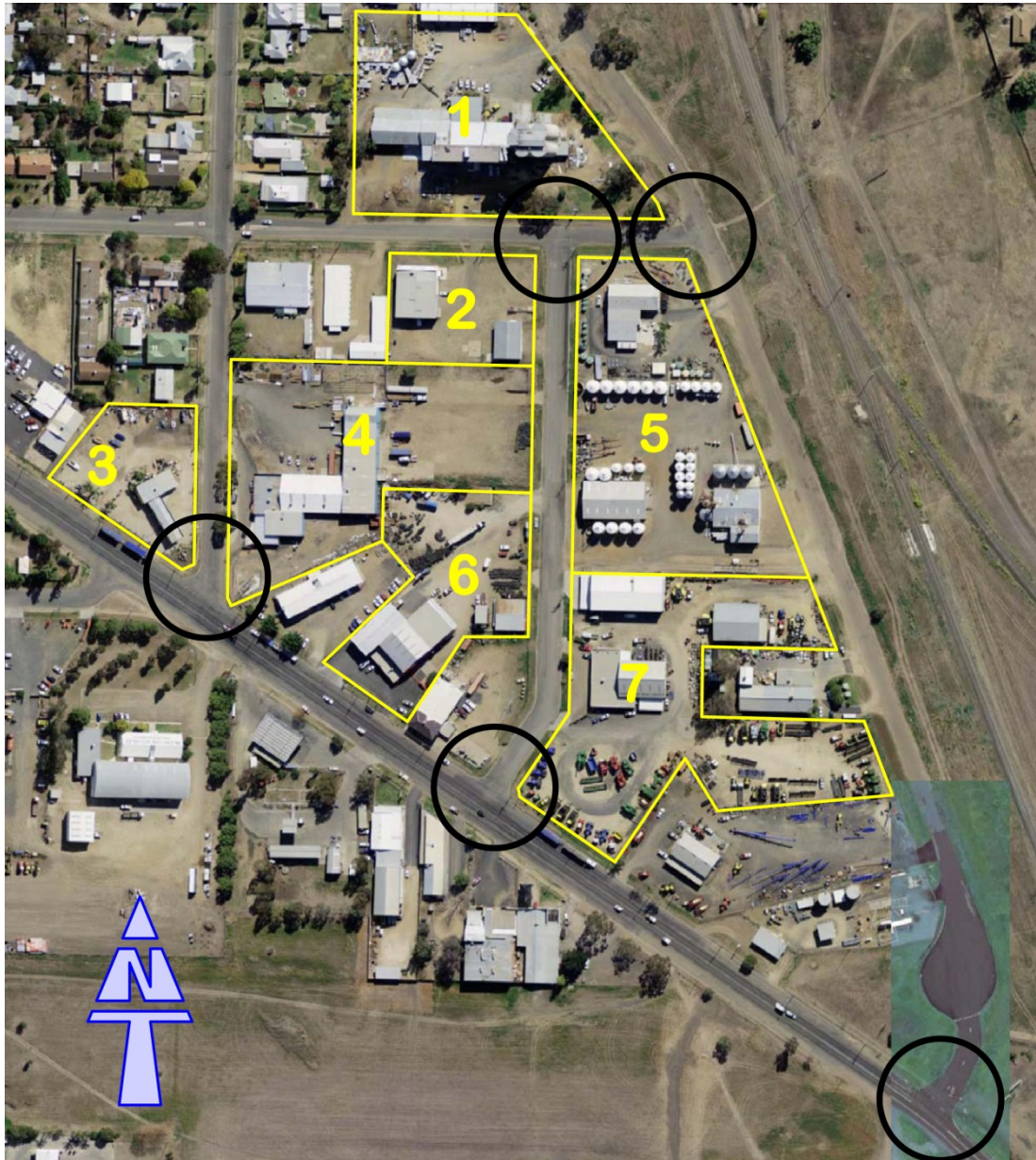
Seven businesses operate out of the Light Industrial Area of Moree with dealings ranging from agricultural goods, hardware, tyre services and the like. Figure 7 shows the currently approved routes and the business locations (indicated by numbers) within the Light Industrial Area. Only businesses 6 and 7 have requested access for up to B-Triples and AB-Triples however with vehicle size constantly increasing it will be initially considered to upgrade the entire area for B-Triples. Figure 7 also shows the roads and intersections that will be investigated as part of this project. An aerial image of the Light Industrial Area is shown in Figure 8 (again with

intersections marked).



**Figure 7: Businesses in Moree's Light Industrial Area**





**Figure 8: Businesses in Moree's Light Industrial Area**

### **2.2.3 Breakdown Facility Location**

A vacant block of land was purchased by MPSC in 2013 and a various number of alternatives have been considered to ensure the economic viability of this purchase. These options have included but aren't limited to residential housing, car parking facilities and an extension of the nearby sporting facility. This study looks at the potential of developing a portion of this land as a breakdown facility and an aerial image of the land can be seen in Figure 9.



**Figure 9: Proposed Location of Breakdown Facility**



### 3.0 Literature Review

In order to upgrade Moree's Light Industrial Area for access up to AB-Triples appropriately research has been done regarding guidelines from national and state road authorities. This is to ensure that when completing designs the proposals will sufficiently satisfy the authorities and that RAV approval can be gazetted.

Many studies have been completed regarding regional areas addressing freight or transport plans in order to determine strategies to improve these networks for that particular region. None of these strategies however specifically focus on heavy vehicles as a means for freight transport. They focus on transport and freight as a whole and focus on meeting needs for all users. This project focuses exclusively on one particular area in the Moree region to ensure that local industries remain local. This area is already linked by roads that have approved access for AB-Triples and a Moree currently has a sufficient and working (however often changing) plan for heavy vehicles throughout the township and the Shire.

Most traffic studies conducted within Moree Plains Shire were conducted by the Roads and Maritime Services in conjunction with planning the Moree Bypass. Whilst these all briefly mention heavy vehicles, none are specifically directed at investigating heavy vehicles and their movements throughout the Shire. This is unexpected as 17% of the vehicles travelling through Moree are deemed heavy vehicles.

According to the Moree Plains Shire Growth Management Strategy population within Moree and the Shire is expected to grow over the next decade and corresponding to this the Roads and Maritime Services Environmental Impact Statement for The Moree Bypass Project predicts that traffic flow along the Newell Highway will significantly increase over the coming years. With these in mind, it is important that freight routes within the township and continued to be a part of the planning process. With the light industrial area supplying Moree and surrounding farms with goods and services it is integral that they have a road freight network that is adequate to initially import the goods.

### 3.1 Austroads Guidelines

Austroads is a national authority that has produced a substantial number of guides, technical reports and research reports regarding a number of transport aspects including asset management, freight, pavement, road design and safety and traffic management. Several guides and reports specifically focus on heavy vehicles and freight networks and are outlined below:

- Austroads Design Vehicles and Turning Path Templates Guide (2013)
- Guideline for Freight Routes in Urban and Rural Areas (2007)
- Guidelines for Assessing Heavy Vehicle Access to Local Roads (2009)

#### 3.1.1 Austroads Design Vehicles and Turning Path Templates Guide

This guide primarily details vehicle dimensions and performance capability of a wide range of design vehicles at different speeds. It provides valuable information for designers when considering the dimensions of intersections so that they are safe for all users. Turning templates are included of all vehicles that represent the vehicle and the wheel path it would cover when manoeuvring a corner or different angles of turn.

Details of how to select a vehicle are included for instances of designing new roads however as with the case of this project the vehicle template will be utilised to determine if manoeuvres are possible on an existing intersection. When applying the templates it must be ensured that no part of the vehicles crosses into adjacent lanes as all manoeuvres must be performed legally.

Of particular importance to this project is the outline of procedures to check the adequacy of an existing road layout. The overlaying of templates must again perform the manoeuvres legally and allowing any part of a heavy vehicle to encroach on an adjacent traffic lane is strongly advised against. These guidelines provided a solid basis in assessing the light industrial area of Moree for heavy vehicles and the processes in which these need to be carried out.

#### 3.1.2 Guideline for Freight Routes in Urban and Rural Areas

Austroads developed this guideline to identify and keep road freight routes that are of strategic and economic importance. With the freight task of Australia expected to

double by 2020 it is vital to also plan for further road freight routes throughout the country. Through completing these tasks it is hoped that state road agencies, transport industries and the community benefit from both the urban and rural freight route as well as provide information on why it is an integral part of road freight.

With two sections in the guide – identification and planning it is described how important it is to strategically maintain and/or create freight routes to preserve the transport industry in Australia. It clearly distinguishes between the needs of urban and rural Australia specifically identifying problems that may occur between heavy vehicles and general vehicles in both instances.

Case studies are provided for both identification and planning of freight routes which demonstrate the principles being utilised at all levels within the network. With this project focussing on one particular area that would directly be accessing businesses this document provides little support. However the access roads to the light industrial area form part of a freight route along the Newell Highway and it is important to ensure that this route is maintained as it provides a significant link through rural NSW.

### **3.1.3 Guidelines for Assessing Heavy Vehicle Access to Local Roads**

The purpose of these guidelines is to ensure all parties that may consider heavy vehicle and RAV access to local roads understand what implications approved or disapproved access may have on the local economy. It aims to improve the consistency of decision-making for route assessments across all of Australia however it is important to keep in mind that individual states will have their own legislation that must still be followed.

Part A of this guideline outlines opinions raised by local councils and operators during consultation. It is identified that economic, environmental and social factors all need to be considered throughout the application process to achieve clarity in the decision making process. Perceptions of different agencies are also raised and the guidelines aim to improve the understanding of the facts to allow a route assessment to be completed efficiently and without bias.

Part B highlights how important it is to consider the freight network in its entirety as well as strategic objectives. Key principles have been developed to support this and

take into consideration all stakeholders. The principles focus on defining outcomes, adapting to local conditions, understanding impacts of decisions, committing to set timeframes and being accountable by monitoring the process and decisions. The need to think strategically is highlighted through three views – system, network and route views. These form the freight network plan and provide the basis of preferred routes across the country.

A typical method of assessing applications is laid out in Part C and includes ensuring Council's processes are adhered to correctly. Whilst it does not provide step by step instructions on how to complete an assessment it offers assistance to the assessment methods Council's would already have in place.

This guideline will assist in the investigation of upgrading Moree's light industrial area by outlining how all aspects of the freight network should be considered rather than the single particular area. Through providing further information that can be considered when completing a route assessment it is ensured that a more thorough and in-depth evaluation of the route can be carried out.

## **3.2 Roads and Maritime Services NSW Guidelines**

With RAVs becoming more prevalent on the NSW road freight transport network Roads and Maritime Services (RMS) have set guidelines aimed at identifying risk categories related to infrastructure that need to be investigated when assessing roads for heavy vehicle access and also how to determine the suitability of a road for heavy vehicles. These guidelines provide techniques on how roads should be assessed and are as follows:

- NSW Route Assessment Guide for Restricted Access Vehicles (2012)
- NSW Route Assessment Guide – Freight Route Investigation Levels (2012)

### **3.2.1 NSW Route Assessment Guide for Restricted Access Vehicles**

The principle behind these guidelines is to introduce RAVs that apply to the guide and provide procedures that need to be followed by the RMS and council staff when assessing applications for access by heavy vehicles to new routes. The guide applies to B-Doubles, Road Trains, B-Triples and AB-Triples as well as 4.6 metre high vehicles, higher mass limits and performance based standard vehicles however the

latter will not be considered in this project. Information is also provided for applicants on procedures they need to follow on how to apply and how assessments are made.

These guidelines introduce and detail each type of freight vehicle and include possible combinations of each type for all Australian states. Comprehensive details are given regarding how to submit an application and how the application is coordinated through RMS using safety assessments including crash investigation reports, risk assessments and safety audits. Safety audits are only required in particular cases such as where the route is not approved for any comparable vehicles or the vehicles are more than 36.5 metres in length.

In many instances, a local council will be the authority required to complete the assessment and approve the application. The person completing the assessment must be suitably qualified and in all cases the assessment is to be submitted to the RMS whether the route is deemed suitable or not. Whether applications are submitted to RMS or local councils an appeal process can be followed if the applicant is unhappy with the outcome. It is important in all applications to consider strategic importance of a route and how it will affect the heavy vehicle network of a town and even a region.

### **3.2.2 NSW Route Assessment Guide – Freight Route Investigation Levels**

The purpose of these guidelines is to provide thorough details on how to carry out a route assessment and the levels of investigation that need to be considered before approving a route. Infrastructure characteristics have been grouped into risk categories of which investigation levels form the sub-categories for RAVs. The risk categories and subsequent sub-categories are as follows:

- Legal/Regulatory – vehicle size, dimensions and land zoning.
- Road Safety – alignment, speed, width, rural or urban, curves, structures, intersections, visibility and local conditions.
- Rail-Road Safety – grade separated crossings and railway crossings.
- Work Health and Safety – decoupling areas and driver breaks.
- Amenity and Environment – existing land use, noise and vibration, air quality and flora and fauna.

- Infrastructure Loading – bridge loadings, pavement structure, flood ways and causeways.
- Property Damage – low clearances.

The guidelines provide figures on what is appropriate for each of the above sub-categories so that when completing the route assessment they can each be passed or require further investigation. If further investigation is required then this does not automatically govern a fail but determination of the level of risk is necessary. If the level of risk is low then it is possible the route may still be approved. This decision is dependent on the assessor. As with the NSW Route Assessment Guide for Restricted Access Vehicles the assessor must meet certain qualification to be deemed capable of making an accurate decision.

### **3.3 National Heavy Vehicle Regulator**

The National Heavy Vehicle Regulator (NHVR) is an Australian first national regulator for heavy vehicles that currently manage the National Heavy Vehicle Accreditation Scheme and Performance Based Standards Scheme. As a national regulator the aim is to reduce inconsistencies across state and territory borders, increase efficiency, safety and productivity and encourage unified compliance and enforcement.

As each state or territory currently has individual legislation regarding the combinations and loadings of what is permitted as well as how route assessments are carried out, results are often varying and/or conflicting. NHVR are planning to deliver a standalone set of laws including the administration of accesses and gazettal's. This is expected to be available late 2013.

## 4.0 Background Material

The following section contains excerpts from the Preliminary Report which provide background information in regards to consequential effects, resources available, project timelines and risk assessments.

### 4.1 Assessment of Consequential Effects

#### 4.1.1 Sustainability Aspects

The Institution of Engineers, Australia has produced a document titled *Towards Sustainable Engineering Practice: Engineering Frameworks for Sustainability* (1997) that stipulates ten aspects of sustainability. Five of these are particularly relevant to this project and are discussed below:

*2. Environmental protection shall constitute an integral part of the development process.*

Stormwater forms part of the environmental protection dimensions that will be considered in this project. Throughout upgrading of the light industrial area it will be ensured through standard construction procedures that pollutants do not enter the stormwater system and that the potential risk of this occurring is minimised. Culverts form part of the stormwater system in this area and often become cluttered with litter as seen on several site visits.

Designs in this study will provide table drains that can be easily maintained by the Moree Plains Shire Urban crew rather than the existing drains that are very steep adjacent to the road proving difficult to keep tidy.

*3. Engineering [and surveying] people should take into consideration the global environmental impacts of local actions and policies.*

The immediate impacts of this project will be minimal as it only investigates the feasibility of upgrading the light industrial area for up to AB-Triples. If Moree Plains Shire Council decides to proceed with the works there will be extensive long term global impacts including less damage to infrastructure, particularly the kerb and gutter and road pavement and more importantly, a safer road network for all road users. This would potentially be achieved through the use of deeper pavement sub-

base, sufficient road widths, marked road centrelines and wider kerb lips. These techniques/designs are not limiting to what will be used in this research project.

*5. Environmental issues should be handled with the participation of all concerned citizens.*

Whilst there will be no one environmentally impacted, the sustainability of a business may be impacted through construction works. When works occur on the Council road reserve access to these businesses may be disrupted. In peak agricultural times this could particularly affect the sales of all businesses in this area. This would need to be mediated through community consultation with each of the businesses before any works begin.

*7. The polluter should bear the cost of pollution and so environmental costs should be internalised by adding them to the cost of production.*

If kerb and gutter, culverts and the like need replacing then waste costs will be incurred through disposal of these at the local Waste Management Facility. These costs will be incorporated into the project budget. Any materials that are removed from the area for example, existing gravel or soil will be spread over existing car parks or ovals that require re-surfacing.

*8. The eradication of poverty, the reduction in differences in living standards and the full participation of women, youth and indigenous people are essential to achieve sustainability.*

This project and its potential construction works have no impact on the above mentioned groups. The works will aid in improving the ability of a business not only to import goods but also deliver them to customers within the Moree Shire. If drivers of heavy vehicles were in excess then this group would suffer as larger and more efficient vehicles negate the need for more drivers. However, with drivers often in short supply this will not disadvantage any particular groups of people.

Furthermore to these aspects, other sustainability factors that require consideration are noise and vibration, aesthetic values, air quality and impacts on existing road users. However, as the area being investigated is already considered as a light industrial area the status of all these factors will remain very similar if not be



reduced when and if construction is finalised.

#### **4.1.2 Ethical Aspects**

The only significant ethical aspect that needs to be taken into consideration is the necessity to remain objective when deciding on the order of works and when seeking quotations. With all businesses in the area relying on the upgrade for improved efficiency when importing and delivering stock no business can be given priority over another. Order of works must be decided simply based on which works will benefit the most businesses.

Seeking quotations based on the expected works requires a tender process and since this project is centred on feasibility it is not possible or within the scope of this project to do so. To calculate expenses for similar construction that occurs throughout Moree Shire unit rates will be used. Otherwise quotes will be sought from local contractors. These would require further investigation before any construction was to start.

#### **4.1.3 Safety Aspects**

Safety aspects associated with completion of this project are limited to any issues that may occur in the field on site visits as no physical experiments will be carried out. To counteract these appropriate measures will be taken in the field with Moree Plains Shire Council safety procedures and safe work method statements (SWMS) followed at all times.

Safety aspects related to the construction phase will be similarly dealt with through the use of safety procedures and SWMS.

If the work proceeds then there will be no safety implications afterwards that would not be expected on a normal road. Safety will have been improved via the use of appropriate lane widths – especially at intersections and provide a better road network for drivers of all vehicles.

### **4.2 Resource Analysis**

As this is not an experimental project no laboratories or workshops are required. All work will be done via site visits and research and design work on a computer. Research will be completed using freely available resources such as research papers,

journal articles, study books and dependable internet sites. This is available through University of Southern Queensland and the internet. As an external student I have access to a computer and reliable internet connection so research will pose no resource setbacks.

Site visits may require equipment such as cameras to take photos of the site, measuring wheels or tapes and possibly survey equipment. The design work to assess intersections will require a design program such as AutoCAD Map 3D and if surveys are required then also a Total Station. As a member of the Engineering Department at Moree Plains Shire Council all of the above equipment and programs are readily available to be used for completion of this project.

There will be no financial resources required for successful completion of this project. Quotations will be sought after but only on a free quotation basis and many of the cost estimates will be based on previous unit rates. There is a very low risk of not having any of the resources required so this should not affect the project.

### 4.3 Project Timelines

The following table presents the project timelines required for successful completion of this project. Objectives 1 and 2 have been completed with this report finalising 3 and 4 currently in progress.

<b>Objective</b>	<b>Requirements</b>	<b>Date</b>	<b>Status</b>
1 –Project Allocation	Confirm project topic.	06/03/2013	Complete
2 – Project Specification	Submit project specification for approval.	13/03/2013	Complete
3 – Preliminary Report	Submit project preliminary report. Have draft literary review, background and risk, resource and effects assessments complete.	30/05/2013	Complete
4 – Progress Assessment	Have draft intersection assessments complete.	12/06/2013	Complete
5 – Partial Dissertation	Submit draft of entire report. Have quotations and social factors mostly complete.	11/09/2013	Complete
6 – ENG4903 Res School	Presentation based on findings to other academic students.	23-27/09/2013	Complete

7 – Dissertation Due Date	Submit all works.	24/10/2013	Complete
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**Table 1: Timeline of Project Objectives**

## **4.4 Risk Assessment**

### **4.4.1 Risks During Project Execution**

The execution of this project is limited to research and design work on a computer and site visits to the light industrial area of Moree. Hazards related to research and design work on a computer include repetitive strain injury (RSI), eye strains and headaches or back and joint pain from being seated for long period of time. These only pose slight risks as I maintain good health and have had no previous issues related to these risks. My position at work requires me to sit for periods of time however also with appropriate breaks to ensure these don't become an issue.

To ensure these risks remain at low levels periodic breaks will continue to be taken and work will always be completed when adequate lighting is available. These risks do not extend to other any other people.

Site visits pose risks associated with vehicles, gradients of footpaths and table drains and sun management. Hazards that may be related with these risks include:

- Vehicles colliding with those on the site visit
- Vehicle accidents
- Trips or falls when walking on the footpath
- Trips or falls when entering or exiting the table drain to do culvert inspections
- Sun burn

These all pose a significant level of risk but will be mediated through using Moree Plains Shire SWMS. These detail that sun protection (including personal protective equipment (PPE) and sunscreen) be used at all times, safety boots be worn and care taken especially when within a table drain and in terms of vehicles – potentially taking a second person to act as a spotter if measurements need to be taken on or directly adjacent to the road.

These risks would extend to other people who are also on the site visits however it is

expected that with others available to identify hazards and the potential risks the level of an incident occurring remains low.

#### **4.4.2 Risks Beyond Project Completion**

Beyond completion of this work Moree Plains Shire Council may resolve to proceed with some or all of the works. If this is the case the risks involved are quite extensive. Risks and hazards would include (but are not limited to):

- Trips or falls caused by excess rubbish, holes, trenches
- Injuries from not wearing correct PPE
- Accidents between machinery or between machinery and workers
- Machinery hitting power lines or excavating an underground cable
- Vehicle accidents through inadequate traffic control plans
- Sun burn (or sun cancers if there is prolonged exposure)

All of these pose significant risks and as with the risks identified during project completion would be mediated through the use of SWMS. Any contractors employed to do work would be required to show the relevant Workplace Health and Safety documentation to satisfy Council regulations and all workers on site would be trained in their respective fields.

## 5.0 Methodology

Prior to this analysis, representatives of the businesses of Moree's Light Industrial Area met to discuss possibilities and opportunities for RAV access within the area. No results were produced from this meeting with all parties focussing only on their own requirements. However, with RMS and NHVR focussing more on route approvals for RAVs and law enforcement imposing increasing penalties for heavy vehicles that are off-route Moree Plains Shire Council received requests for the Light Industrial Area to be given RAV approval.

The commissioning of this investigation removed the need to individually correspond with businesses yet provided a process in which the needs of each business could be met whilst ensuring the entire area functioned effectively. The initial stages of analysis involved the determination of which intersections could legally cater for RAVs with the infrastructure in its current condition.

The process of assessing intersections is typical of the process followed by MPSC each time approvals are requested. Aerial photos of all intersections were obtained and turning path templates for each class of RAV overlayed. The B-Doubles, Road Trains and B-Triples were obtained from Austroads Design Vehicles and Turning Path Templates, 2013. The respective design vehicle lengths are 26m, 36.2m and 35.4m. Templates for AB-Triples are not available through Austroads and were instead produced by the Australian Road Research Board (ARRB) for MPSC with a length of 36.5m. The AB-Triple template produced by ARRB was based on a typical AB-Triple of length 36.5m that complies with RMS dimension requirements.

These template overlays are provided in Appendix C and made it clear which infrastructure is not capable of supporting RAVs so costs could be determined for upgrades. Where the angle of turn does not exactly fit the intersection angle the outer wheel path of the vehicle is used to interpolate where the vehicles would track. Upgrade costs to allow RAV access will be identified so the feasibility – both technical and economical can be discussed. Each intersection was assessed for all turning manoeuvres and began with B-Triple assessments, working down to B-Doubles.

It is important to again note that this study is not a short term solution. Some works

as a result of the study findings could potentially be completed immediately however it is expected implementation of the results will require extensive funding and further planning. Works will be ranked in order of importance and then funding can be sought from local, state and federal government. It is also possible for the dynamics of an area to change and if the works are put onto a long term plan it may be necessary for additional investigations to occur when it comes time for construction.

Following the assessment of the Light Industrial Area a currently vacant block of land will be examined to determine its potential for a breakdown facility so that RAVs can disconnect their trailers and travel into the Light Industrial Area as an approved vehicle. This would be a legitimate option irrespective of whether the Light Industrial Area upgrade progresses as per this study as Moree currently has no such facility. For the purposes of this study this option is being considered as conceptual and only to provide background information and brief budgetary requirements as an alternative to the Light Industrial Area upgrade.

It is imperative that it is understood the location of the possible breakdown area along Jones Avenue as seen in Figure 9 is not currently approved for all levels of RAV access. B-Doubles and A-Doubles both have access along this section of Jones Avenue however AB-Triples and B-Triples do not. It does however form part of the route given to wide loads as they pass through Moree. This will be treated as a separate concern and the assumption for this study will be made that all levels of RAV will have access along Jones Avenue. The expenses of such an area will remain similar even if MPSC was to choose to construct a breakdown facility in a location that is more readily available to RAVs at this moment.

## **5.1 Intersection Evaluation**

Each intersection was evaluated as a pass or fail. A pass was only granted if the heavy vehicle could complete all turning manoeuvres legally. A legal manoeuvre is one where the vehicle does not cross the centreline or onto the footpath and would not impede any other vehicles using the intersection at the same time. Works required will be identified in the following sections.

### **5.1.1 B-Triples, AB-Triples and A-Doubles**

In a turning path comparison B-Triples have the most severe tracking followed by A-

Doubles and then AB-Triples. B-Doubles will be dealt with separately in Section 5.1.2. However, at the angle of turn where the vehicle covers the largest area the variation is limited to less than 2.3m. This evidence formed the conclusion to base the upgrade of the Light Industrial Area on B-Triples. Completing a cost assessment of all three vehicle classes would have limited use with such a minor difference in vehicle tracking. When evaluating each intersection it was found B-Triples, AB-Triples and A-Doubles all failed on the same intersections and manoeuvres. The number of manoeuvres each vehicle failed is shown below.

<b>Intersection</b>	<b>Total Manoeuvres Possible</b>	<b>Failure Manoeuvres</b>	<b>Overall Rating</b>
Gosport Street & Jones Avenue	4	4	Fail
Jones Avenue & Joyce Avenue	4	4	Fail
Joyce Avenues & Newell Highway	4	3	Fail
Newell Highway & Warialda Street	4	2	Fail
Gosport Street & Newell Highway	2	0	Pass

**Table 2: Intersection Evaluation for B-Triples, AB-Triples and A-Doubles**

An upgrade plan was developed to give RAV access up to B-Triples throughout the area and is shown in Figure 10. As the intersection of Gosport Street and the Newell Highway passed and require no works this is not included on the upgrade plan. The plan indicates the new kerb alignment, power pole relocations, new culverts and where land acquisitions are necessary. Road rehabilitation is inclusive of wherever new kerb is required or where new pipe culverts are installed. Construction works have been divided into intersections to allow costs to be better quantified. As the light industrial area has minimal pedestrian traffic there would be no reason to deny RAV approval upon completion of these works.





**Figure 10: Upgrade Plan for B-Triples, AB-Triples and A-Doubles**

### 5.1.2 B-Doubles

A similar process was completed for B-Doubles. These were kept separate to B-Triples, AB-Triples and A-Doubles as they are 10.5 metres shorter in length and have a significantly smaller turning path. The number of failing manoeuvres is shown below in Table 3.

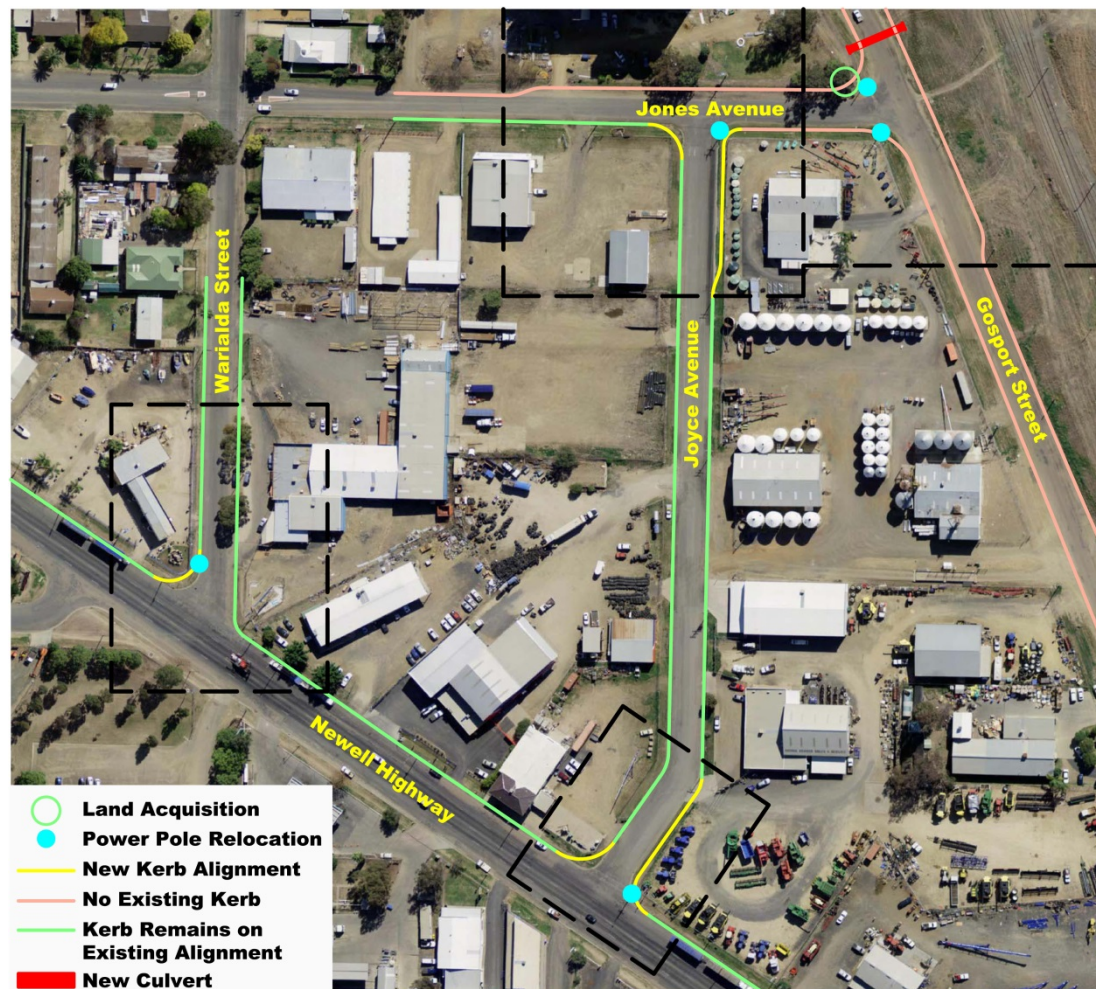
Intersection	Total Manoeuvres Possible	Failure Manoeuvres	Overall Rating
Gosport Street & Jones Avenue	4	4	Fail
Jones Avenue & Joyce Avenue	4	4	Fail
Joyce Avenue & Newell Highway	4	1	Fail
Newell Highway & Warialda Street	4	1	Fail



Gosport Street & Newell Highway	2	0	Pass
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**Table 3: Intersection Evaluation for B-Doubles**

Similarly, an upgrade plan has been developed for access only up to a B-Double with works distributed to each intersection (excluding Gosport Street and the Newell Highway). It also indicates the works necessary to make approval a realistic possibility.



**Figure 11: Upgrade Plan for B-Doubles**

## 5.2 Determination of Order of Works

A plan of how RAVs access each business has been developed and is shown in Figure 12. This formed the basis of the decisions to determine which intersections are given the highest priority. The intersection priority is shown in Table 4.



**Figure 12: RAV Access to Businesses**

Priority	Intersection
1	Joyce Avenue & Newell Highway
2	Jones Avenue & Joyce Avenue
3	Newell Highway & Warialda Street
4	Gosport Street & Jones Avenue

**Table 4: Intersection Priority**

In conjunction with the Newell Highway, Joyce Avenue provides all or partial RAV access for 6 of the 7 businesses in the Light Industrial Area. This resulted in the 2 associated Joyce Avenue intersections being placed with the highest priority in the determined order of works. With an upgrade of these 2 intersections these 6 businesses have substantial access which would allow RAVs to operate legally and without obstructions. The intersection adjacent to the Newell Highway is given the highest priority as the Newell Highway is already approved for RAV access.



To grant access to the final business within the Light Industrial Area the intersection of the Newell Highway and Warialda Street must be upgraded. This provides the 3<sup>rd</sup> level of priority in terms of intersection upgrades and leaves the intersection of Gosport Street and Jones Avenue with the 4<sup>th</sup> level of priority.

As all 7 businesses have adequate access without the intersection upgrade of Gosport Street and Jones Avenue consideration will be given to not upgrading this intersection. As seen in Figures 10 and 11 it requires extensive construction to be legally utilised by any level of RAV and potentially may be more feasible to disallow any RAV access.

### 5.3 Cost Estimates

To assess the costs of an upgrade for each intersection as well as an upgrade of the entire area unit costs for each type of work were obtained. These costs are shown in Table 5 and further details are included below.

<b>Construction Work</b>	<b>Unit Rate (\$)</b>	<b>Per Unit</b>
Road Rehabilitation	30	Square metre
Kerb and Gutter	260	Lineal metre
Pipe Culverts	3 800	Pipe and headwall
Power Pole Relocations	10 000-50 000	Relocation
Land Acquisitions	75-488	Square metre
Labour	40	Hour per Person

**Table 5: Unit Rates for Construction Works**

#### 5.3.1 Road Rehabilitation

The cost element for road rehabilitation was based on a unit rate of \$30 per square metre. This is the standard figure used by MPSC when estimating the cost of works in 2013. It is inclusive of a 75mm overlay of fresh gravel, the addition of 1.5% lime which is stabilised to a depth of 200mm, a final trim and a double coat bitumen seal (using 14mm and 7mm aggregate).

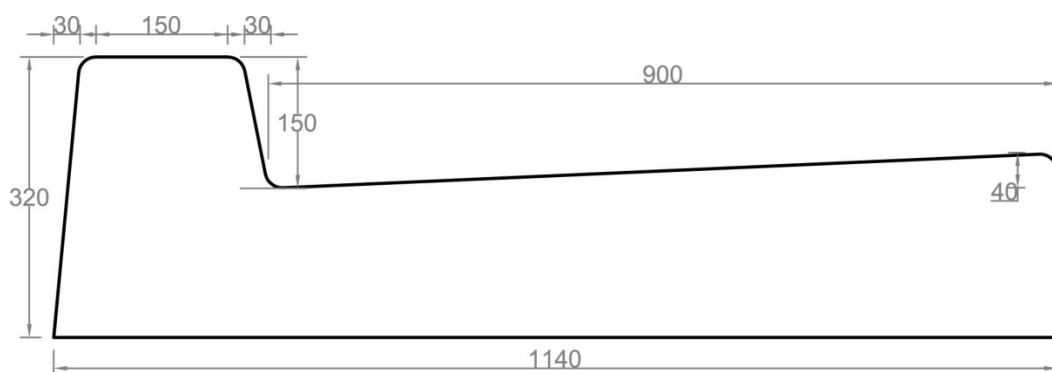
#### 5.3.2 Kerb and Gutter

Kerb and gutter costs are also unit rates typically used by MPSC when determining construction costs. The value used is \$260 per lineal metre and is inclusive of the removal of old kerb and gutter, excavation and removal of materials to the necessary

depth, importing and depositing of the gravel sub-base, pouring the new kerb and gutter, backfilling and connecting the existing driveways and stormwater into the new kerb.

This unit rate is based on standard SA type kerb and gutter however instead of a typical 500mm kerb lip it has a 900mm kerb lip. This type of kerb and gutter has been trialled in other areas of Moree that have high levels of heavy vehicles on the road. This design is based on the concept that when heavy vehicles (including RAVs) park on the road shoulder adjacent to the kerb the loading is placed entirely on the concrete kerb lip rather than the join between the lip and bitumen seal. If loads are applied to this join the bitumen seal weakens and deteriorates, eventually allowing water to penetrate into the seal and under the kerb and gutter. This causes the kerb and gutter to deform and in some instances crack and split.

This kerb and gutter is also constructed with a stronger concrete than in general residential streets and is reinforced. A typical profile of this kerb and gutter is shown in Figure 13.



**Figure 13: Kerb and Gutter Profile for Light Industrial Area**

### 5.3.3 Pipe Culverts

In the Light Industrial Area there is only one intersection that would require pipe culvert replacement. The cost estimate for this is \$7 000 and is based on pipes of 450mm diameter including headwalls. There is no set supplier for this cost estimate but this value encompasses most quotes received for a similar style pipe culvert in other MPSC projects.

### 5.3.4 Power Poles

Obtaining cost estimates for relocation of power poles is very difficult with there

being no typical unit rate as per the energy supplier. Estimates have often been obtained from the Level 1 Service Providers in the past for large MPSC projects and these have been used as a basis to estimate relocation costs for this study. These values range from \$10 000 to \$50 000 and depend on the structure itself, the electrical arrangement it supports and if any street lights are associated with the power pole.

#### **5.3.5 Land Acquisitions**

For RAV access up to B-Triples in the Light Industrial Area it is necessary for land acquisitions to occur as some turning manoeuvres are not possible on the existing MPSC infrastructure alone. Costs for land acquisitions are provided to MPSC from the Valuer General as Unimproved Land Values and were issued on 1<sup>st</sup> July 2011. These are provided as a bulk figure and square metre values were calculated. These ranged from \$75-\$488 per square metre.

Registered surveyors and solicitors are also necessary for land acquisitions to go through and unit rates for these were estimated based on past acquisitions MPSC have completed. These do not specify a particular surveyor or solicitor to be used. The cost estimate for each of these professions is \$5 000 for all legal paperwork in transferring ownership and the surveying necessary to mark out new boundaries.

#### **5.3.6 Labour**

Unit rates for labour are based on current rates for works throughout MPSC. It is expected that for each intersection upgrade a minimum of 4 workmen will be required and this cost estimate is averaged to include a ganger and 3 other workers. Labour costs with MPSC workmen are only applied to kerb and gutter preparation and final works and pipe culverts. The road rehabilitation, pouring of kerb and gutter, power pole relocation and land acquisition costs are inclusive of contractors completing the works. This is typical of what currently happens with such projects in MPSC.

#### **5.3.7 Survey and Design**

For the majority of all road and drainage works MPSC does not employ contractors to complete survey and design works. These are carried out by MPSC staff that form part of the Project and Development Team. The roles performed by these staff include detailed surveying of the required area, analysis of the survey data and

design of the associated feature in accordance with the necessary Australian Standards. In terms of the Light Industrial Area works required the survey and design staff would provide designs for the new kerb and gutter. Designs would not be required for the road construction as only rehabilitation is being completed and the standard superelevation would apply. Designs would however be required for the construction of a breakdown facility to ensure stormwater drains off the surface and into the appropriate stormwater pits.

Survey and design costs are generally not included in the construction budget. These expenses are covered by a standard survey and design budget and hence do not need to be factored into this study.

## 5.4 Intersection Construction Costs

### 5.4.1 B-Triple, AB-Triple and A-Double Upgrade Costs

Each intersection was evaluated and total costs per intersection were calculated. Initially upgrade costs were only calculated on a per intersection basis and are shown in Table 6. This would ensure that RAVs can legally perform the manoeuvres around the intersections but no other construction work is completed. It includes the replacement of new kerb and gutter where necessary and where no kerb and gutter is currently provided the construction of new kerb and gutter. Consideration was given to not constructing new kerb and gutter where no kerb and gutter currently exists however this was dismissed since this upgrade is to rehabilitate the Light Industrial Area for RAVs. Kerb and gutter lining each side of the road with bitumen seal extending to the kerb and gutter is more appealing and creates a more inviting atmosphere for customers accessing the businesses. It also ensures the road shoulders that have no kerb and gutter do not become saturated during periods of rain and cause water to penetrate the bitumen seal. This per intersection basis only includes new bitumen seal to widen the intersections and then match into the existing bitumen seal. The full breakdown of construction required, quantities and individual costs can be seen in Appendix D.

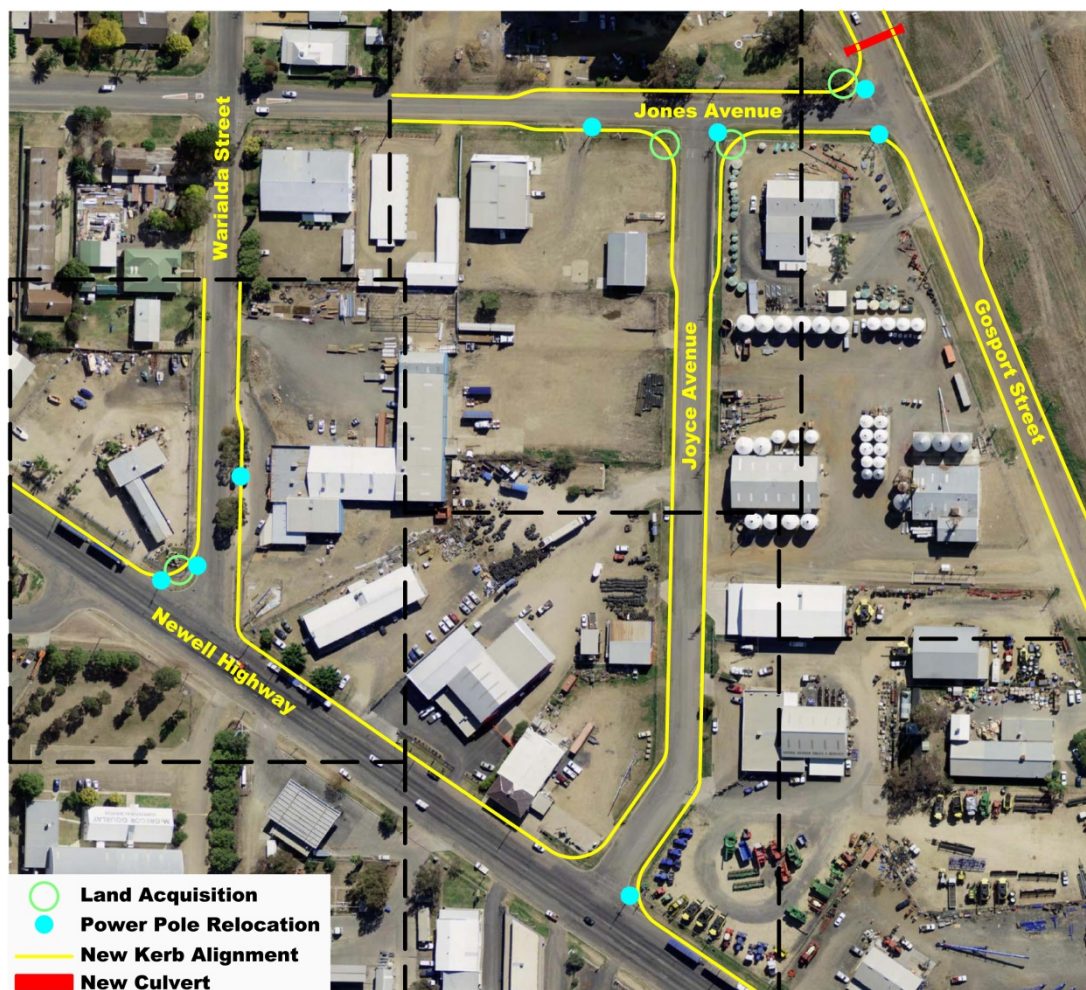
Intersection	Construction Required	Price
Joyce Avenue & Newell Highway	Road rehabilitation, kerb and gutter, power pole relocation.	\$143 500

Jones Avenue & Joyce Avenue	Road rehabilitation, kerb and gutter, power pole relocation, land acquisition.	\$290 596
Newell Highway & Warialda Street	Road rehabilitation, kerb and gutter, power pole relocation, land acquisition.	\$147 195
Gosport Street & Jones Avenue	Road rehabilitation, kerb and gutter, new pipe culverts, power pole relocation, land acquisition.	\$239 120

**Table 6: Intersection Upgrade Costs for RAVs up to B-Triples**

Another set of upgrade costs were also considered for RAVs up to B-Triples. These upgrade costs included an upgrade of the entire Light Industrial Area rather than on the basis of intersections only. It includes new kerb and gutter for the entire area and full road rehabilitation in addition to the construction required for legal manoeuvres (new culverts, power pole relocations and acquisitions). The costs are still divided into intersections but the boundaries are extended as seen in Figure 14. At the extents of the Light Industrial Area the works are extended to the access of the final business requiring access. The total upgrade costs are in Table 7.





**Figure 14: Full LIA Upgrade Plan for B-Triples, AB-Triples and A-Doubles**

Intersection	Construction Required	Price
Joyce Avenue & Newell Highway	Road rehabilitation, kerb and gutter, power pole relocation.	\$350 530
Jones Avenue & Joyce Avenue	Road rehabilitation, kerb and gutter, power pole relocation, land acquisition.	\$417 956
Newell Highway & Warialda Street	Road rehabilitation, kerb and gutter, power pole relocation, land acquisition.	\$358 135
Gosport Street & Jones Avenue	Road rehabilitation, kerb and gutter, new pipe culverts, power pole relocation, land acquisition.	\$447 110

**Table 7: Full LIA Upgrade Costs for RAVs up to B-Triples**

It can be seen that full upgrade costs are evidently more expensive than individual intersection upgrades. This will be discussed further in Chapter 6.0.

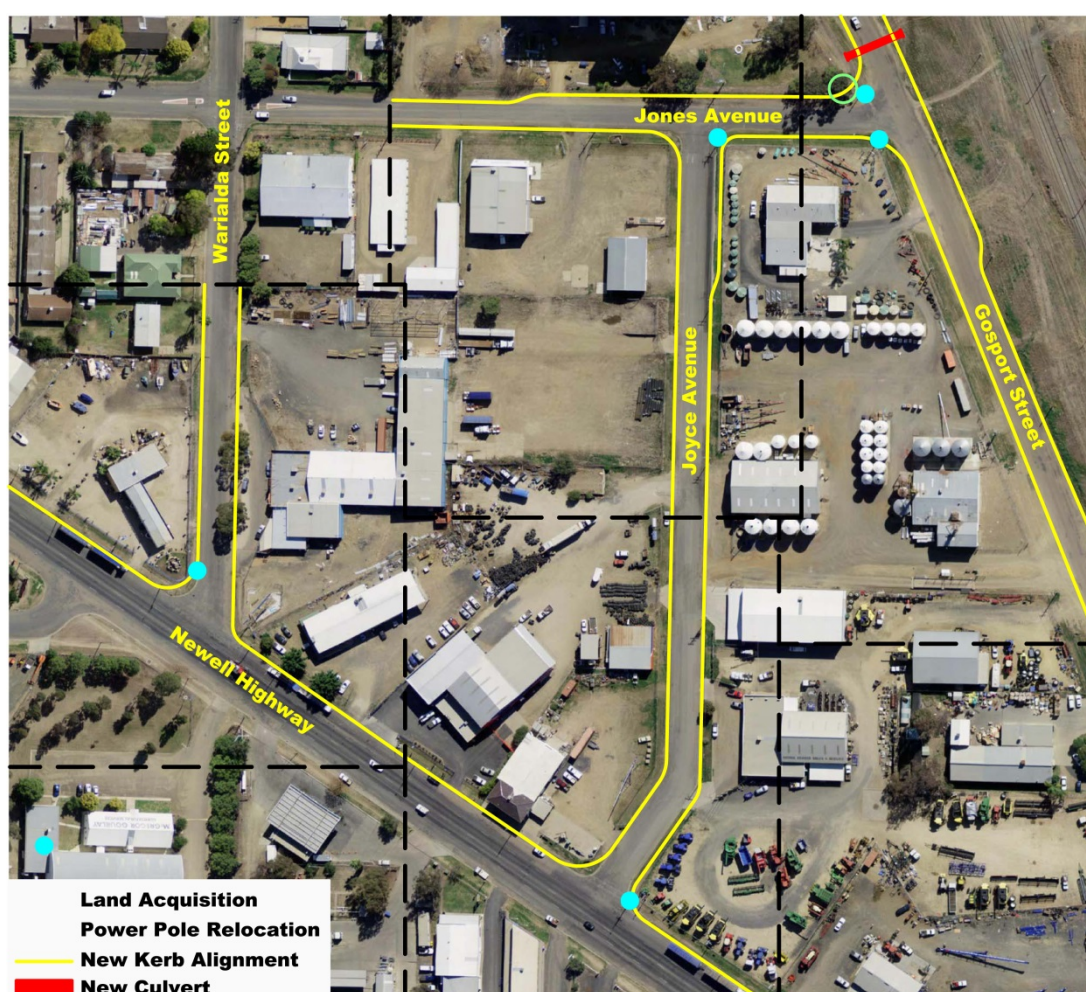
#### 5.4.2 B-Double Upgrade Costs

The process followed for evaluating intersections for B-Triples, AB-Triples and A-

Doubles was exactly the same for B-Doubles. Initially costs were evaluated on a per intersection basis and then for the entire Light Industrial Area. The intersection upgrade costs, full Light Industrial Area upgrade plan and full Light Industrial Area upgrade costs are shown in Table 8, Figure 15 and Table 9 respectively.

