UNIVERSITY OF SOUTHERN QUEENSLAND
FACULTY OF HEALTH, ENGINEERING AND SCIENCES

MANAGEMENT OF LOW TRAFFIC VOLUME ROADS
UNSEALED ROAD CLASSIFICATION SYSTEM

A DISSERTATION SUBMITTED BY

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ABSTRACT

Unsealed roads play an important role within Australia's 825,000km road network. Providing the necessary funds to the unsealed portion of the network is an ongoing issue. Investigation into Toowoomba Regional Council's unsealed road maintenance practices was undertaken to determine if any improvements or modifications could be made to improve delivery of this service. The aim was to provide consistency across Tooowoomba Regional Council resulting in maximisation of limited maintenance funds. To achieve consistency and maximise funds across Tooowoomba Regional Council a road classification system was developed.

A four tier classification system was developed that outlines the service function and characteristics of roads throughout Tooowoomba Regional Council. Maintenance activities, intervention levels and response times were developed in accordance with the classification system. Estimated costs in maintaining the road network based on this system were calculated to predict funding requirements for the future.

From a comparison completed, on previous years maintenance expenditure and future funding requirements, there was minimal difference between the two. Determining if the classification system is adequate for Tooowoomba Regional Council's requirements, involves the classification system to be trialled for a period, so as to make adjustments and provide community feedback.

The development of the classification system, while not providing a definitive answer on maintenance costs, has provided a method of adopting consistent maintenance practices and standards across the region which did not previously exist.

It is anticipated that Toowoomba Regional Council can achieve savings on future maintenance costs with the adoption of such a system, and this will provide value for money services that the community can afford.

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Date

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CHAPTER 1
INTRODUCTION

1.1. Background

1.1.1. Local Government in Australia

The system of government that operates within Australia comprises three tiers (ie. Federal, State and Local) and each level of government has roles and responsibilities to make sound judgements and decisions to provide and share services for the country, state and local community.

The Federal level of government in Australia is one of the oldest continuous democracies in the world, being established in 1901 by the Federation of the then six British colonies (now Australian States) to form the Commonwealth of Australia. Issues that affect the whole nation such as Foreign Affairs, Trade, Immigration and Defence are the responsibility of the Federal government.

The six states of Australia, Queensland, New South Wales, Victoria, Tasmania, South Australia and Western Australia, as well as the Northern and Australian Capital Territories, have the responsibility to manage affairs that are directly related to the running of the state or territory. These responsibilities include health, education and law enforcement. The states are also responsible for the establishment of Local Government boundaries.

There are 562 local governments within Australia, 73 of which are located within the state of Queensland (Facts and Figures on Local Governments in Australia 2013). This is the final level of government in Australia and provides governing at a community level. The main role of local government is to provide maintenance and improvement of the local environment (construction and maintenance of roads, park maintenance and waste collection services), and provision of community based activities such as libraries, swimming pools, recreation facilities and child care centres.

Rates on land and property is the main source of revenue for local governments and this is supplemented through licence fees, fines and grants provided by the State and Federal government such as the Financial Assistance Grants, Roads to Recovery Road Program, Safety Black Spot program, Royalties for the Regions (Roads to Resources) program and Transport Infrastructure Development Scheme (TIDS) program.

1.1.2. Toowoomba Regional Council

Toowoomba Regional Council is a local government authority located approximately 125km west of Brisbane on the Darling Downs in South East Queensland, location shown in Appendix B. Created by the amalgamation of eight councils (the Shire Councils of Rosalie, Crows Nest, Jondaryan, Cambooya, Pittsworth, Clifton, Millmerran and Toowoomba City Council) on 15 March 2008, Toooowoomba Regional Council is responsible for an area of 12,950km^2 and a population of approximately 165,000 people (Toowoomba Regional Council 2013).

The region is undergoing strong growth, particularly in the urban residential areas but lesser growth in its rural communities. With unprecedented resource sector activity in the adjoining Surat Basin and significant industrial expansion in the Charlton-Wellcamp Enterprise Area, Council is faced with many infrastructure challenges. Along with the industrial areas, Toowoomba Regional Council has a large primary production sector which includes beef and dairy cattle, crop growing and plantation forests.

The majority of the population is concentrated within Toowoomba City and the greater urban footprint, but as the balance of the population is spread across the region, there is an extensive road network in place. Details obtained from Council's Road Register show there is 3,215km of sealed roads, 3,283km of unsealed roads and 3,102km of other roads (unformed or unopened). In addition, Council is responsible for carrying out maintenance to 857km of state controlled roads for the Department of Transport and Main Roads under a contract arrangement.

1.1.3. Australian Road Network

Australia is the sixth largest country in the world by land area, 7,682,300km^2, with a population of approximately 22,683,000 (Australian Demographic Statistics 2012). The majority reside along the eastern coast. Due to the remaining population being sparsely located across the country, there is an established road network of some 825,000km which contains 80% local roads (responsibility of local government) and about 41% of these roads are unsealed (Australian Rural Roads Group 2013).

The local road network is a vital asset and valued at approximately $75 billion, but the amount of funding needed to maintain the network is of concern, which is being underfunded by about $3 billion each year. Local governments contribute 21% of the total amount of funding for roads in Australia, with the remainder coming from state and federal government (Australian Rural Road Group 2013). It is vitally important that road assets are well maintained as they connect remote communities, provide transport routes for the majority of freight around the country as well as access for tourists and residents.