Intersection	Construction Required	Price
Joyce Avenue & Newell Highway	Road rehabilitation, kerb and gutter, power pole relocation.	\$94 540
Jones Avenue & Joyce Avenue	Road rehabilitation, kerb and gutter, power pole relocation.	\$191 030
Newell Highway & Warialda Street	Road rehabilitation, kerb and gutter, power pole relocation.	\$28 860
Gosport Street & Jones Avenue	Road rehabilitation, kerb and gutter, new pipe culverts, power pole relocation, land acquisition.	\$239 120

**Table 8: Intersection Upgrade Costs for B-Doubles**



**Figure 15: Full LIA Upgrade Plan for B-Doubles**



<b>Intersection</b>	<b>Construction Required</b>	<b>Price</b>
Joyce Avenue & Newell Highway	Road rehabilitation, kerb and gutter, power pole relocation.	\$341 200
Jones Avenue & Joyce Avenue	Road rehabilitation, kerb and gutter, power pole relocation.	\$347 630
Newell Highway & Warialda Street	Road rehabilitation, kerb and gutter, power pole relocation.	\$291 960
Gosport Street & Jones Avenue	Road rehabilitation, kerb and gutter, new pipe culverts, power pole relocation, land acquisition.	\$447 110

**Table 9: Full LIA Upgrade Costs for B-Doubles**

It is important to note that the upgrade costs for the intersection of Gosport Street and Jones Avenue are the same for both B-Doubles and RAVs up to B-Triples. This intersection is currently in very poor condition with the existing pipe culvert severely damaged by heavy vehicles currently being unable to make the turning manoeuvre and hence placing extensive loads on the pipe culvert which it is not designed for. Because the intersection is not a strict ninety degree turn heavy vehicles encounter significant issues when turning North onto Gosport Street from Jones Avenue. After extensive discussions with MPSC's Road Safety Officer it was decided that regardless of which level of RAVs this intersection is upgraded for it should be constructed to no less than a B-Triple standard for safety reasons.

### **5.5 Breakdown Facility Construction**

The proposed layout for the breakdown facility is shown in Figure 16. It covers an area of 12 410 square metres which was considered to be sufficient for a minimum of 10 B-Triples to park at least 2 of their 3 trailers as well as provide manoeuvring room to enter and exit the area safely.

A construction cost of \$50 per square metre was used as it is a unit rate commonly used by MPSC in the construction of new roads. Costs for the breakdown area itself totalled \$620 500 however turning lanes into the area are required as well as extra area to allow vehicles adequate room to exit. The area of the turning lanes is approximately 600 square metres. This brought the total area to 13 010 square metres and total construction cost of the breakdown area to \$650 500. This cost is inclusive of the preparation earthworks, installation of the gravel sub-base and base course including 1.5% lime stabilisation, a final trim and a bitumen seal. This seal may be a

primer seal or a double coat bitumen seal.

Rather than constructing kerb and gutter around the extents of the breakdown facility it would simply be ensured through survey and design that stormwater can naturally flow off the bitumen seal and into the appropriate drainage provision. Kerb and gutter is deemed not necessary in such construction and would only further add to the expenses required.



**Figure 16: Proposed Layout for the Breakdown Facility**

## 6.0 Design Analysis

### 6.1 Economic Considerations

The overall costs for each set of upgrade costs are shown in Table 10.

Upgrade	Total Cost
B-Triples per Intersection	\$820 411
B-Triples Full Upgrade	\$1 573 731
B-Doubles per Intersection	\$553 550
B-Doubles Full Upgrade	\$1 427 900

**Table 10: Total Costs for Each Upgrade Level**

The initial proposal intended on supplying a cost benefit analysis to accompany the proposed upgrades so the actual economic practicality could be determined. However, with 7 businesses all whose goods and services as well as economic input into the community varying a cost benefit analysis proved to be very problematic. Difficulties arose with seeking the returns of each business and the determination of the portion of this that remains in the Moree community. Rather than investigate the tangible revenues accrued by these businesses and hence the effect their dealings have on Moree Plains Shire it was decided to take an overview approach on the economic implications that an upgrade of the Light Industrial Area has on Moree as a whole. The following sections showcase the economic implications of specific RAV level upgrades as well as focussing on what such upgrades can do for the economy of Moree itself. Finally, the economic significance of a breakdown area will be investigated to determine its viability against the Light Industrial Area upgrade.

#### 6.1.1 B-Triples, AB-Triples and A-Double Economic Considerations

It is evident that irrespective of whether a full upgrade or intersection upgrade is completed an upgrade for the higher classes of RAVs is significantly more expensive than B-Doubles. There is however significant demand for these higher class RAVs to be given more access to this Light Industrial Area in Moree and the financial aspects must be given attention. With Australia's freight task drastically increasing it is certainly expected that RAVs will become more prevalent in road freight. This is especially the case with AB-Triples which can carry more weight for a better turning

path and for B-Triples which have better efficiency in terms of pavement wear.

In a comparison of upgrade costs only for RAVs up to B-Triples a full upgrade will cost close to double the amount of an intersection only upgrade. However, a full upgrade would have a design life of 30 years. A 30 year design life would imply no new kerb and gutter would be constructed for 30 years nor would the road be fully rehabilitated. Reseals would occur on a regular basis which is typically every 10 years. Maintenance costs would still be incurred however these would be minimal.

Upgrading only the intersections would increase maintenance costs not only over the whole Light Industrial Area but also over the intersections where upgrades had already occurred. When heavy vehicles and in particular RAVs operate over bitumen seals that have been joined to existing bitumen seals the excessive loads tend to deform the seal and allow water to penetrate causing rutting and hence requiring maintenance. It is unknown when the current kerb and gutter was installed in this area but if approval was to be given for RAVs up to B-Triples the increased loadings would cause further stresses and not allow for a remaining design life to be calculated on the existing infrastructure.

Gosport Street currently has no existing kerb and gutter infrastructure. The bitumen seal on the straights is wide enough for RAV's of all levels to pass each other however with no kerb and gutter to match the bitumen seal into the RAVs are driving along the shoulder of the road when trying to turn corners at intersections. The road shoulders typically extend towards the table drain so in most cases these vehicles are driving along the table drains in order to safely (not necessarily legally) make the turning manoeuvre. This causes drainage issues because of the pressure exerted on the soil. Moree is a very flat town with only 0.2% - 0.5% fall throughout most streets. A slight rise or indentation in natural table drains like the one that occurs along both sides of Gosport Street causes water to pool and not drain away. This creates further maintenance issues and increases costs. This would be alleviated by widening the road especially around intersections and constructing new kerb and gutter.

### **6.1.2 B-Double Economic Considerations**

For MPSC to opt for the least expensive way of gaining approval for some level of



RAV access to the Light Industrial Area then an upgrade would be completed on a per intersection basis and only for B-Doubles. At less than \$600 000 this is a project that could easily be budgeted for and achieved within 2-3 years – if not less if there is a consistently increasing push from businesses for approval. Serious consideration needs to be given to the financial issues that may arise if the decision is made to then upgrade for higher class RAVs at a later stage.



**Figure 17: A Typical B-Double (Mohr, 2010)**

If a B-Double upgrade occurred followed by another upgrade within the following 5-10 years for RAVs up to B-Triples then much of the infrastructure that would still be in quite adequate condition would be replaced before it has had a chance to reach any point close to its design life. For less than an extra \$300 000 an upgrade for RAVs up to B-Triples can be completed on an intersection only basis. Whilst maintenance costs would still be incurred due to some older infrastructure remaining; when the time came to do a full upgrade including complete road rehabilitation and kerb and gutter construction then not all of the new infrastructure would need to be removed to realign the kerb.

As the kerb alignments are different for B-Doubles and RAVs up to B-Triples it is more economical to only upgrade for B-Triples. This would allow all levels of RAV



legal access to the businesses and if in the future it was decided that B-Triples weren't to be allowed on such roads then access could be removed without having to alter the infrastructure.

### **6.1.3 Breakdown Area Economic Considerations**

For the same expense of a B-Double intersection only upgrade of the Light Industrial Area a breakdown facility could be constructed which could potentially provide more benefits to the community. It would still allow RAV access into the Light Industrial Area however it would require disconnection of trailers and several trips to the businesses to unload or load goods. It would also provide a safe area where heavy vehicles could be parked overnight during rest periods for the drivers.

Due to the consistent pressure from the existing businesses in the Light Industrial Area it would be most wise to consider completing a full upgrade for RAVs up to B-Triples as well as construct a breakdown facility. As a feature that has been consistently missing in Moree over the past decade many heavy vehicles pass straight through Moree and utilise the large rest areas at the towns both North and South of Moree along the Newell Highway. A breakdown facility in Moree would encourage the vehicles to stop for their rest periods in Moree and promote money to be spent in Moree rather than surrounding towns.

The area proposed for the breakdown facility does not utilise all of the vacant land that has been purchased by MPSC. This would allow the remaining land to be utilised for whatever Council chooses. With the current housing market being very limited in Moree it would be a viable option to subdivide this remaining land into residential lots and potentially offer house and land packages which would further economically benefit MPSC and the community.

### **6.1.4 Moree's Economic Considerations**

The two largest sectors contributing to Moree's economy are agriculture and tourism. In the tourism sector the hot artesian spa baths are a major attraction. In terms of agriculture though, this alone contributes millions of dollars each year into the Moree Plains Shire. With 5 of the businesses in the Light Industrial Area largely focussing on providing agricultural goods and services it is vital that every effort is made to accommodate them as they strive to service Moree and the wider

community.



**Figure 18: Moree's Hot Artesian Spa Baths - A Major Economic Contributor (Swimplex Aquatics, 2010)**

Without adequate RAV access a number of these businesses have been deliberating on their location and the possibility of relocating so that adequate RAV access available. With some of these businesses having a turnover in excess of millions of dollars in a single month it is a genuine issue for MPSC if these businesses were to relocate out of Moree and to another town. Moree has an existing industrial area however with it at capacity and limited room for new businesses expenditure must occur in the Light Industrial Area in order to maintain and further improve the local economy.

#### **6.1.5 Alternative Funding**

It is common practice for local government to seek funding for various works within a Council. MPSC applies for funding such as Roads to Recovery (R2R) funding and shared pathway funding consistently each year. Funding can be sought from state or federal government as well as RMS (a state government agency). RMS has total control of the Newell Highway as this is a state highway. It would be highly recommended to seek funding for the upgrade of the intersections adjacent to the

Newell Highway from RMS. It is possible to seek 100% funding but more likely that 50% funding would be sought with the remaining 50% of expenses to be covered by MPSC.

Irrespective of RMS funding consultation should be carried out with MPSC's grants officer to determine if any other funding is available to further enhance the possibility of upgrading the Light Industrial Area or constructing a breakdown facility. Despite the full amount of construction being less than two million dollars regardless of the upgrade level any funding that can be sought and approved would lessen the input from MPSC and allow those funds to be put towards other significant Council projects or maintenance.

Whilst this study focuses on the ability of RAVs to access any business located in the Light Industrial Area rather than the individual businesses that currently operate it could prove to be a worthwhile venture to seek a contribution towards an upgrade from these businesses. This could potentially bring about many problems and for it to be successful would require a contribution from all businesses. With the extensive pressure the businesses are placing on MPSC to gain approved access involvement in the associated costs would certainly ease the pressure on MPSC and potentially increase the chances of construction starting sooner.

## **6.2 Technical Considerations**

### **6.2.1 Technical Feasibility**

All construction works that have been planned in this study are not beyond the realms of possibility. Road rehabilitation, kerb and gutter construction and installation of new pipe culverts are all commonly occurring works carried out as part of MPSC maintenance and new projects. Power pole relocations and land acquisitions are far less common and in most cases attempts are made to avoid them however there are some instances that avoidance is not possible. Several options were considered in regards to changing the traffic flow of the area and these will be discussed in Section 6.2.2. These were deemed to be deficient in terms of providing RAV access to the Light Industrial Area so power pole relocations and land acquisitions became necessary.

The construction works in this study are deemed feasible also because the works can

be completed without extensive waiting periods and without major disruption to services provided to ratepayers such as electricity or water. All works except the power pole relocations can be completed by MPSC staff or local contractors that are commonly used for similar projects. Power pole relocations must be completed by Level 1 Service Providers of the energy supplier and travel may be necessary for this but this is generally restricted to a minimum distance. Ensuring that all works stated are not impractical gives MPSC a better opportunity of budgeting and planning the works.

The breakdown facility as proposed is also deemed to be technically feasible due to the construction being possible and could commence nearly immediately. It consists of works that can be completed entirely by MPSC staff and commonly used contractors and does not involve such extensive works like the Light Industrial Area. Whilst RAV access to the Light Industrial Area may then prove to be an arduous procedure with RAVs having to disconnect trailers before entering zero disruption will occur to the Light Industrial Area businesses during construction. With road rehabilitation and kerb and gutter works these businesses would be affected to some extent with typical dealings interrupted. Accesses would have to be closed whilst construction is carried out however this is not the case with the breakdown area. It would be recommended to take business owners opinions into account before making a final decision on technical feasibility and which option to progress with.

### **6.2.2 Traffic Considerations**

Upon the determination of the works required traffic alternatives were considered to lessen the extent and/or expense of the construction and still allow safe and legal turning manoeuvres of RAVs around intersections in the Light Industrial Area. These alternatives included the installation of traffic lights, roundabouts and the potential for one way streets. As the intersection of the Newell Highway and Warialda Street only provides access to 2 businesses and is nearly the cheapest intersection to upgrade for any level it was not considered for any traffic alternatives.

Traffic lights have the ability to regulate traffic flow by allowing and hence disallowing the right of way to vehicles travelling in a particular direction. The intersection of Joyce Avenue and the Newell Highway was examined as a location for traffic lights however with approximately 18 000 vehicles travelling along the

Newell Highway through Moree each day and 45% of these being heavy vehicles it was deemed that regularly stopping vehicles to allow RAV's right of way in and out of Joyce Avenue would cause a severe accumulation of vehicles on the major thoroughfare.

A roundabout was also considered in this location as rather than stopping traffic at regular times it allows consistent traffic flow. This however still has the potential to cause a build-up of vehicles along the Newell which is unnecessary. Both North and South of the Light Industrial Area vehicles commonly accumulate and cause bottlenecking especially around peak times so it is advisable that in this area the Newell Highway remains as the dominant street with right of way.

It is important to note that the installation of either traffic lights or a roundabout would not negate the need to carry out construction works as additional space is required to accommodate the wide turning paths. For this reason the possibility of utilising Joyce Avenue as a one way street was considered. This allows a heavy vehicle to operate on the entire width of the road and not have to negotiate with oncoming traffic.

Initially a one way street with the traffic flowing North only was investigated however this was immediately discounted. Whilst it allows direct access into the businesses off Joyce Avenue issues are raised when RAVs exit the businesses onto Joyce Avenue. The RAVs must head North and the only physical way back to the Newell Highway and out of the Light Industrial Area is to head North along Gosport Street. This is because the intersection of Gosport Street and the Newell Highway is only one way. Vehicles can enter Gosport Street off the Newell Highway but not exit onto the Newell Highway. If heading South this adds an additional 3 kilometres to the trip which is not an extensive length but during peak times can add an additional 10 minutes minimum to trip times.

A one way street with traffic flowing South is far more feasible in terms of RAVs entering and exiting the Light Industrial Area. It still allows access into the 5 businesses that utilise Joyce Avenue via Gosport Street and exit out of the Light Industrial Area via Joyce Avenue itself. However, if this was to occur it would alter the intersection priority as it would not be possible without an upgrade of the

Gosport Street and Jones Avenue intersection. Also, a one way street would not necessarily mean that the adjacent intersections do not need any upgrade works at all. It is highly likely that construction works would still be required however potentially not to the extent included in this study.

The final decision regarding one way streets in either direction was to not proceed and instead maintain two way streets. With either option upgrade costs are unavoidable and brief discussions were held with business owners which revealed one way streets were not an ideal solution for the businesses. This discounted all traffic considerations but still maintains technical feasibility with the proposed works.

The breakdown facility poses no extra traffic considerations as it would not be a thoroughfare for vehicles unlike the Light Industrial Area. With adequate turning lanes when entering and exiting the breakdown area there should be minimal detrimental effects to the traffic along Jones Avenue. Traffic would only stop when a heavy vehicle from the opposing lane was turning into the breakdown area and had to wait for the oncoming traffic that have right of way to pass.

### **6.2.3 Safety Concerns**

Heavy vehicles pose quite a number of safety concerns not only for other vehicles but also pedestrians. Accidents involving heavy vehicles are more likely to result in fatalities due to the large size and weight of the vehicle. There are two safety aspects with regards to this study and the use of RAVs and the proposed construction works – legal manoeuvres and a lack of footpath.

The proposed construction works will allow RAVs to perform safe and legal manoeuvres improving the safety of the RAV drivers and other road users. This is done by making the intersections wide enough so that turning manoeuvres can be completed entirely on the correct side of the road. Without adequate road width RAVs often have to cross onto the wrong side of the road when completing a turning manoeuvre. This can happen when a RAV is making a turning manoeuvre in either direction. If a vehicle is heading towards the RAV it must immediately move onto the road shoulder to avoid the oncoming RAV. If a vehicle has to give way to the RAV there is a very high chance that with insufficient road width an accident could



occur as the RAV crosses onto the opposing side of the road whilst the other vehicle allows right of way.

Particularly around the intersections the proposed upgrade plans in this study widen the road and narrow the footpath. In this instance footpath is deemed to be any area between the kerb and gutter and the property boundary of the businesses. At some intersections the upgrade plans propose to severely narrow or completely remove the footpath. This was initially considered a safety issue however the number of pedestrians in the Light Industrial Area is very limited. Warialda Street does shift from the Light Industrial Area into a residential street and the Newell Highway has high numbers of pedestrians moving from the Moree CBD to accommodation on the Southern side of Moree however these pedestrians do not tend to progress through the Light Industrial Area itself. For the extremely small number of pedestrians that may pass through the Light Industrial Area a lack of footpaths is not expected to be a safety issue.

Consultation with MPSC's Road Safety Officer was completed before this safety issue was fully deemed to be insignificant. Whilst the quantity of heavy vehicles and in particular RAVs travelling along the roads within the area may be large, the total number of vehicles is not particularly high with respect to the Newell Highway and vehicle speeds will be limited due to roads not being extensively long. However, if footpaths are removed as per the upgrade plans, plans would be made by the Road Safety Officer to monitor the pedestrian activity and to investigate any near-misses if any should occur.

Removing the existing footpaths could be avoided in all upgrade cases however to do so would require further land acquisitions. This would prove to increase the upgrade costs and without initial safety reservations it is advised to complete the works as proposed and re-examine the pedestrian situation at least every three months or more frequently if necessary.

A breakdown facility has the possibility to alleviate some safety concerns associated with such large vehicles trying to manoeuvre around intersections. The option to disconnect trailers and move into the Light Industrial Area as a smaller vehicle is safer for the driver of the RAV as well as other road users. Care must still be taken



when turning at intersections however there is a significantly less chance of an accident occurring due to the considerably smaller turning path.

However, disconnecting trailers at the breakdown area can decrease the safety of RAV drivers as there is an increased possibility of a collision between one disconnecting trailers and another RAV. Sight distance in any heavy vehicle is limited and extra care must be given to ensure accidents between people and vehicles do not occur. Incidences such as this are almost always more disastrous than those between two vehicles. However, through providing an actual area where breakdowns are legal discourages trailer disconnections along the side of the road and hence significantly decreases the chances of a driver disconnecting trailers being hit by any vehicle travelling along the road.

A safety matter directly related to the breakdown area is that of drivers utilising the area to drive dangerously and perform illegal manoeuvres. Such behaviour is often regarded as hooning and a large bitumen sealed area that at times would have very little traffic would enhance this. If construction of a breakdown area was carried out it would be necessary for consultation to be carried out with the Road Safety Officer and also local police to determine possible methods of reducing such behaviour. Consideration may need to be given to lighting the area so general surveillance of passer-bys can be carried out and hopefully act as a deterrent of any negative behaviour.

### **6.3 Social Considerations**

MPSC has for an extensive period of time been seen as a local Council that does not strive to improve the community, maintain business within the community or encourage new business to move into the community. This is significantly evident by local residents' views towards the seeming inability of MPSC to attract a discount department store to Moree as well as a ten pin bowling facility and the incapability to re-establish a cinema. Throughout 2013 locals within the community have taken to expressing these opinions via the local newspaper as well as social media.

This proposal attempts to showcase to the Moree community that MPSC are making a sincere attempt to maintain the current business rather than forcing it out of town due to insufficient and inadequate access which is required to sustain the existing

business practices. Whilst this is not a big step forward in bringing new businesses into the community it is a vital one to ensure existing businesses remain. It also ensures that if any businesses do choose to discontinue their own reasons then Moree has an attractive Light Industrial Area with potentially full RAV access up to B-Triples to entice new businesses into the community.

It is expected that a breakdown area would be considered as a very sensible design by the wider Moree community especially those in areas other than the Light Industrial Area that require or have requested RAV access. It is something that has long been considered a necessity by the community due to the large amounts of RAVs that travel through Moree and transport goods and services, particularly grain during the wheat harvest. Difficulties arise with these RAVs as there are very few locations in Moree currently approved for RAV access. With no currently available areas to breakdown RAVs within Moree they have to disconnect the trailers outside of Moree at unsuitable locations where break-ins and theft are becoming a genuine problem. With an area such as the one proposed, safety would be better promoted through surveillance by the general public and heavy vehicle drivers could use the area for overnight stays as well as to park their disconnected trailers.

Whilst this would prove to be advantageous to the Moree community as a whole the business owners in the Light Industrial Area may disagree. It would not provide direct RAV access as the upgrades in this study otherwise propose. In the instance that they disagree with the decision to construct a breakdown area rather than upgrade the Light Industrial Area there is a heightened likelihood that the RAVs will continue to illegally run through this area. This greatly increases the chances of additional damage to the already deficient infrastructure and also the chances of an accident occurring. Consideration must be given to whether drivers of RAVs are willing to take the time to disconnect their trailers or run the risk of being fined by the police if caught travelling through an unapproved area. Serious thought must also be given by MPSC to the effect on the Light Industrial Area and the Moree community as to whether an upgrade or new construction better enhances the access of RAVs to locations within Moree.

It must also be considered that the proposed location of the breakdown area is adjacent to a residential area. This may cause concerns with the residents regarding

noise and air pollution. RAVs, especially those carrying quite heavy loads tend to make a large amount of noise when in operation. If these vehicles are moving in and out of the breakdown facility in the very early hours of the morning or late at night disruption is almost certain to occur to the adjoining residents. This could be alleviated by imposing a time limit during which the RAVs and any other heavy vehicles can operate. Consultation could be completed with the police to ensure that this is monitored and disruption to residents is kept to a minimum.

## 7.0 Recommendations

The recommendations for improved access to Moree's Light Industrial Area for RAVs include the following:

- Upgrade the Light Industrial Area of Moree for no less than B-Triple access and complete the works as a full area upgrade rather than on an intersection only basis.
- Where land acquisitions are necessary acquire enough land to still allow for a minimum of a one metre footpath for safety purposes.
- During planning of the works implement the expenses into the MPSC construction budget based on the priority previously identified.
- Seek alternative funding from State and National government and consider the possibility of consulting with businesses for contributions to the upgrade.
- Investigate further the need for a breakdown area and its potential for use if constructed in the specified location.

It is recommended that this study be taken to a Council meeting for presentation to the MPSC Councillors with the above recommendations as the resolution for MPSC to take on board.

## 8.0 Conclusion

The road network of Australia is a vital part of the national transport and freight industries. Many classes of heavy vehicles operate on Australia's roads as part of the road freight task and within the next 6-10 years it is expected that this task will double. This is a direct result of a push to increase efficiency and productivity and counteract the growing risk of driver shortages.

In order to increase the efficiency of the road freight task vehicles are becoming larger in size and carrying more in weight. These vehicles typically fall into the category of restricted access vehicles (RAVs). Four of the most common RAVs include B-Doubles, A-Doubles, AB-Triples and B-Triples. These range from 26m to 36.5m and are all considered as higher productivity vehicles as they can operate at higher mass limits than typical heavy vehicles which then allow more goods to be transported using the same number of vehicles in a fleet.

Whilst this is beneficial in terms of vehicle productivity the movements of larger and heavier vehicles can be detrimental to the road network. Due to the significantly large turning path of RAVs infrastructure in town and cities is being damaged as these vehicles make their way through currently unsuitable areas. This is the case in the Light Industrial Area of Moree, NSW where 7 businesses operate from and are pressuring Moree Plains Shire Council (MPSC) to approve RAV access into the businesses. The current infrastructure is not of a standard that RAVs can sufficiently and safely legally perform turning manoeuvres at the intersections.

This resulted in the commissioning of an investigation into the cost and technical implications of upgrading the Light Industrial Area for RAVs up to B-Triples as well as the potential for a breakdown area in another part of Moree to operate on its own or in conjunction with the upgrade. Moree is largely a farming town with millions of dollars generated each year through agriculture and crop production such as wheat and cotton. The businesses in the Light Industrial Area have a primary focus on agricultural goods and services and with vehicles only up to a semi-trailer having current approval the ability of these businesses to bring goods in are difficult and long-winded.

The initial stages of this investigation involved analysing each intersection on a pass

or fail basis using heavy vehicle sweep path templates produced by the Australian Road Research Board and aerial photos of the intersections. This allowed an order of priority to be determined based on the number of businesses each intersection provided access to. Construction works required to allow legal access were investigated on two levels. Firstly for RAV access up to B-Triples (this is inclusive of B-Doubles, A-Doubles and AB-Triples) and secondly for RAV access only for B-Doubles. The construction works required include road rehabilitation, kerb and gutter construction, power pole relocation, land acquisitions and installation of new pipe culverts.

The costs of construction were calculated and also considered on two levels – the costs for upgrading the intersections only and the costs for an upgrade of the entire Light Industrial Area. This provided the results expected – that a full upgrade for RAVs up to B-Triples would be the most expensive with construction and labour costs totalling over 1.5 million dollars. The cost for a breakdown area was also calculated and totalled \$650 500.

The four upgrade options – B-Double intersection only and full upgrade and B-Triple intersection only and full upgrade and the breakdown are possibility were then considered for their economic, technical and social considerations. Economically, the cost implications are quite large however if budgeted over several years certainly achievable. Cost savings would also apply as new infrastructure reduces the amount of money required to maintain existing infrastructure. Funding would be sought to assist in these ventures as well as the discussion with the businesses about financial input into the Light Industrial Area upgrade.

Technically, all works are feasible and could be completed within reasonable timeframes by existing MPSC staff or contractors and with minimal disruption to the community. This is a far better result than expected with options such as one-way streets and roundabouts being considered to improve RAV access.

The upgrade of the Light Industrial Area and/or the construction of a breakdown facility improve the social aspects of how MPSC is viewed in the community and ensure businesses are in a better position to stay situated in Moree. Through keeping the business owners happy and allowing significantly better access to their locations

by RAVs the revenue generated can stay within the local community and benefit the economy of Moree.

The final recommendations include a full upgrade of the Light Industrial Area to legally allow RAV access up to B-Triples as well as investigate the possibility of the construction of a breakdown area to be implemented into the MPSC budget. Whilst this is not a short term solution it provides the basic framework for a full overhaul of the Light Industrial Area to be given RAV access. For construction to proceed further planning would be required with potentially more detailed cost estimates. This study however, could also be used as background information and support if and when heavy vehicle access becomes an issue in other parts of Moree or in other towns within the Shire.



## 9.0 Southern Moree Bypass

A final note must be made with respect to the Southern Moree Bypass. The Northern Bypass was completed in 2010 however works on the Southern Bypass were put on hold until funding was available. With all survey and design works already completed the Australian Coalition (otherwise known as the Liberal or National Party) promised completion of the Southern Bypass if they were voted in during the September 2013 election.

This in fact was the case and at the time of printing of this study works on the Southern Bypass was set to begin early to mid-2014. The Southern Bypass is proposed to progress adjacent to Gosport Street. This may affect the works planned for the intersection of Gosport Street and Jones Avenue. It would be highly recommended to evaluate the development of the Southern Moree Bypass before implementing any construction works on this intersection into the MPSC budget.

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# Appendix A – Project Specification

University of Southern Queensland

FACULTY OF HEALTH, ENGINEERING & SCIENCES

## **ENG4111/4112 Research Project** **PROJECT SPECIFICATION**

**FOR:** Casey SPILSBURY-BRINKMANN

**TOPIC:** THE ECONOMIC FEASIBILITY OF UPGRADING MOREE'S LIGHT INDUSTRIAL AREA TO LEGALLY CATER FOR RESTRICTED ACCESS VEHICLES

**SUPERVISOR:** Mr Trevor Drysdale

Ms Lila Fisher, Project and Development Manager, Moree Plains Shire Council

**SPONSORSHIP:** Moree Plains Shire Council

**PROJECT AIM:** To investigate the cost implications, technical feasibility and social effects of upgrading a light industrial area in Moree, NSW to legally cater for Restricted Access Vehicles up to AB-Triples.

**PROGRAMME:** Issue A, 15<sup>th</sup> March 2013

1. Research similar situations where Restricted Access Vehicles required approval, interactions between Restricted Access Vehicles and passenger vehicles and the varieties of designs and traffic devices available to better suit Restricted Access Vehicles.
2. Overlay Restricted Access Vehicle templates onto aerial photos of the area to determine which roads/intersections can already cater for such vehicles.
3. Investigate which roads/intersections will benefit the most businesses when upgraded to determine an order of works.
4. Examine the works required for the roads/intersections for each heavy vehicle type (B-Double, A-Double, B-Triple, AB-Triple) and develop designs including refurbishment and/or the implementation of new traffic devices.
5. Calculate the expense of upgrading and develop a spreadsheet showing all inclusive costs.
6. Investigate the social factors linked to the economic and technical feasibility including determining if businesses will leave that location if legal access isn't granted.

7. Develop designs for a new breakdown area and calculate cost implications of proceeding with this avenue rather than upgrading existing infrastructure.
8. Present findings on which option is more feasible on all accounts – economic, technical and social.

AGREED: Casey Spilsbury-Brinkmann

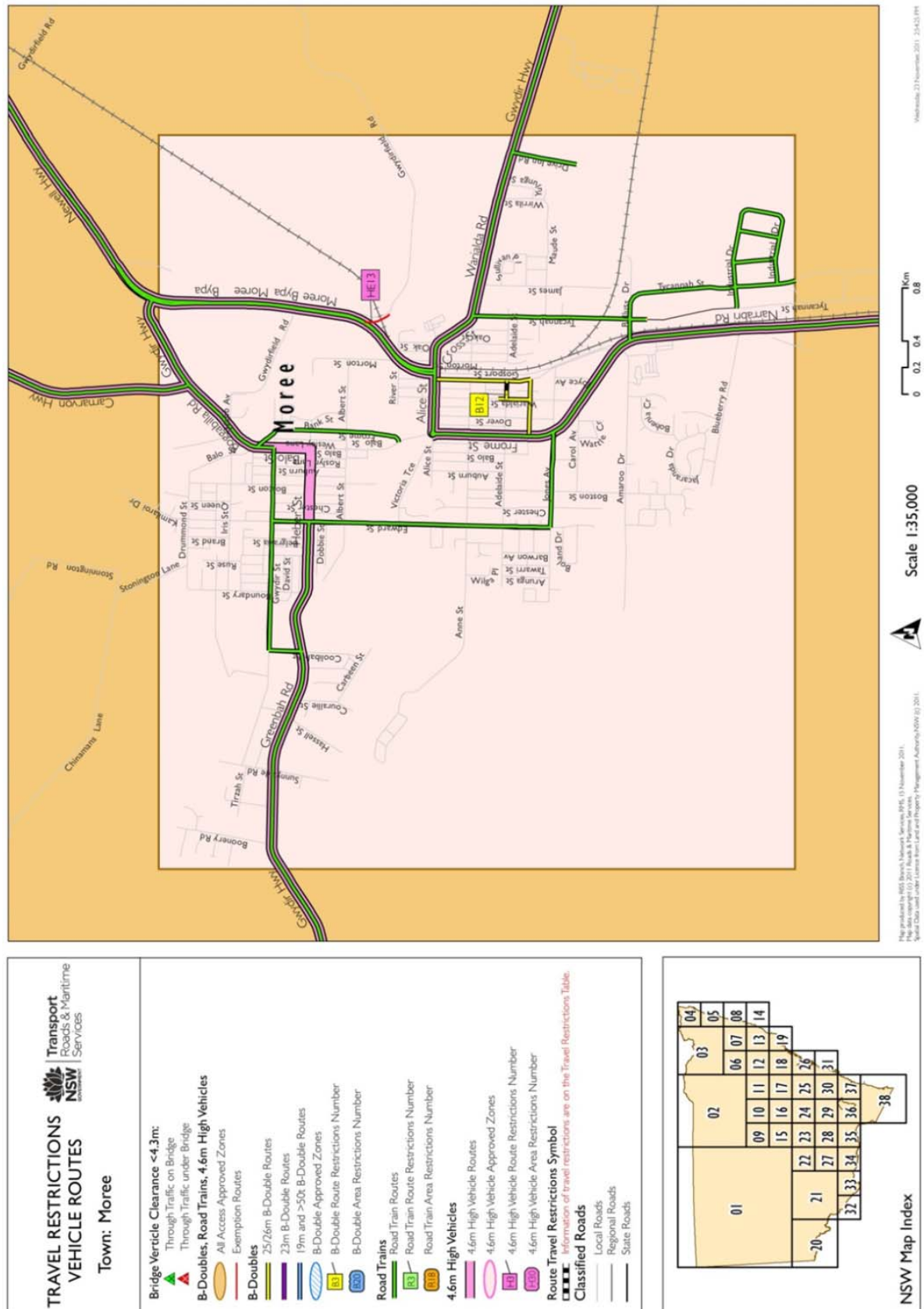
Trevor Drysdale

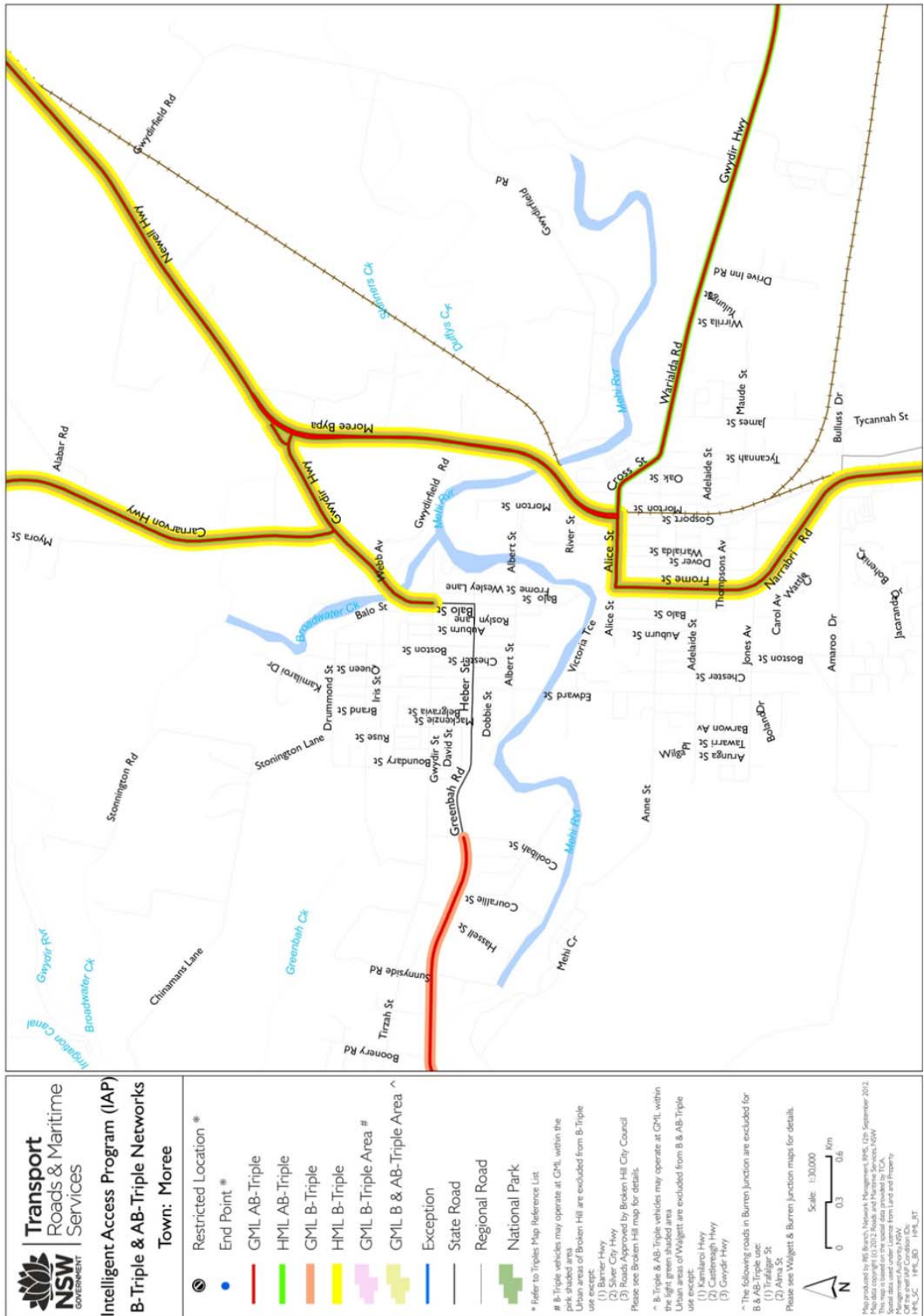
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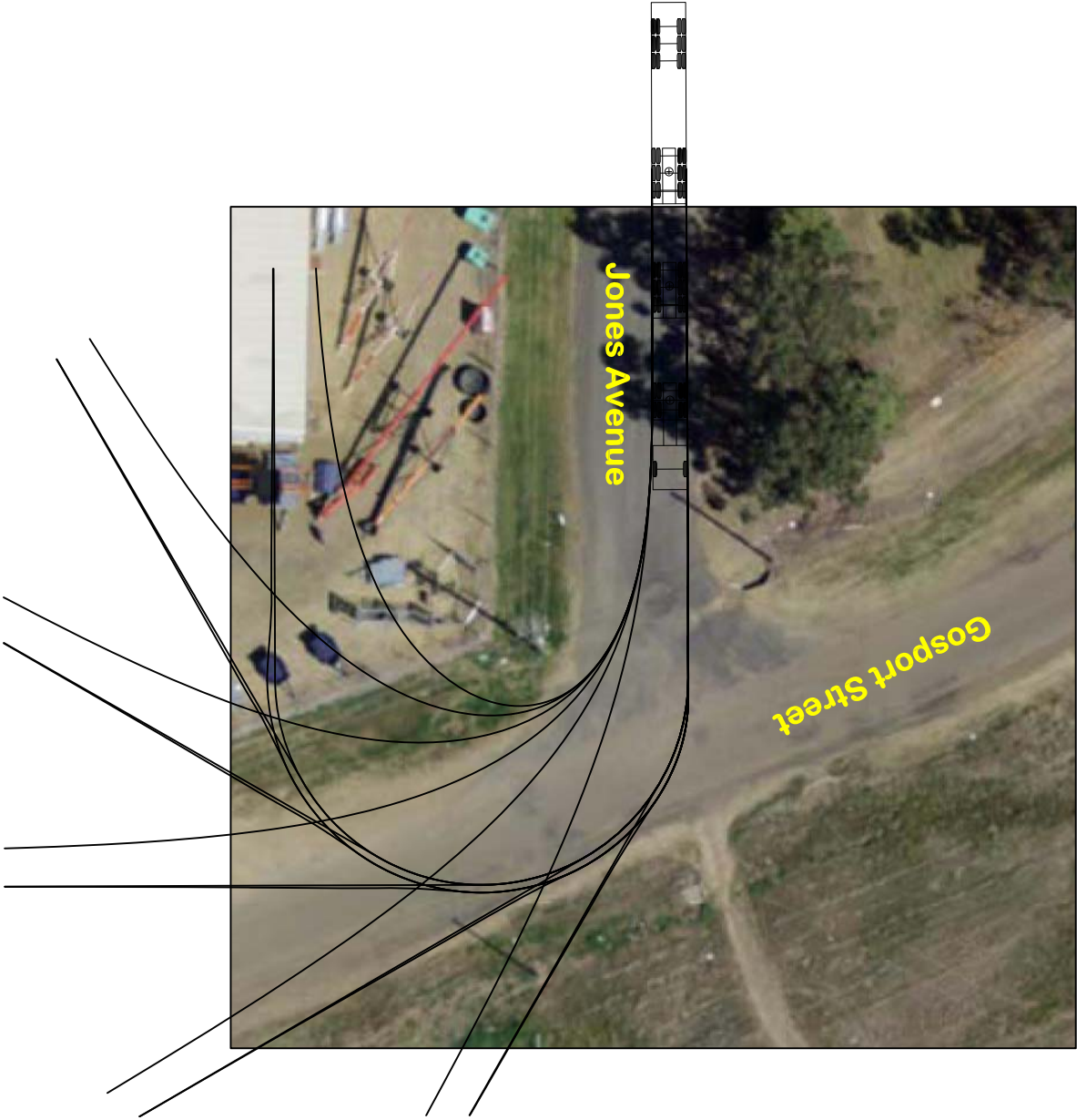
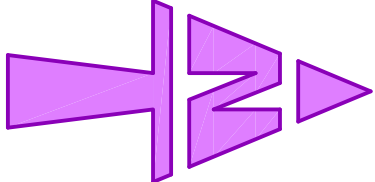
## Appendix B – Moree Vehicle Routes for B-Doubles, A-Doubles, AB-Triples and B-Triples





## **Appendix C – RAV Template Overlays for Each Vehicle Class**

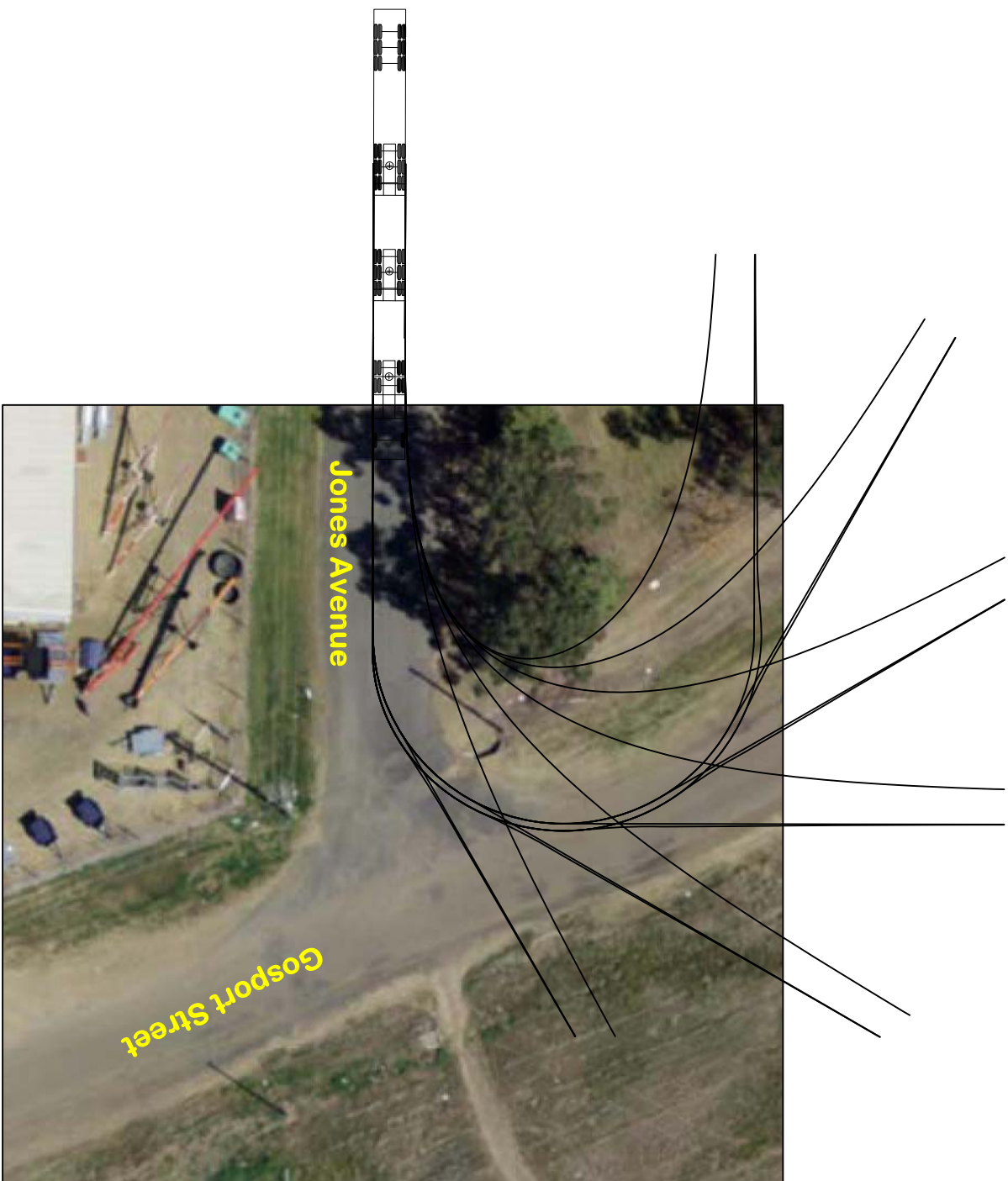
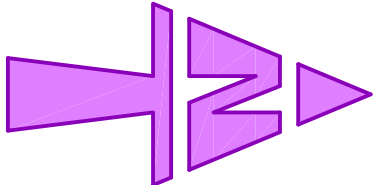
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**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



**Title      B-Triple Assessment: Intersection of Gosport Street and Jones Avenue**  
**Scale    1:500      @ A3      Sheet    01 of 18      Plan Number    13-500-01-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**

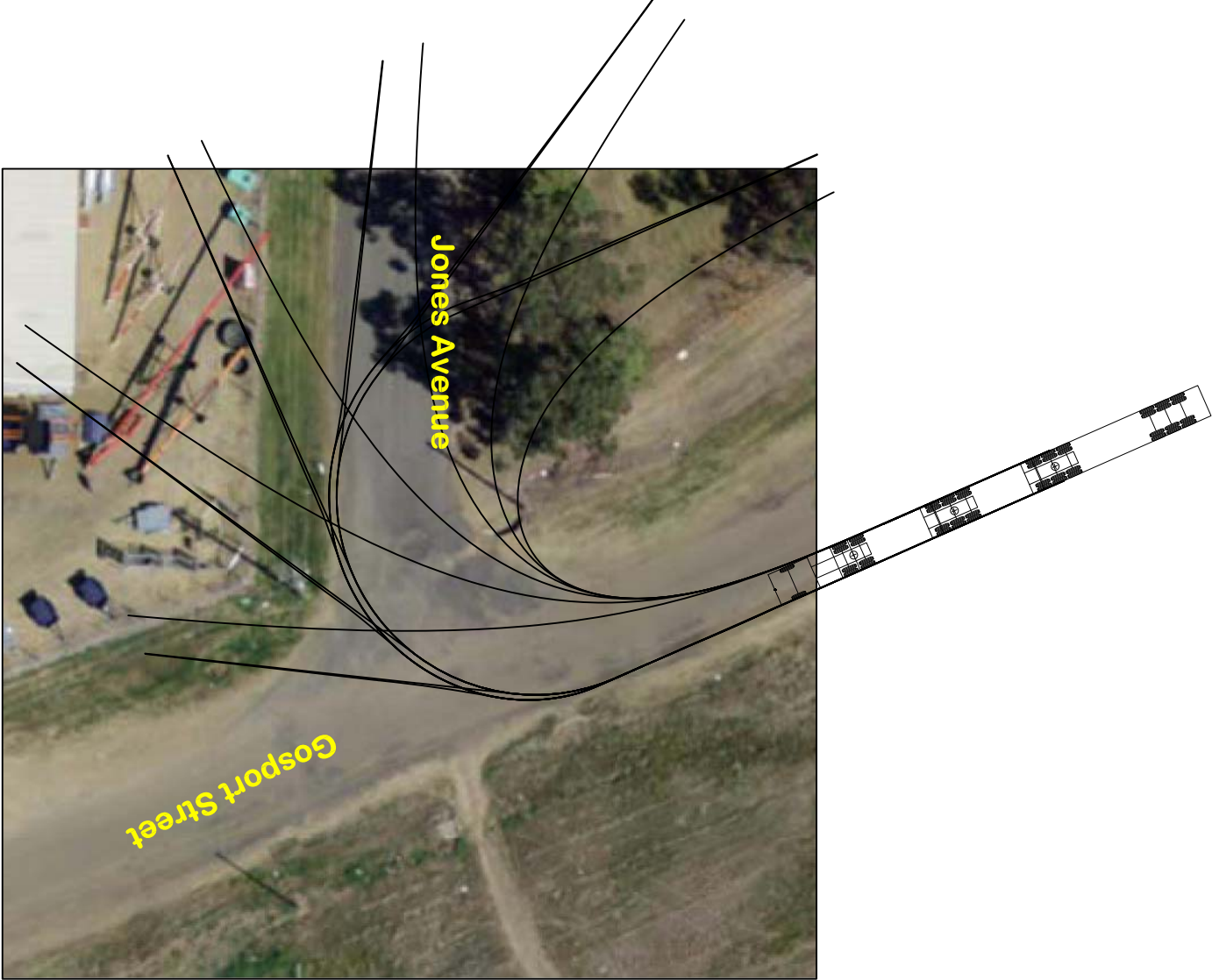
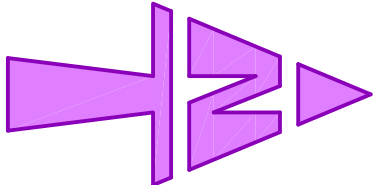


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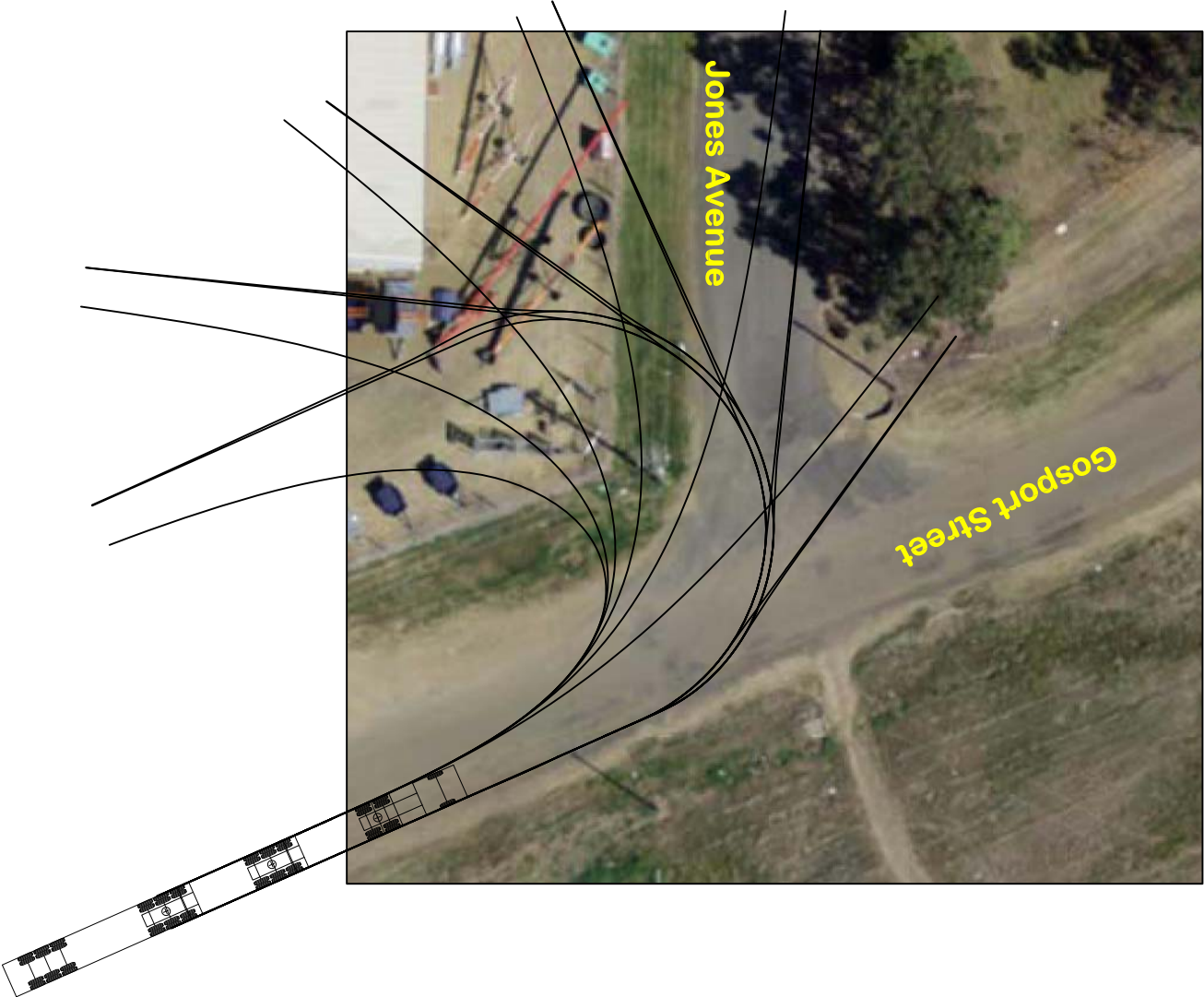
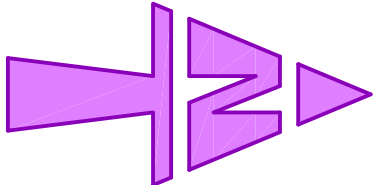


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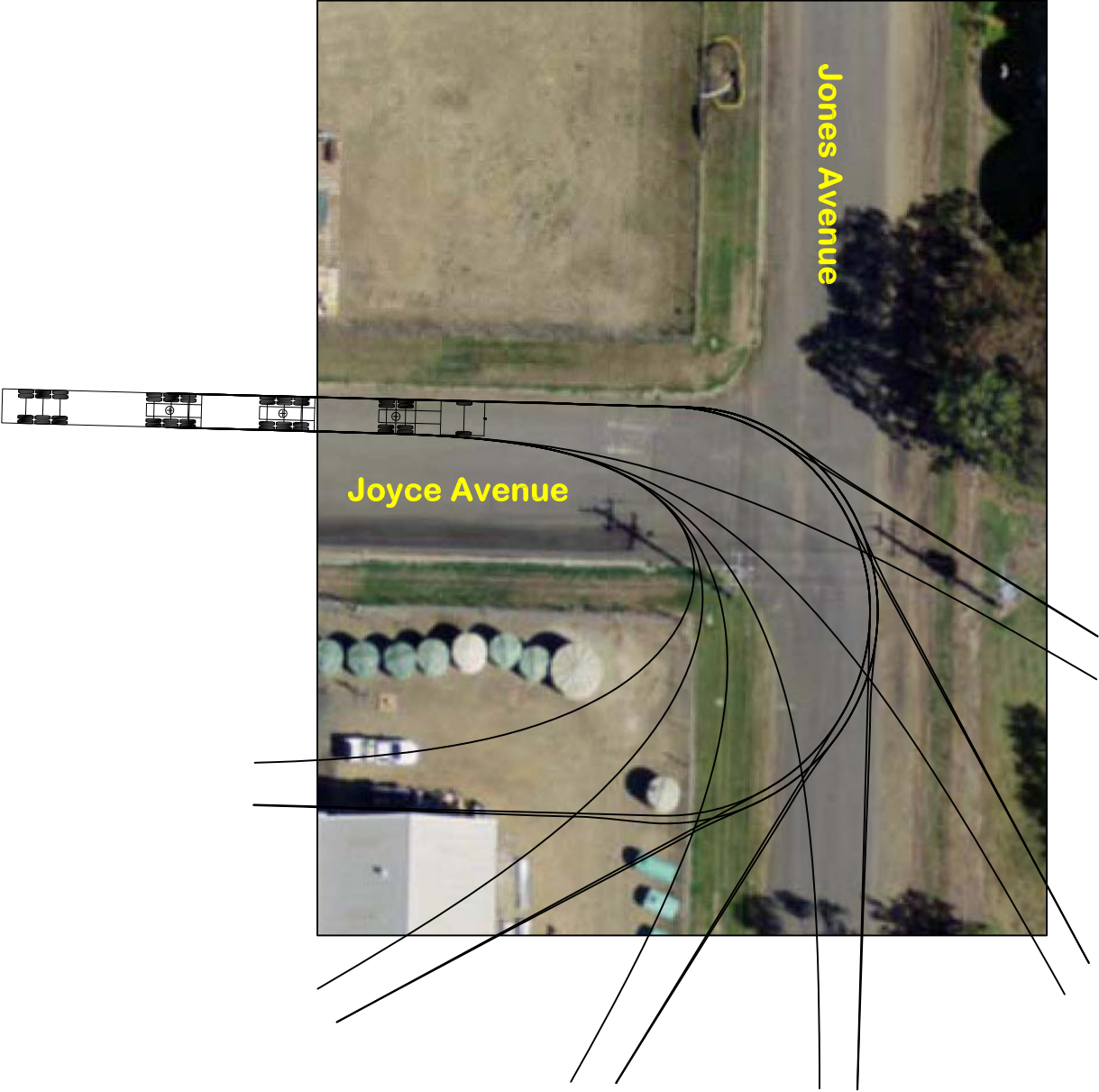
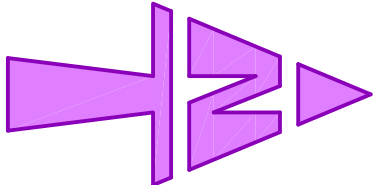
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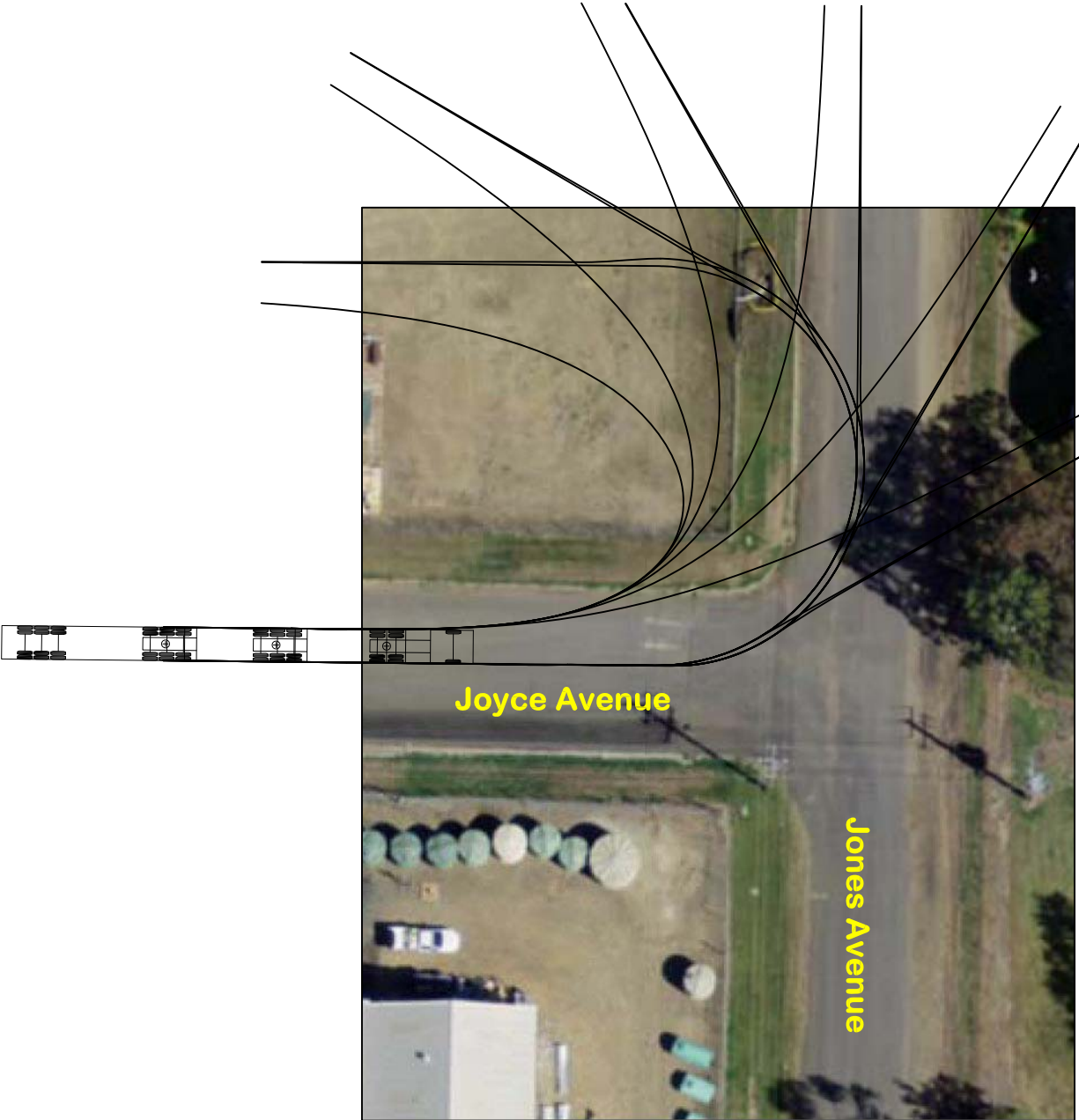
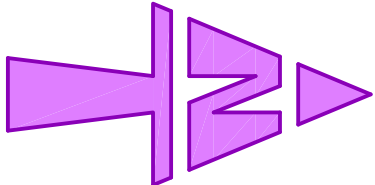
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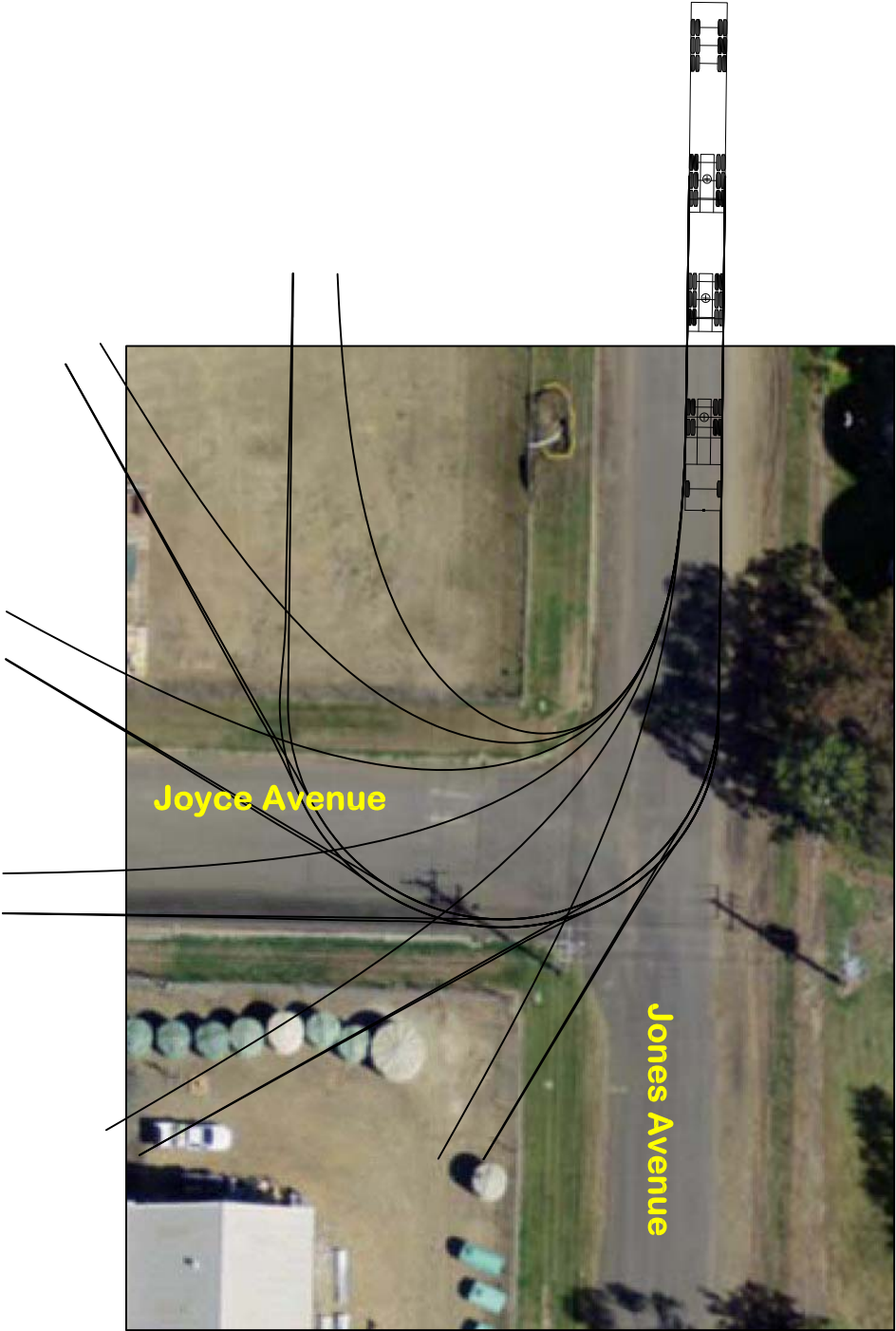
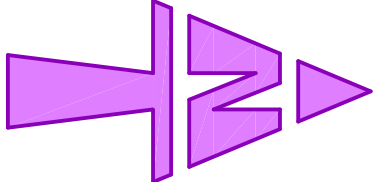
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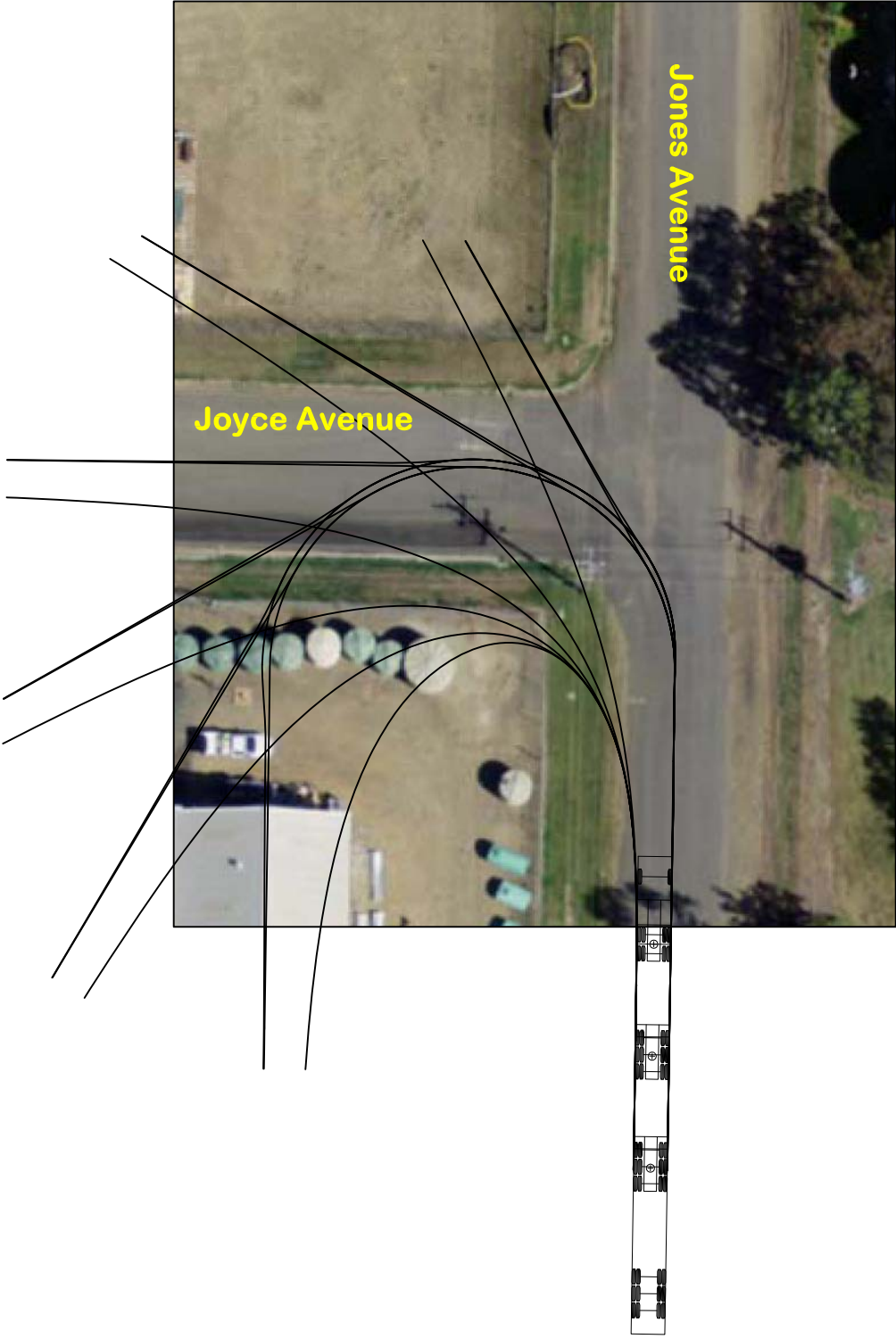
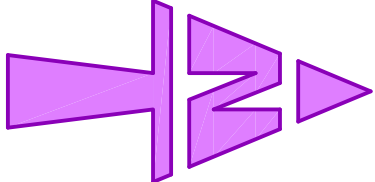
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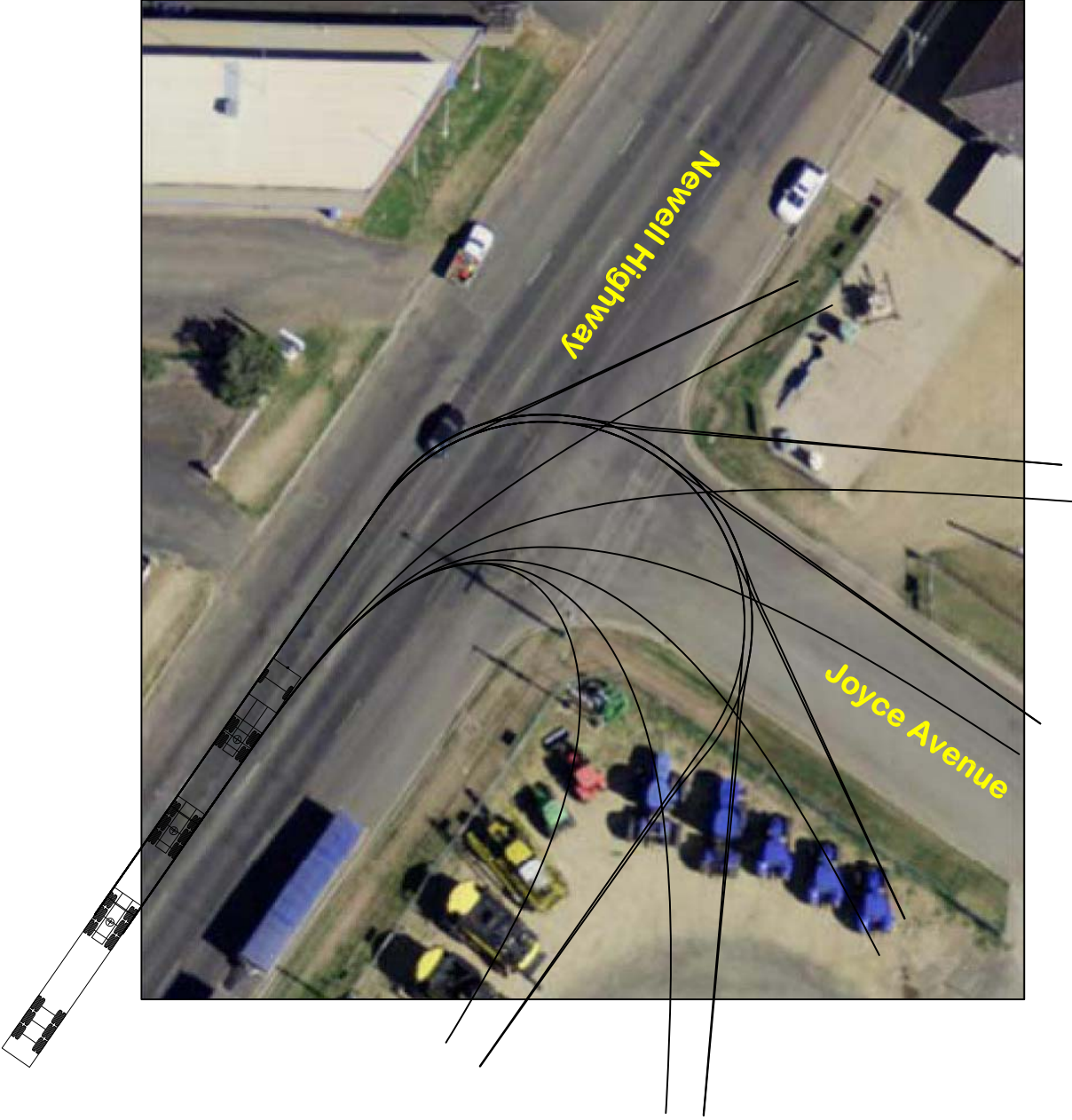
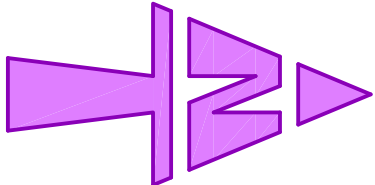
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**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**



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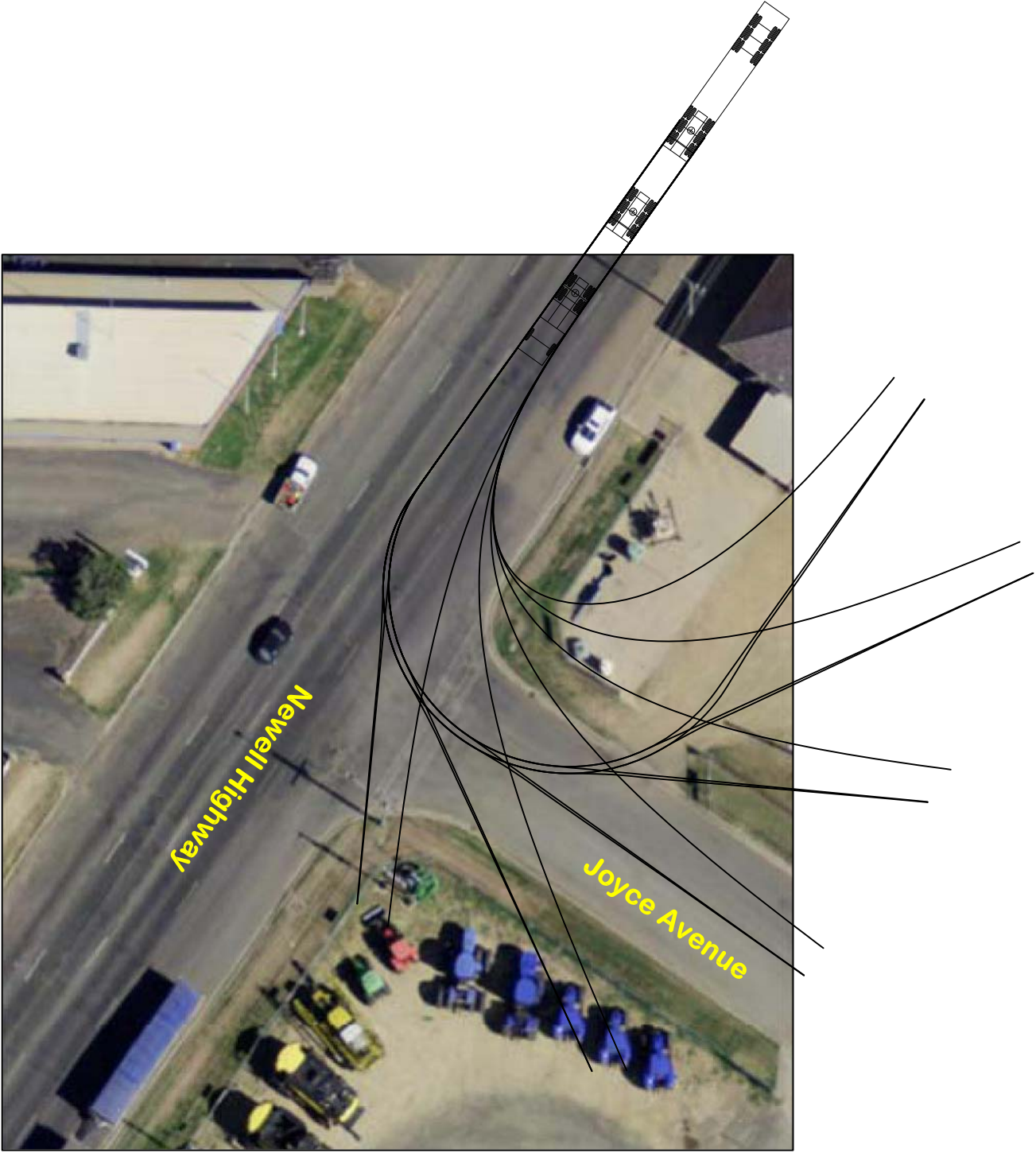
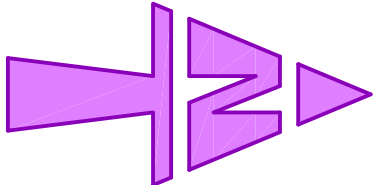


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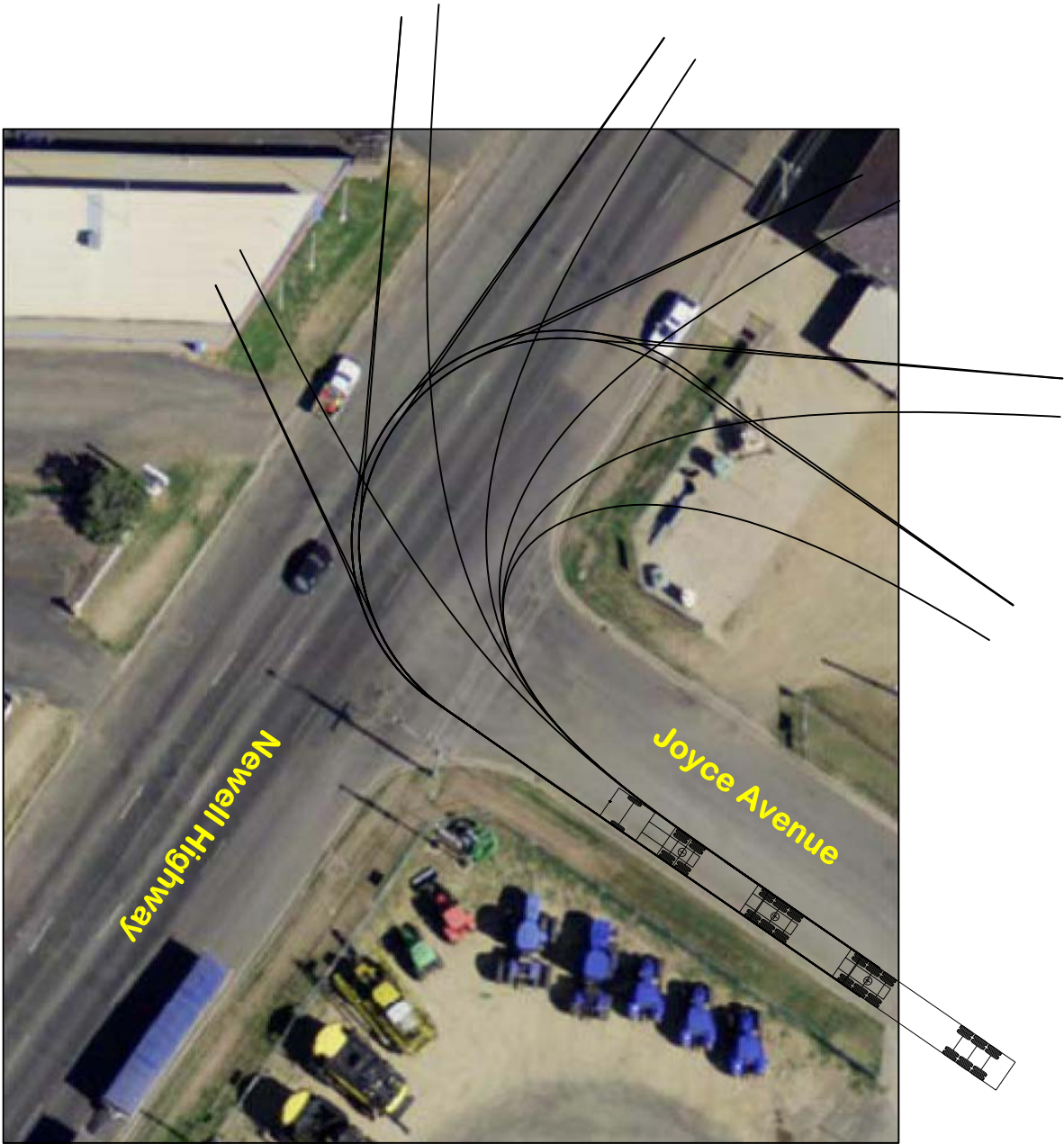
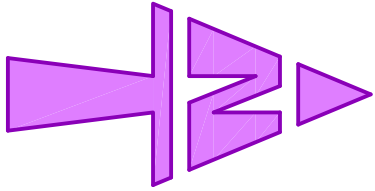


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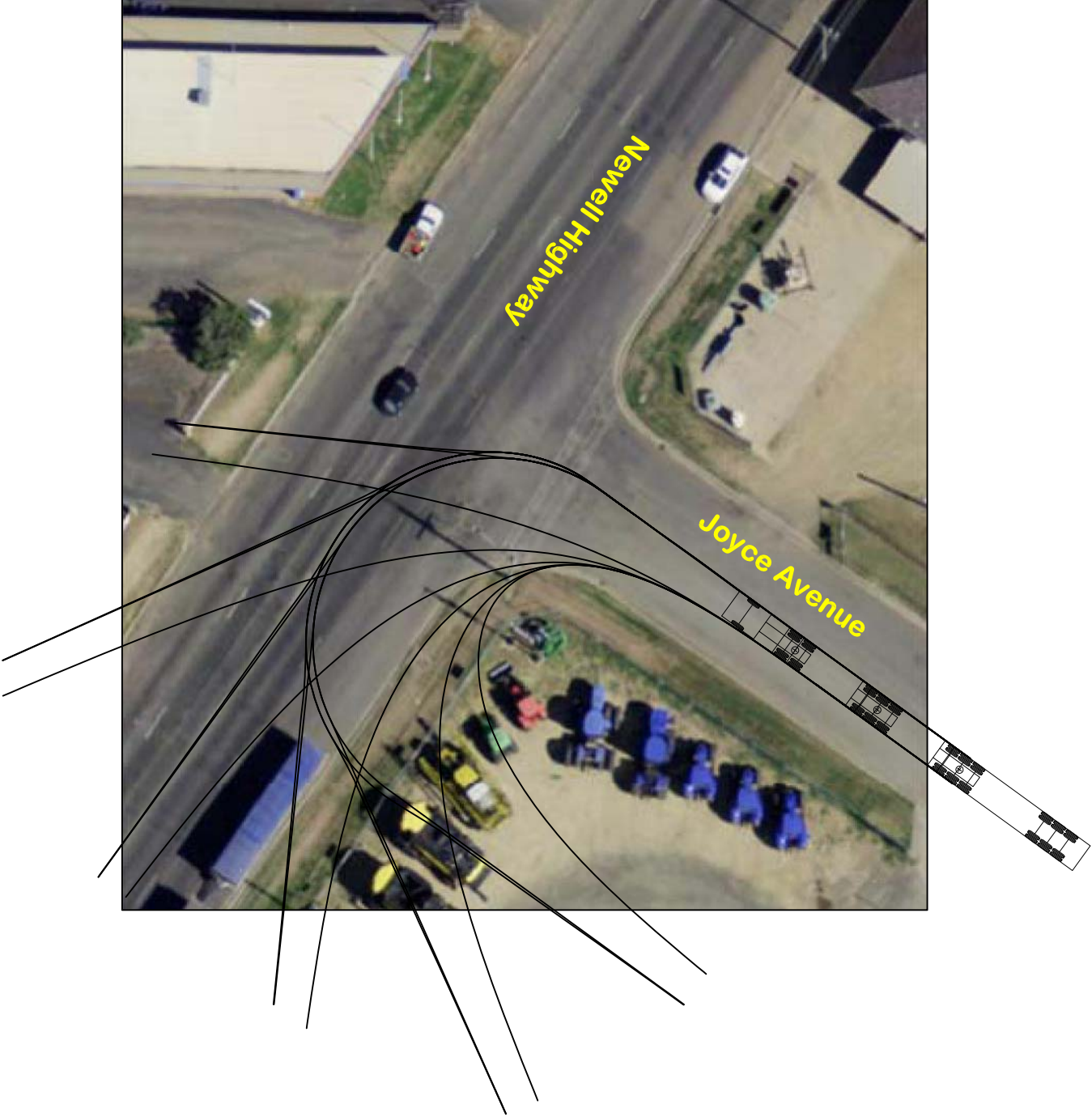
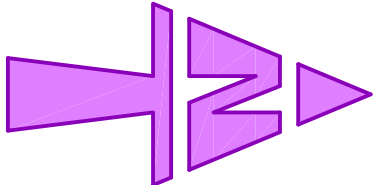


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**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**





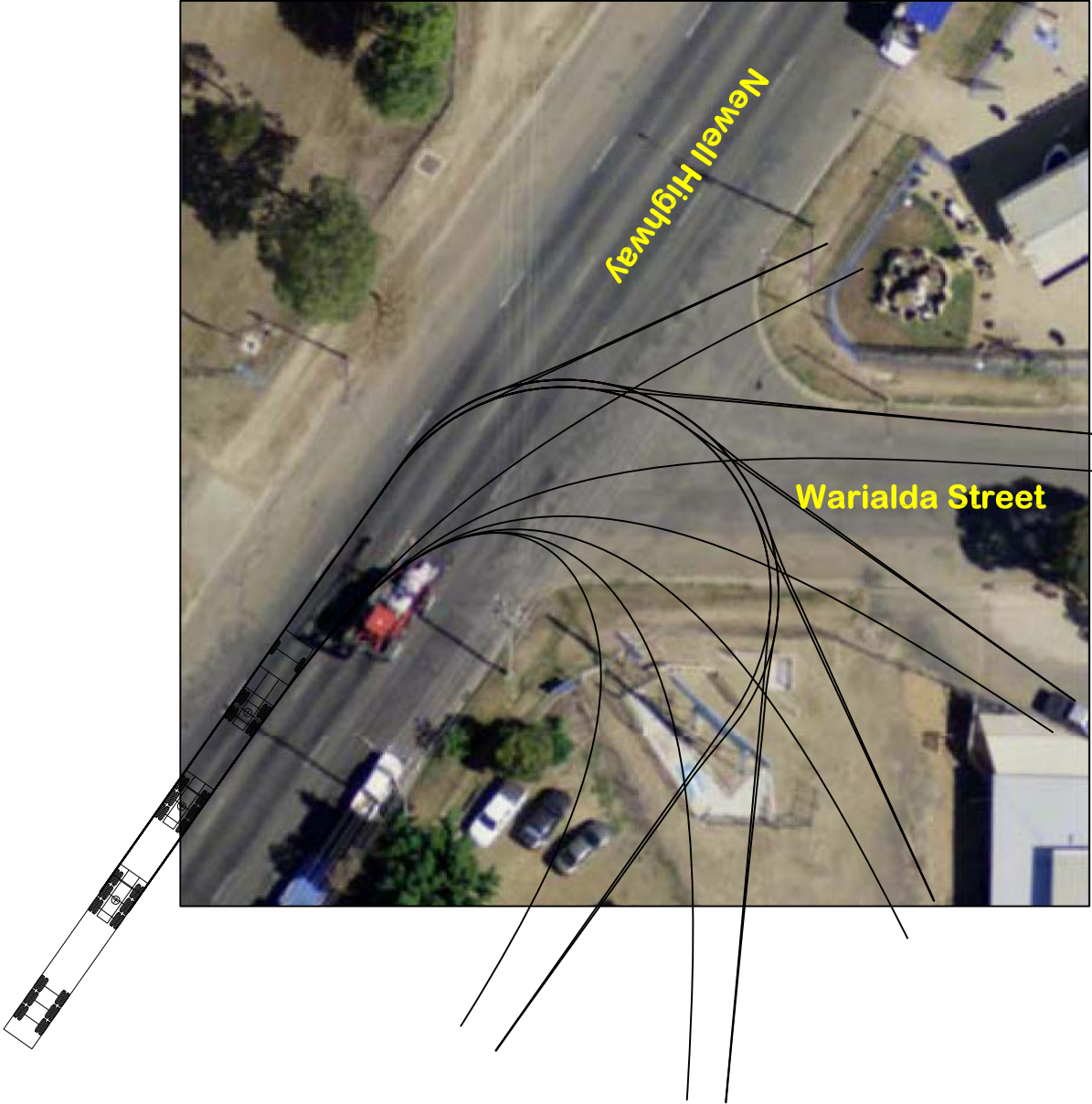
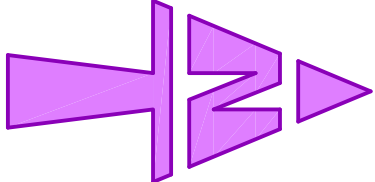
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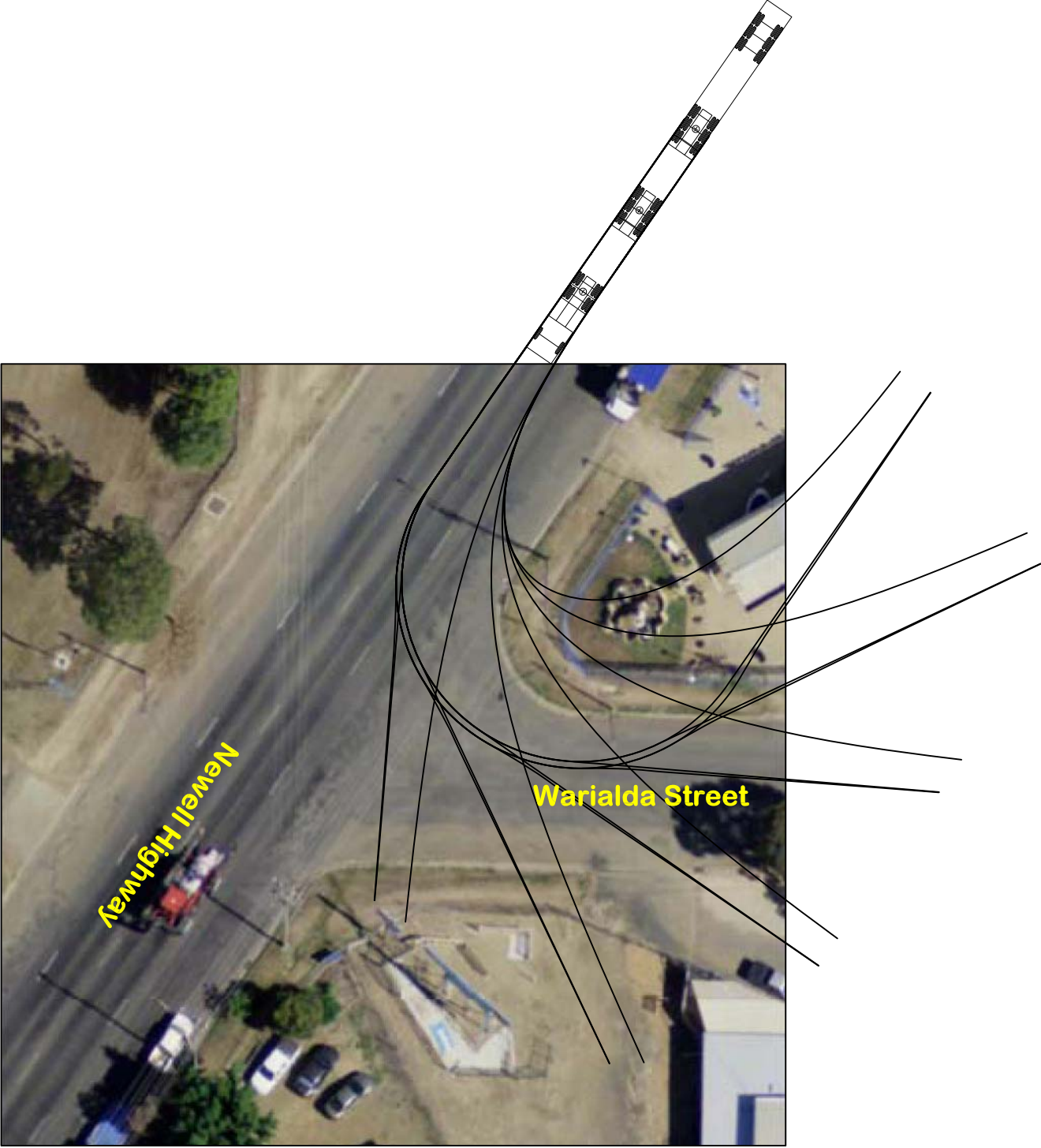
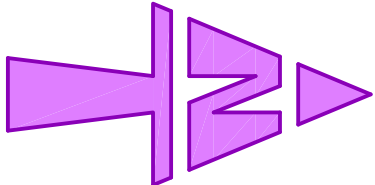
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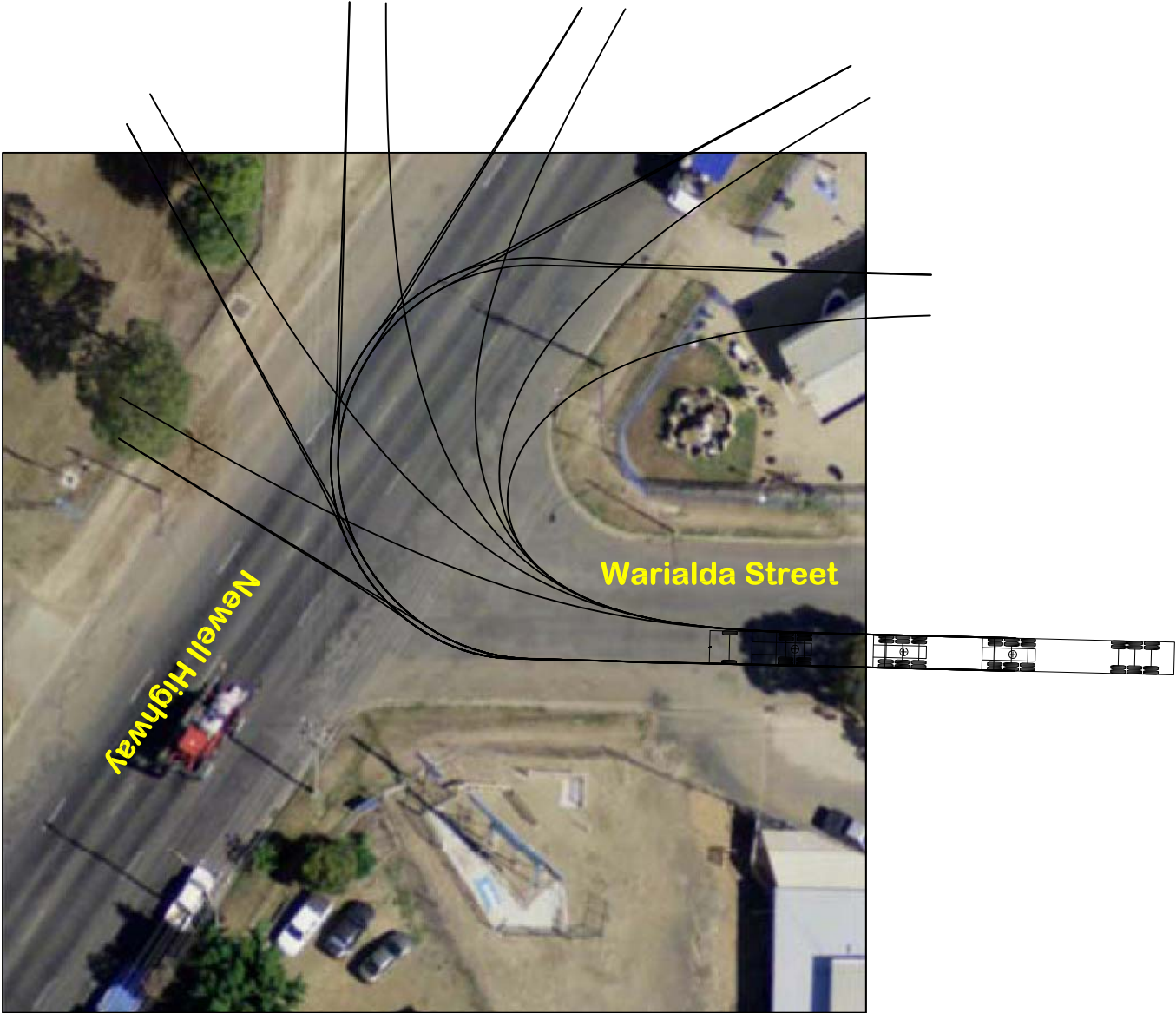
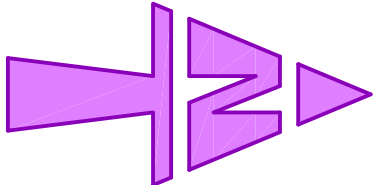


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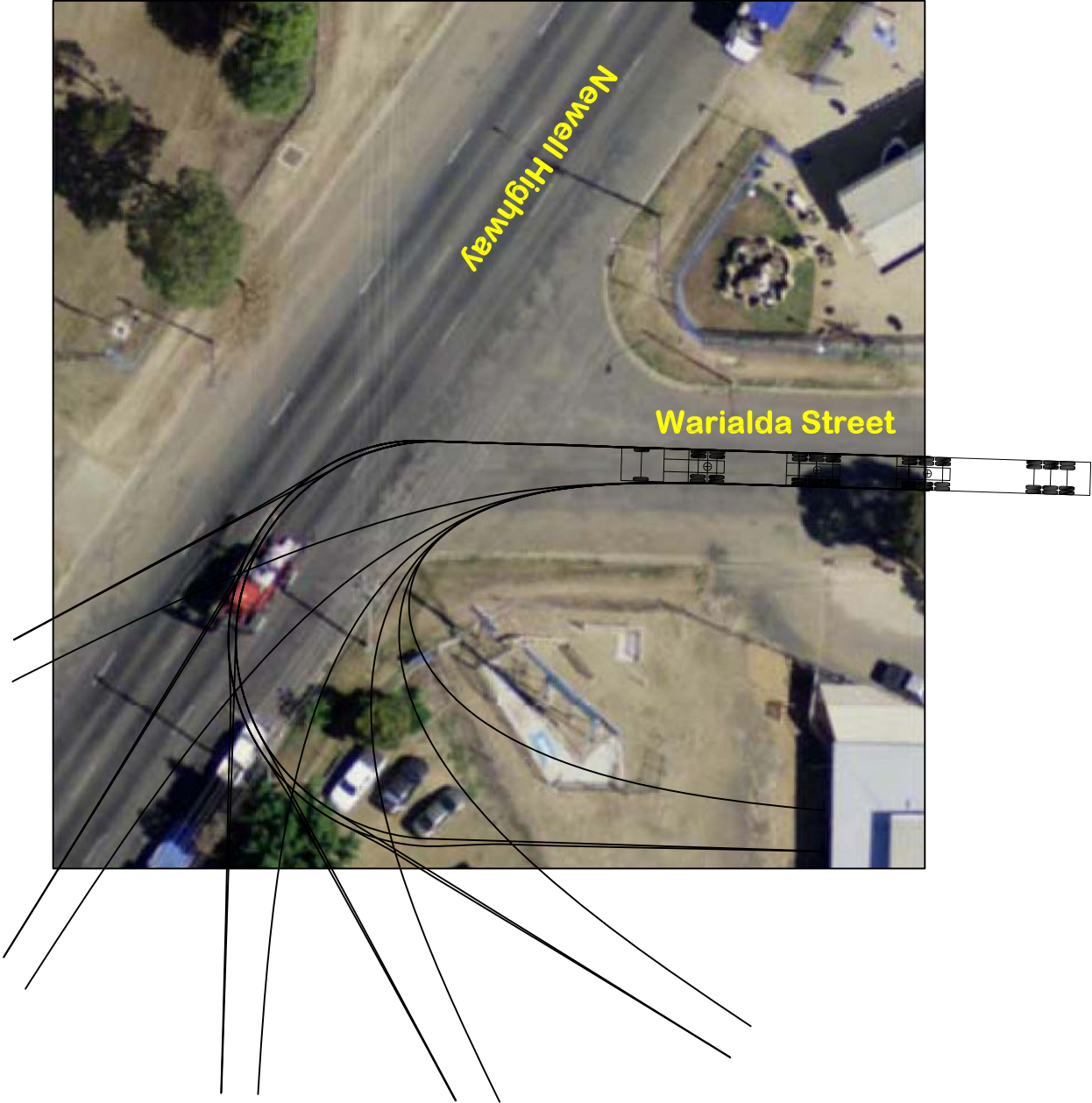
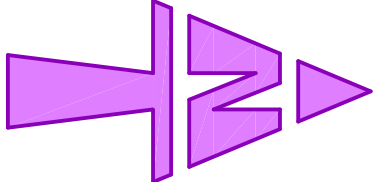
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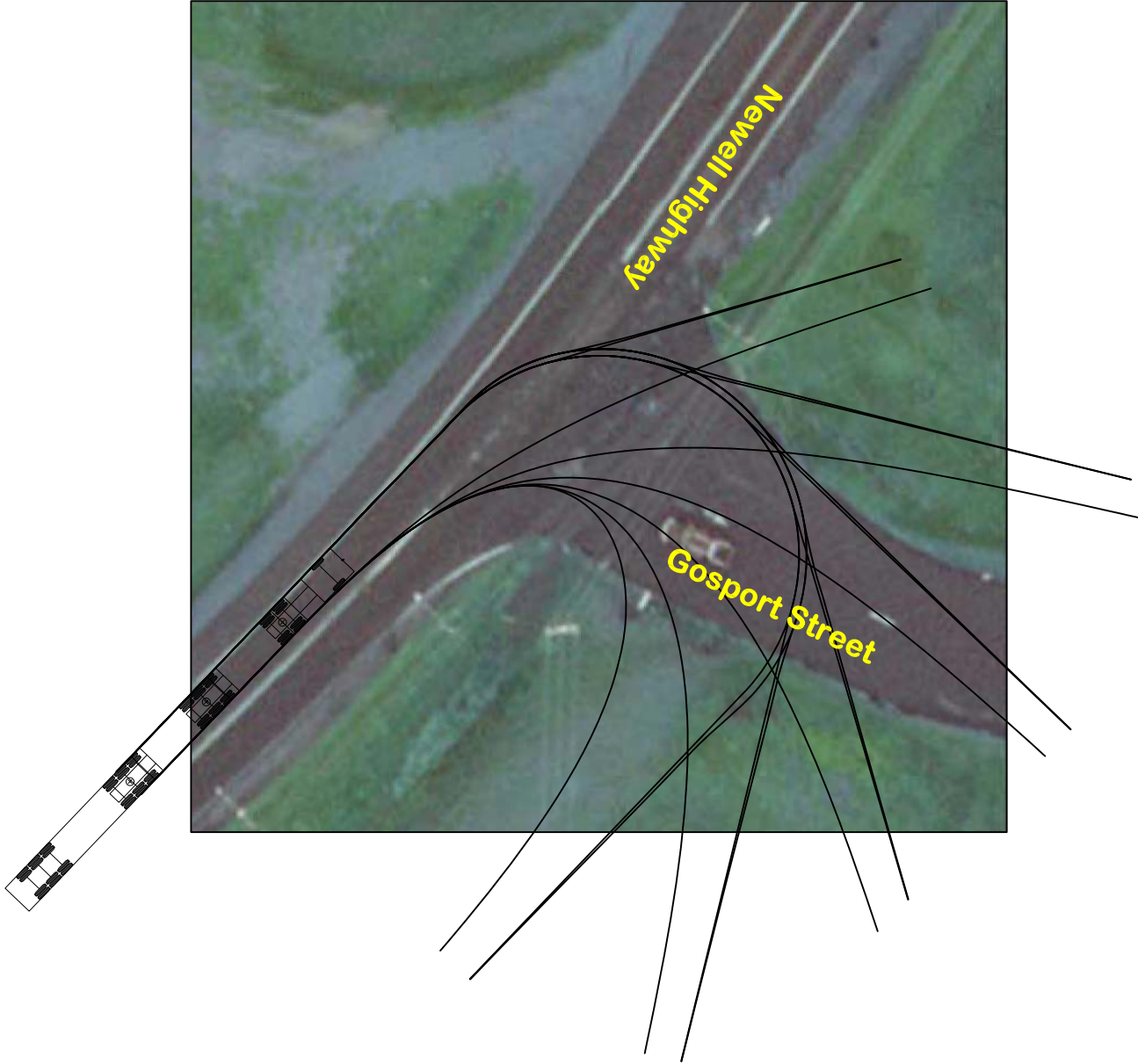
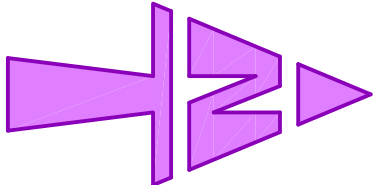
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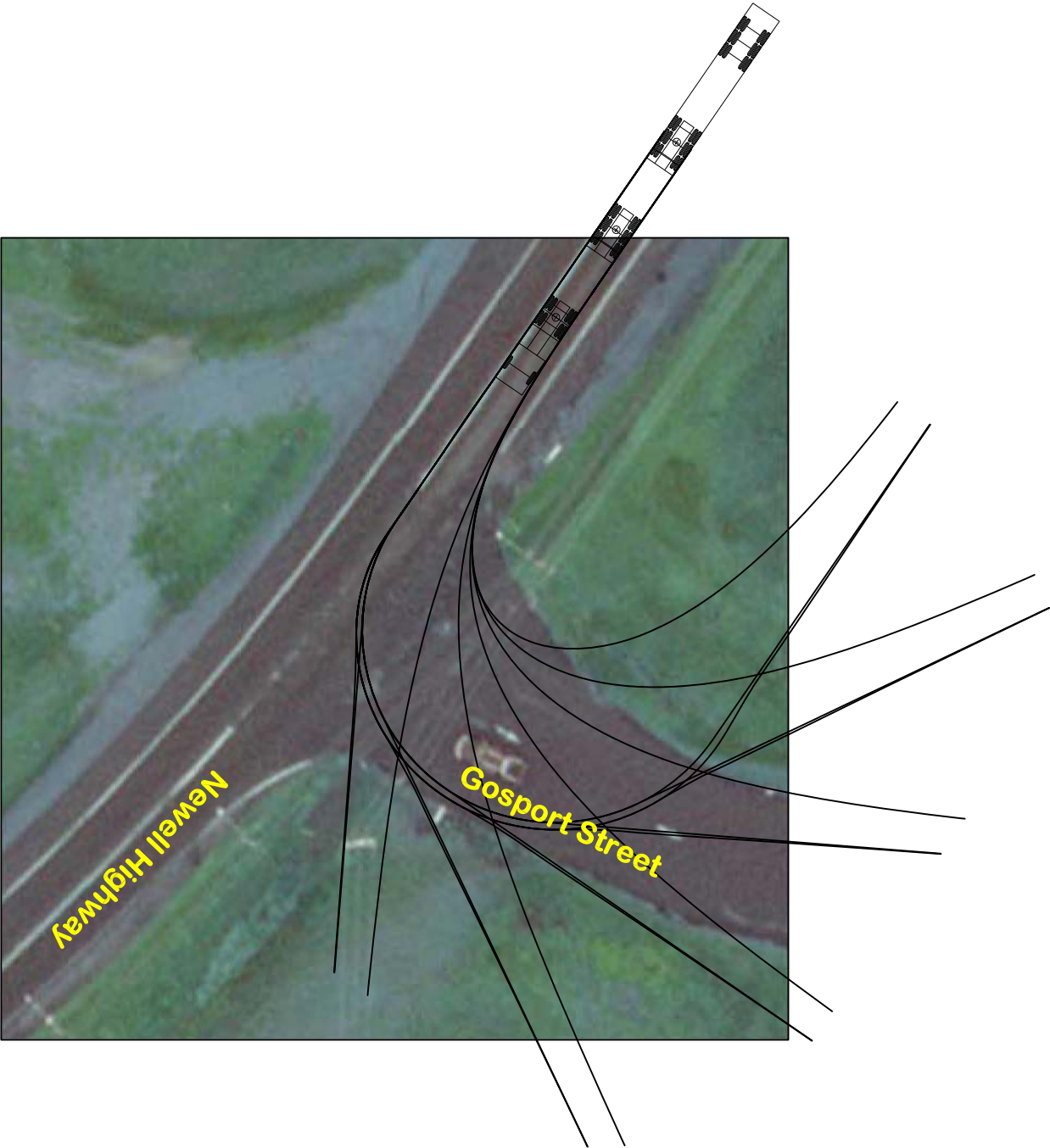
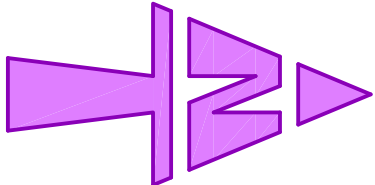
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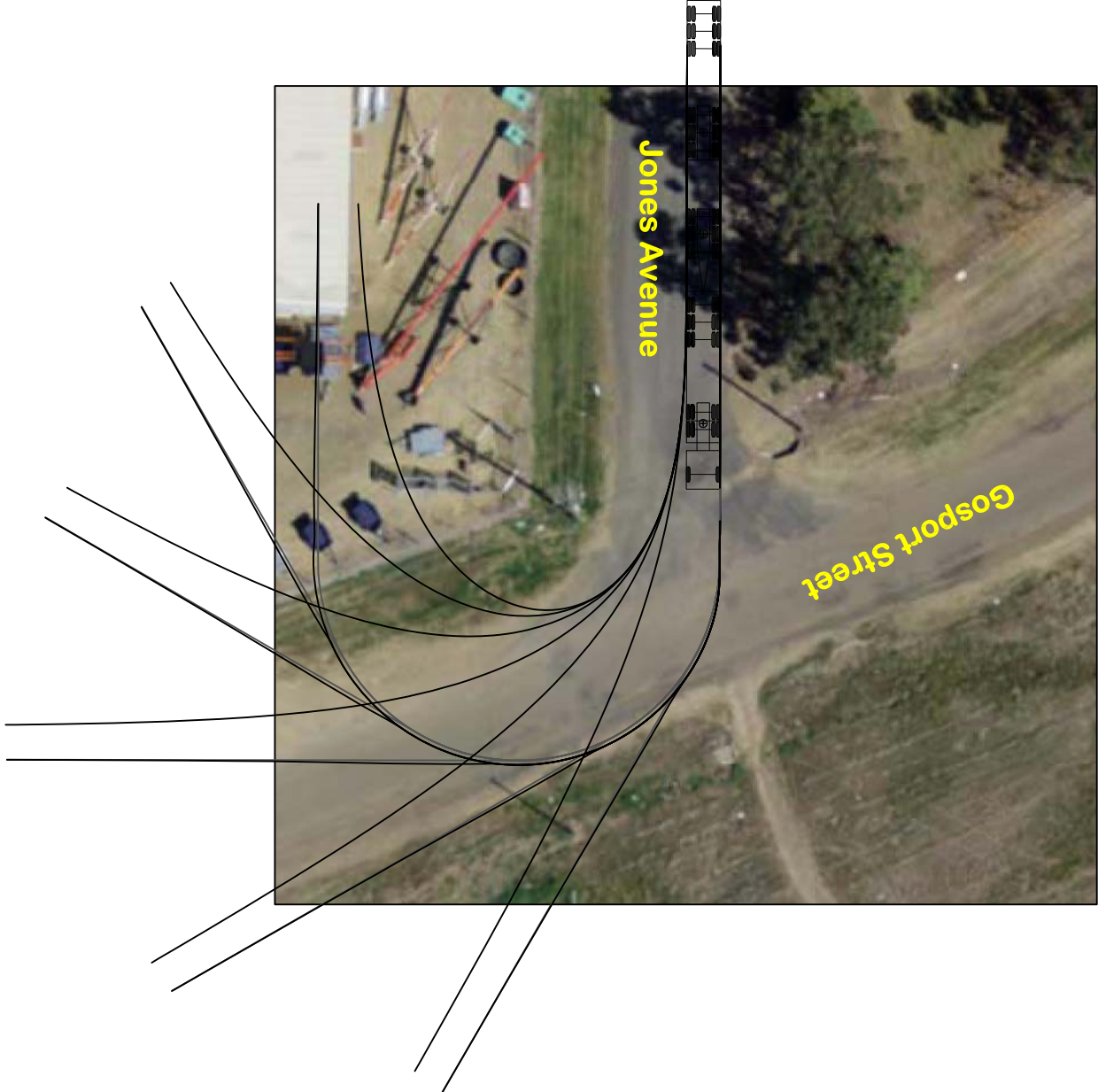
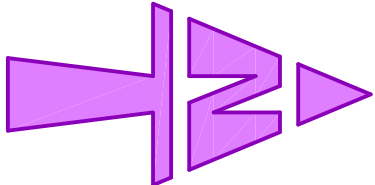


MOREE PLAINS SHIRE COUNCIL

AB-TRIPLE (36.5 m)

Radius 15 m

Indicative turning speed 5-15 km/h



**Title** AB-Triple Assessment: Intersection of Gosport Street and Jones Avenue

**Scale** 1:500 @ A3 **Sheet** 01 of 18 **Plan Number** 13-503-01-A

**Drawn/Designed** Casey Spilsbury-Brinkmann **Date** 12/07/2013

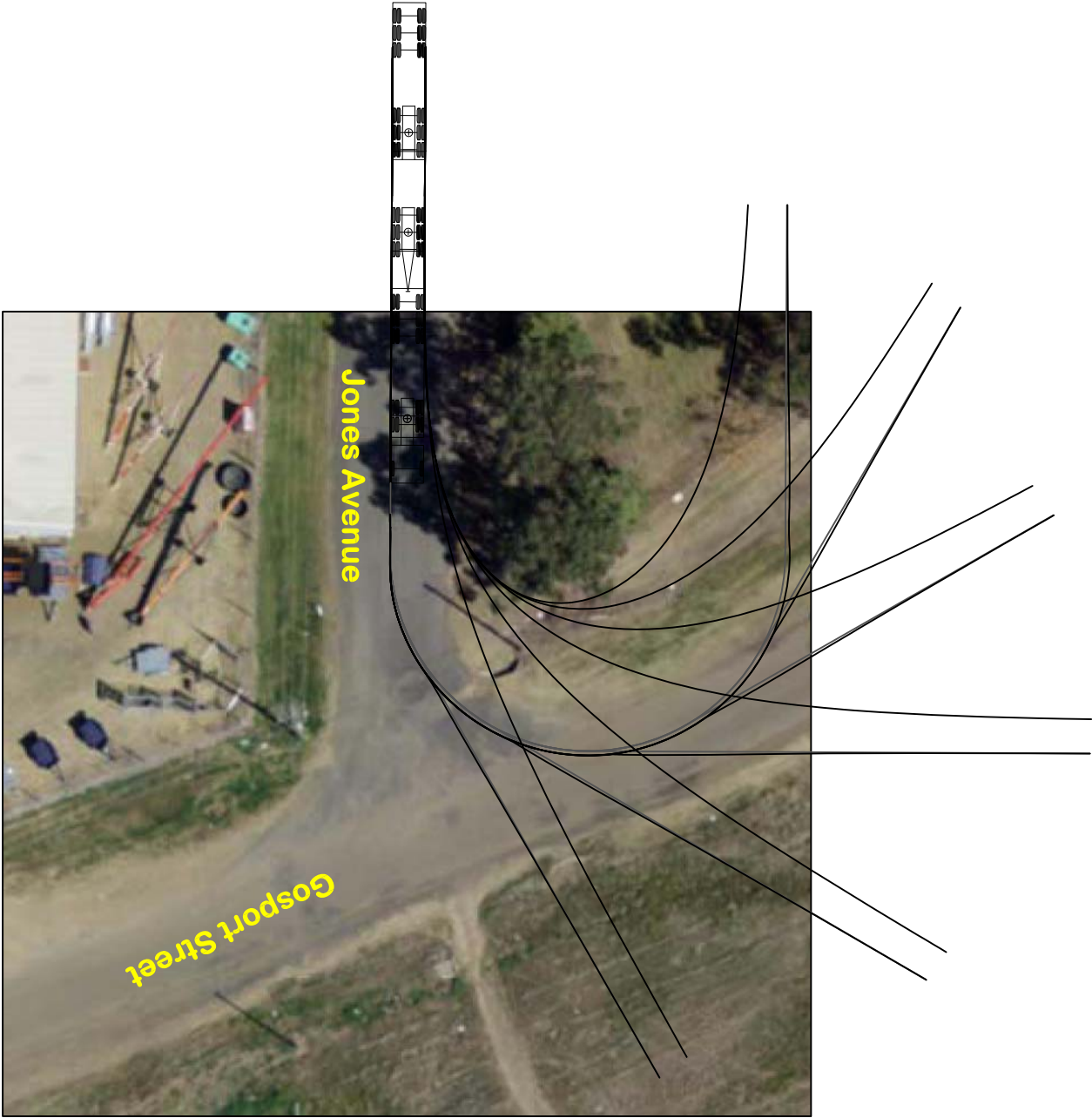
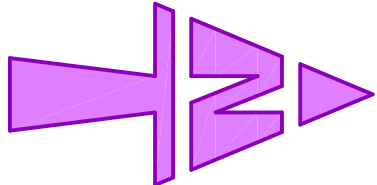


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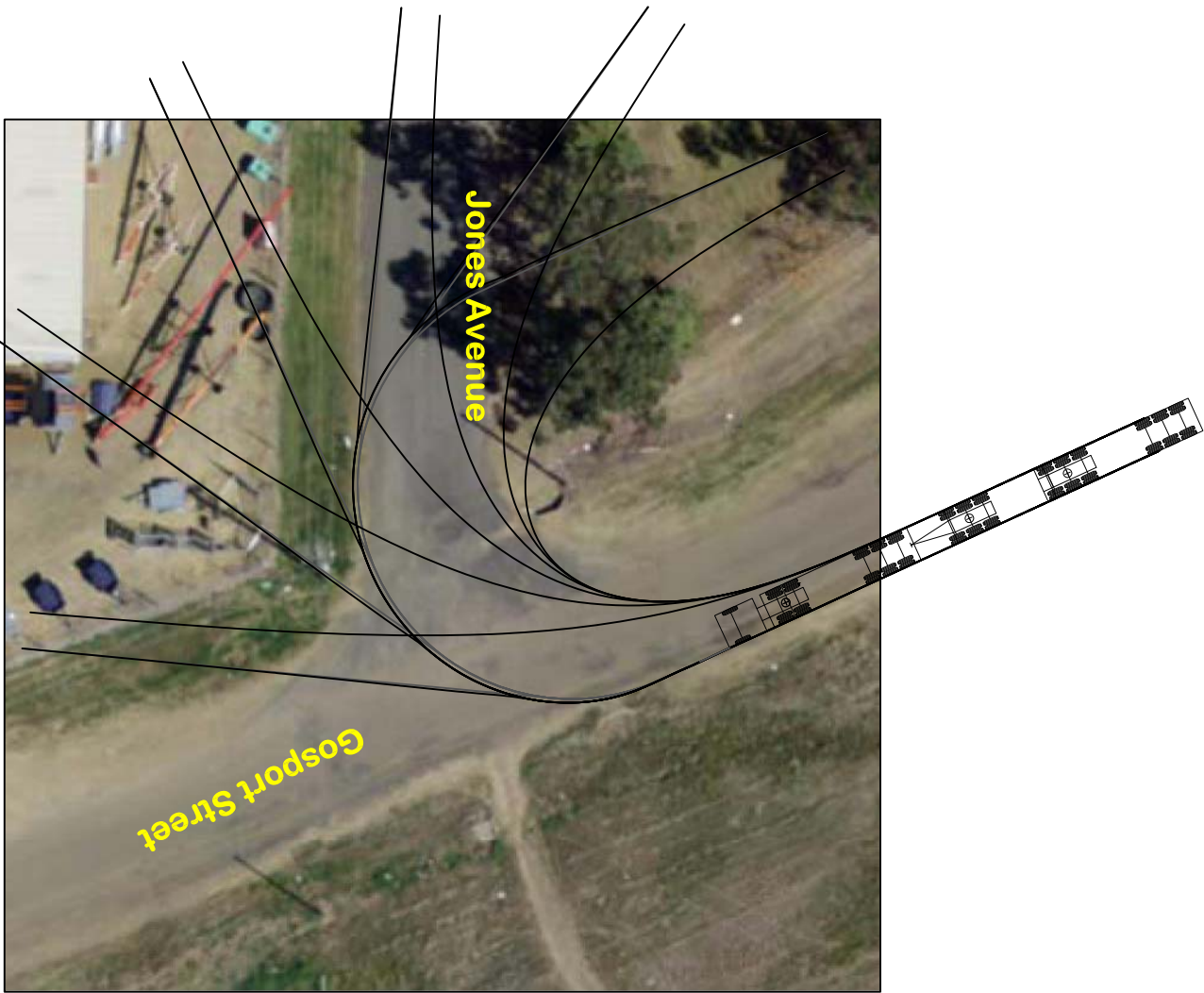
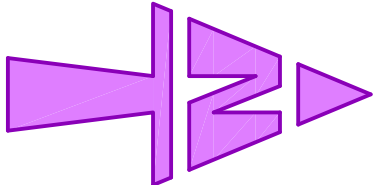
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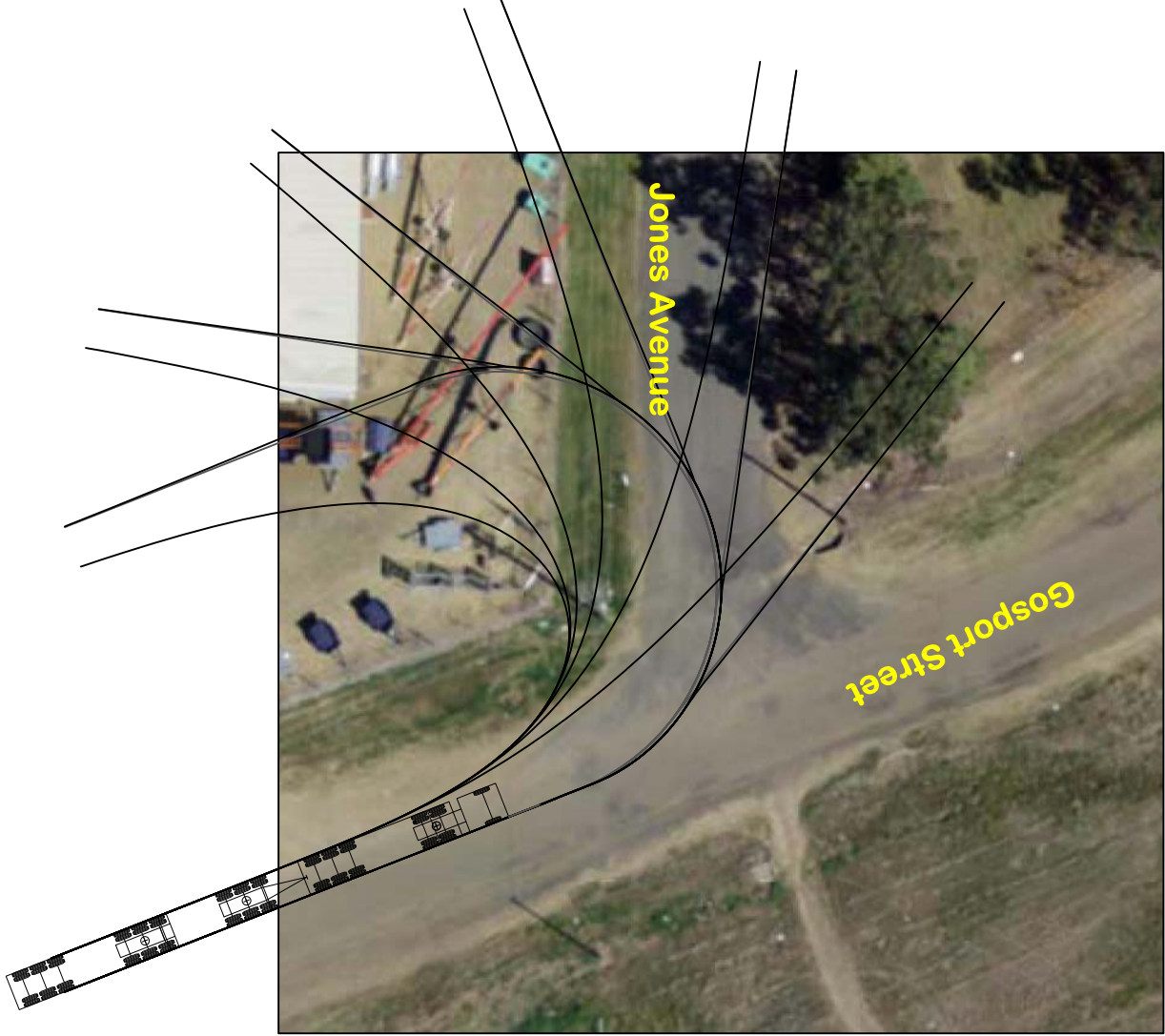
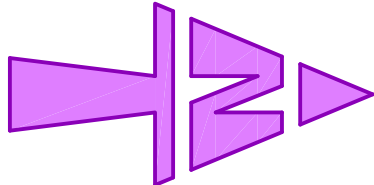


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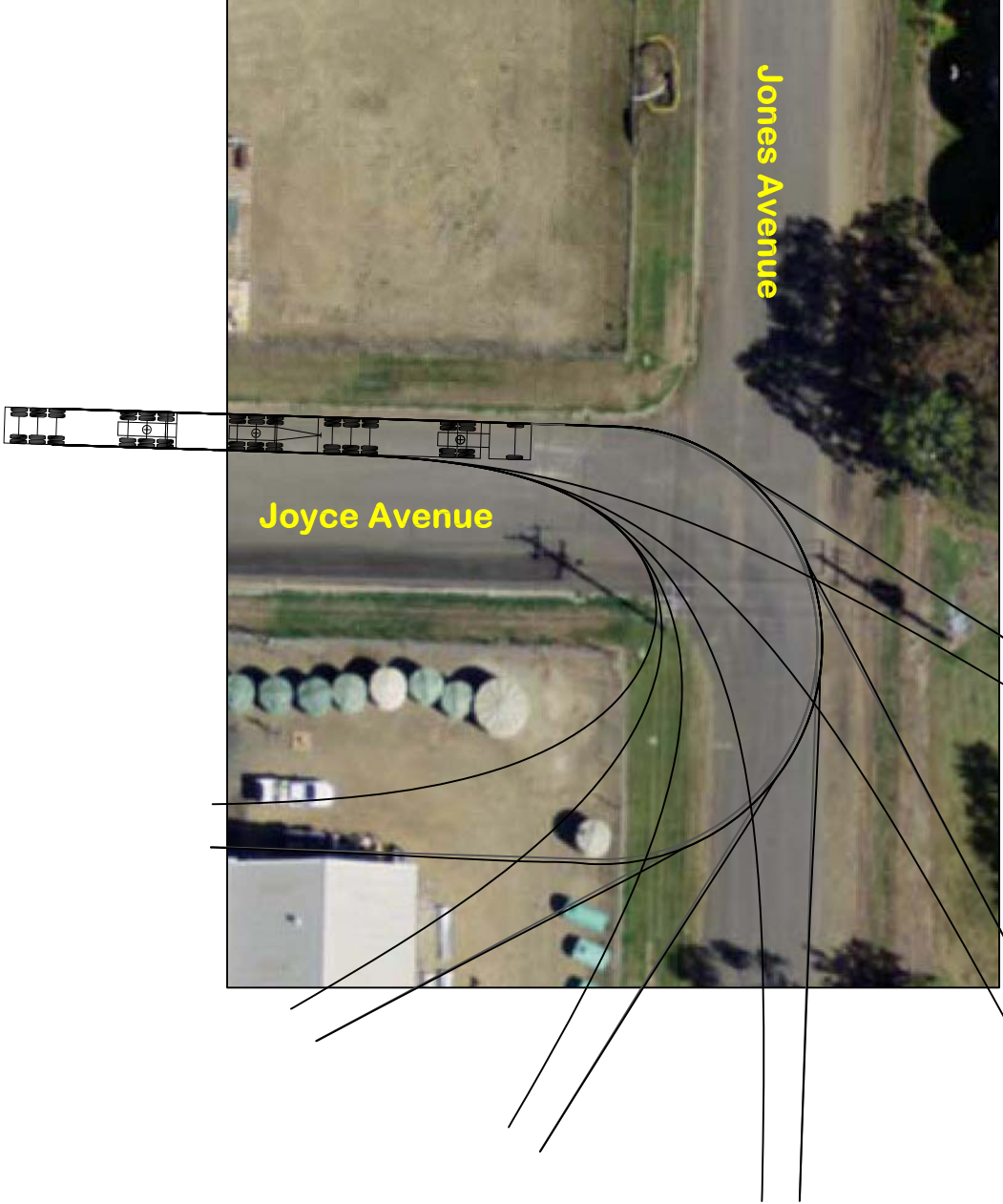
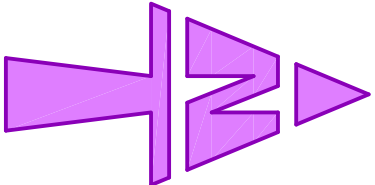
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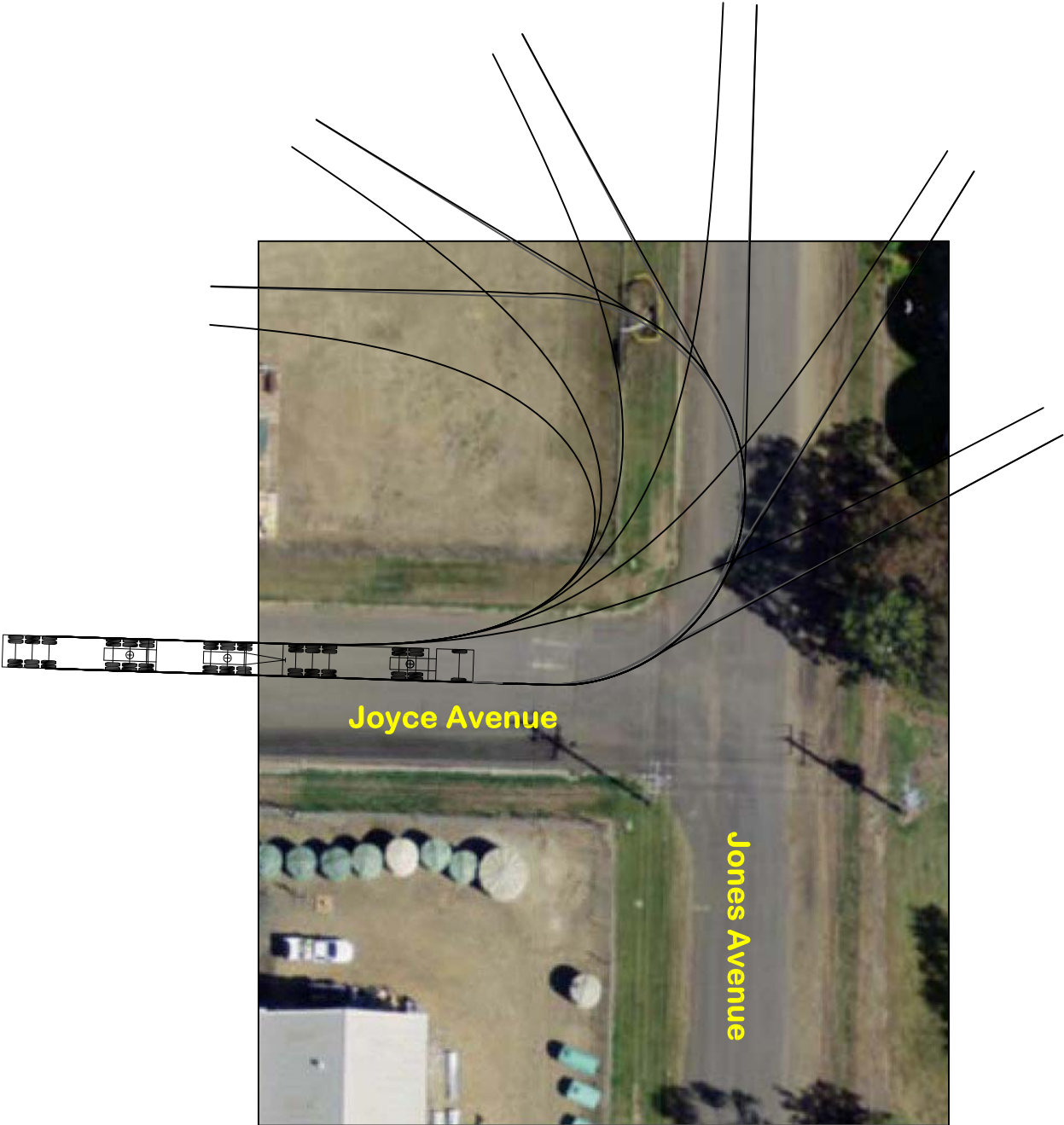
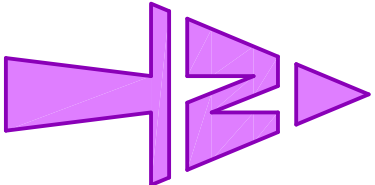
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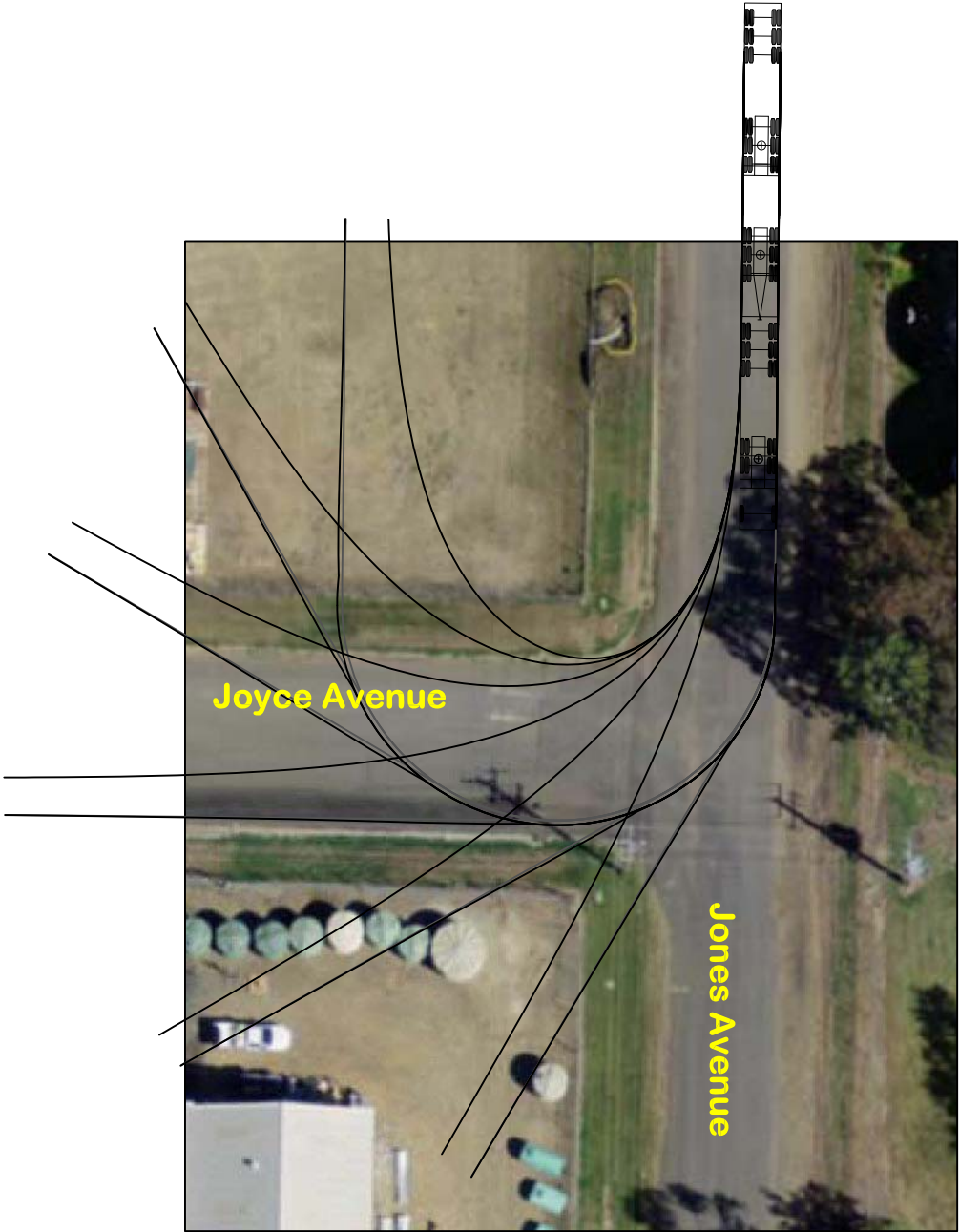
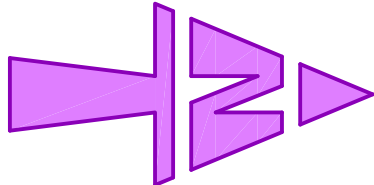


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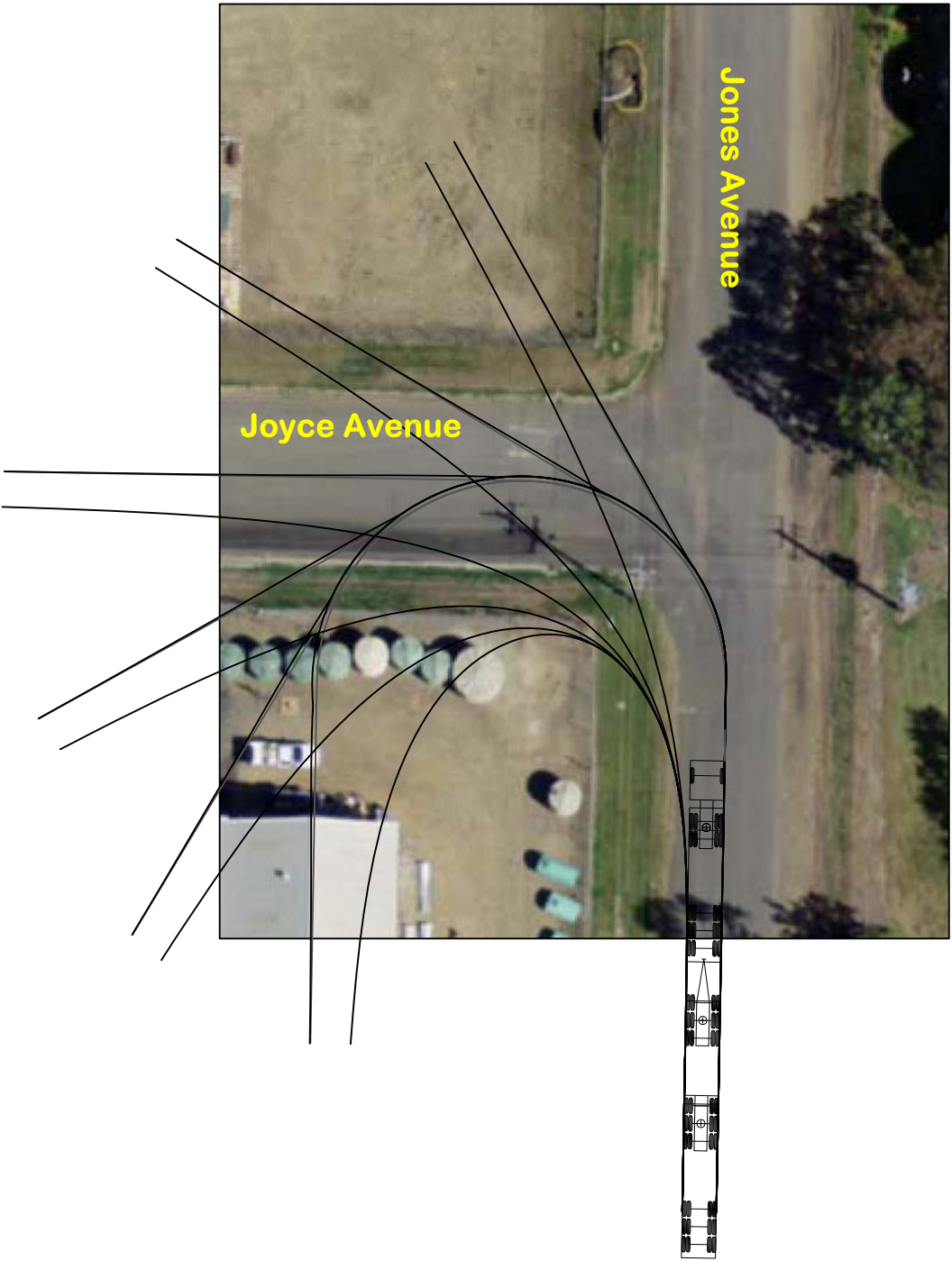
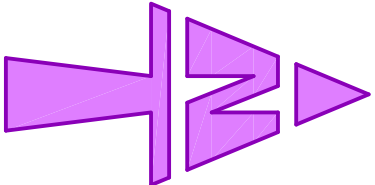
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AB-TRIPLE (36.5 m)  
Radius 15 m  
Indicative turning speed 5-15 km/h



**Title**      **AB-Triple Assessment: Intersection of Jones Avenue and Joyce Avenue**

**Scale**    **1:500**      **@ A3**      **Sheet**    **08 of 18**      **Plan Number**    **13-503-08-A**

**Drawn/Designed**      **Casey Spilsbury-Brinkmann**      **Date**      **12/07/2013**

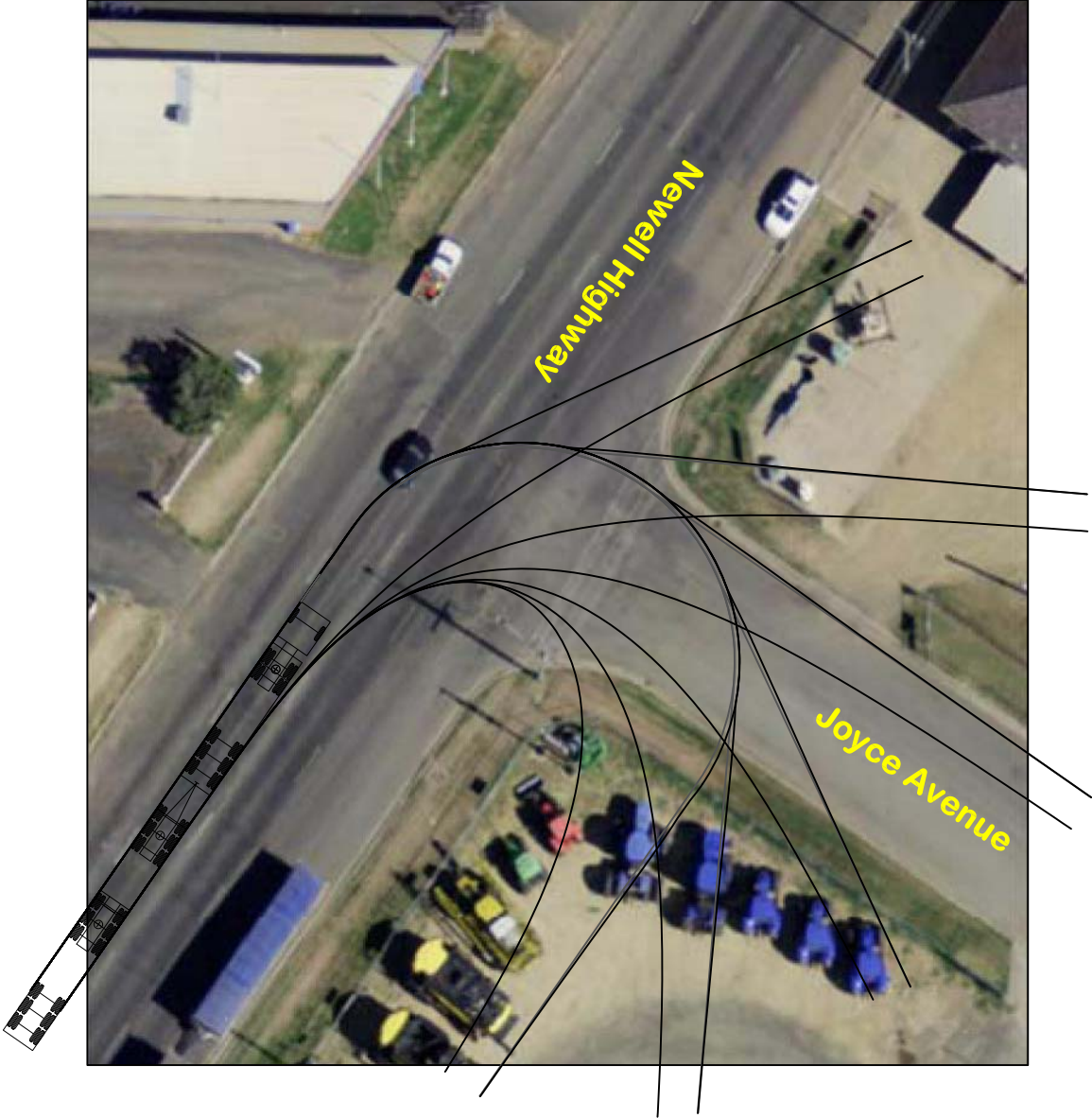
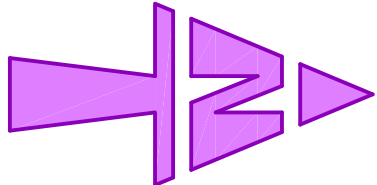


MOREE PLAINS SHIRE COUNCIL

AB-TRIPLE (36.5 m)

Radius 15 m

Indicative turning speed 5-15 km/h



**Title      AB-Triple Assessment: Intersection of Joyce Avenue and Newell Highway**

**Scale    1:500      @ A3      Sheet    09 of 18      Plan Number    13-503-09-A**

**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**

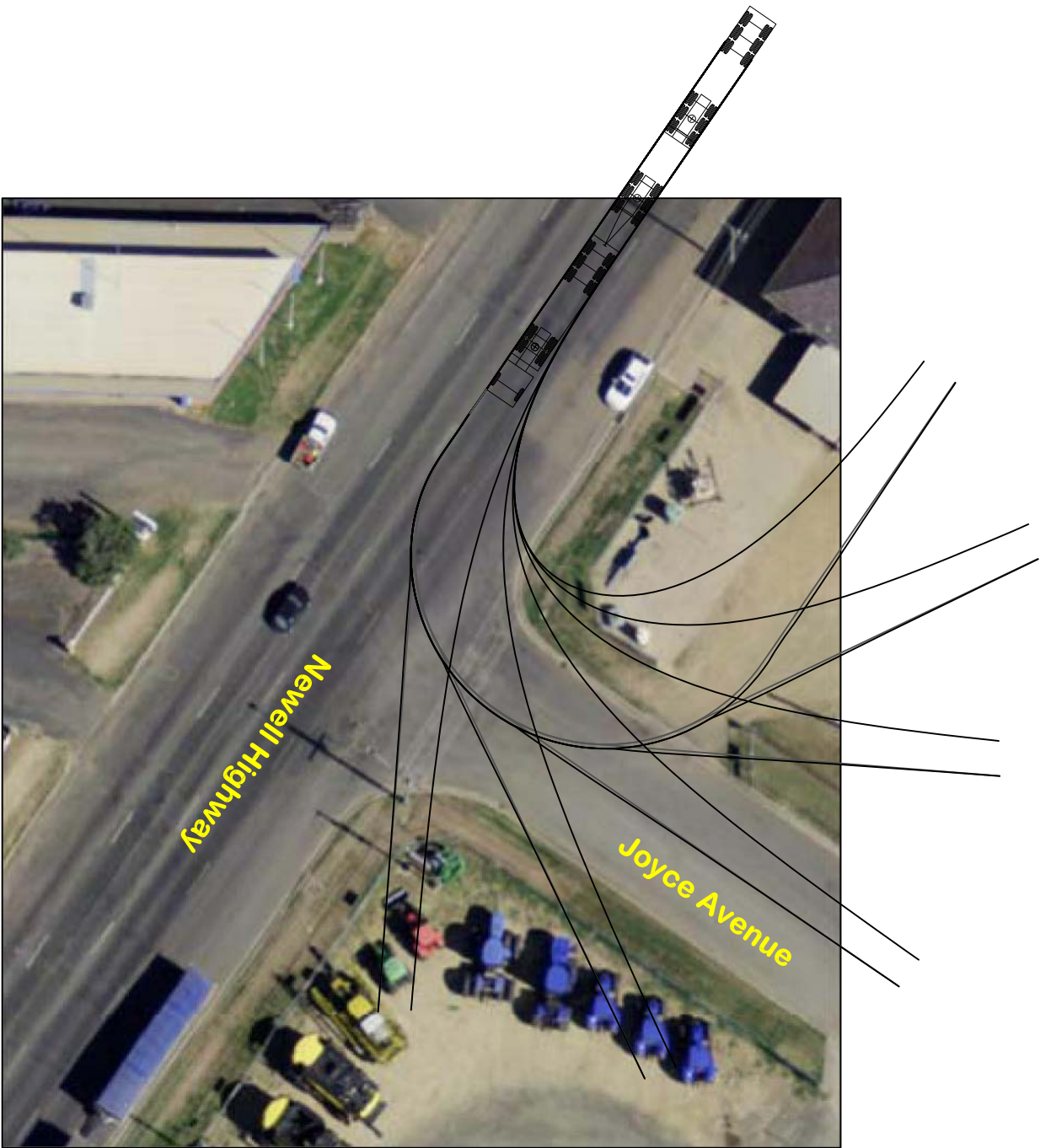
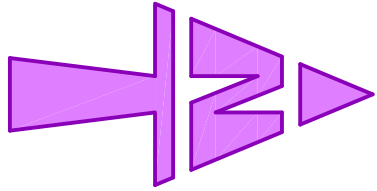


MOREE PLAINS SHIRE COUNCIL

AB-TRIPLE (36.5 m)

Radius 15 m

Indicative turning speed 5-15 km/h



**Title      AB-Triple Assessment: Intersection of Joyce Avenue and Newell Highway**

**Scale    1:500      @ A3      Sheet    10 of 18      Plan Number    13-503-10-A**

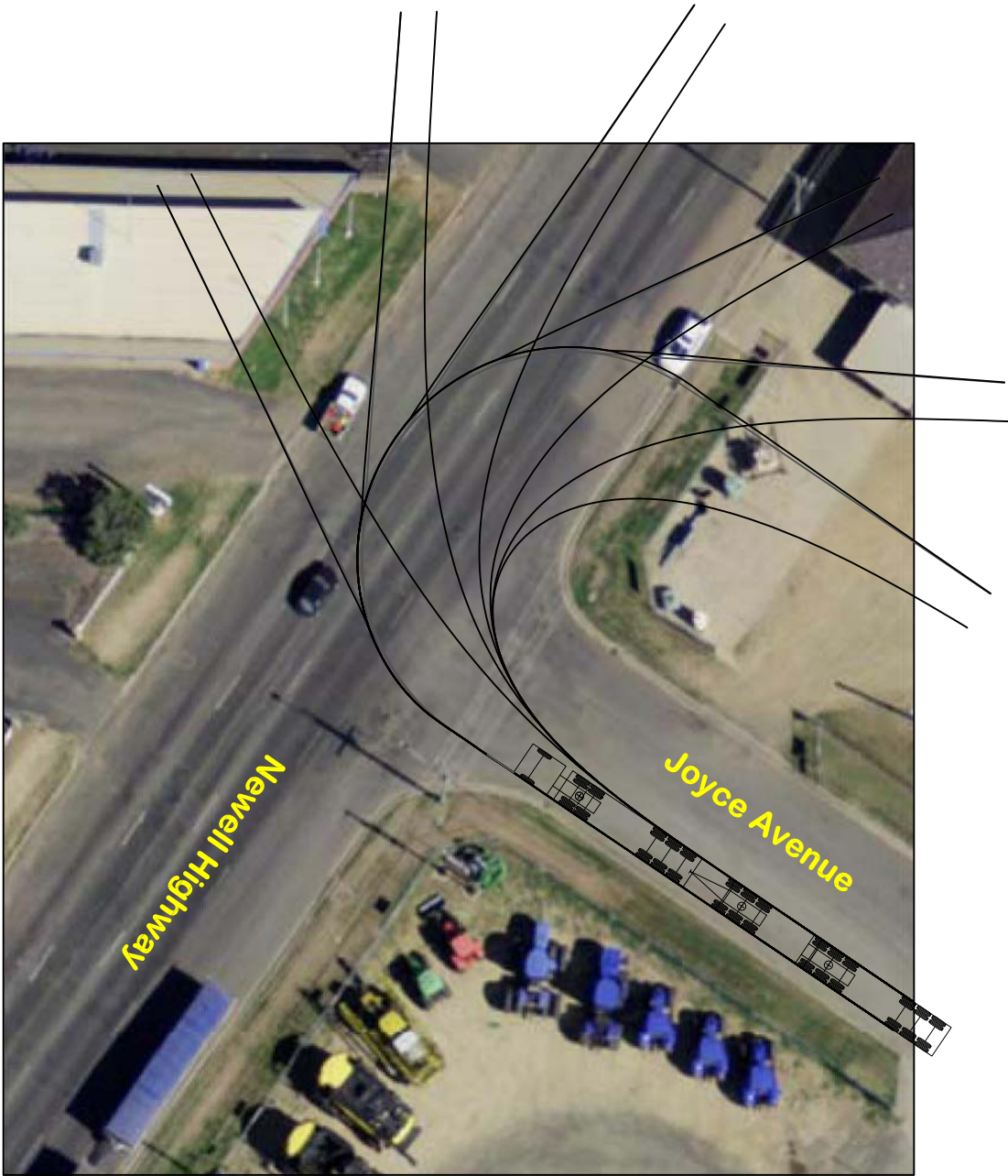
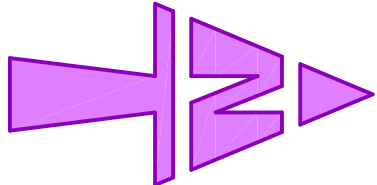
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**

MOREE PLAINS SHIRE COUNCIL

AB-TRIPLE (36.5 m)

Radius 15 m

Indicative turning speed 5-15 km/h



**Title      AB-Triple Assessment: Intersection of Joyce Avenue and Newell Highway**

**Scale    1:500      @ A3      Sheet    11 of 18      Plan Number    13-503-11-A**

**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**

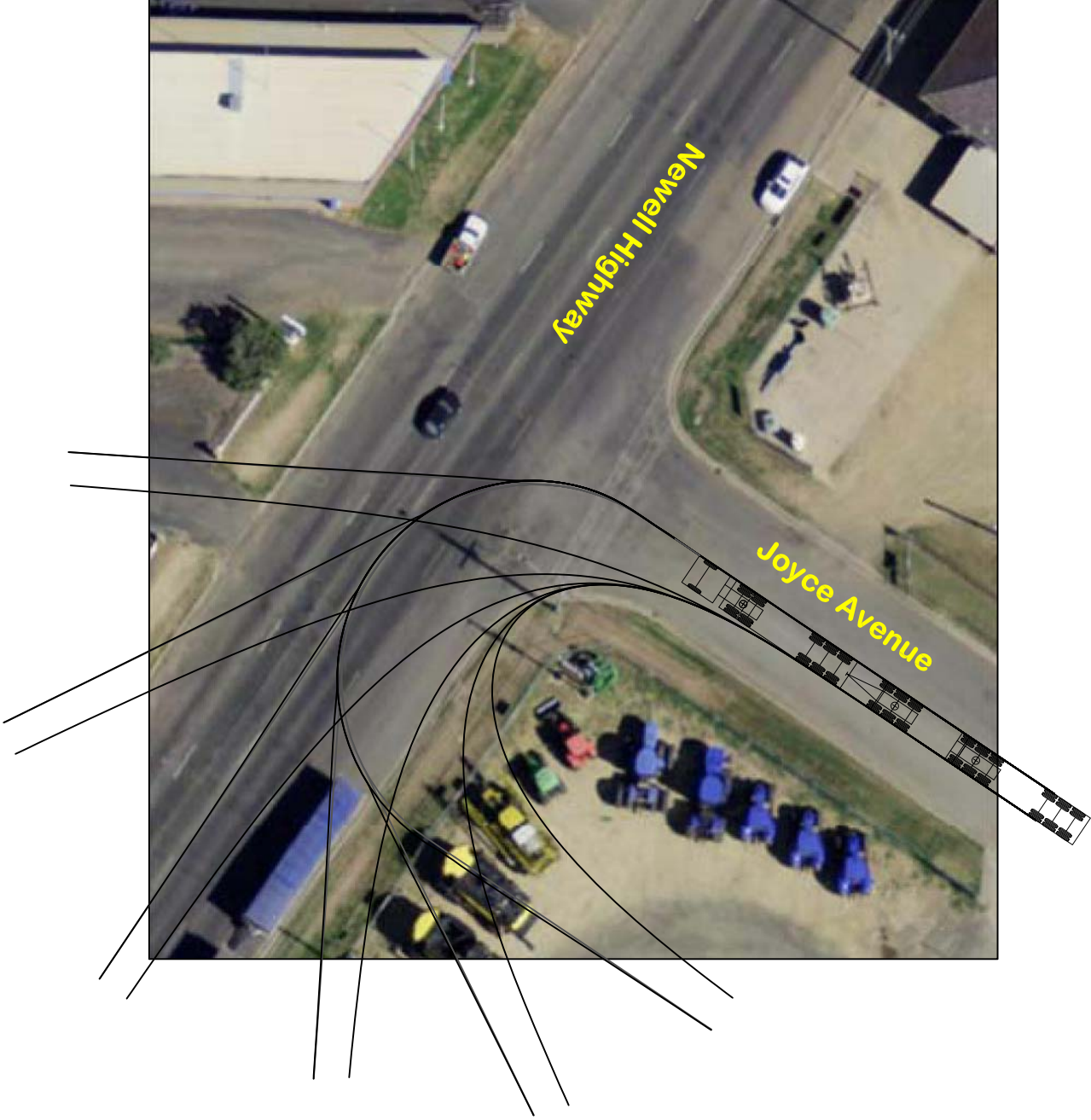
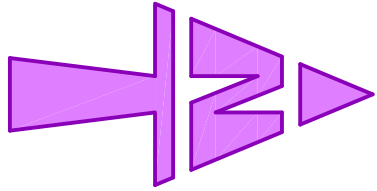


MOREE PLAINS SHIRE COUNCIL

AB-TRIPLE (36.5 m)

Radius 15 m

Indicative turning speed 5-15 km/h



**Title      AB-Triple Assessment: Intersection of Joyce Avenue and Newell Highway**

**Scale    1:500      @ A3      Sheet    12 of 18      Plan Number    13-503-12-A**

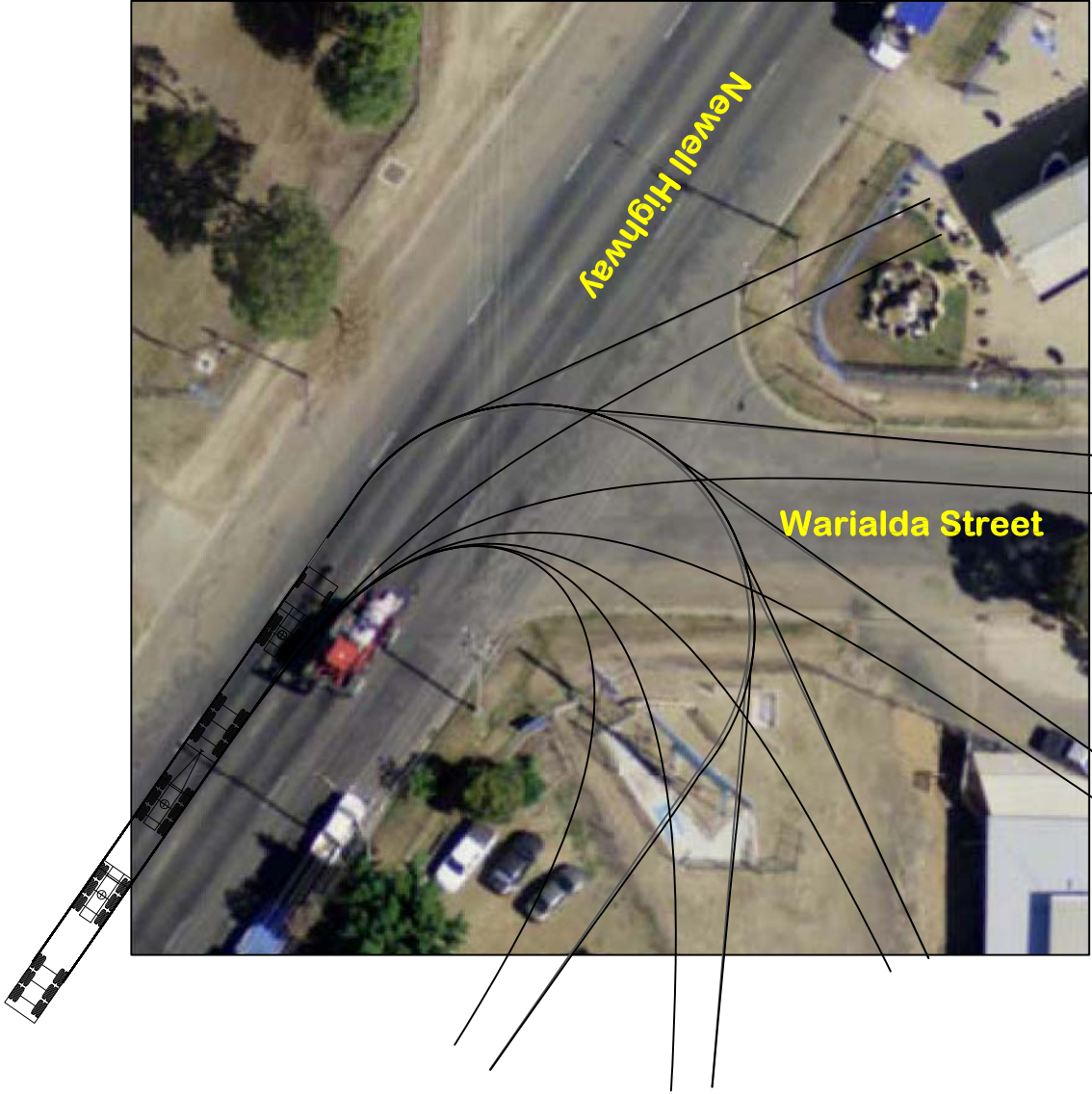
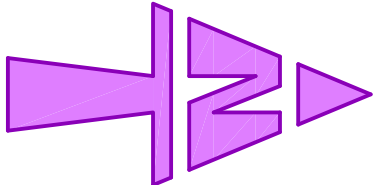
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**

MOREE PLAINS SHIRE COUNCIL

AB-TRIPLE (36.5 m)

Radius 15 m

Indicative turning speed 5-15 km/h



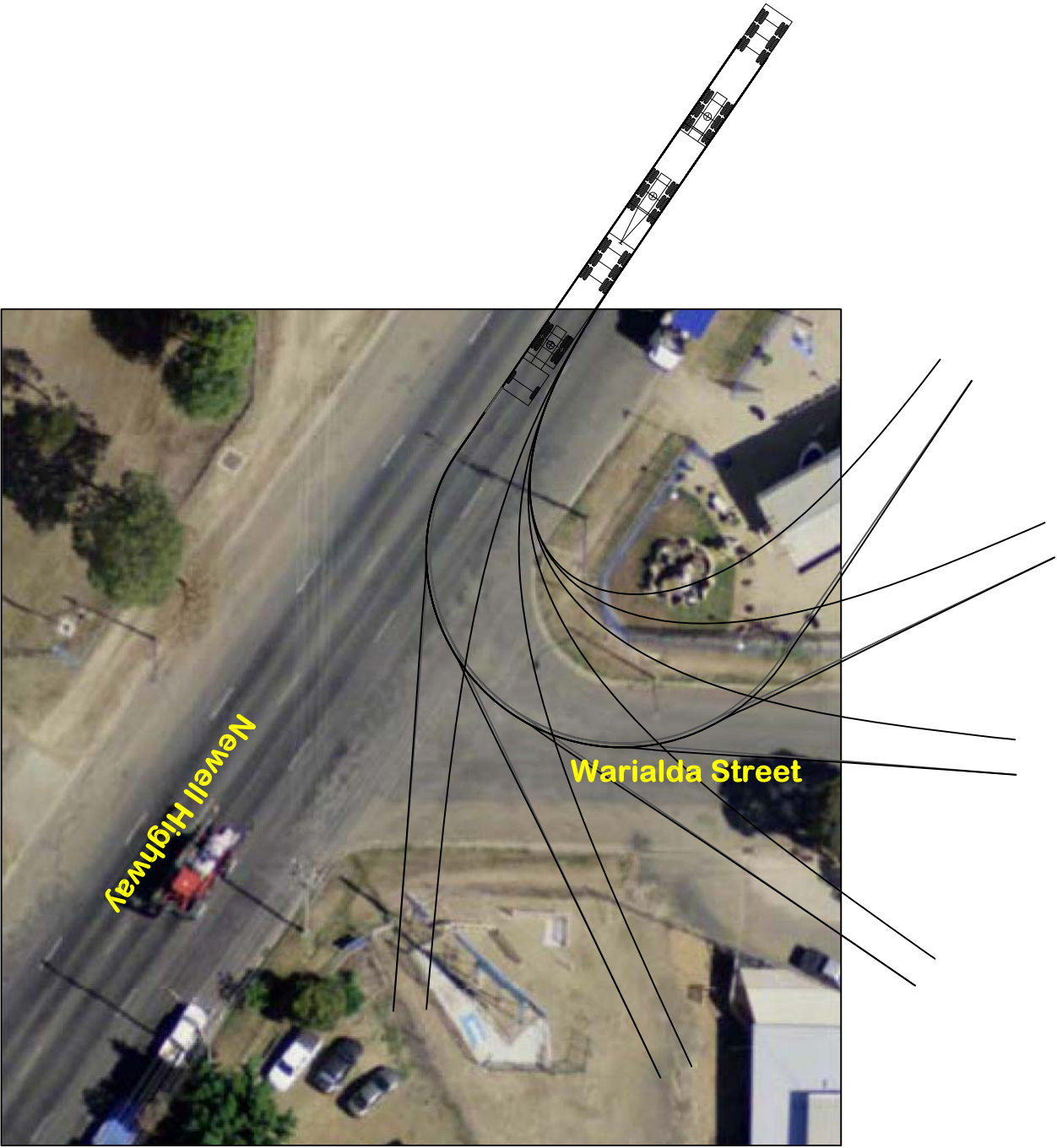
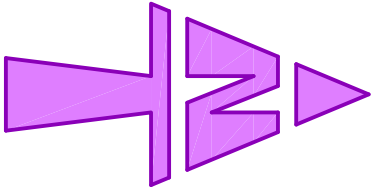
**Title**      **AB-Triple Assessment: Intersection of Newell Highway and Warialda Street**

**Scale**    **1:500**      **@ A3**      **Sheet**    **13 of 18**      **Plan Number**    **13-503-13-A**

**Drawn/Designed**      **Casey Spilsbury-Brinkmann**      **Date**      **12/07/2013**



**MOREE PLAINS SHIRE COUNCIL**  
**AB-TRIPLE (36.5 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**

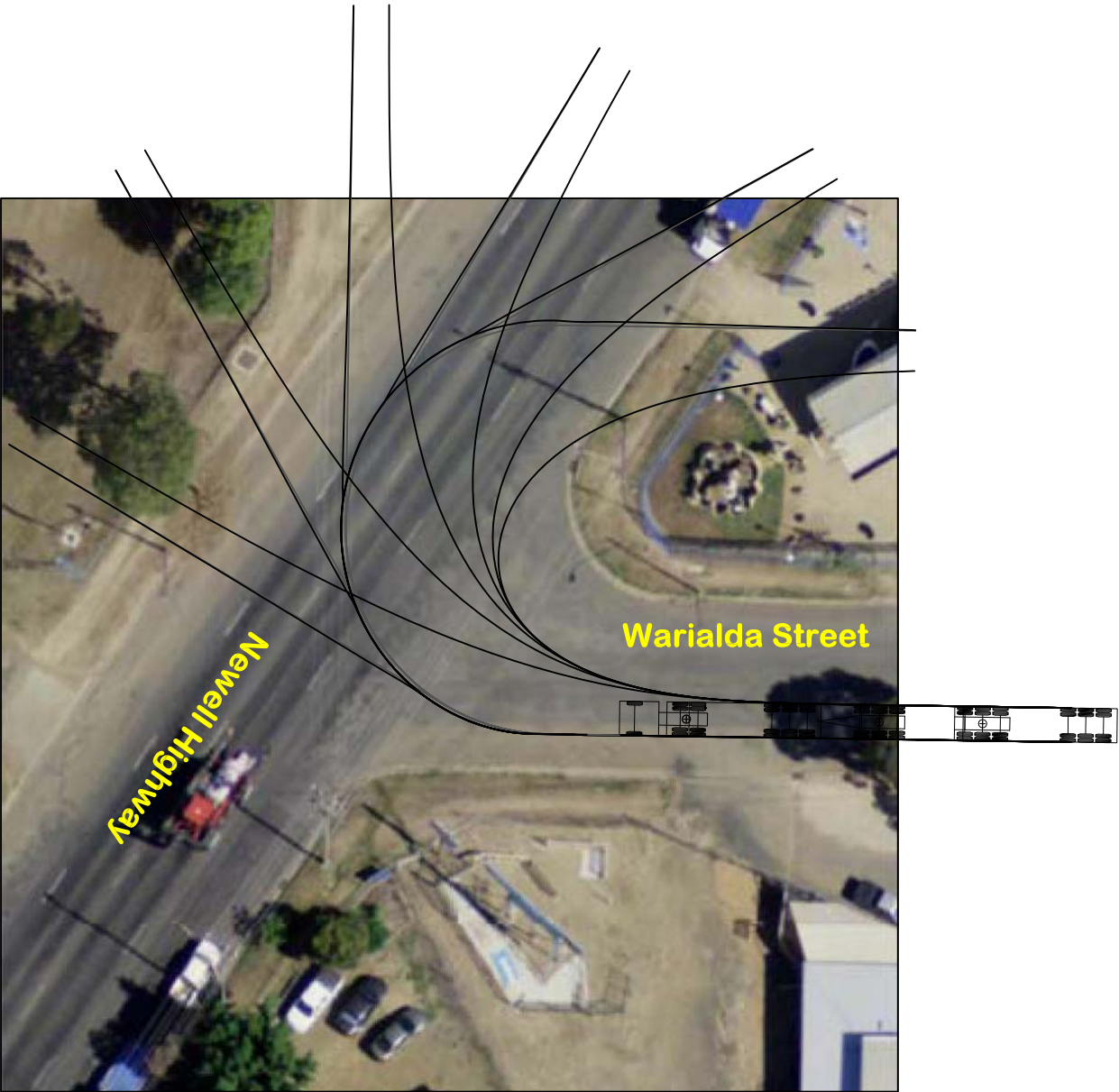
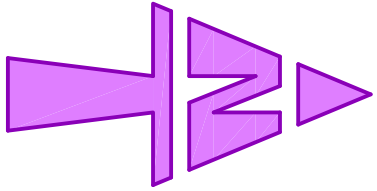


**Title AB-Triple Assessment: Intersection of Newell Highway and Warialda Street**  
**Scale 1:500 @ A3 Sheet 14 of 18 Plan Number 13-503-14-A**  
**Drawn/Designed Casey Spilsbury-Brinkmann Date 12/07/2013**





**MOREE PLAINS SHIRE COUNCIL**  
**AB-TRIPLE (36.5 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



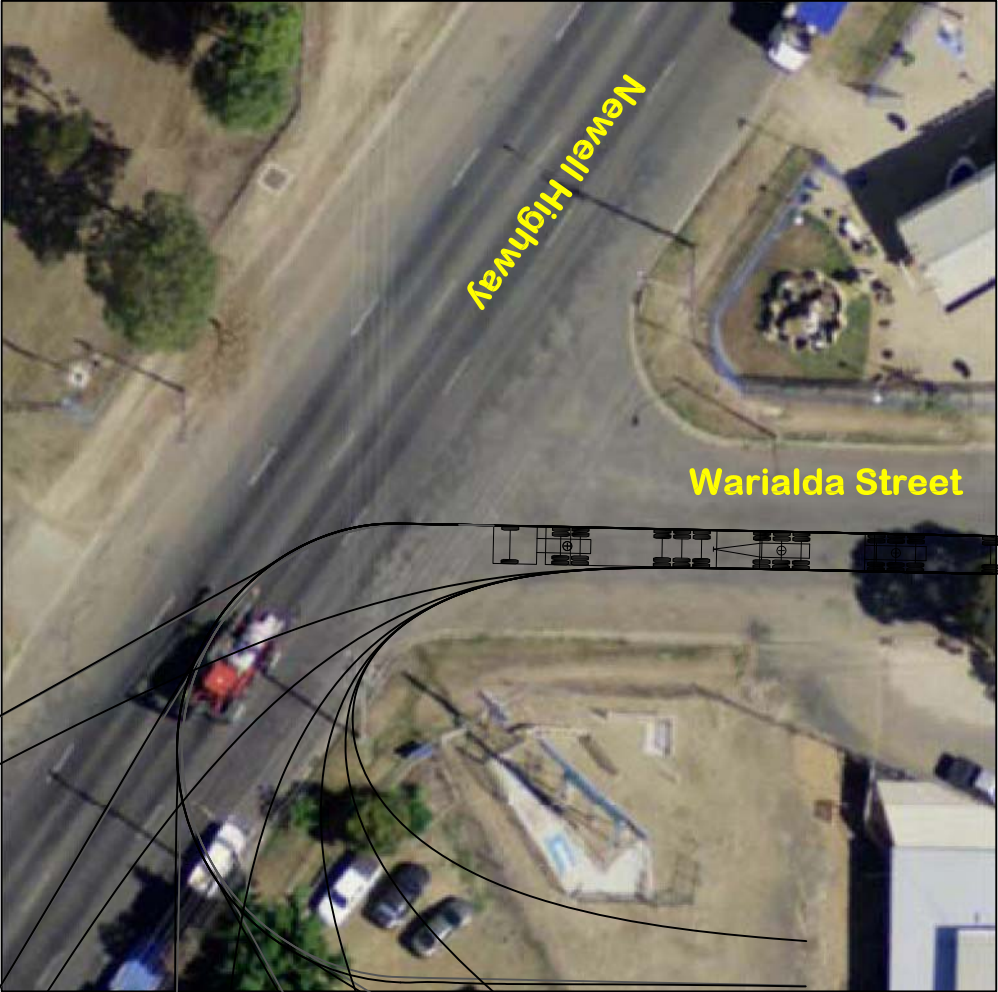
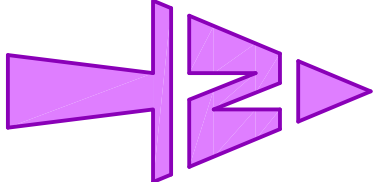
**Title    AB-Triple Assessment: Intersection of Newell Highway and Warialda Street**  
**Scale    1:500        @ A3        Sheet    15 of 18        Plan Number    13-503-15-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann        Date        12/07/2013**

MOREE PLAINS SHIRE COUNCIL

AB-TRIPLE (36.5 m)

Radius 15 m

Indicative turning speed 5-15 km/h



**Title** AB-Triple Assessment: Intersection of Newell Highway and Warialda Street

**Scale** 1:500 @ A3 **Sheet** 16 of 18 **Plan Number** 13-503-16-A

**Drawn/Designed** Casey Spilsbury-Brinkmann **Date** 12/07/2013

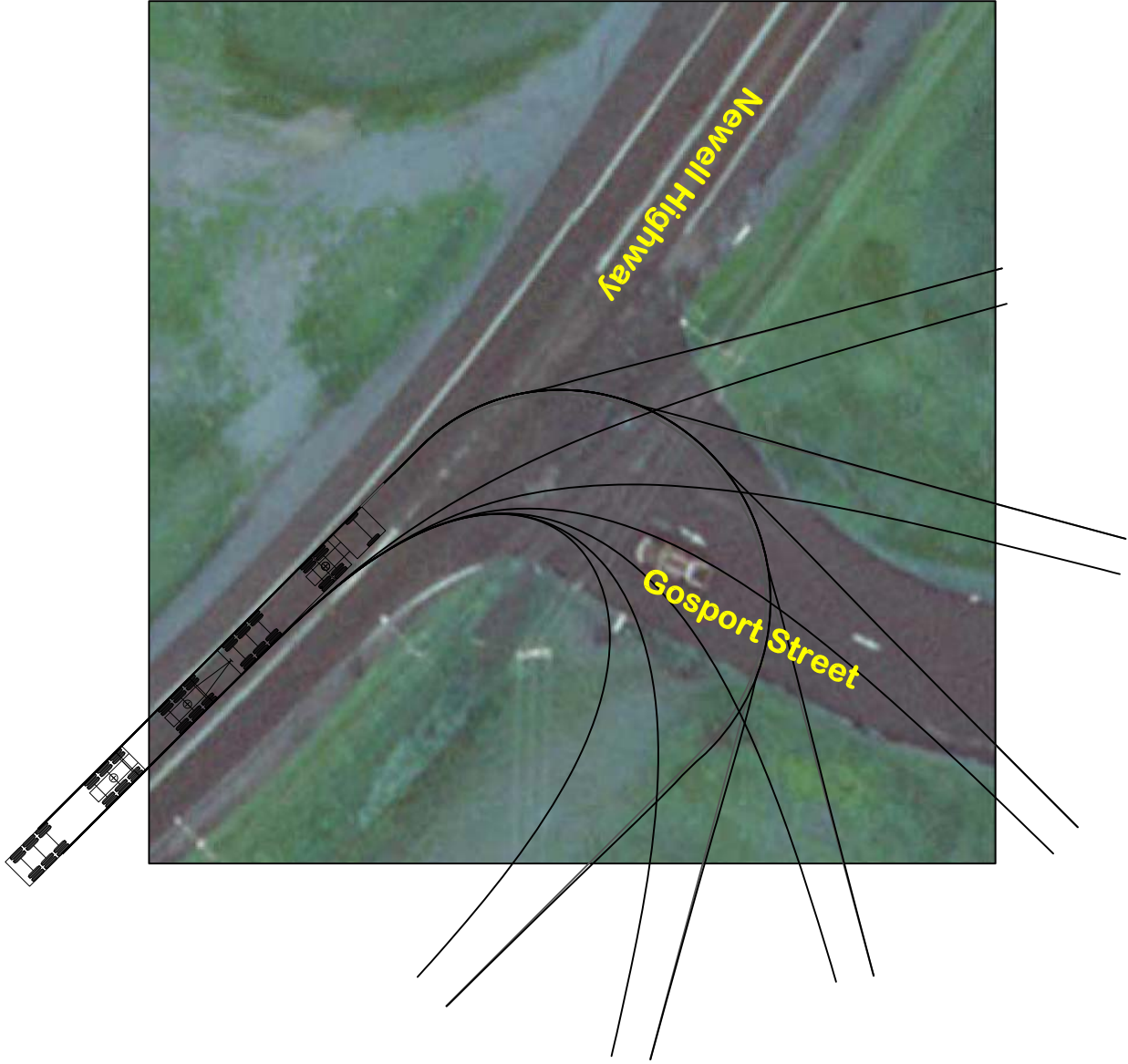
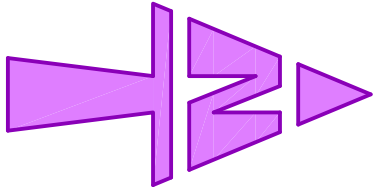


MOREE PLAINS SHIRE COUNCIL

AB-TRIPLE (36.5 m)

Radius 15 m

Indicative turning speed 5-15 km/h



**Title      AB-Triple Assessment: Intersection of Gosport Street and Newell Highway**

**Scale      1:500      @ A3      Sheet      17 of 18      Plan Number      13-503-17-A**

**Drawn/Designed      Casey Spilsbury-Brinkmann      Date      12/07/2013**



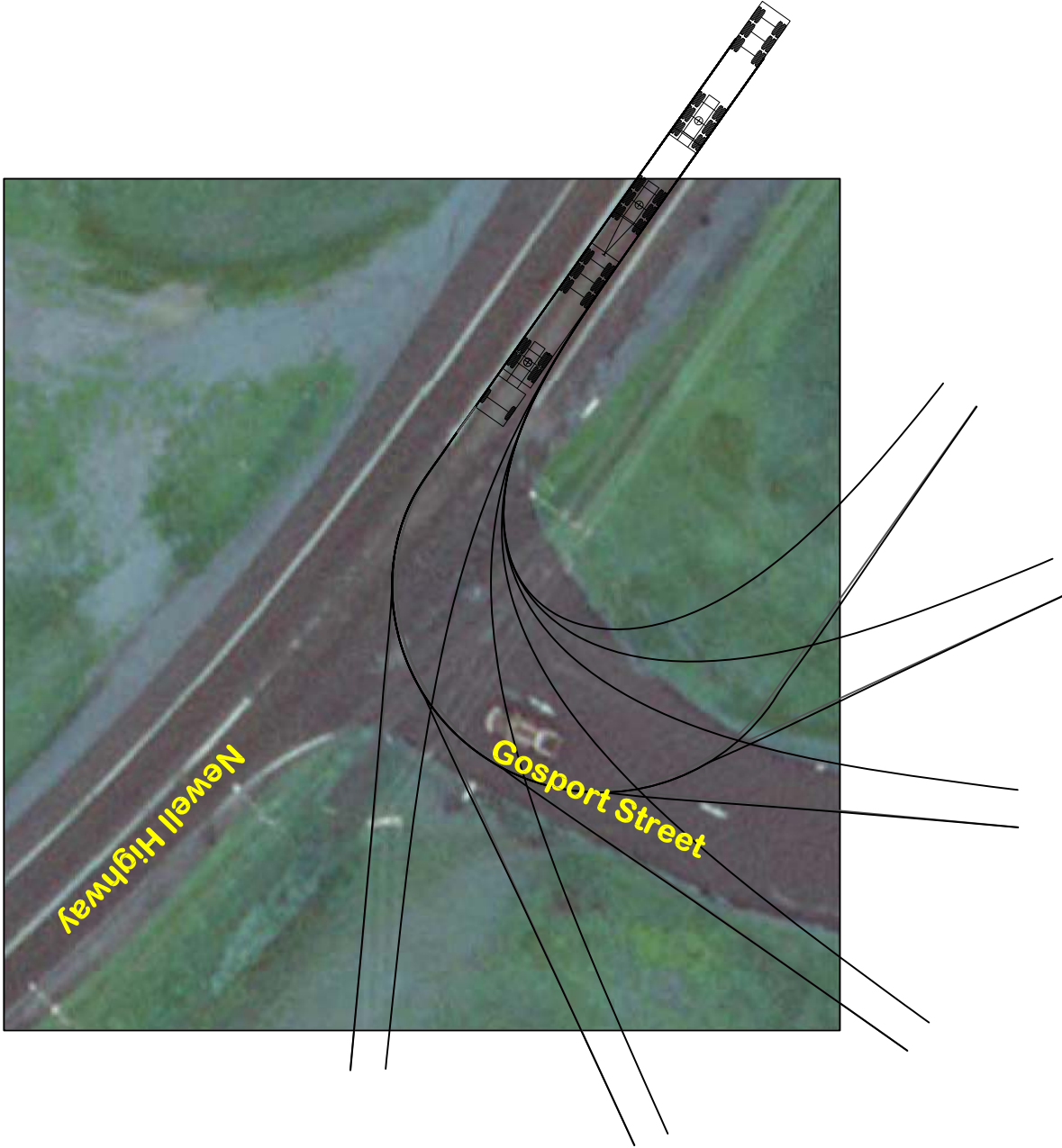
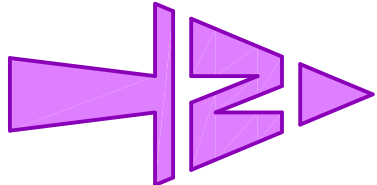


MOREE PLAINS SHIRE COUNCIL

AB-TRIPLE (36.5 m)

Radius 15 m

Indicative turning speed 5-15 km/h

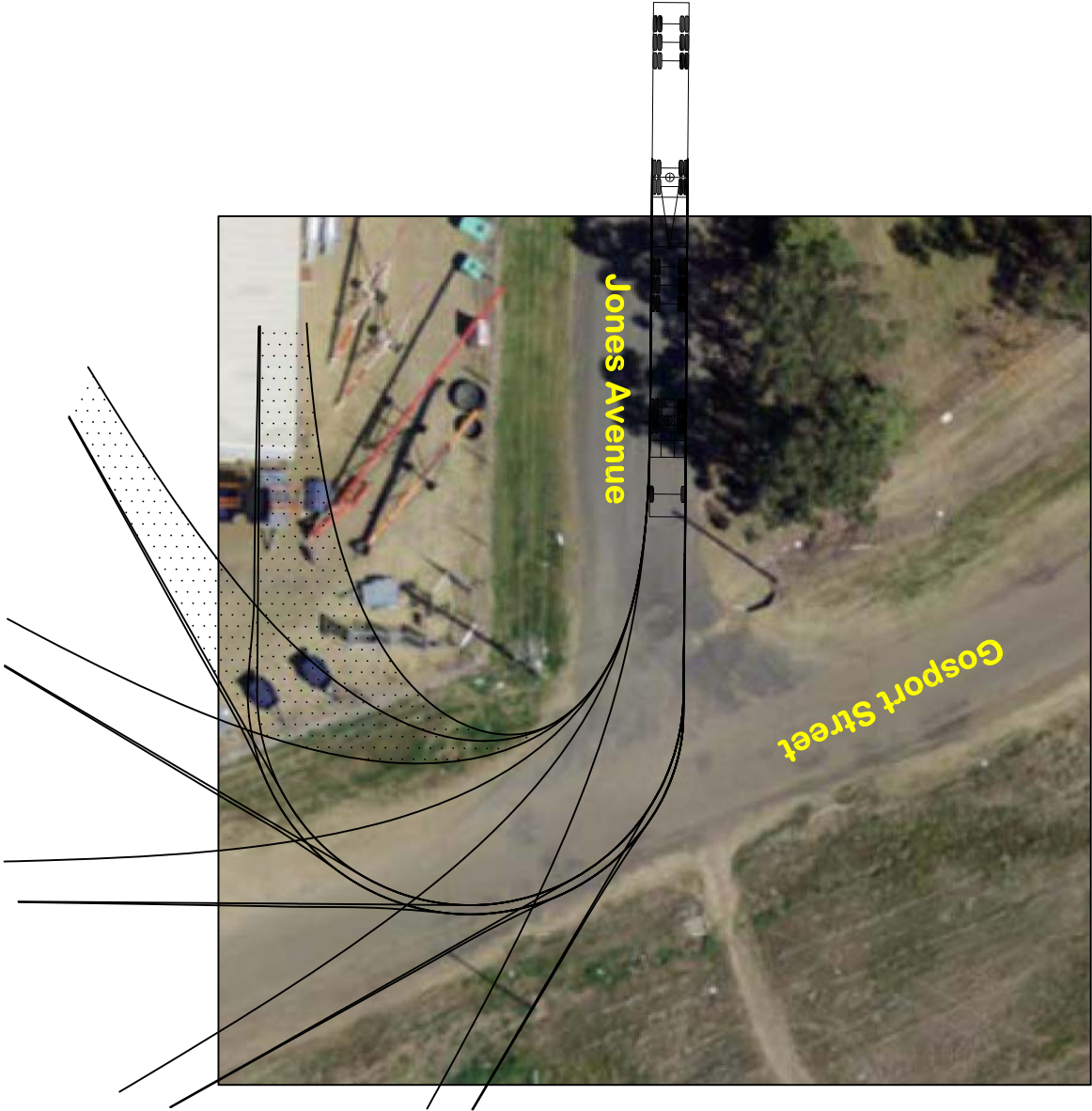
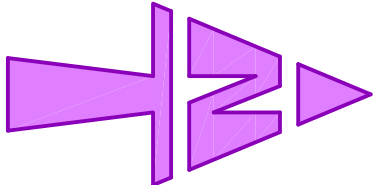


**Title      AB-Triple Assessment: Intersection of Gosport Street and Newell Highway**

**Scale    1:500      @ A3      Sheet    18 of 18      Plan Number    13-503-18-A**

**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**

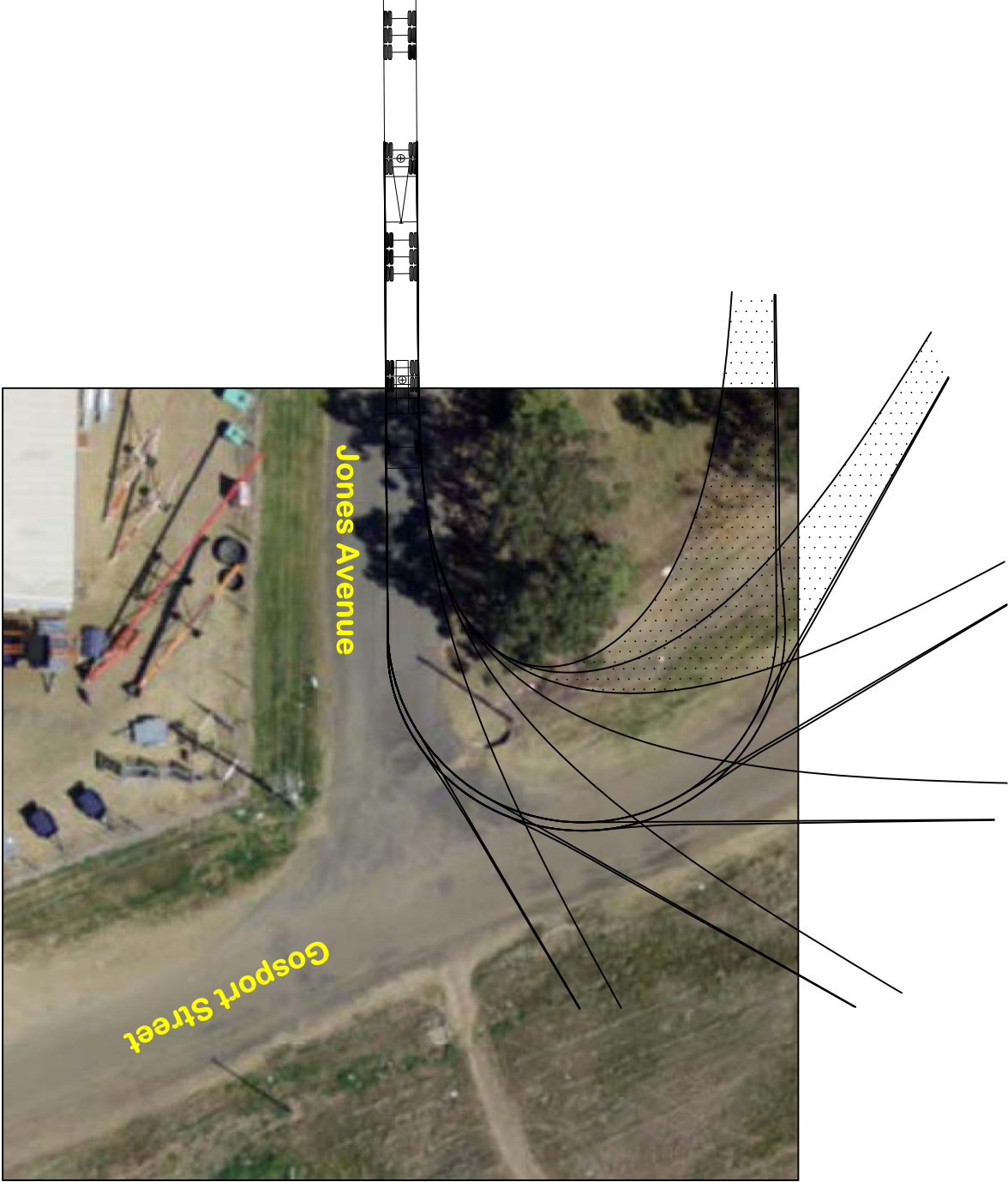
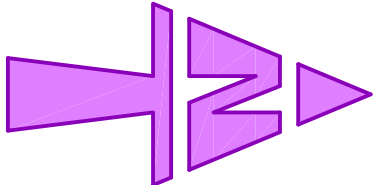
**AUSTROADS**  
**A-Double (Type 1) (36.2 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



**Title     A-Double (Road Train) Assessment: Intersection of Gosport Street and Jones Avenue**  
**Scale     1:500     @ A3     Sheet     01 of 18     Plan Number     13-502-01-A**  
**Drawn/Designed     Casey Spilsbury-Brinkmann     Date     12/07/2013**

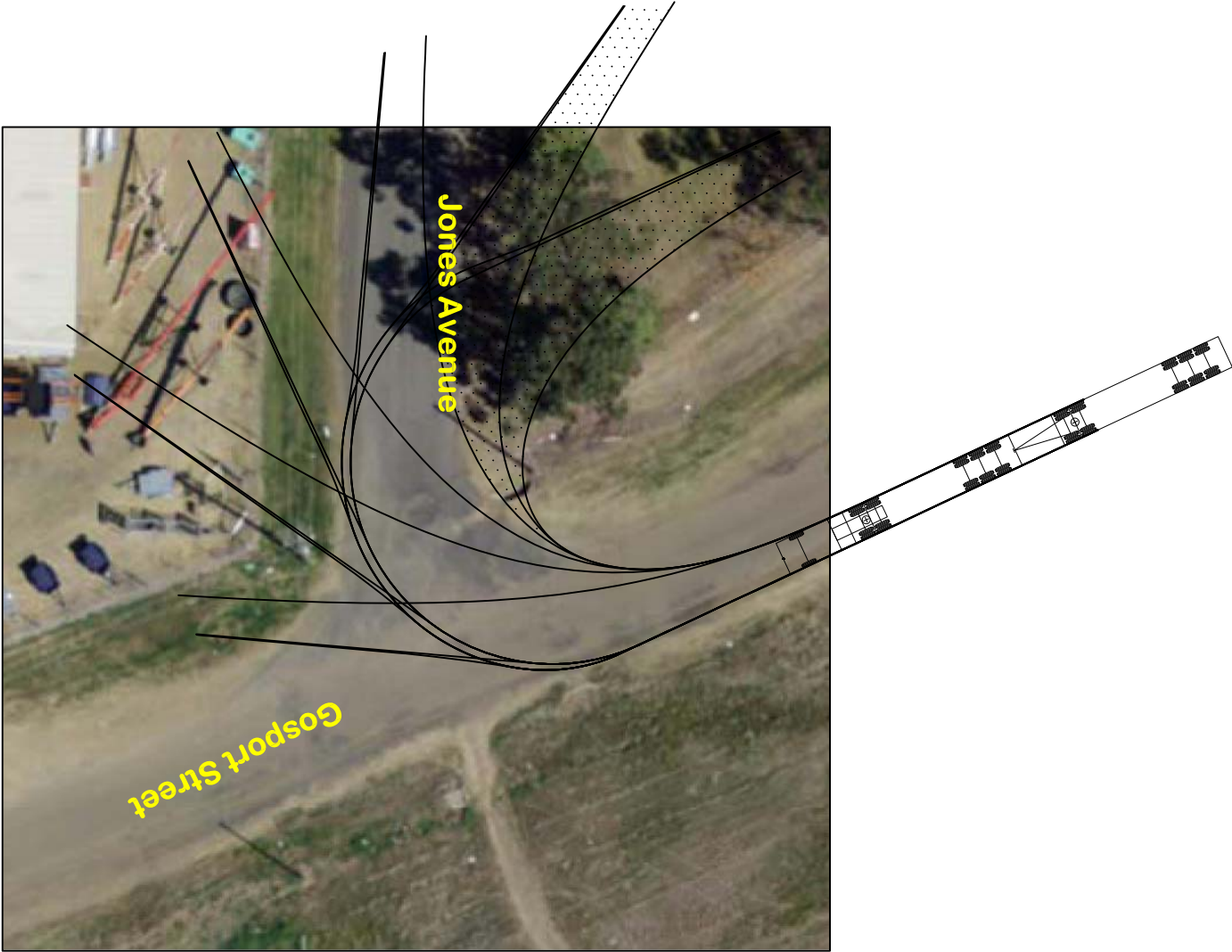
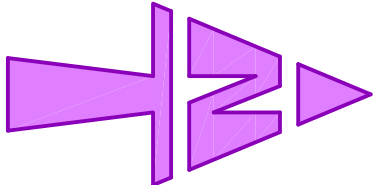


**AUSTROADS**  
**A-Double (Type 1) (36.2 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



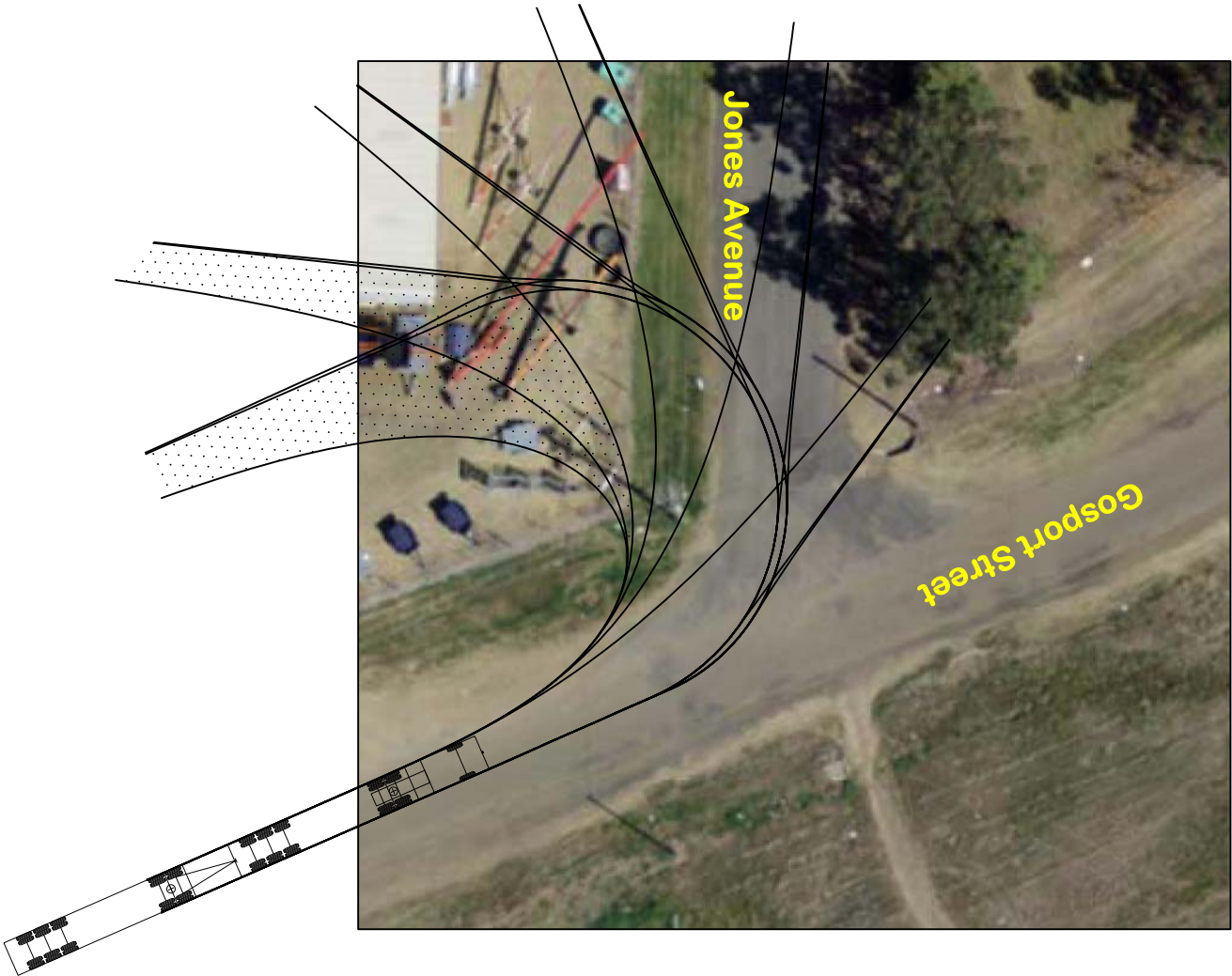
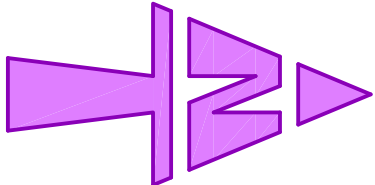
**Title     A-Double (Road Train) Assessment: Intersection of Gosport Street and Jones Avenue**  
**Scale     1:500     @ A3     Sheet     02 of 18     Plan Number     13-502-02-A**  
**Drawn/Designed     Casey Spilsbury-Brinkmann     Date     12/07/2013**

**AUSTROADS**  
**A-Double (Type 1) (36.2 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



**Title     A-Double (Road Train) Assessment: Intersection of Gosport Street and Jones Avenue**  
**Scale     1:500     @ A3     Sheet     03 of 18     Plan Number     13-502-03-A**  
**Drawn/Designed     Casey Spilsbury-Brinkmann     Date     12/07/2013**

**AUSTROADS**  
**A-Double (Type 1) (36.2 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**

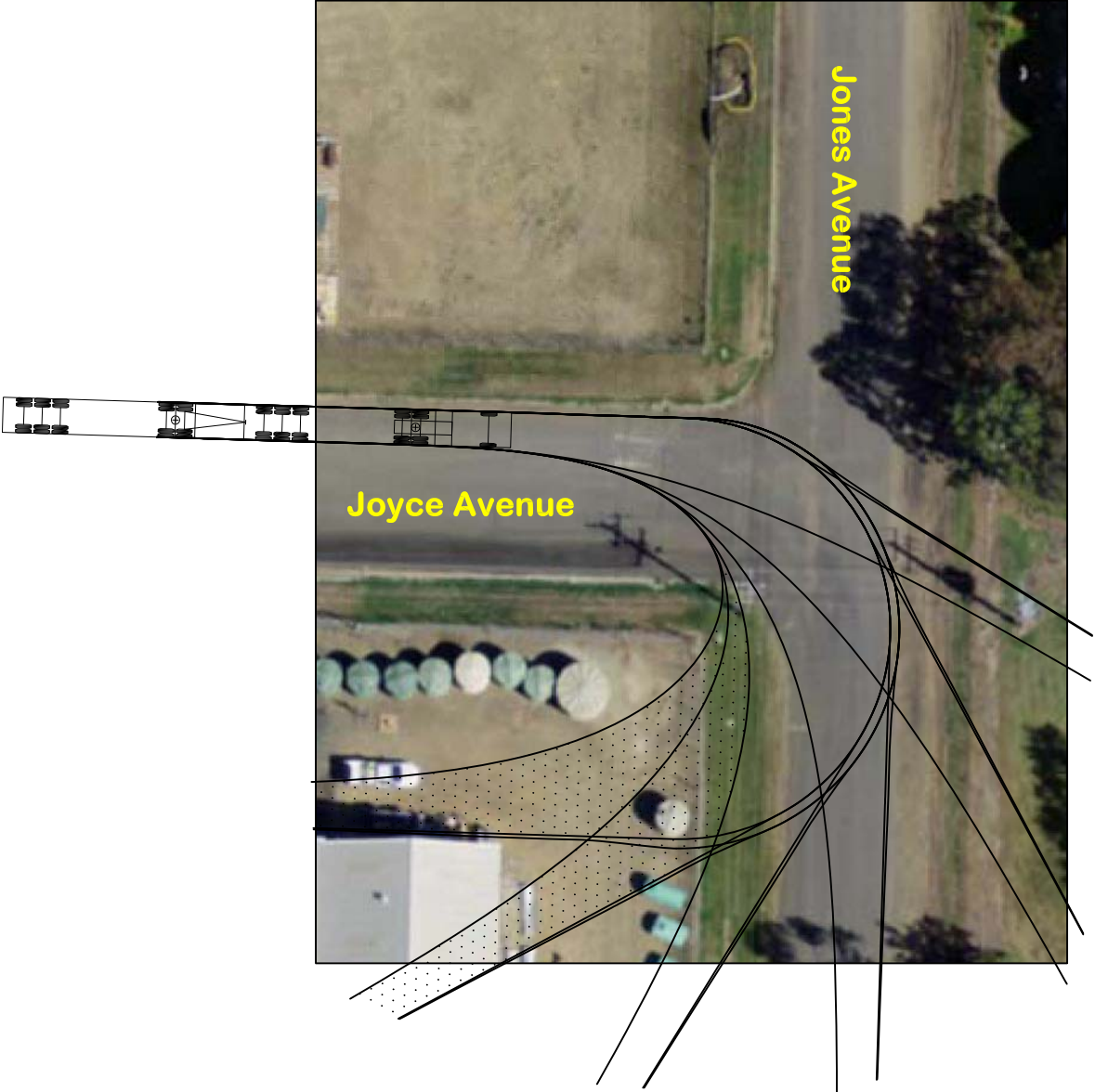
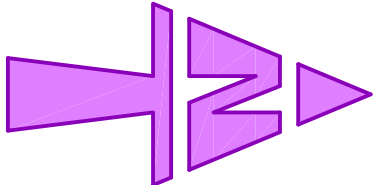


**Title     A-Double (Road Train) Assessment: Intersection of Gosport Street and Jones Avenue**  
**Scale    1:500       @ A3       Sheet    04 of 18       Plan Number    13-502-04-A**  
**Drawn/Designed     Casey Spilsbury-Brinkmann       Date       12/07/2013**



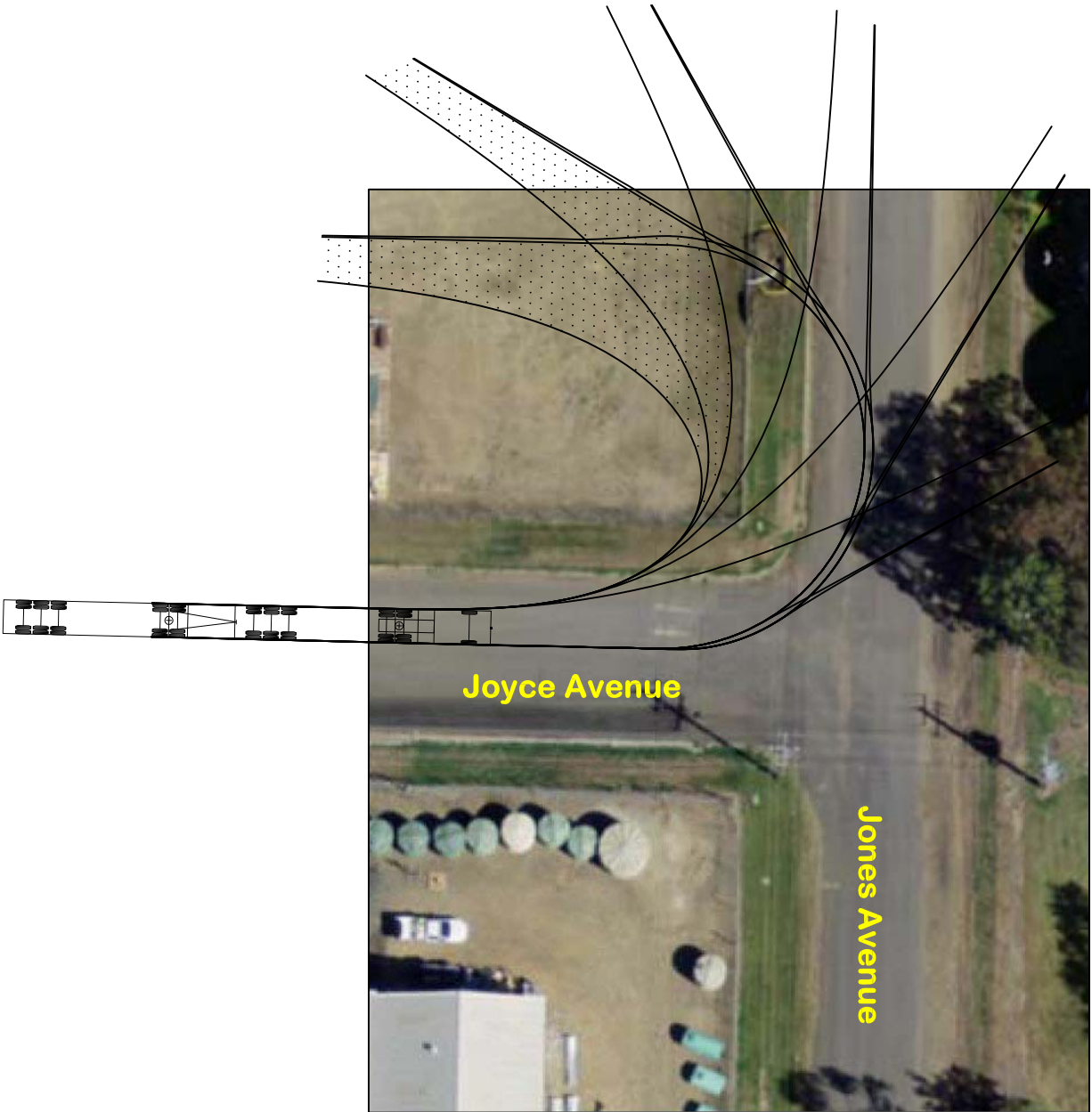
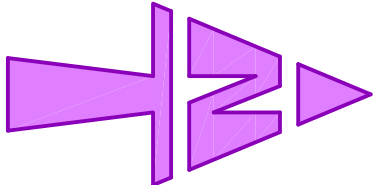


**AUSTROADS**  
**A-Double (Type 1) (36.2 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



**Title      A-Double (Road Train) Assessment: Intersection of Jones Avenue and Joyce Avenue**  
**Scale    1:500      @ A3      Sheet    05 of 18      Plan Number    13-502-05-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**

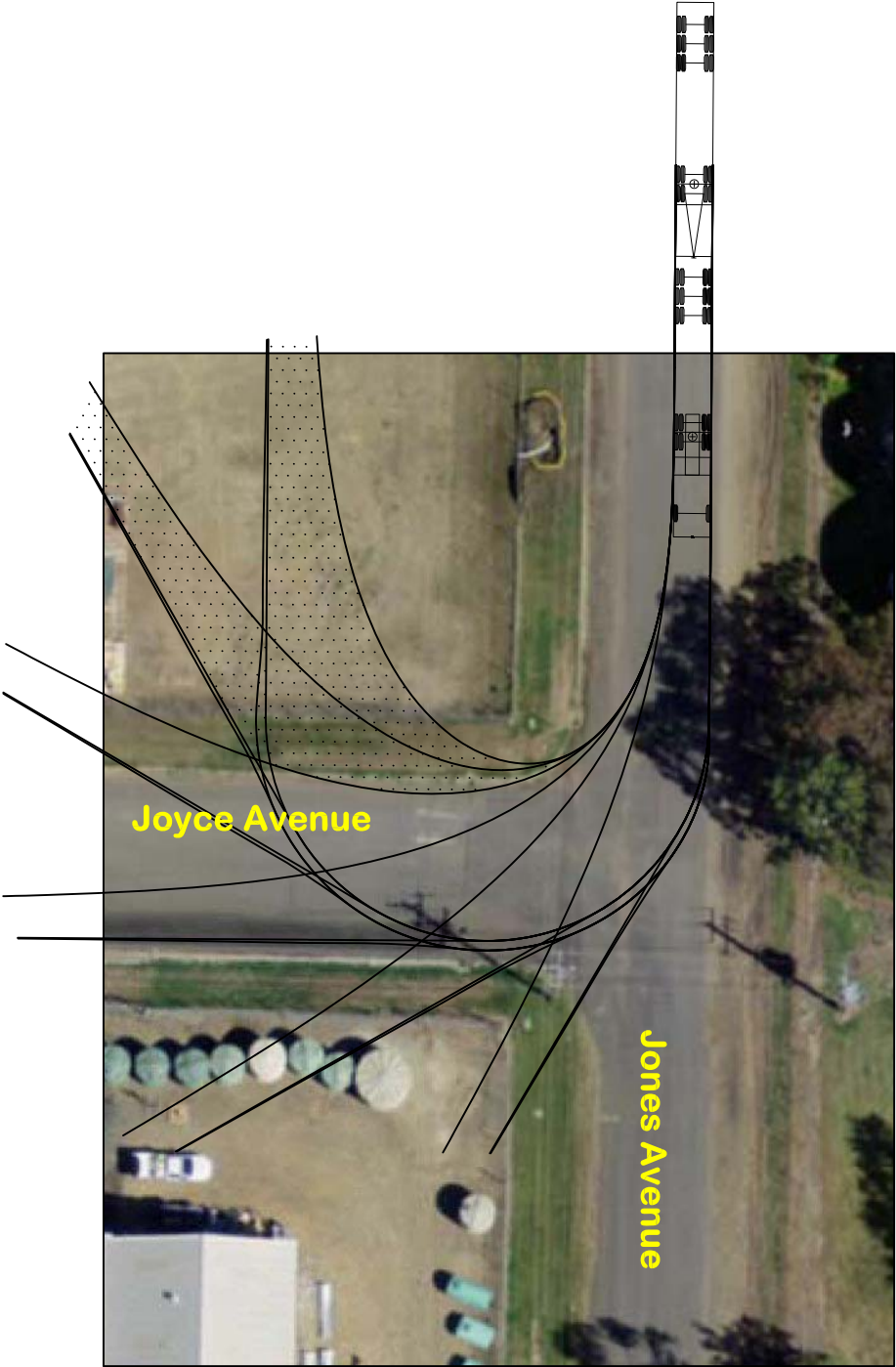
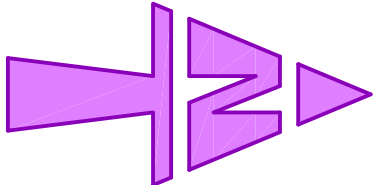
**AUSTROADS**  
**A-Double (Type 1) (36.2 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



**Title     A-Double (Road Train) Assessment: Intersection of Jones Avenue and Joyce Avenue**  
**Scale     1:500     @ A3     Sheet     06 of 18     Plan Number     13-502-06-A**  
**Drawn/Designed     Casey Spilsbury-Brinkmann     Date     12/07/2013**



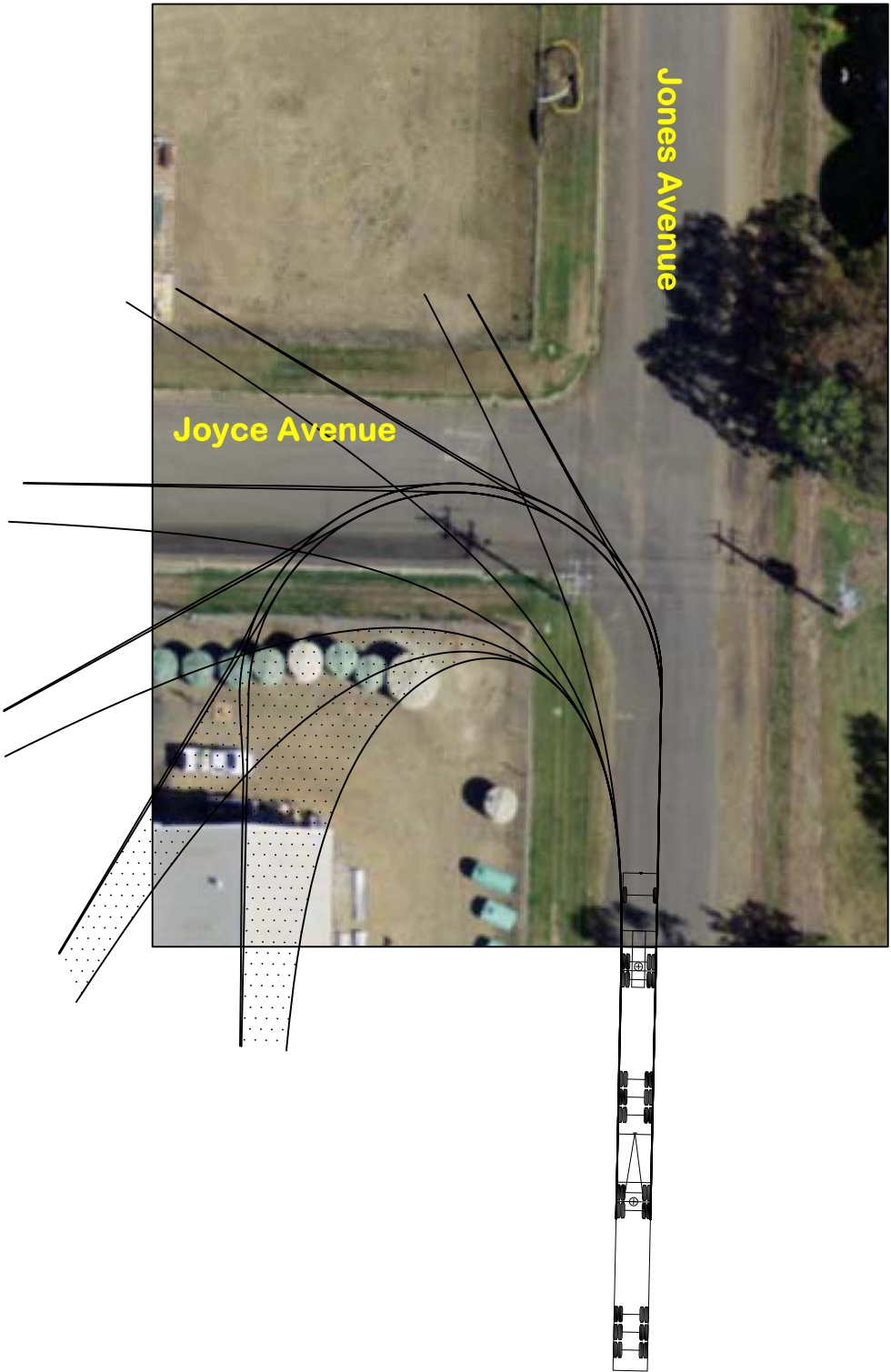
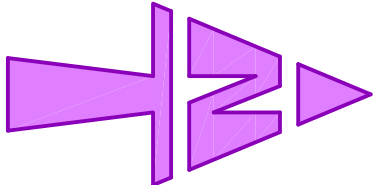
**AUSTROADS**  
**A-Double (Type 1) (36.2 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



**Title      A-Double (Road Train) Assessment: Intersection of Jones Avenue and Joyce Avenue**  
**Scale    1:500      @ A3      Sheet    07 of 18      Plan Number    13-502-07-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**



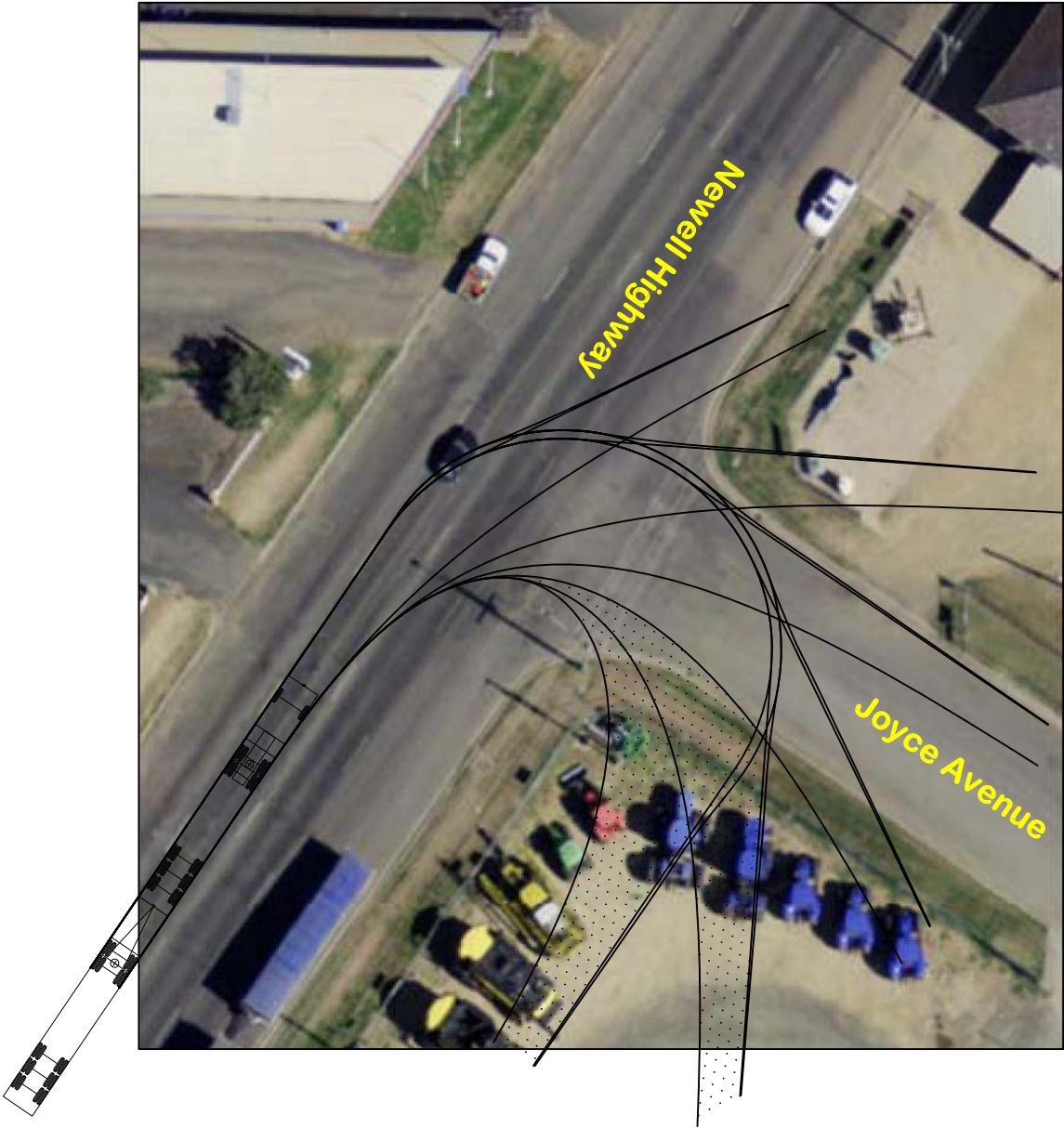
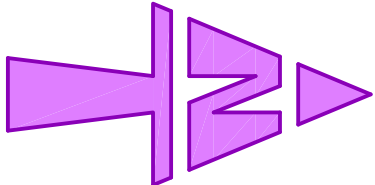
**AUSTROADS**  
**A-Double (Type 1) (36.2 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



**Title      A-Double (Road Train) Assessment: Intersection of Jones Avenue and Joyce Avenue**  
**Scale    1:500      @ A3      Sheet    08 of 18      Plan Number    13-502-08-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**



**AUSTROADS**  
**A-Double (Type 1) (36.2 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**

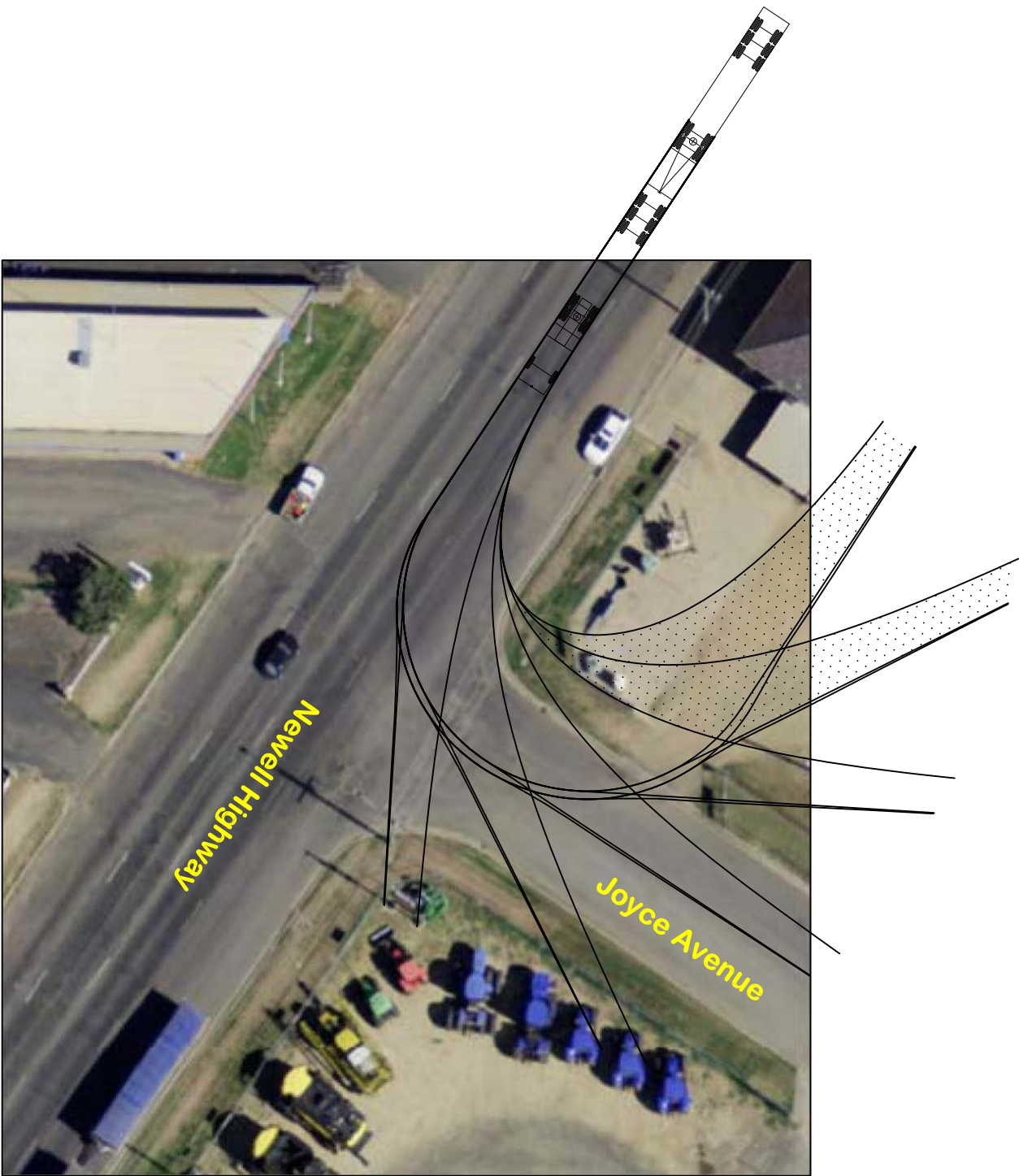
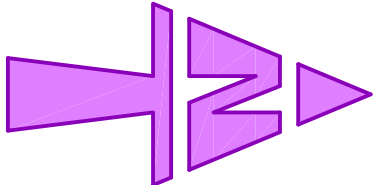


**Title      A-Double (Road Train) Assessment: Intersection of Joyce Avenue and Newell Highway**  
**Scale    1:500      @ A3      Sheet    09 of 18      Plan Number    13-502-09-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**





**AUSTRROADS**  
**A-Double (Type 1) (36.2 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**

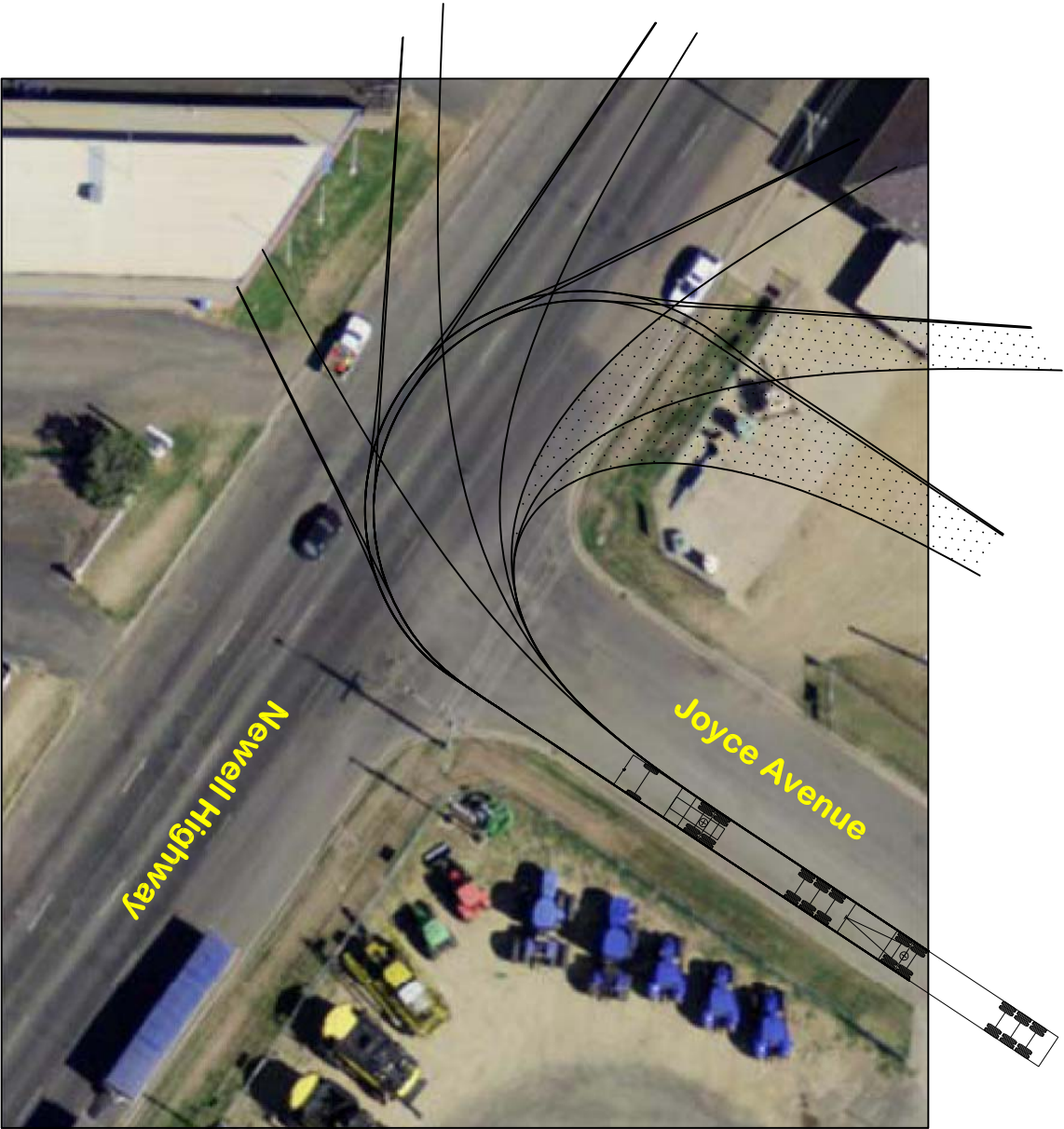
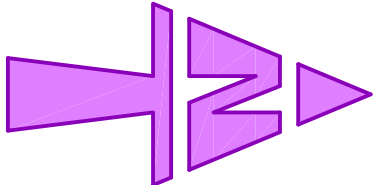


**Title     A-Double (Road Train) Assessment: Intersection of Joyce Avenue and Newell Highway**  
**Scale    1:500       @ A3       Sheet    10 of 18       Plan Number   13-502-10-A**  
**Drawn/Designed     Casey Spilsbury-Brinkmann       Date       12/07/2013**





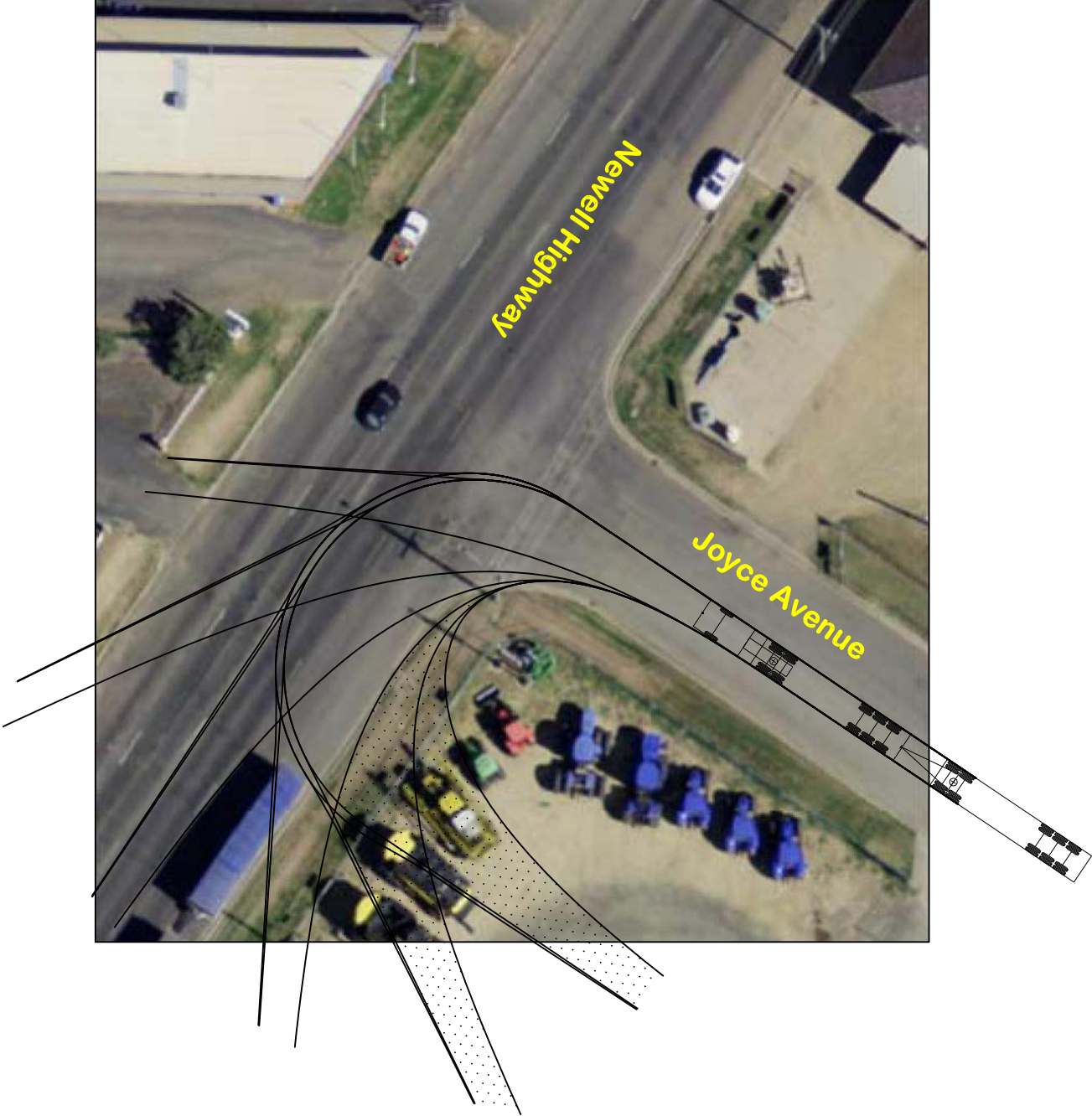
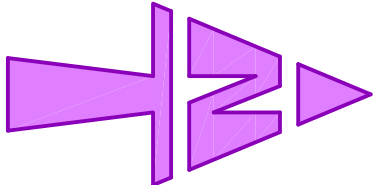
**AUSTRROADS**  
**A-Double (Type 1) (36.2 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



**Title     A-Double (Road Train) Assessment: Intersection of Joyce Avenue and Newell Highway**  
**Scale     1:500     @ A3     Sheet     11 of 18     Plan Number     13-502-11-A**  
**Drawn/Designed     Casey Spilsbury-Brinkmann     Date     12/07/2013**



**AUSTROADS**  
**A-Double (Type 1) (36.2 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**

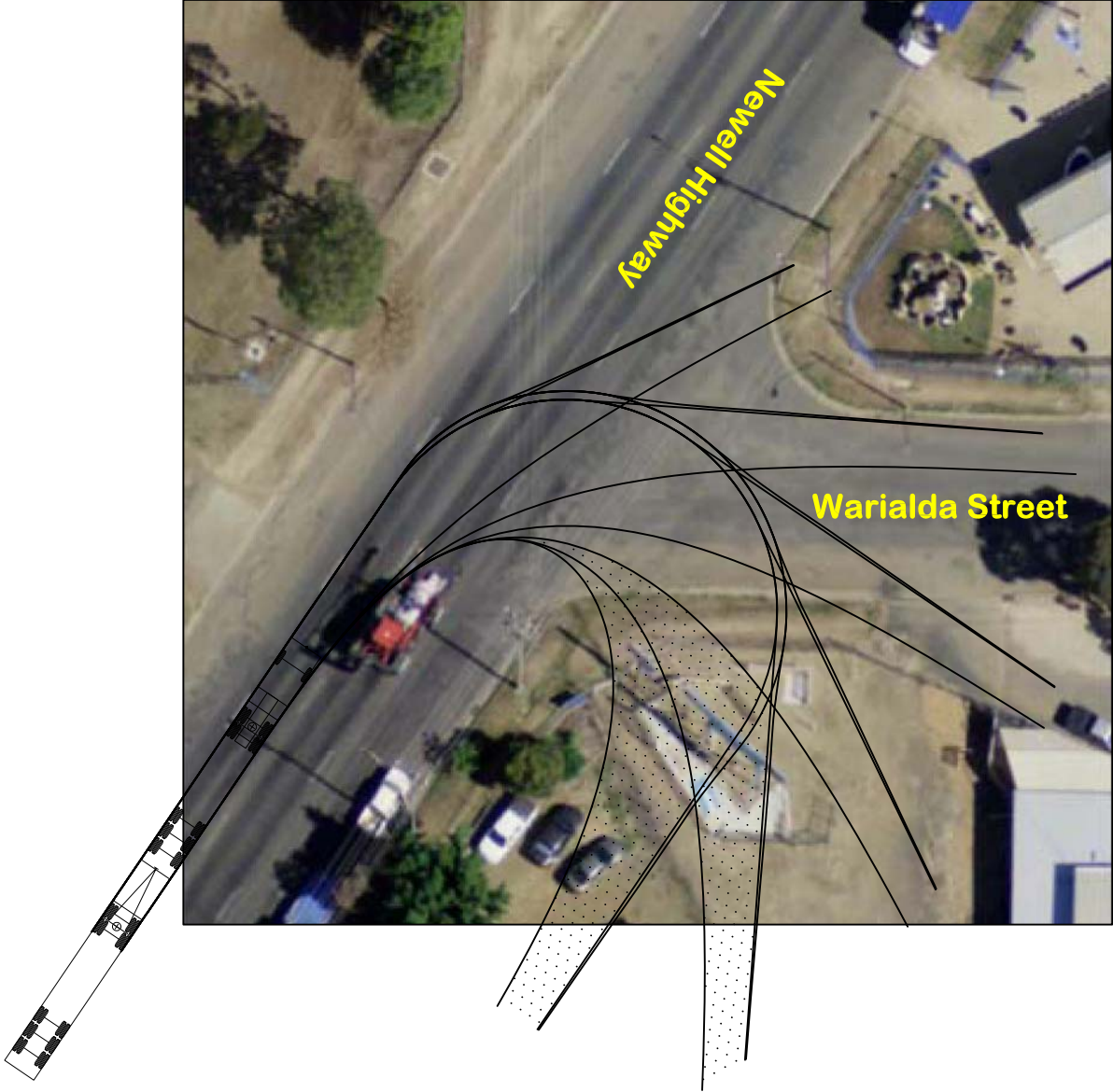
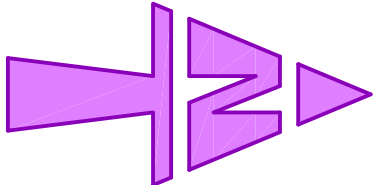


**Title      A-Double (Road Train) Assessment: Intersection of Joyce Avenue and Newell Highway**  
**Scale    1:500      @ A3      Sheet    12 of 18      Plan Number    13-502-12-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**





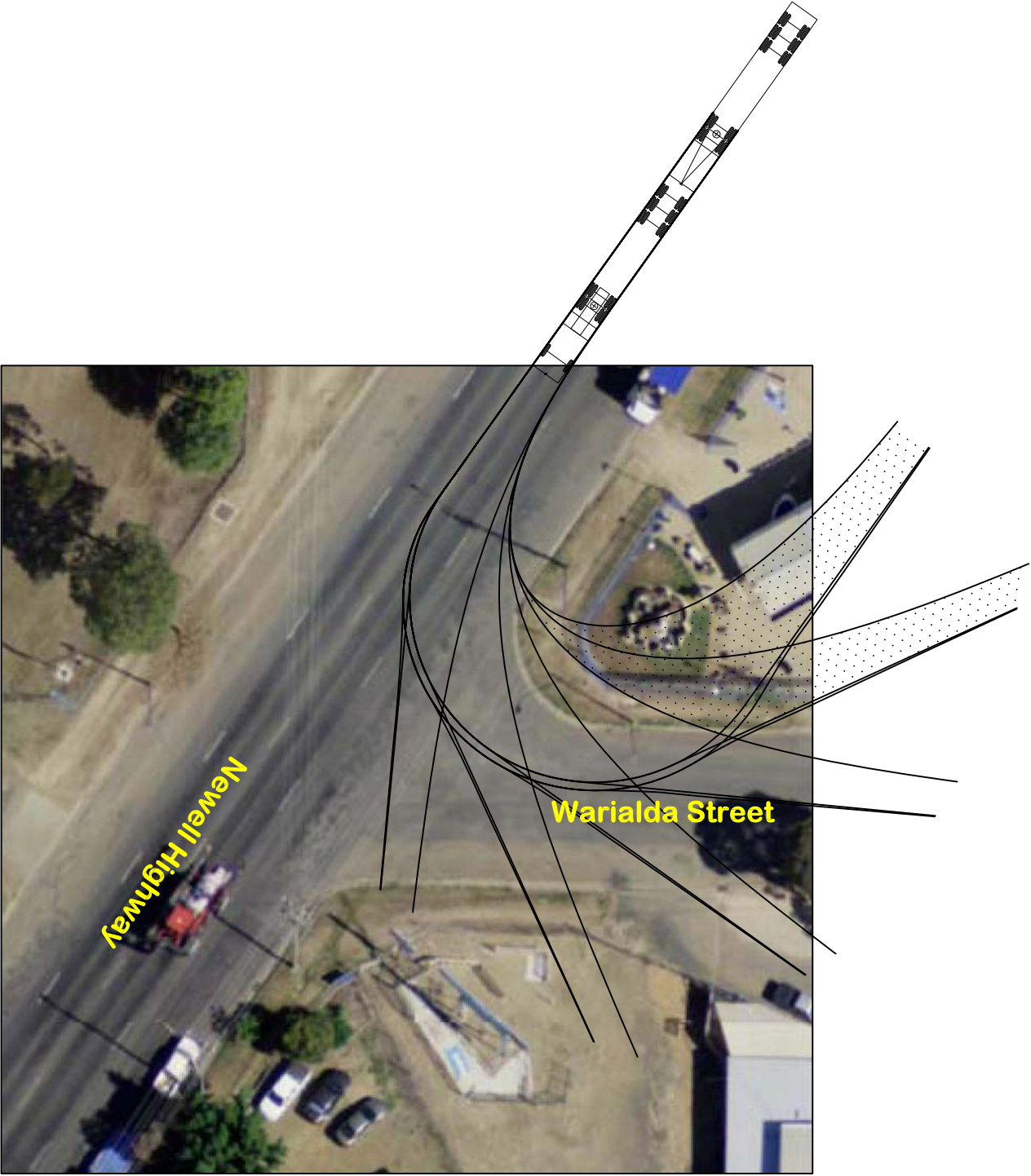
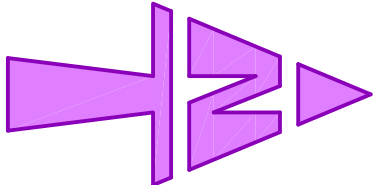
**AUSTROADS**  
**A-Double (Type 1) (36.2 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



**Title     A-Double (Road Train) Assessment: Intersection of Newell Highway and Warialda Street**  
**Scale     1:500     @ A3     Sheet     13 of 18     Plan Number     13-502-13-A**  
**Drawn/Designed     Casey Spilsbury-Brinkmann     Date     12/07/2013**



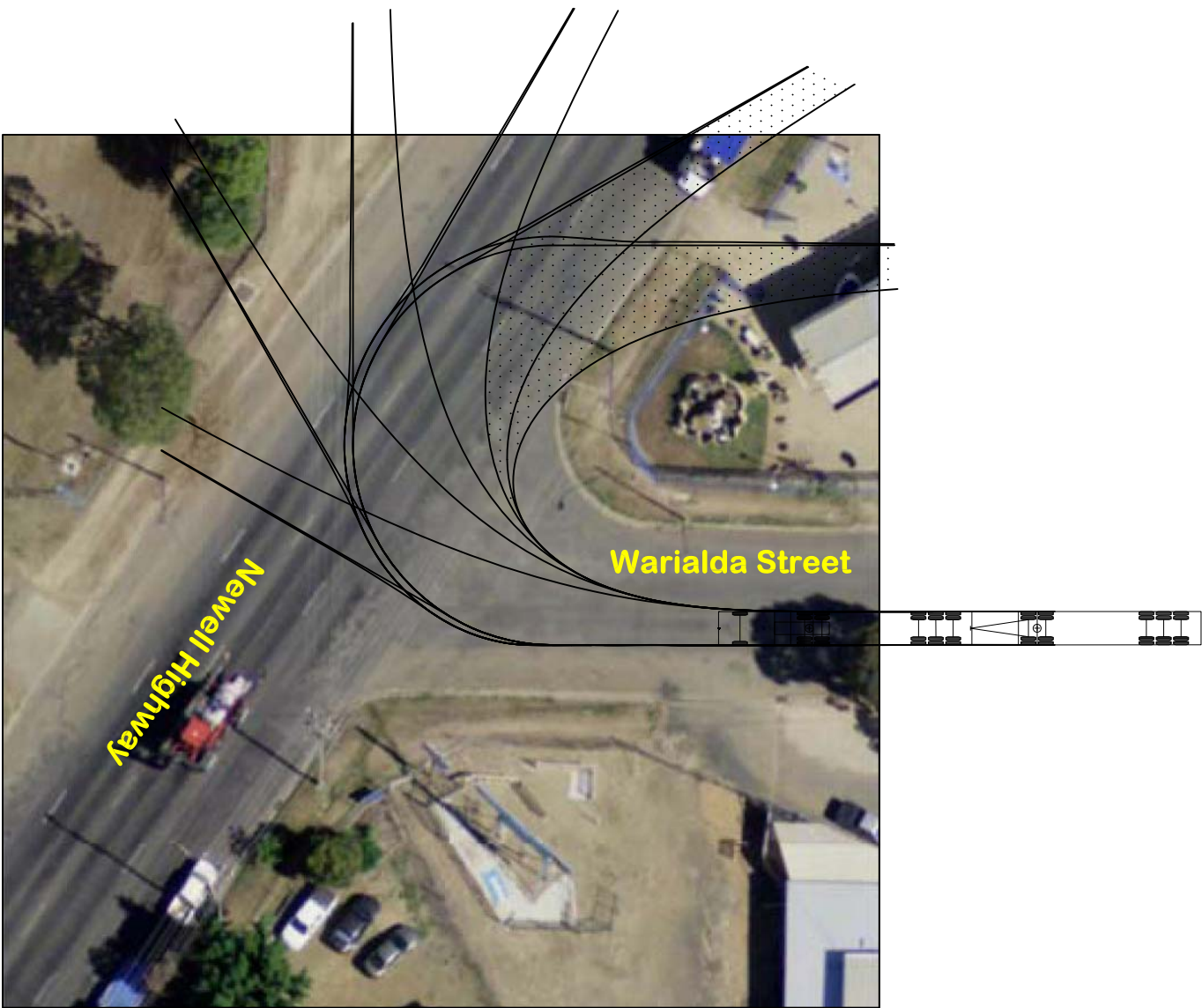
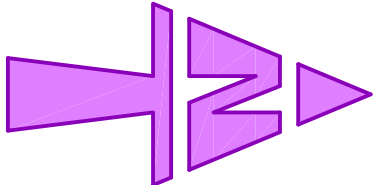
**AUSTROADS**  
**A-Double (Type 1) (36.2 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



**Title    A-Double (Road Train) Assessment: Intersection of Newell Highway and Warialda Street**  
**Scale    1:500    @ A3    Sheet    14 of 18    Plan Number    13-502-14-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann    Date    12/07/2013**

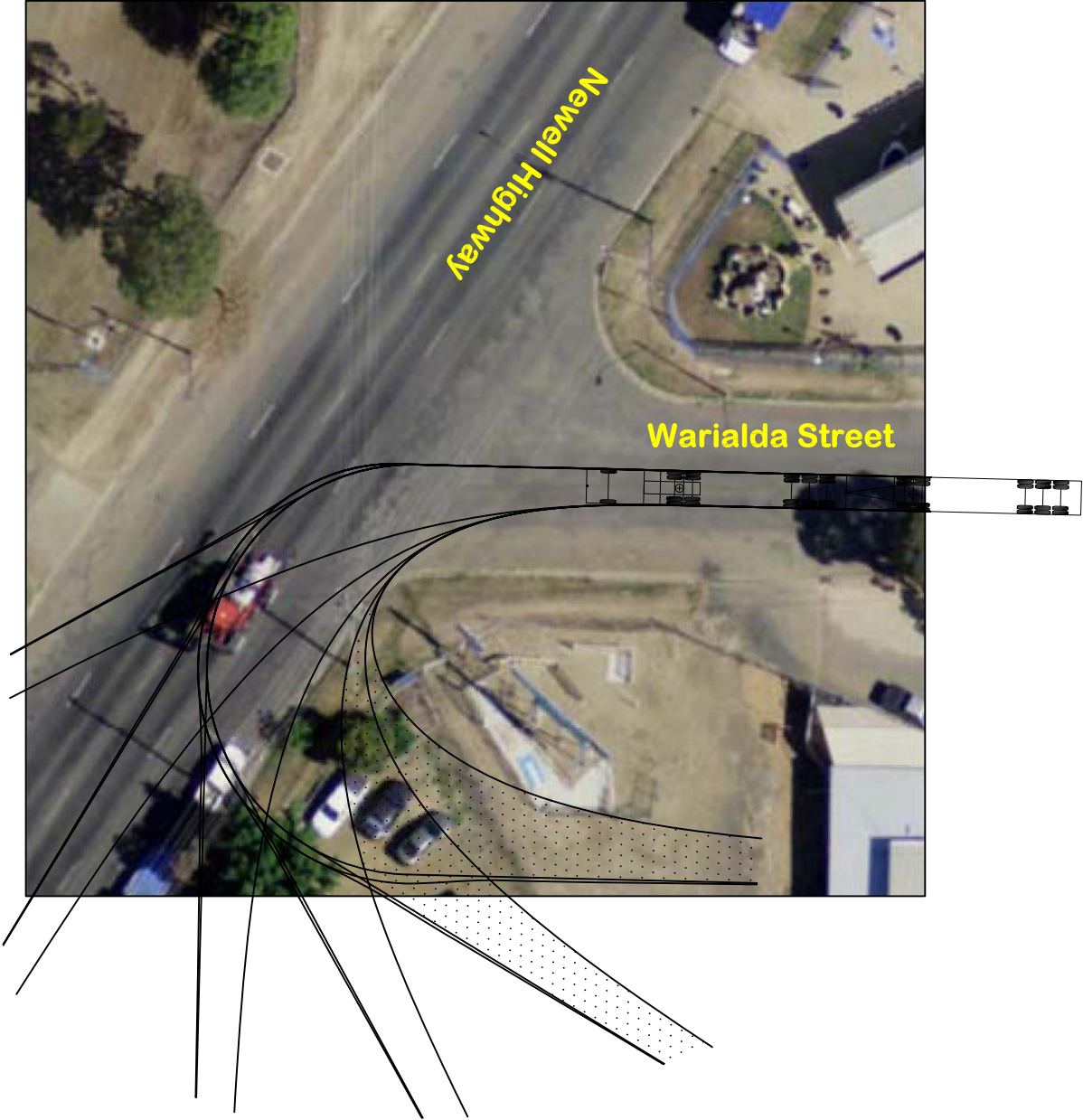
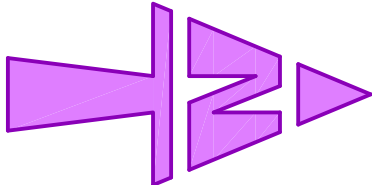


**AUSTROADS**  
**A-Double (Type 1) (36.2 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



**Title     A-Double (Road Train) Assessment: Intersection of Newell Highway and Warialda Street**  
**Scale     1:500     @ A3     Sheet     15 of 18     Plan Number     13-502-15-A**  
**Drawn/Designed     Casey Spilsbury-Brinkmann     Date     12/07/2013**

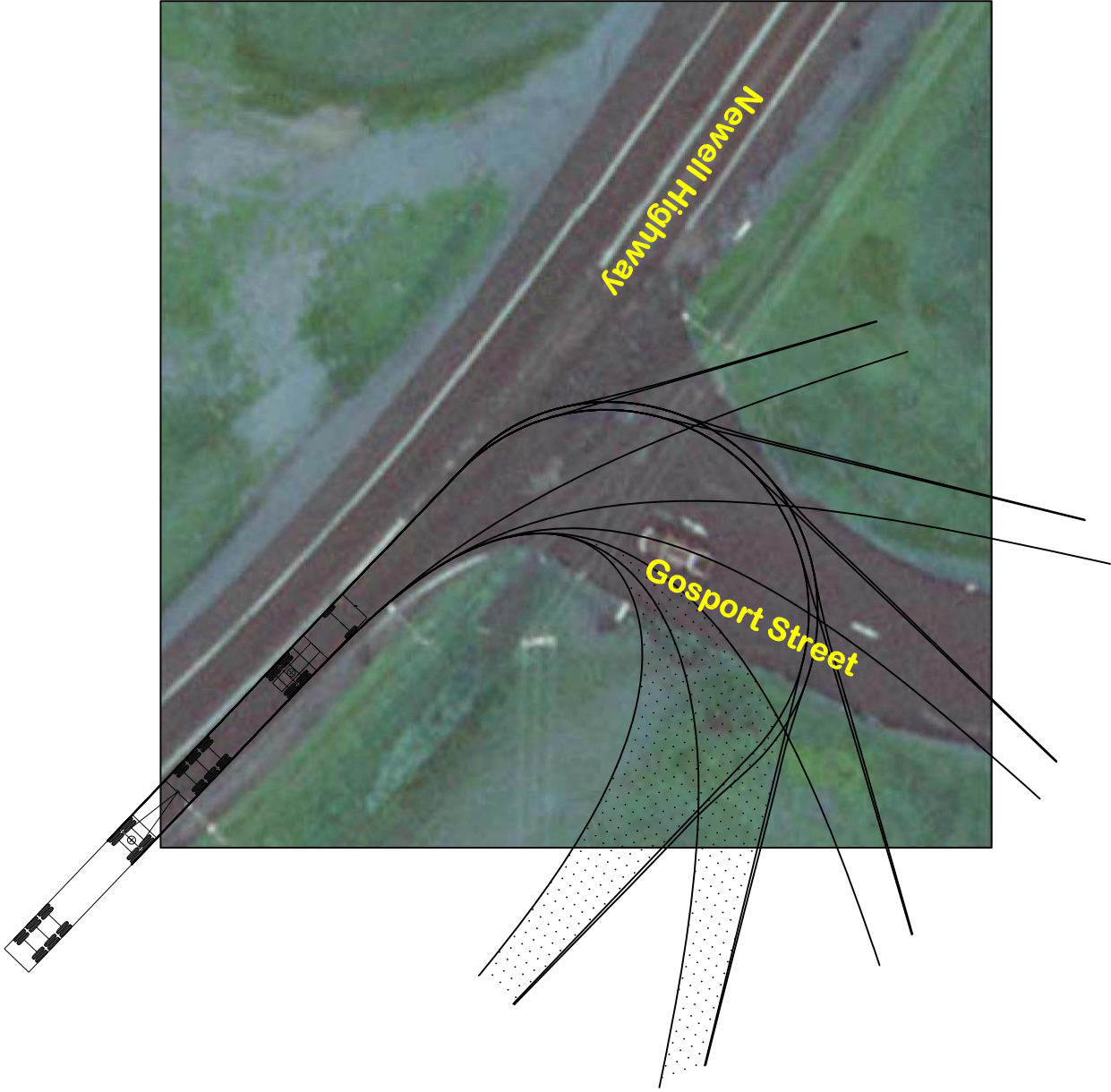
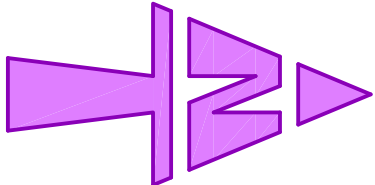
**AUSTROADS**  
**A-Double (Type 1) (36.2 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



**Title     A-Double (Road Train) Assessment: Intersection of Newell Highway and Warialda Street**  
**Scale     1:500     @ A3     Sheet     16 of 18     Plan Number     13-502-16-A**  
**Drawn/Designed     Casey Spilsbury-Brinkmann     Date     12/07/2013**



**AUSTROADS**  
**A-Double (Type 1) (36.2 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**

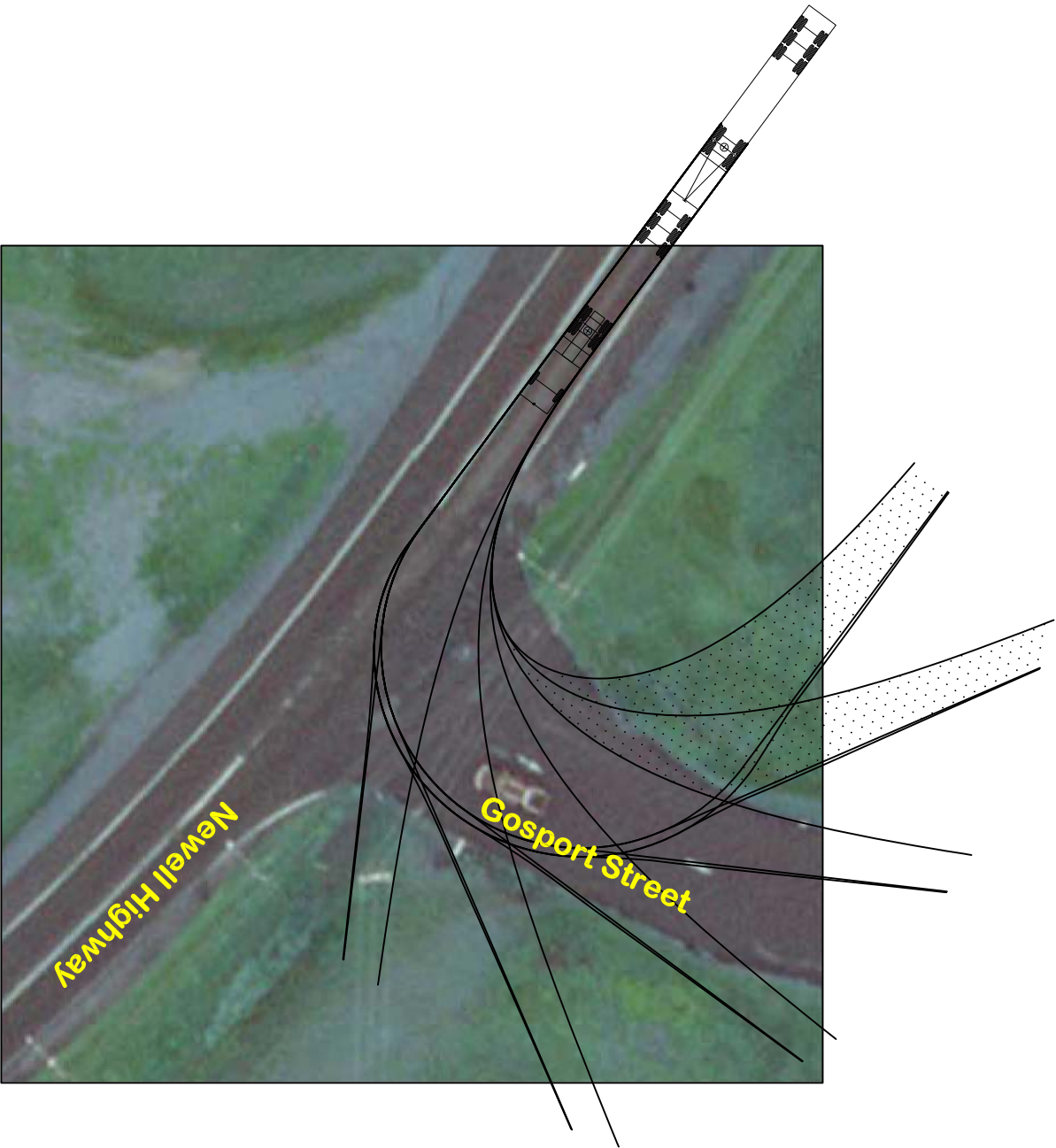
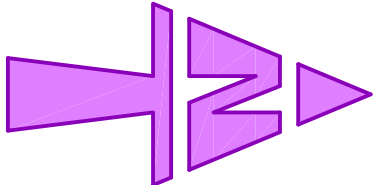


**Title      A-Double (Road Train) Assessment: Intersection of Gosport Street and Newell Highway**  
**Scale    1:500      @ A3      Sheet    17 of 18      Plan Number    13-502-17-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**





**AUSTROADS**  
**A-Double (Type 1) (36.2 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**

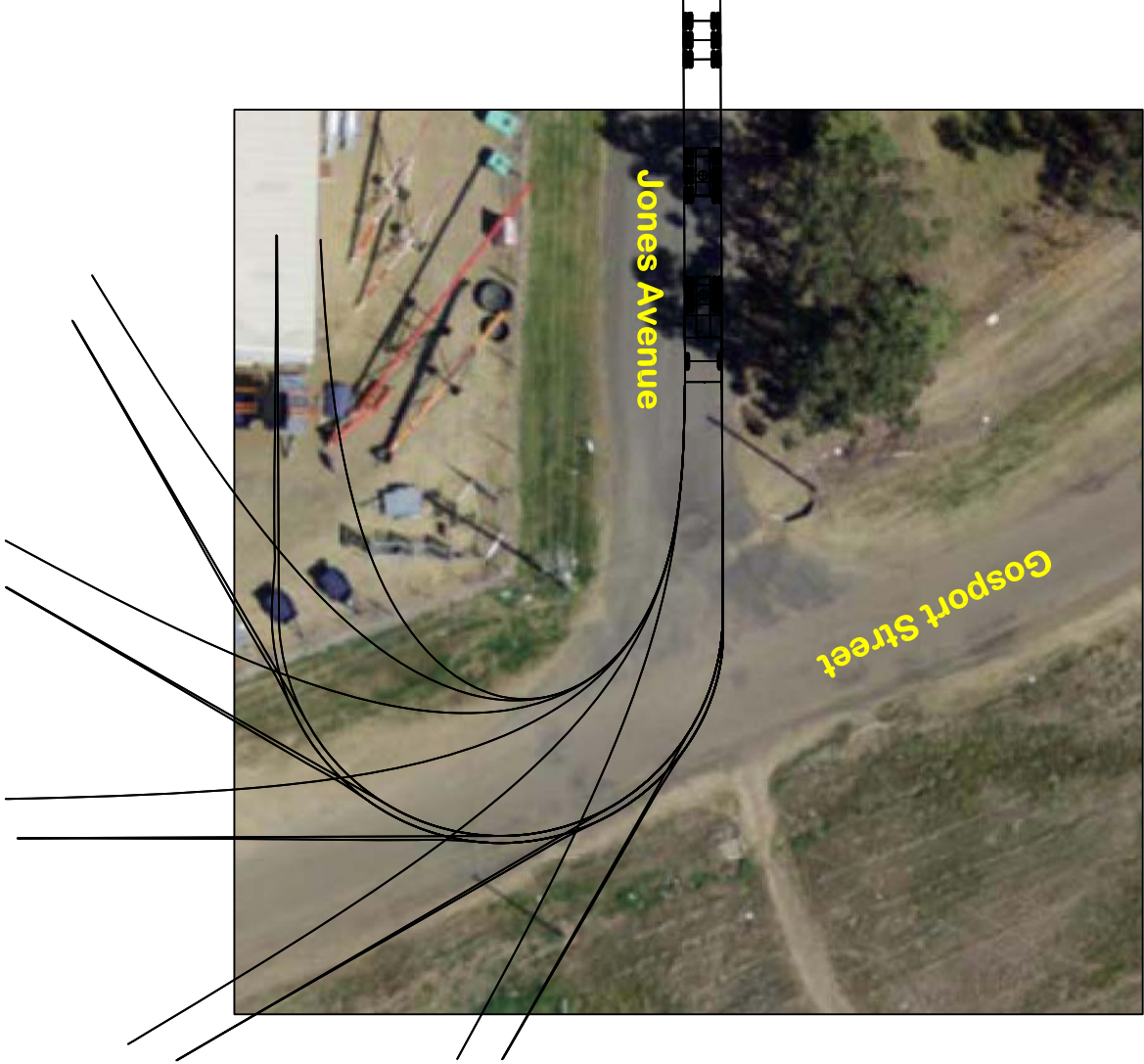
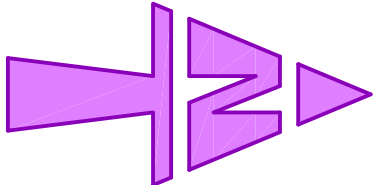


**Title      A-Double (Road Train) Assessment: Intersection of Gosport Street and Newell Highway**  
**Scale    1:500      @ A3      Sheet    18 of 18      Plan Number    13-502-18-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**





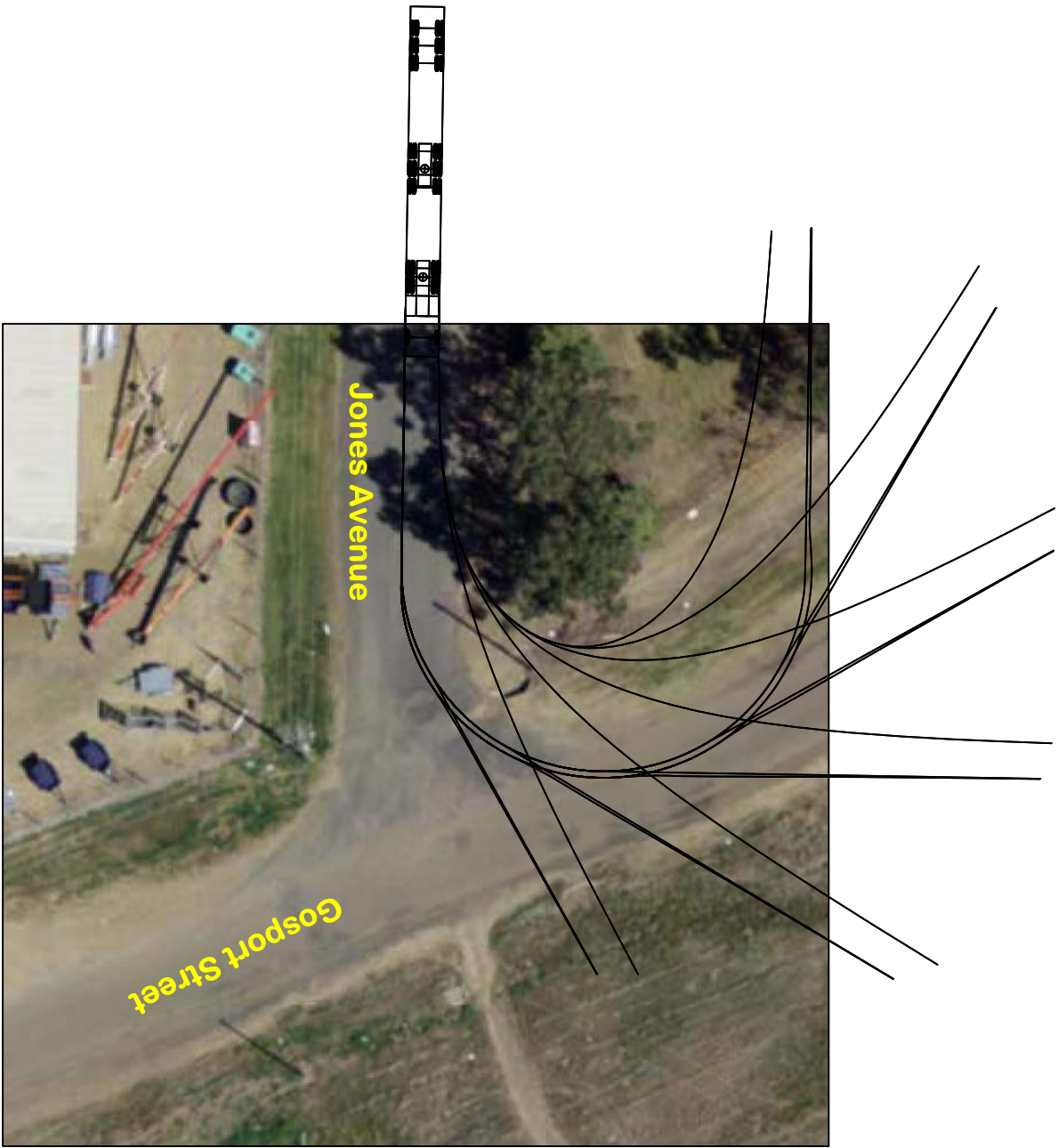
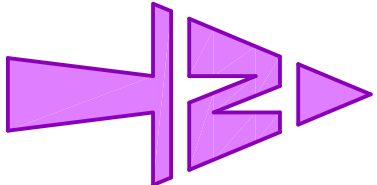
**AUSTROADS**  
**B-Double (26 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



**Title      B-Double Assessment: Intersection of Gosport Street and Jones Avenue**  
**Scale    1:500      @ A3      Sheet    01 of 18      Plan Number    13-501-01-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**

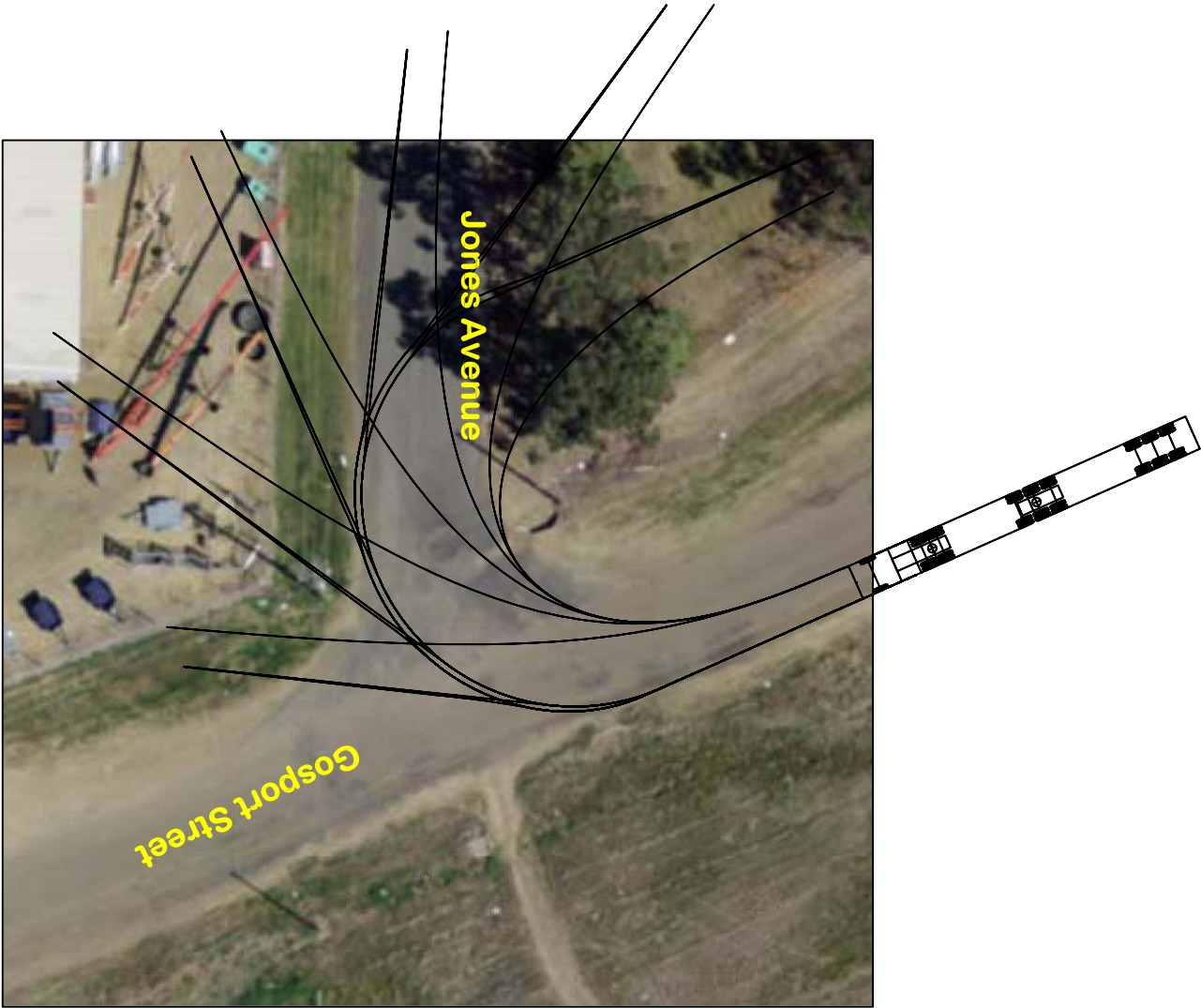
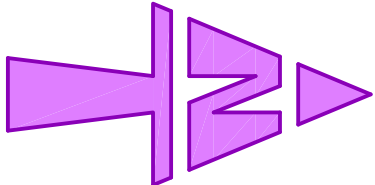


**AUSTROADS**  
**B-Double (26 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



**Title      B-Double Assessment: Intersection of Gosport Street and Jones Avenue**  
**Scale    1:500      @ A3      Sheet    02 of 18      Plan Number    13-501-02-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**

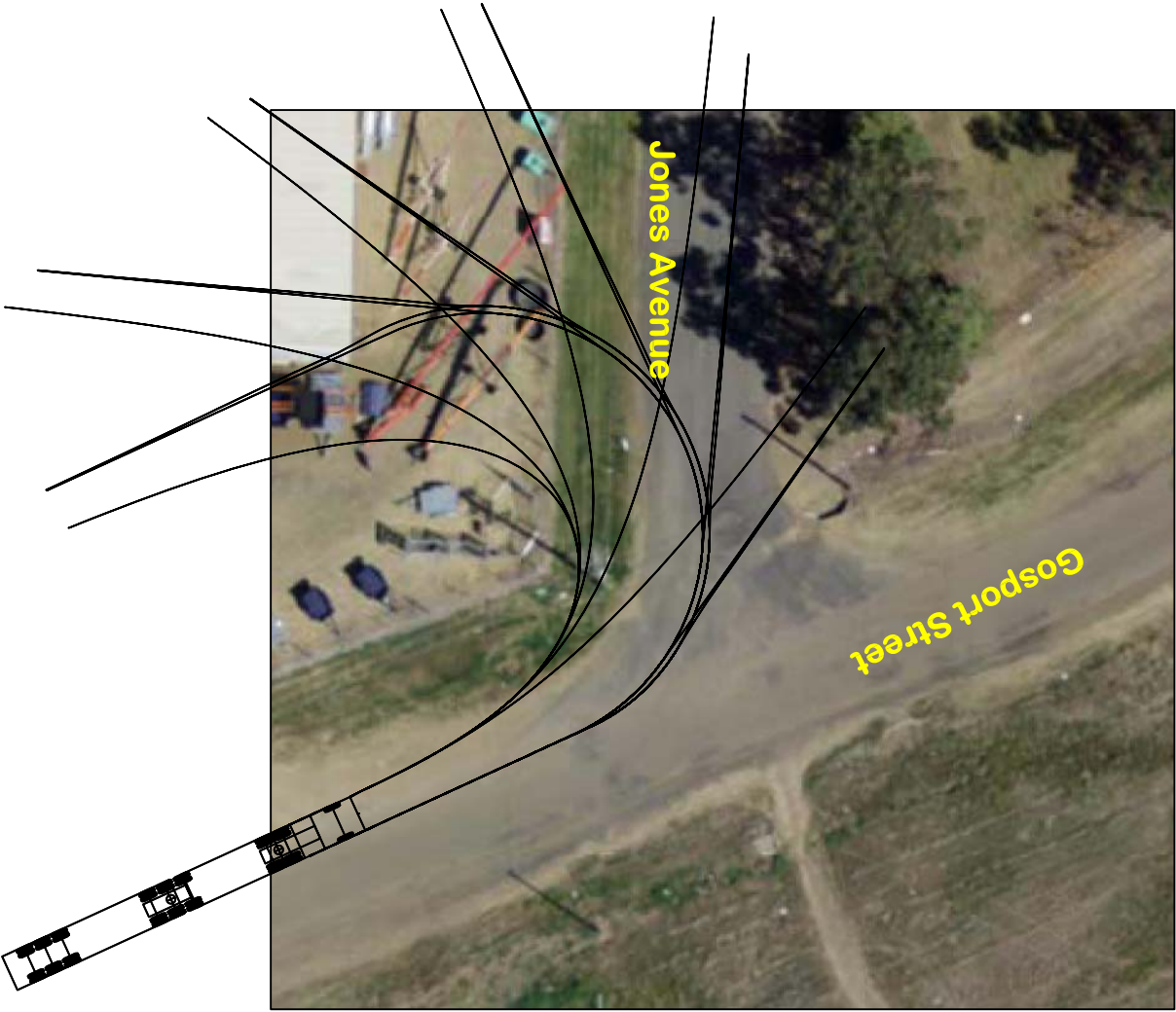
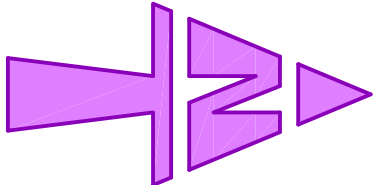
**AUSTROADS**  
**B-Double (26 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



**Title      B-Double Assessment: Intersection of Gosport Street and Jones Avenue**  
**Scale    1:500      @ A3      Sheet    03 of 18      Plan Number    13-501-03-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**



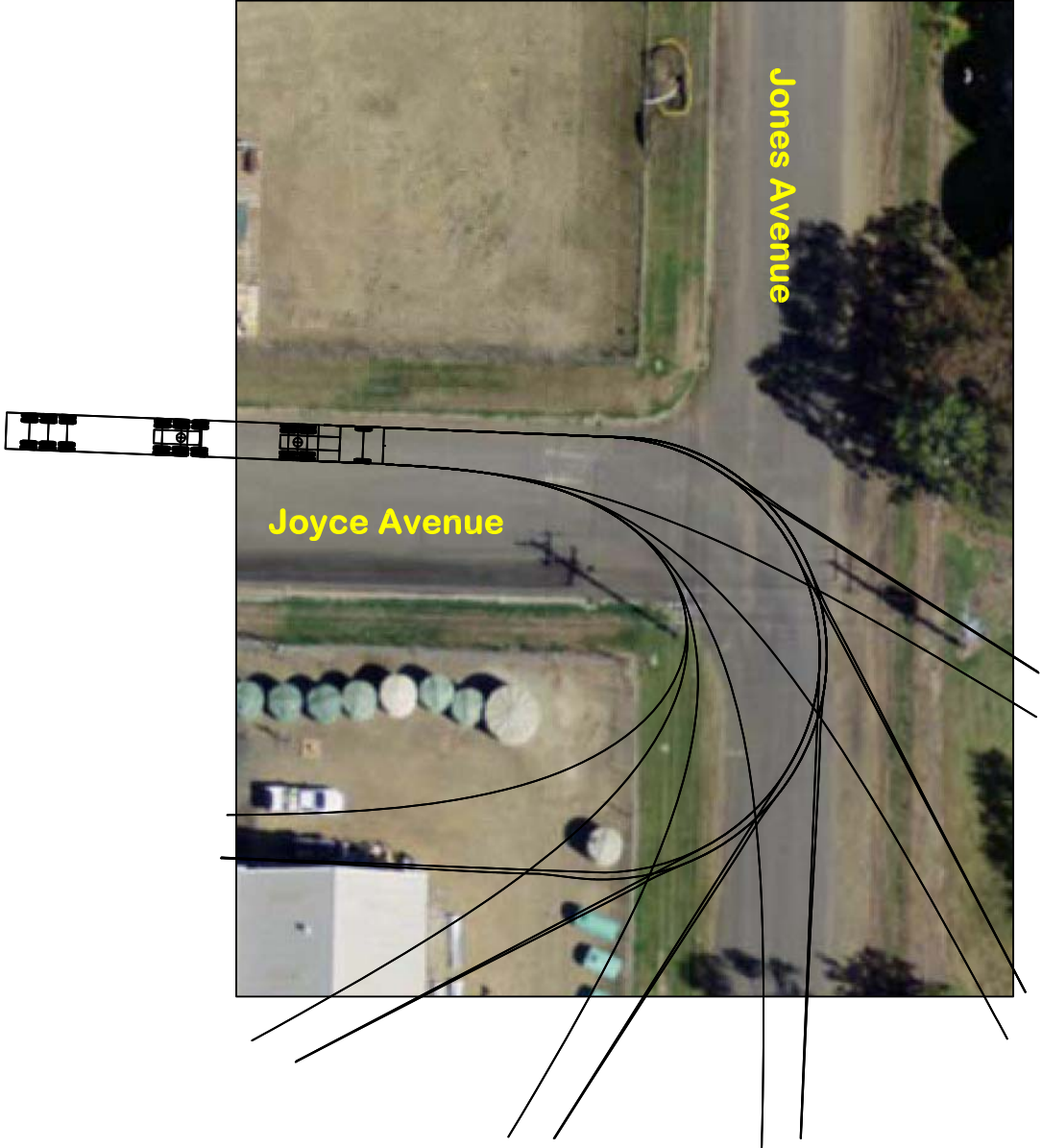
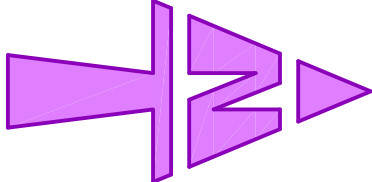
**AUSTROADS**  
**B-Double (26 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



**Title      B-Double Assessment: Intersection of Gosport Street and Jones Avenue**  
**Scale    1:500      @ A3      Sheet    04 of 18      Plan Number    13-501-04-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**

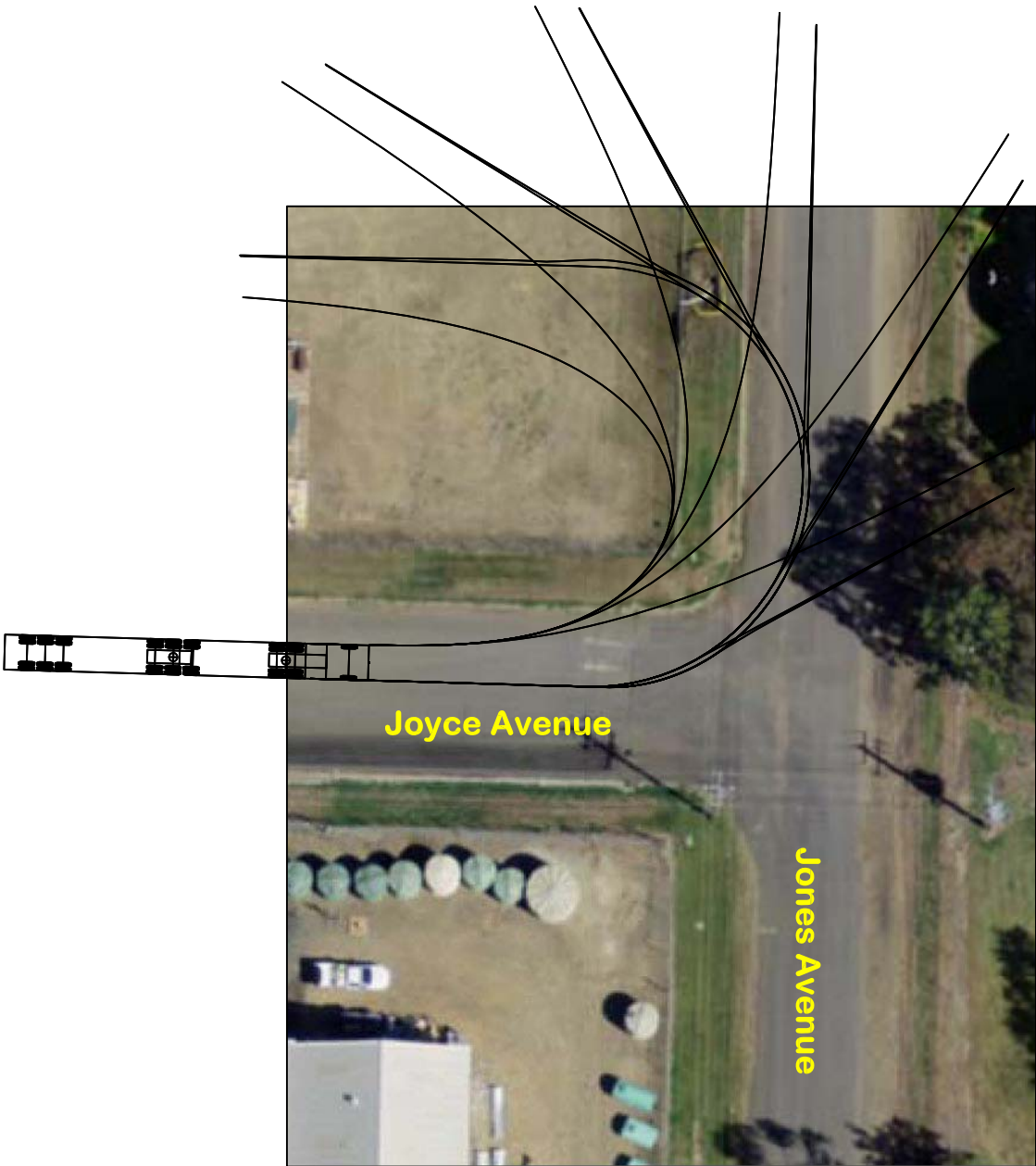
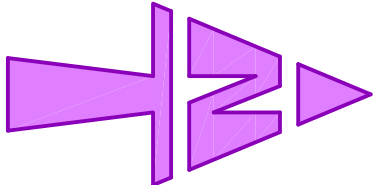


**AUSTROADS**  
**B-Double (26 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



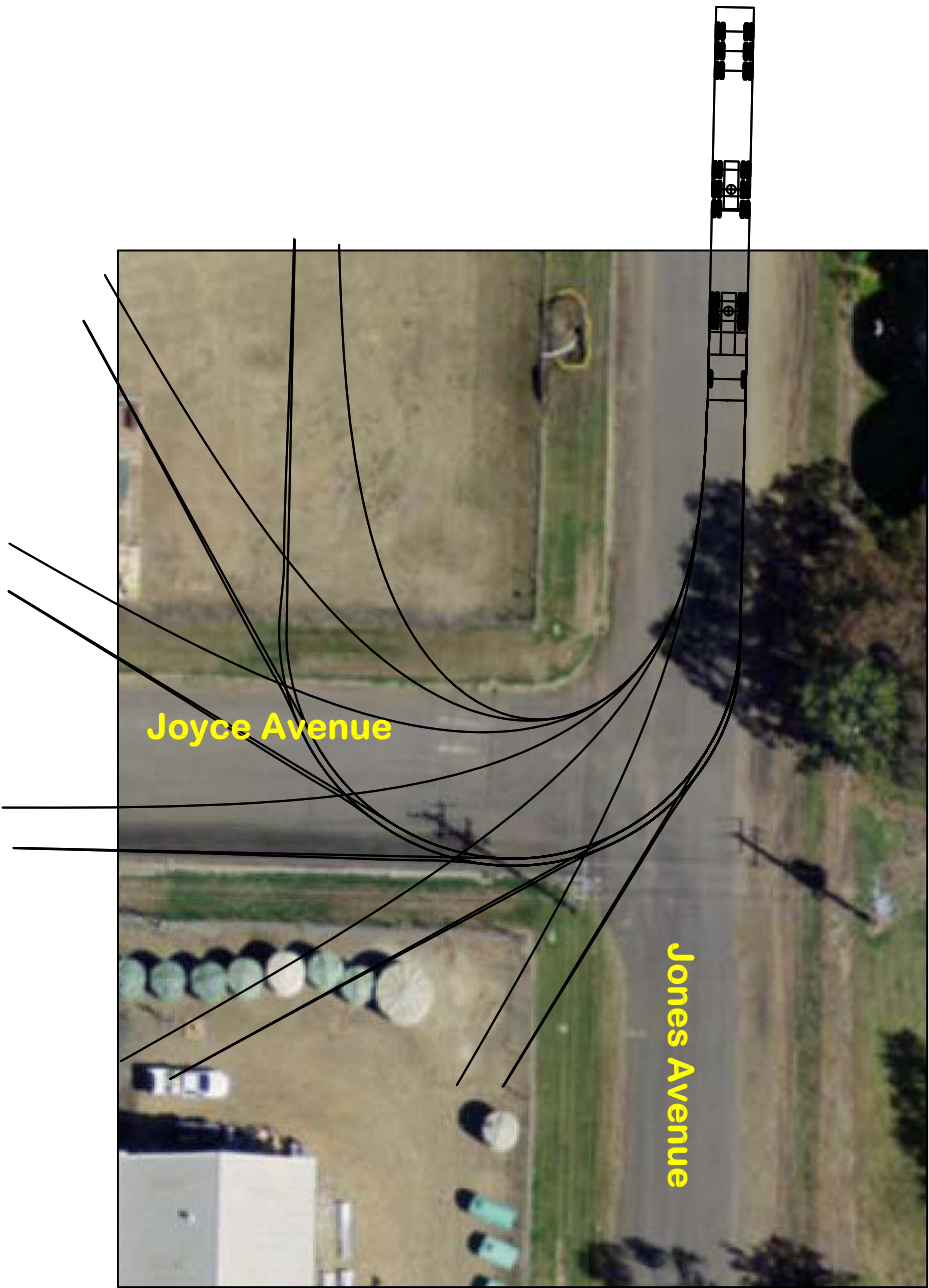
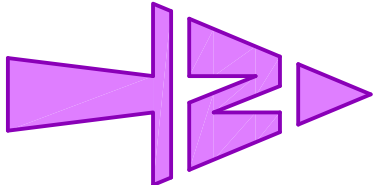
**Title      B-Double Assessment: Intersection of Jones Avenue and Joyce Avenue**  
**Scale    1:500      @ A3      Sheet    05 of 18      Plan Number    13-501-05-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**

**AUSTROADS**  
**B-Double (26 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



**Title      B-Double Assessment: Intersection of Jones Avenue and Joyce Avenue**  
**Scale    1:500      @ A3      Sheet    06 of 18      Plan Number    13-501-06-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**

**AUSTROADS**  
**B-Double (26 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**

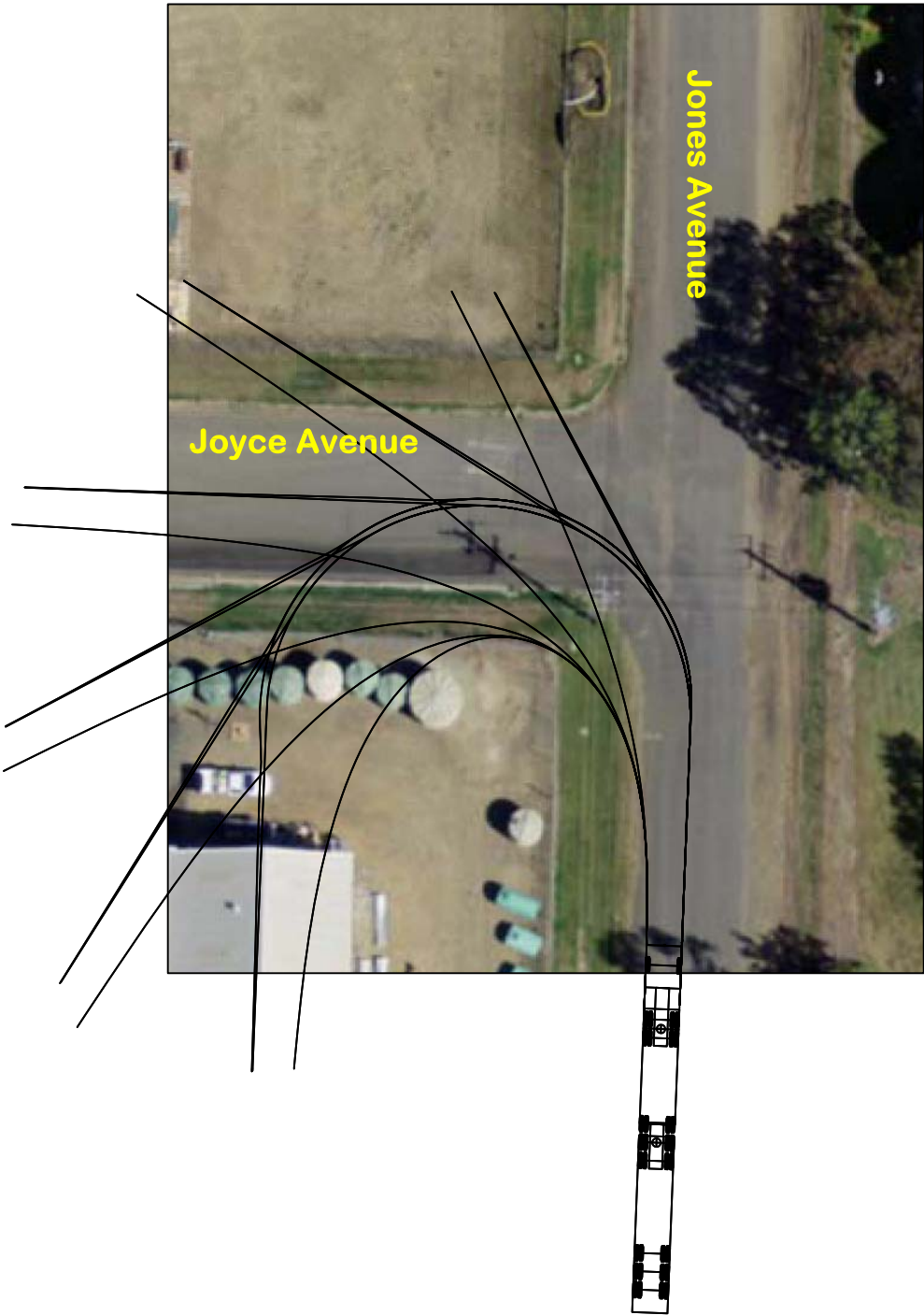
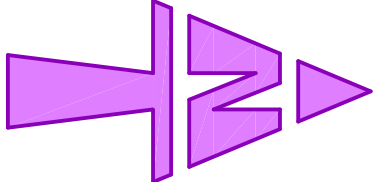


**Title      B-Double Assessment: Intersection of Jones Avenue and Joyce Avenue**  
**Scale    1:500      @ A3      Sheet    07 of 18      Plan Number    13-501-07-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**





**AUSTROADS**  
**B-Double (26 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**

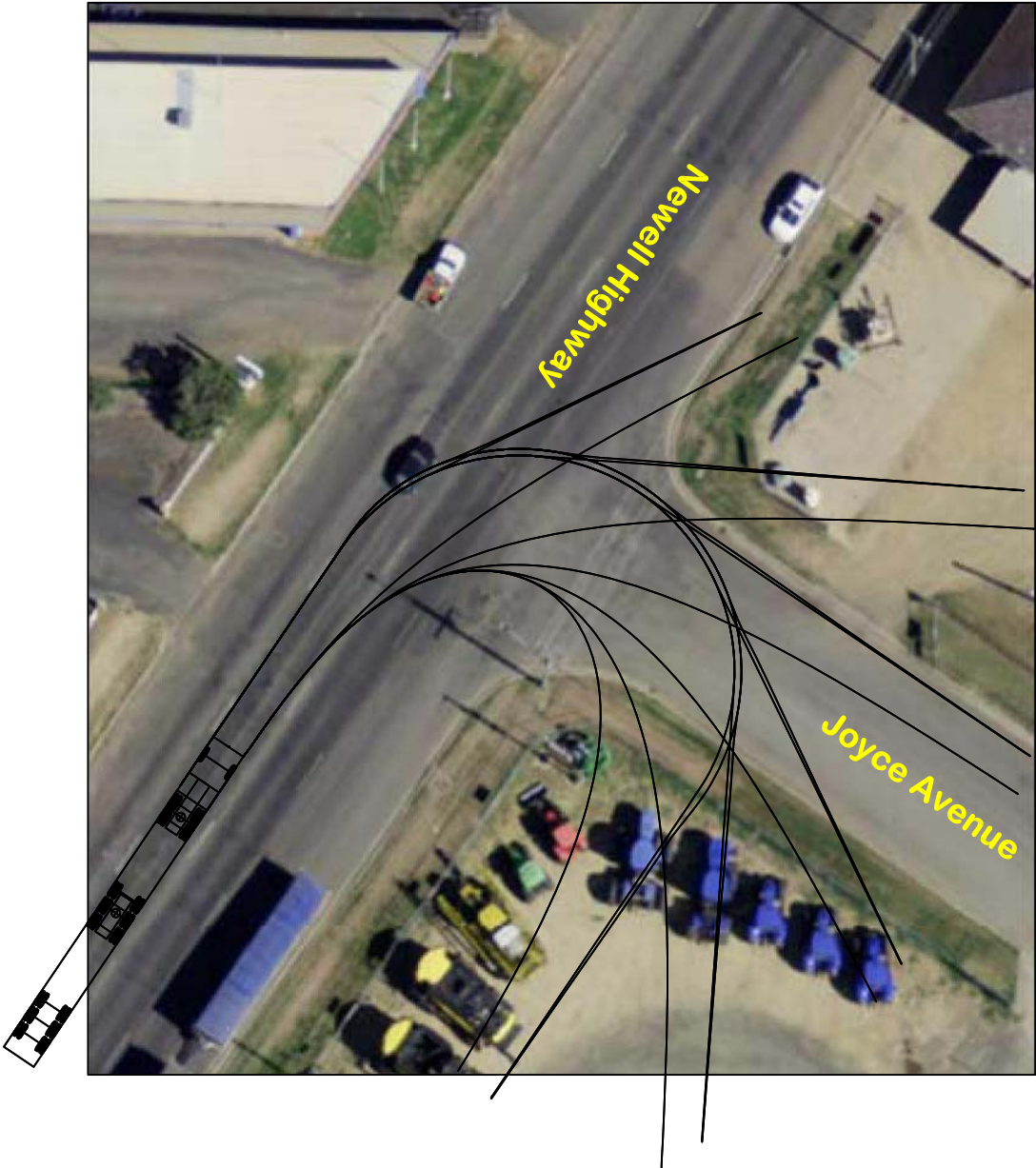
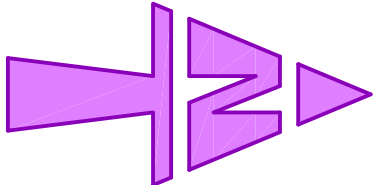


**Title      B-Double Assessment: Intersection of Jones Avenue and Joyce Avenue**  
**Scale    1:500      @ A3      Sheet    08 of 18      Plan Number    13-501-08-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**





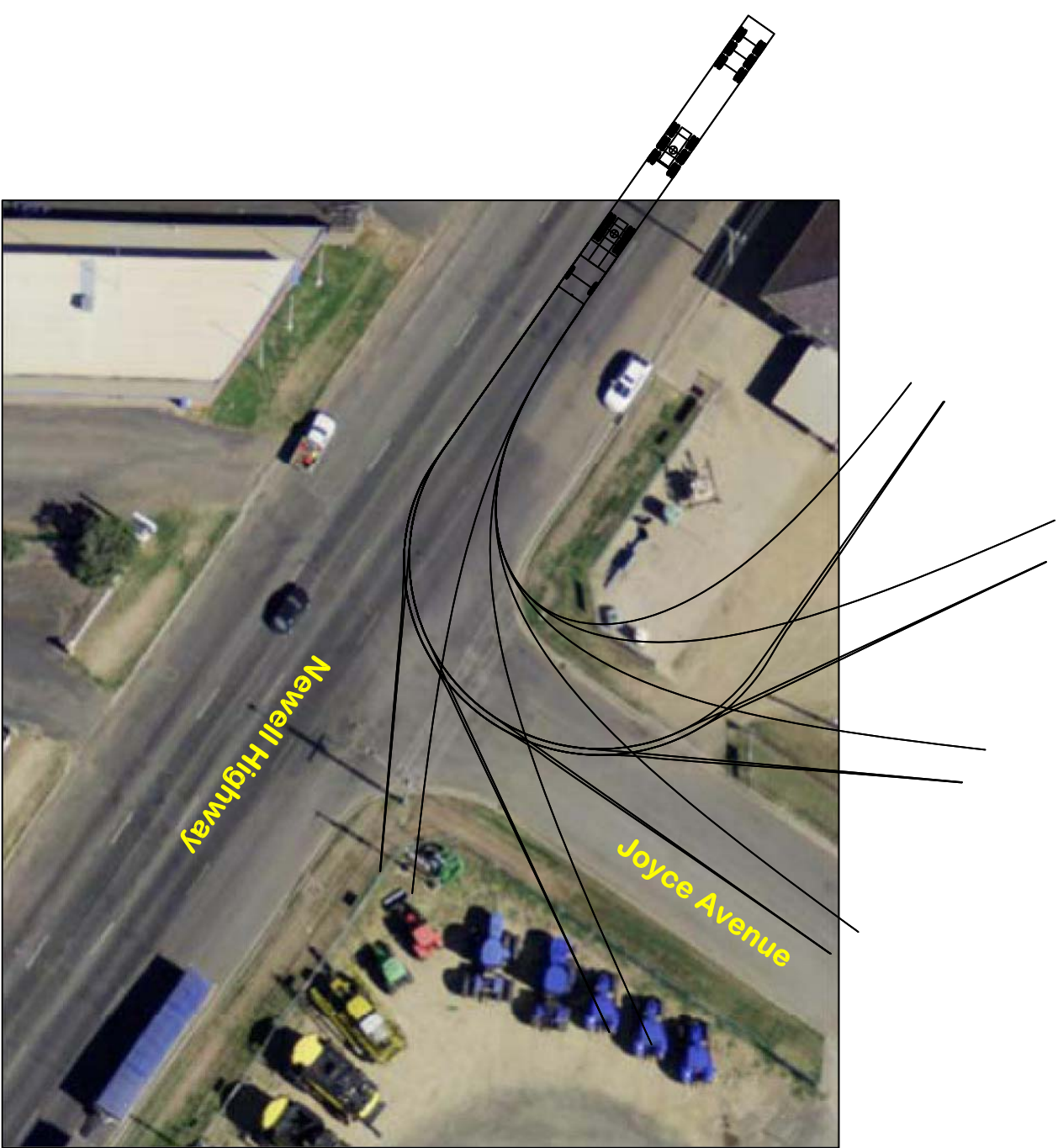
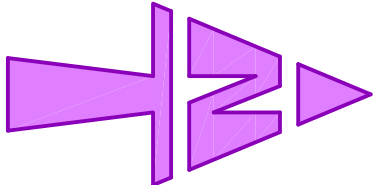
**AUSTROADS**  
**B-Double (26 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



**Title      B-Double Assessment: Intersection of Joyce Avenue and Newell Highway**  
**Scale    1:500      @ A3      Sheet    09 of 18      Plan Number    13-501-09-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**



**AUSTROADS**  
**B-Double (26 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**

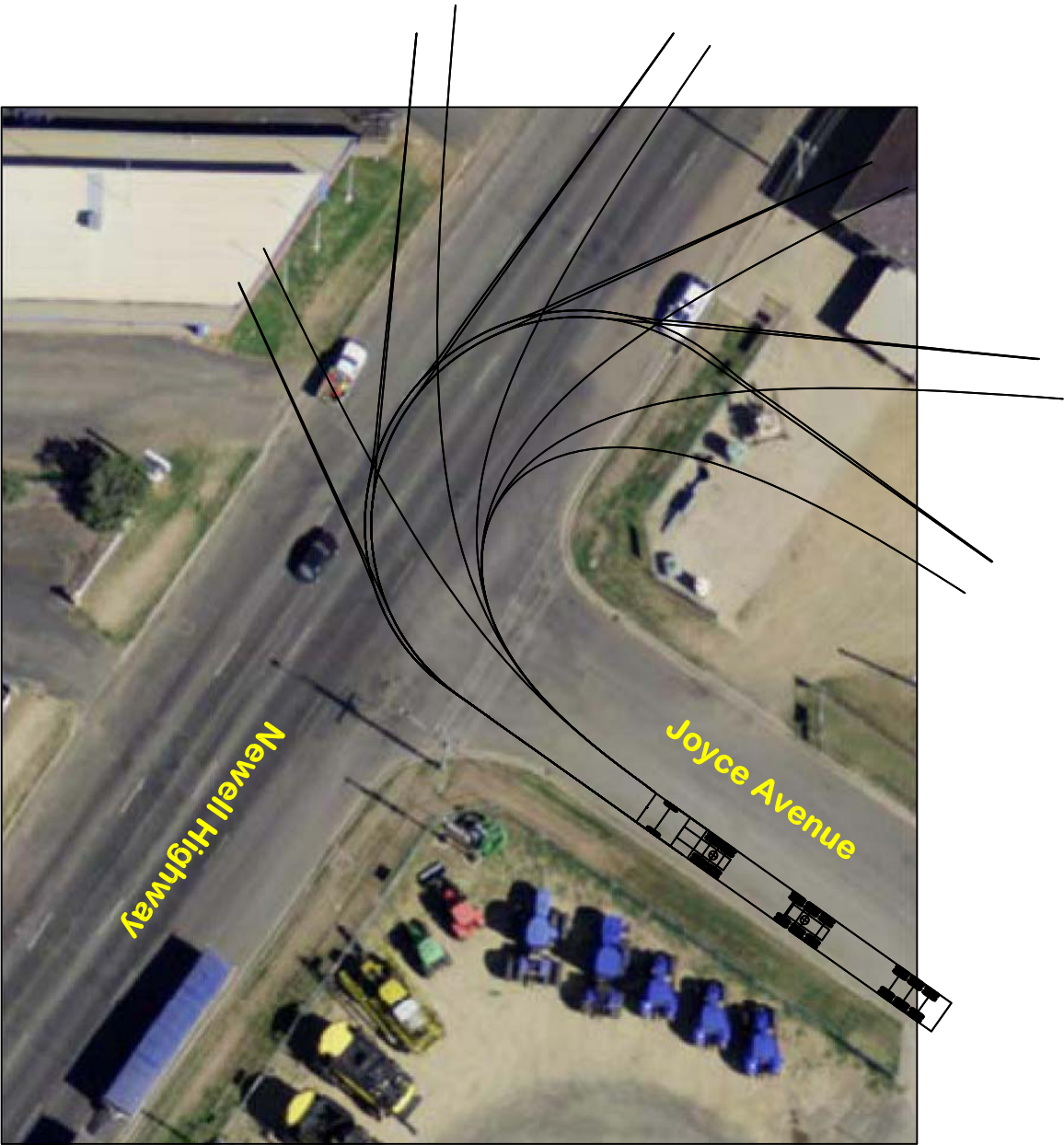
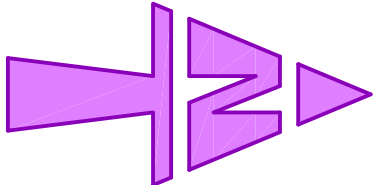


**Title      B-Double Assessment: Intersection of Joyce Avenue and Newell Highway**  
**Scale    1:500      @ A3      Sheet    10 of 18      Plan Number    13-501-10-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**





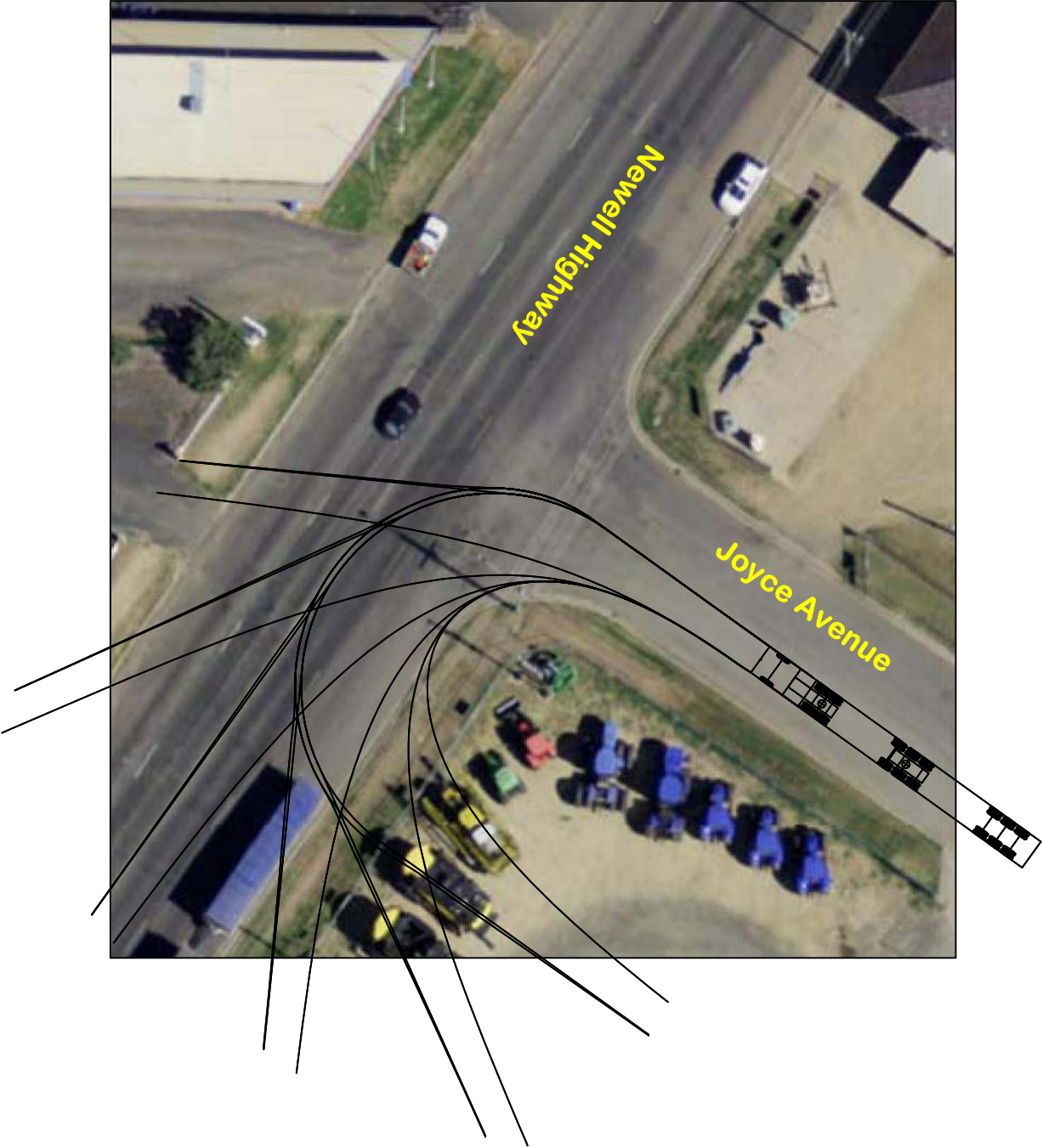
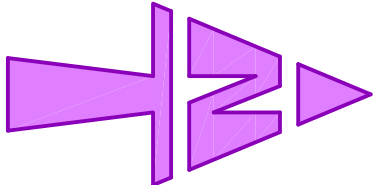
**AUSTROADS**  
**B-Double (26 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



**Title      B-Double Assessment: Intersection of Joyce Avenue and Newell Highway**  
**Scale    1:500      @ A3      Sheet    11 of 18      Plan Number    13-501-11-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**



**AUSTROADS**  
**B-Double (26 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**

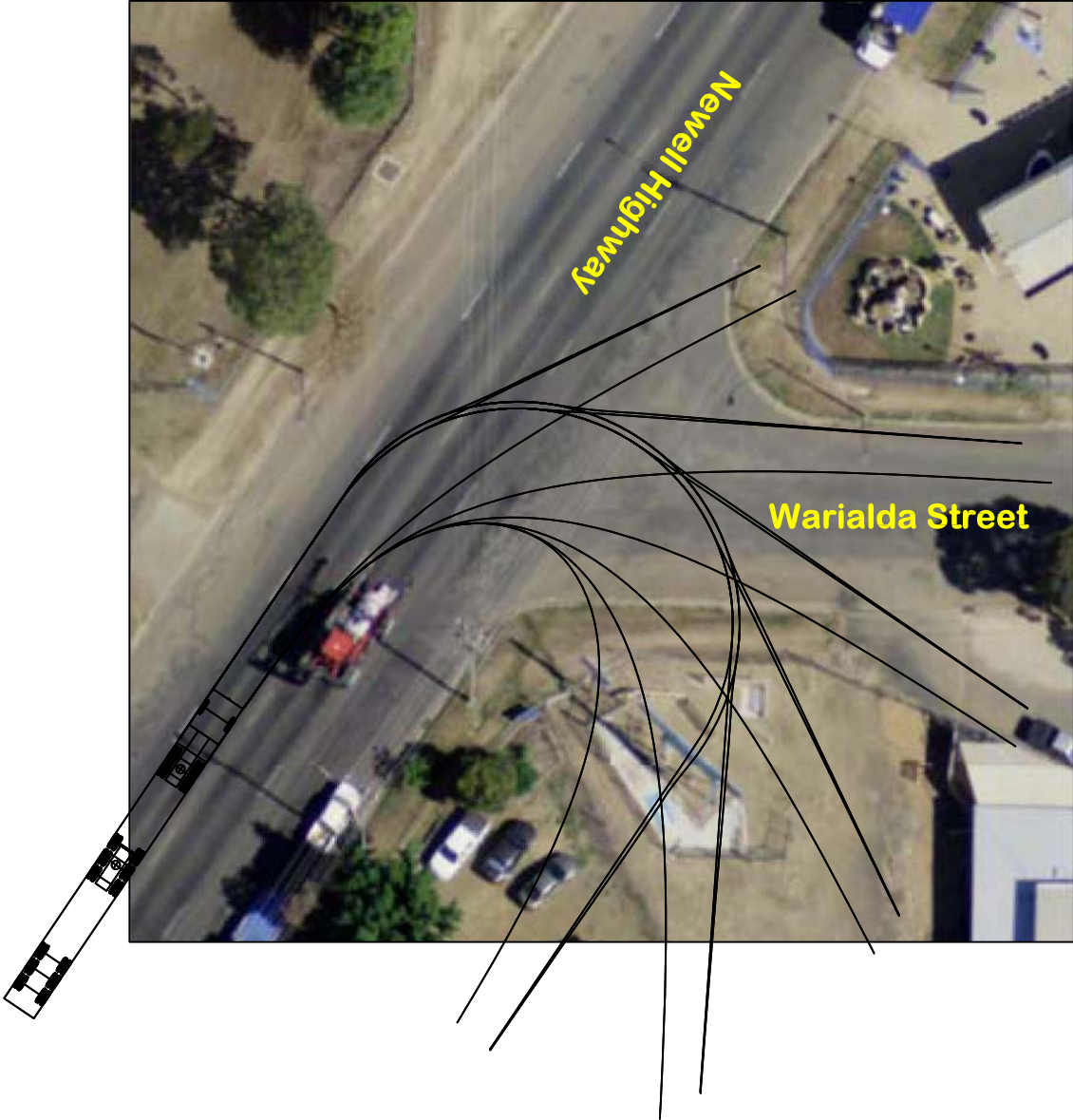
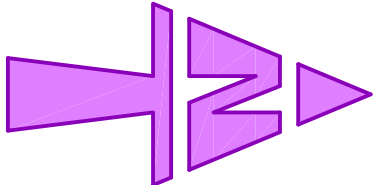


**Title      B-Double Assessment: Intersection of Joyce Avenue and Newell Highway**  
**Scale    1:500      @ A3      Sheet    12 of 18      Plan Number    13-501-12-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**



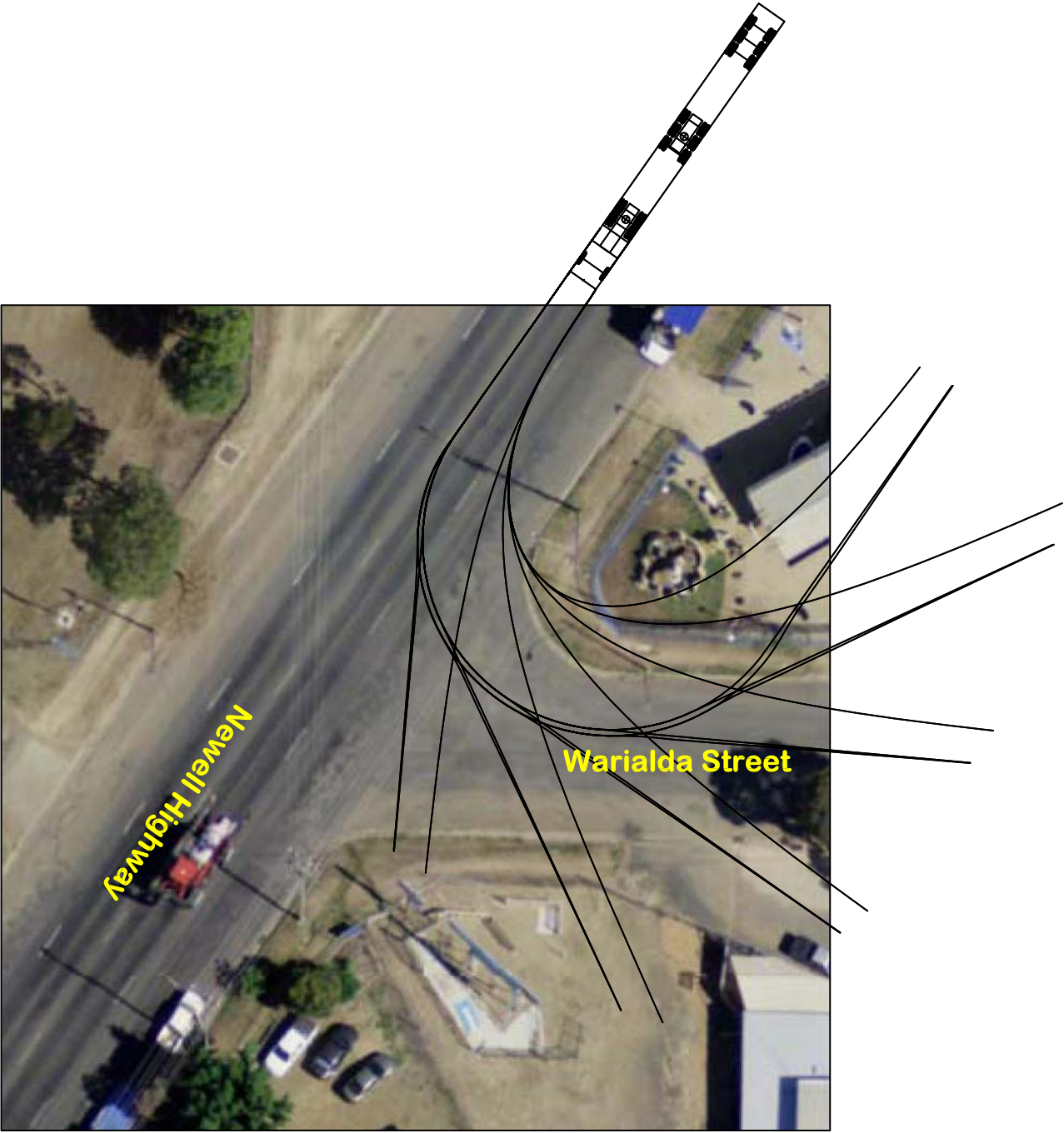
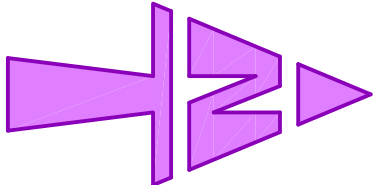


**AUSTROADS**  
**B-Double (26 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



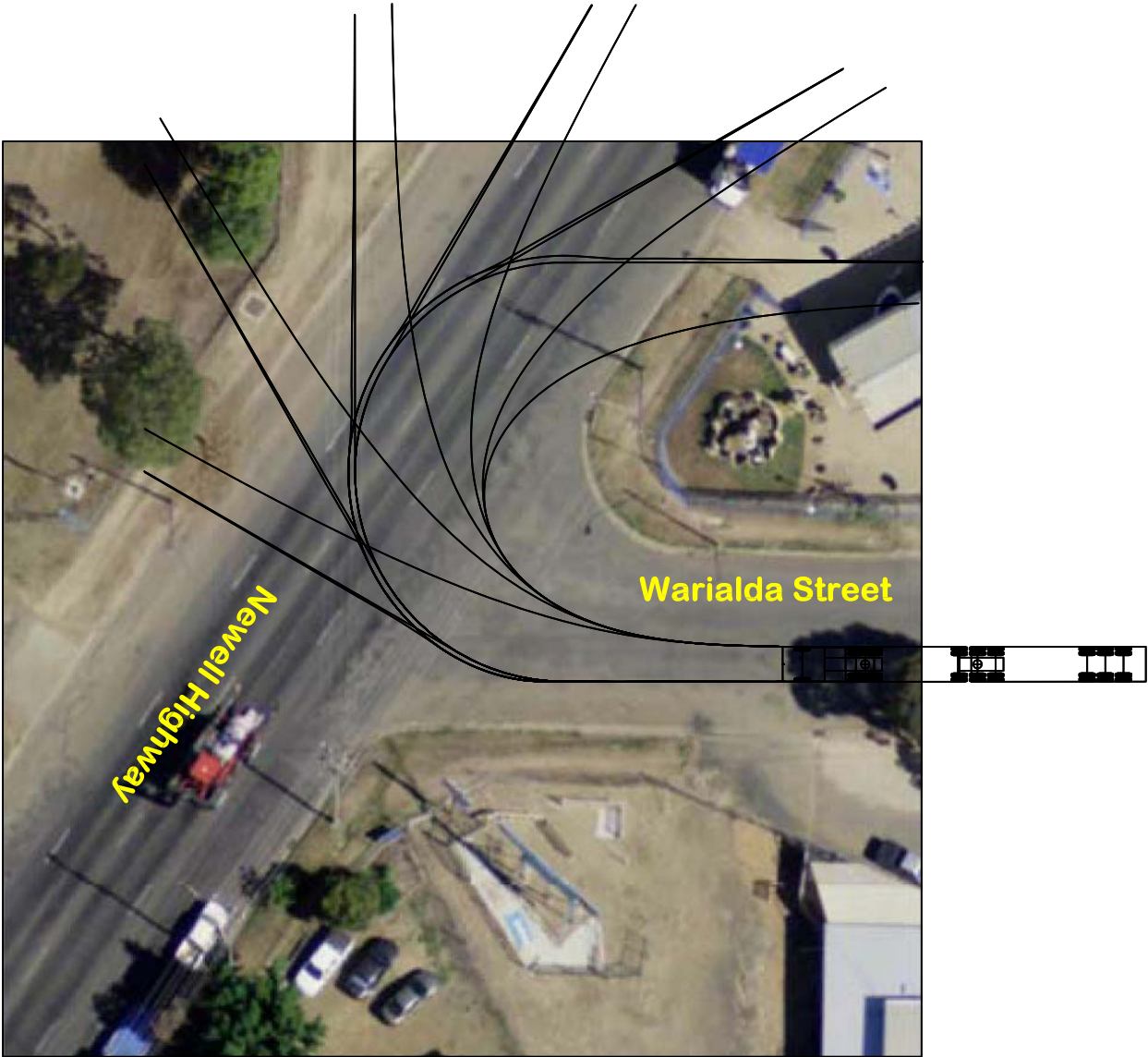
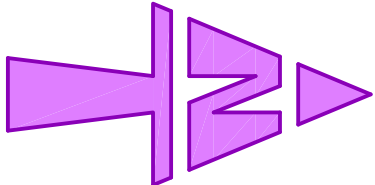
**Title      B-Double Assessment: Intersection of Newell Highway and Warialda Street**  
**Scale    1:500      @ A3      Sheet    13 of 18      Plan Number    13-501-13-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**

**AUSTROADS**  
**B-Double (26 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



**Title      B-Double Assessment: Intersection of Newell Highway and Warialda Street**  
**Scale    1:500      @ A3      Sheet    14 of 18      Plan Number    13-501-14-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**

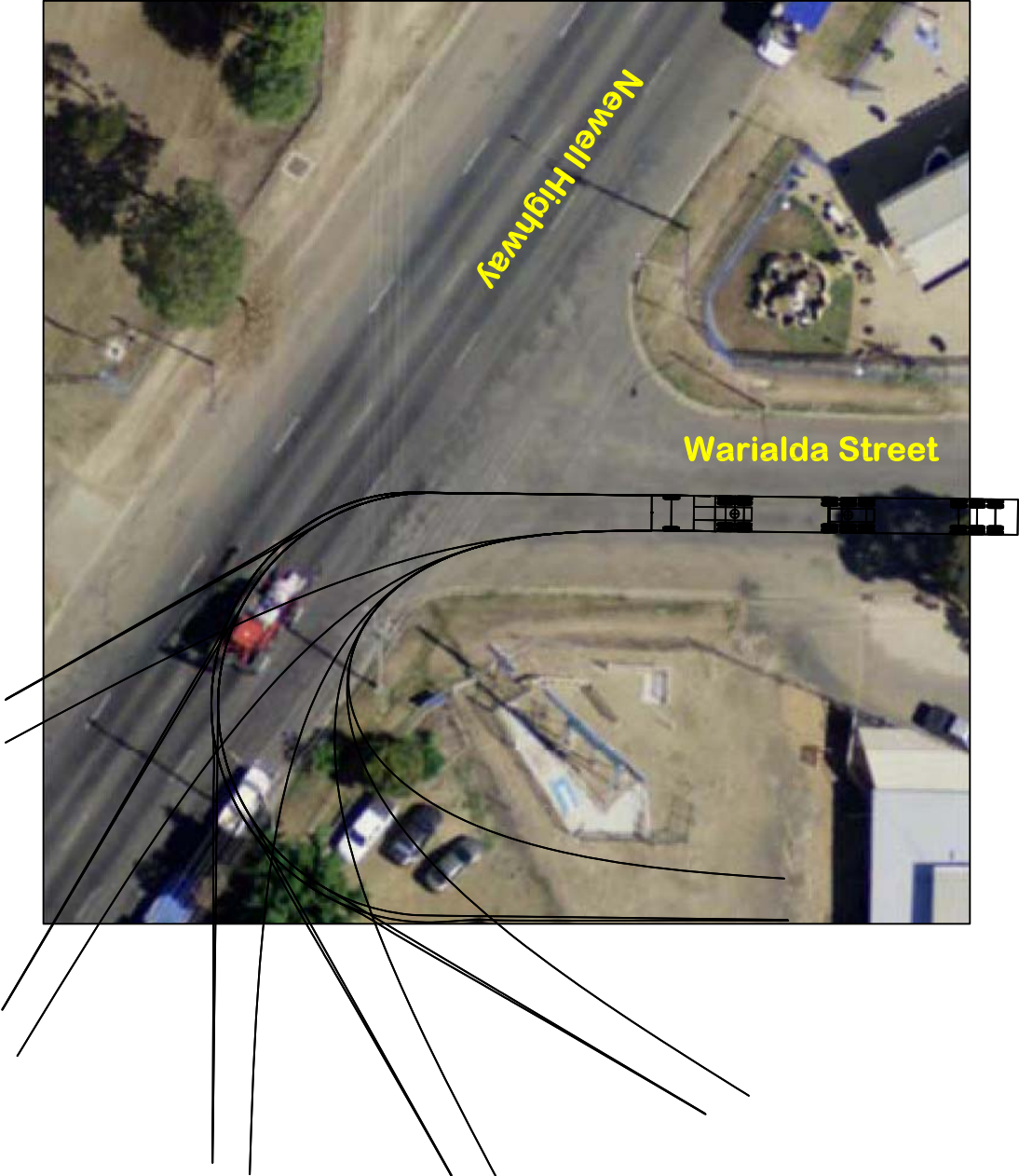
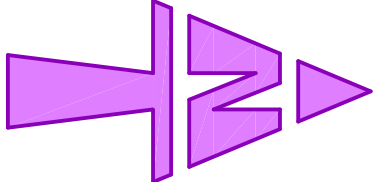
**AUSTROADS**  
**B-Double (26 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



**Title      B-Double Assessment: Intersection of Newell Highway and Warialda Street**  
**Scale      1:500      @ A3      Sheet      15 of 18      Plan Number      13-501-15-A**  
**Drawn/Designed      Casey Spilsbury-Brinkmann      Date      12/07/2013**



**AUSTROADS**  
**B-Double (26 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**

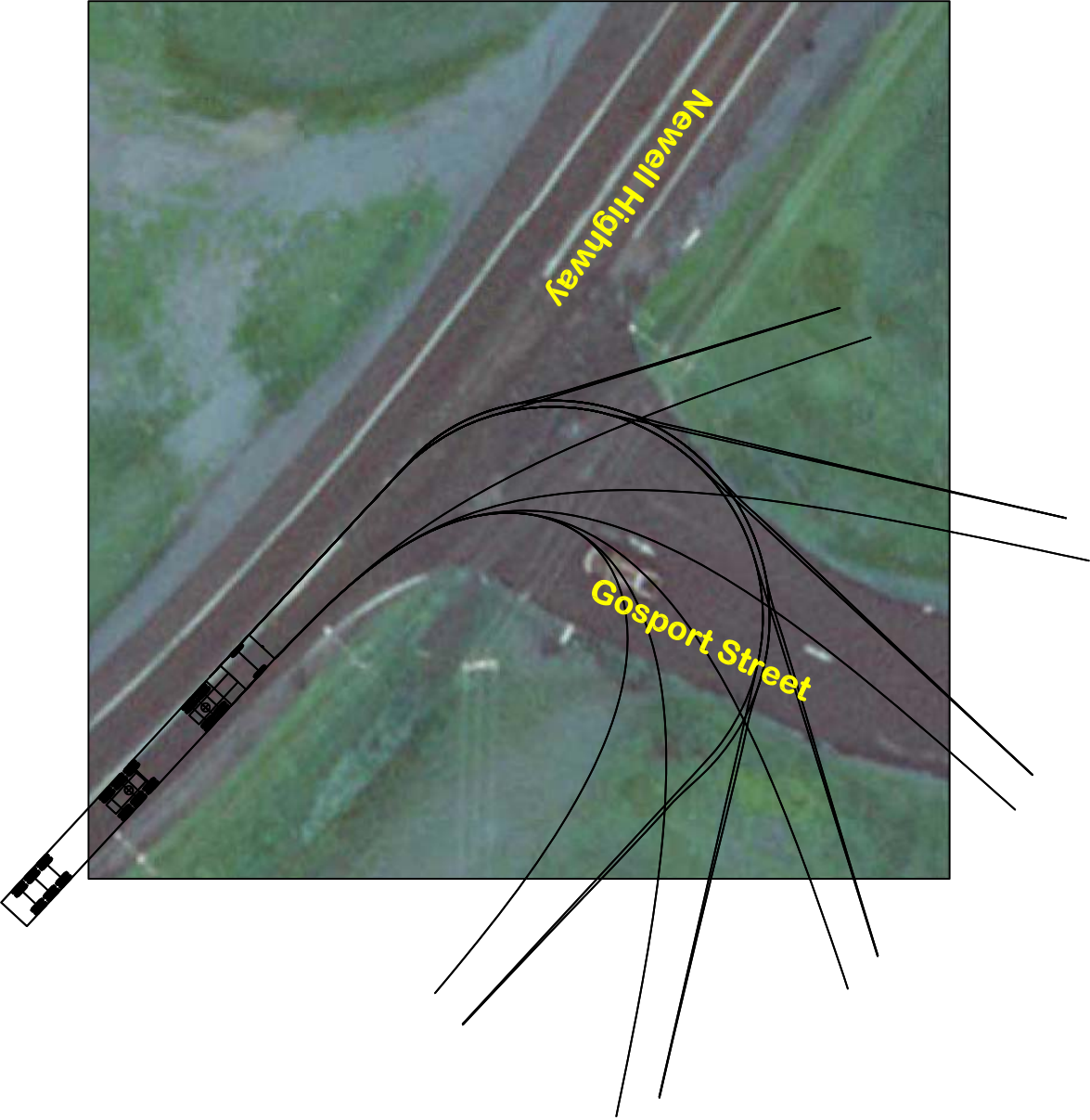
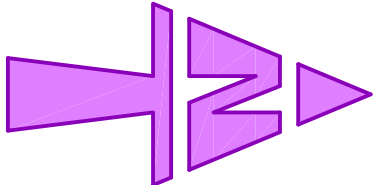


**Title      B-Double Assessment: Intersection of Newell Highway and Warialda Street**  
**Scale    1:500      @ A3      Sheet    16 of 18      Plan Number    13-501-16-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**



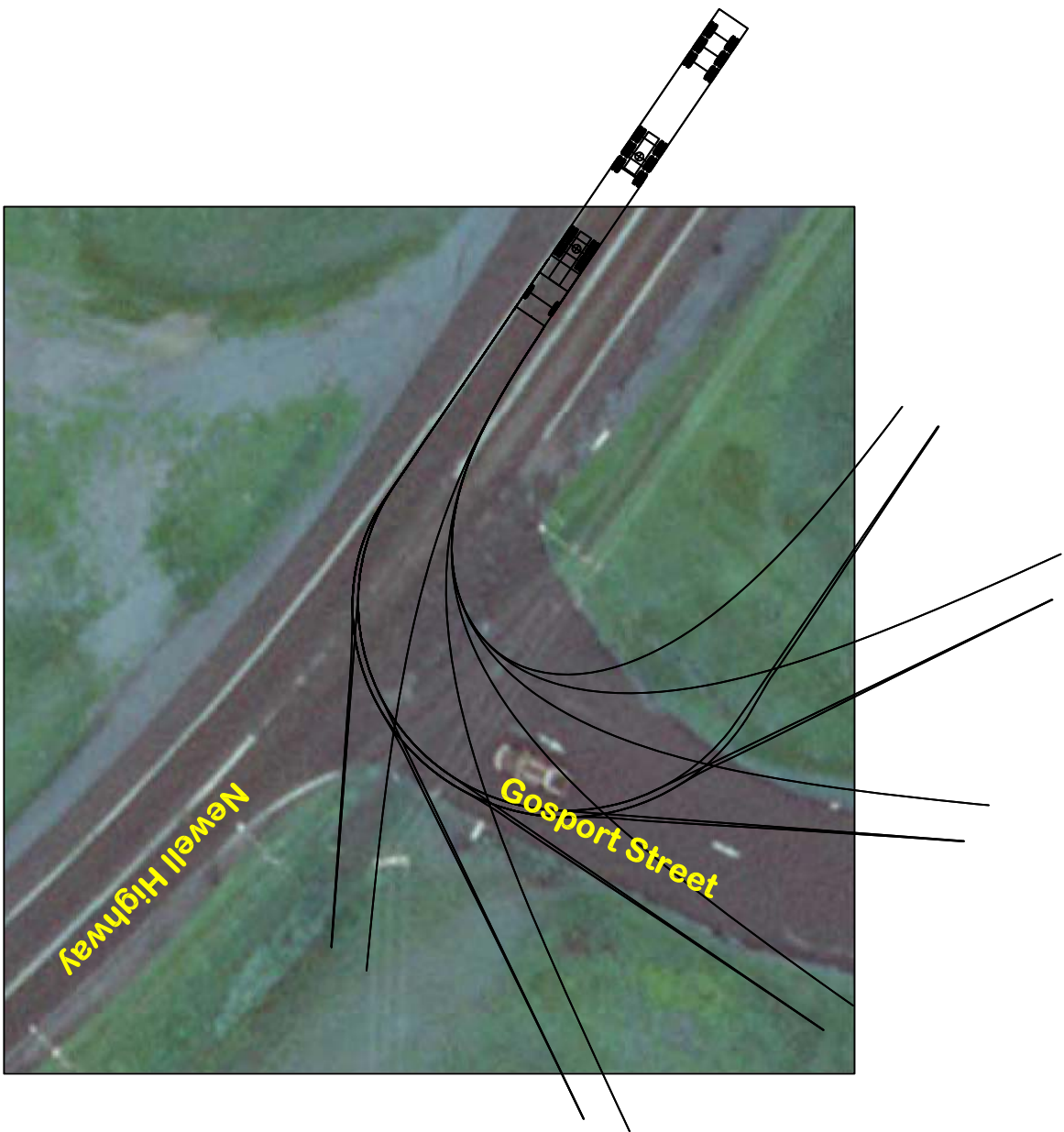
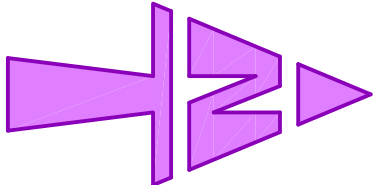


**AUSTROADS**  
**B-Double (26 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



**Title      B-Double Assessment: Intersection of Gosport Street and Newell Highway**  
**Scale    1:500      @ A3      Sheet    17 of 18      Plan Number    13-501-17-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**

**AUSTROADS**  
**B-Double (26 m)**  
**Radius 15 m**  
**Indicative turning speed 5-15 km/h**



**Title      B-Double Assessment: Intersection of Gosport Street and Newell Highway**  
**Scale    1:500      @ A3      Sheet    18 of 18      Plan Number    13-501-18-A**  
**Drawn/Designed    Casey Spilsbury-Brinkmann      Date      12/07/2013**



## **Appendix D – Costing Spreadsheets for Various Levels of Upgrade**

Intersection	Construction Required	Unit Rate	Per Unit	Amount Required	Cost
Joyce Avenue & Newell Highway	Road Rehabilitation	\$30.00	Square Metre	1350	\$40,500.00
	Kerb and Gutter	\$260.00	Lineal Metre	130	\$33,800.00
	Pipe Culverts	\$7,000.00	Culvert		\$0.00
	Power Pole Relocation	\$50,000.00	Relocation	1	\$50,000.00
	Solicitors	\$5,000.00	Acquisition		\$0.00
	Registered Surveyors	\$5,000.00	Acquisition		\$0.00
	Land Acquisition		Square Metre		\$0.00
	Labour	\$1,280.00	Day for 4 People	15	\$19,200.00
				<b>TOTAL</b>	\$143,500.00
Jones Avenue & Joyce Avenue	Road Rehabilitation	\$30.00	Square Metre	2590	\$77,700.00
	Kerb and Gutter	\$260.00	Lineal Metre	310	\$80,600.00
	Pipe Culverts	\$7,000.00	Culvert		\$0.00
	Power Pole Relocation	\$30,000.00	Relocation	1	\$30,000.00
	Power Pole Relocation	\$50,000.00	Relocation	1	\$50,000.00
	Land Acquisition	\$75.00	Square Metre	36	\$2,700.00
	Land Acquisition	\$111.00	Square Metre	36	\$3,996.00
	Solicitors	\$5,000.00	Acquisition	2	\$10,000.00
	Registered Surveyors	\$5,000.00	Acquisition	2	\$10,000.00
	Labour	\$1,280.00	Day for 4 People	20	\$25,600.00
				<b>TOTAL</b>	\$290,596.00
Newell Highway & Warialda Street	Road Rehabilitation	\$30.00	Square Metre	1370	\$41,100.00
	Kerb and Gutter	\$260.00	Lineal Metre	115	\$29,900.00
	Pipe Culverts	\$7,000.00	Culvert		\$0.00
	Power Pole Relocation	\$10,000.00	Relocation	2	\$20,000.00
	Power Pole Relocation	\$30,000.00	Relocation	1	\$30,000.00
	Land Acquisition	\$97.00	Square Metre	35	\$3,395.00
	Solicitors	\$5,000.00	Acquisition	1	\$5,000.00
	Registered Surveyors	\$5,000.00	Acquisition	1	\$5,000.00
	Labour	\$1,280.00	Day for 4 People	10	\$12,800.00
				<b>TOTAL</b>	\$147,195.00
Gosport Strees & Jones Avenue	Road Rehabilitation	\$30.00	Square Metre	1826	\$54,780.00
	Kerb and Gutter	\$260.00	Lineal Metre	235	\$61,100.00
	Pipe Culverts	\$7,000.00	Culvert	1	\$7,000.00
	Power Pole Relocation	\$10,000.00	Relocation	1	\$10,000.00
	Power Pole Relocation	\$40,000.00	Relocation	1	\$40,000.00
	Land Acquisition	\$488.00	Square Metre	110	\$53,680.00
	Solicitors	\$5,000.00	Acquisition	1	\$5,000.00
	Registered Surveyors	\$5,000.00	Acquisition	1	\$5,000.00
	Labour	\$1,280.00	Day for 4 People	2	\$2,560.00
				<b>TOTAL</b>	\$239,120.00

B-Triples Intersection Only



Intersection	Construction Required	Unit Rate	Per Unit	Amount Required	Cost
Joyce Avenue & Newell Highway	Road Rehabilitation	\$30.00	Square Metre	5233	\$156,990.00
	Kerb and Gutter	\$260.00	Lineal Metre	429	\$111,540.00
	Pipe Culverts	\$7,000.00	Culvert		\$0.00
	Power Pole Relocation	\$50,000.00	Relocation	1	\$50,000.00
	Land Acquisition		Square Metre		\$0.00
	Solicitors	\$5,000.00	Acquisition		\$0.00
	Registered Surveyors	\$5,000.00	Acquisition		\$0.00
	Labour	\$1,280.00	Day for 4 People	25	\$32,000.00
				<b>TOTAL</b>	\$350,530.00
Jones Avenue & Joyce Avenue	Road Rehabilitation	\$30.00	Square Metre	4020	\$120,600.00
	Kerb and Gutter	\$260.00	Lineal Metre	561	\$145,860.00
	Pipe Culverts	\$7,000.00	Culvert		\$0.00
	Power Pole Relocation	\$30,000.00	Relocation	1	\$30,000.00
	Power Pole Relocation	\$50,000.00	Relocation	1	\$50,000.00
	Land Acquisition	\$75.00	Square Metre	36	\$2,700.00
	Land Acquisition	\$111.00	Square Metre	36	\$3,996.00
	Solicitors	\$5,000.00	Acquisition	2	\$10,000.00
	Registered Surveyors	\$5,000.00	Acquisition	2	\$10,000.00
	Labour	\$1,280.00	Day for 4 People	35	\$44,800.00
				<b>TOTAL</b>	\$417,956.00
Newell Highway & Warialda Street	Road Rehabilitation	\$30.00	Square Metre	5600	\$168,000.00
	Kerb and Gutter	\$260.00	Lineal Metre	389	\$101,140.00
	Pipe Culverts	\$7,000.00	Culvert		\$0.00
	Power Pole Relocation	\$10,000.00	Relocation	2	\$20,000.00
	Power Pole Relocation	\$30,000.00	Relocation	1	\$30,000.00
	Land Acquisition	\$97.00	Square Metre	35	\$3,395.00
	Solicitors	\$5,000.00	Acquisition	1	\$5,000.00
	Registered Surveyors	\$5,000.00	Acquisition	1	\$5,000.00
	Labour	\$1,280.00	Day for 4 People	20	\$25,600.00
				<b>TOTAL</b>	\$358,135.00
Gosport Strees & Jones Avenue	Road Rehabilitation	\$30.00	Square Metre	4791	\$143,730.00
	Kerb and Gutter	\$260.00	Lineal Metre	555	\$144,300.00
	Pipe Culverts	\$7,000.00	Culvert	1	\$7,000.00
	Power Pole Relocation	\$10,000.00	Relocation	1	\$10,000.00
	Power Pole Relocation	\$40,000.00	Relocation	1	\$40,000.00
	Land Acquisition	\$488.00	Square Metre	110	\$53,680.00
	Solicitors	\$5,000.00	Acquisition	1	\$5,000.00
	Registered Surveyors	\$5,000.00	Acquisition	1	\$5,000.00
	Labour	\$1,280.00	Day for 4 People	30	\$38,400.00
				<b>TOTAL</b>	\$447,110.00

B-Triples Full Upgrade

Intersection	Construction Required	Unit Rate	Per Unit	Amount Required	Cost
Joyce Avenue & Newell Highway	Road Rehabilitation	\$30.00	Square Metre	330	\$9,900.00
	Kerb and Gutter	\$260.00	Lineal Metre	84	\$21,840.00
	Pipe Culverts	\$7,000.00	Culvert		\$0.00
	Power Pole Relocation	\$50,000.00	Relocation	1	\$50,000.00
	Land Acquisition		Square Metre		\$0.00
	Solicitors	\$5,000.00	Acquisition		\$0.00
	Registered Surveyors	\$5,000.00	Acquisition		\$0.00
	Labour	\$1,280.00	Day for 4 People	10	\$12,800.00
				<b>TOTAL</b>	\$94,540.00
Jones Avenue & Joyce Avenue	Road Rehabilitation	\$30.00	Square Metre	2385	\$71,550.00
	Kerb and Gutter	\$260.00	Lineal Metre	218	\$56,680.00
	Pipe Culverts	\$7,000.00	Culvert		\$0.00
	Power Pole Relocation	\$50,000.00	Relocation	1	\$50,000.00
	Land Acquisition		Square Metre		\$0.00
	Solicitors	\$5,000.00	Acquisition		\$0.00
	Registered Surveyors	\$5,000.00	Acquisition		\$0.00
	Labour	\$1,280.00	Day for 4 People	10	\$12,800.00
				<b>TOTAL</b>	\$191,030.00
Newell Highway & Warialda Street	Road Rehabilitation	\$30.00	Square Metre	250	\$7,500.00
	Kerb and Gutter	\$260.00	Lineal Metre	24	\$6,240.00
	Pipe Culverts	\$7,000.00	Culvert		\$0.00
	Power Pole Relocation	\$10,000.00	Relocation	1	\$10,000.00
	Land Acquisition		Square Metre		\$0.00
	Solicitors	\$5,000.00	Acquisition		\$0.00
	Registered Surveyors	\$5,000.00	Acquisition		\$0.00
	Labour	\$1,280.00	Day for 4 People	4	\$5,120.00
				<b>TOTAL</b>	\$28,860.00
Gosport Strees & Jones Avenue	Road Rehabilitation	\$30.00	Square Metre	1826	\$54,780.00
	Kerb and Gutter	\$260.00	Lineal Metre	235	\$61,100.00
	Pipe Culverts	\$7,000.00	Culvert	1	\$7,000.00
	Power Pole Relocation	\$10,000.00	Relocation	1	\$10,000.00
	Power Pole Relocation	\$40,000.00	Relocation	1	\$40,000.00
	Land Acquisition	\$488.00	Square Metre	110	\$53,680.00
	Solicitors	\$5,000.00	Acquisition	1	\$5,000.00
	Registered Surveyors	\$5,000.00	Acquisition	1	\$5,000.00
	Labour	\$1,280.00	Day for 4 People	2	\$2,560.00
				<b>TOTAL</b>	\$239,120.00

B-Doubles Intersection Only

Intersection	Construction Required	Unit Rate	Per Unit	Amount Required	Cost
Joyce Avenue & Newell Highway	Road Rehabilitation	\$30.00	Square Metre	5000	\$150,000.00
	Kerb and Gutter	\$260.00	Lineal Metre	420	\$109,200.00
	Pipe Culverts	\$7,000.00	Culvert		\$0.00
	Power Pole Relocation	\$50,000.00	Relocation	1	\$50,000.00
	Land Acquisition		Square Metre		\$0.00
	Solicitors	\$5,000.00	Acquisition		\$0.00
	Registered Surveyors	\$5,000.00	Acquisition		\$0.00
	Labour	\$1,280.00	Day for 4 People	25	\$32,000.00
				<b>TOTAL</b>	\$341,200.00
Jones Avenue & Joyce Avenue	Road Rehabilitation	\$30.00	Square Metre	3635	\$109,050.00
	Kerb and Gutter	\$260.00	Lineal Metre	553	\$143,780.00
	Pipe Culverts	\$7,000.00	Culvert		\$0.00
	Power Pole Relocation	\$50,000.00	Relocation	1	\$50,000.00
	Land Acquisition		Square Metre		\$0.00
	Solicitors	\$5,000.00	Acquisition		\$0.00
	Registered Surveyors	\$5,000.00	Acquisition		\$0.00
	Labour	\$1,280.00	Day for 4 People	35	\$44,800.00
				<b>TOTAL</b>	\$347,630.00
Newell Highway & Warialda Street	Road Rehabilitation	\$30.00	Square Metre	5200	\$156,000.00
	Kerb and Gutter	\$260.00	Lineal Metre	386	\$100,360.00
	Pipe Culverts	\$7,000.00	Culvert		\$0.00
	Power Pole Relocation	\$10,000.00	Relocation	1	\$10,000.00
	Land Acquisition		Square Metre		\$0.00
	Solicitors	\$5,000.00	Acquisition		\$0.00
	Registered Surveyors	\$5,000.00	Acquisition		\$0.00
	Labour	\$1,280.00	Day for 4 People	20	\$25,600.00
				<b>TOTAL</b>	\$291,960.00
Gosport Strees & Jones Avenue	Road Rehabilitation	\$30.00	Square Metre	4791	\$143,730.00
	Kerb and Gutter	\$260.00	Lineal Metre	555	\$144,300.00
	Pipe Culverts	\$7,000.00	Culvert	1	\$7,000.00
	Power Pole Relocation	\$10,000.00	Relocation	1	\$10,000.00
	Power Pole Relocation	\$40,000.00	Relocation	1	\$40,000.00
	Land Acquisition	\$488.00	Square Metre	110	\$53,680.00
	Solicitors	\$5,000.00	Acquisition	1	\$5,000.00
	Registered Surveyors	\$5,000.00	Acquisition	1	\$5,000.00
	Labour	\$1,280.00	Day for 4 People	30	\$38,400.00
				<b>TOTAL</b>	\$447,110.00

B-Doubles Full Upgrade