1.2. Project Objectives

1.2.1. Councils Unsealed Road Maintenance Objective

As shown in Figure 1, Toowoomba Regional Council is structured into three precincts, (North, Central and South) for the purpose of delivering road construction and maintenance activities. Each precinct is responsible for the construction and maintenance of the roads within their area (Slader, I H 2013, pers. comm. 26 March).

Maintenance currently performed on the unsealed road network involves patrol grading, with a target to grade 80% of the unsealed roads at a frequency of once every 12 months. Activities consist of dry grading only, use of water truck, roller and grader, table drain correction or scarifying and reshaping. The type of maintenance carried out on the class of road is generally decided by the Manager of each precinct and varies across the region (Slader, I H 2013, pers. comm. 26 March).

At present, road maintenance is more reactive than a proactive practice. This is due to a minimum number of Road Condition Inspectors being employed to log defects so maintenance can be scheduled once the appropriate intervention level has been reached. The reactive response is being driven largely by ratepayer complaints and Councillor Requests indicating that roads are generally not being maintained to the

communities' expectations. The flood events in 2010/11 and 2013 have impacted significantly on the condition of the unsealed network, such that Maintenance Teams have struggled to keep up with the workload (Slader I H 2013, pers. comm. 26 March).

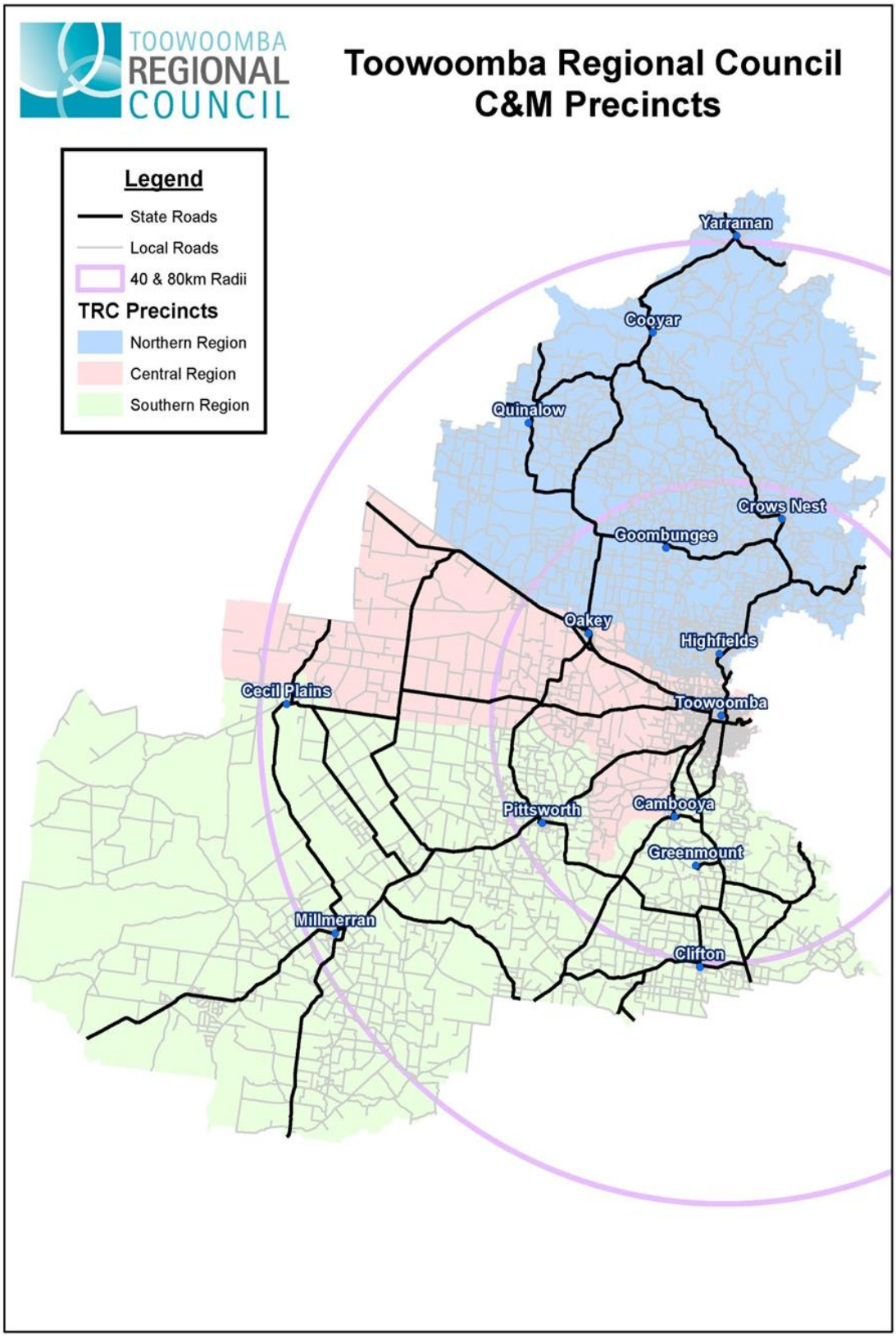

Figure 1 Toowoomba Regional Council Precincts (Construction and Maintenance - North, South, Central 2013)

1.2.2. Issues

A large portion of Council's road network was damaged during the 2011 flood events, with unsealed roads receiving most of the damage. As the recovery process is still in progress, gravel resheeting is the main activity being undertaken on the unsealed roads.

The standard of resheeting being conducted is the same for all road classifications across the region. With council having a limited budget for maintaining the unsealed road network, delivering the same maintenance standard for each road is not sustainable and cannot be achieved with the current maintenance allocation. For the 2011/2012 financial year, Toowoomba Regional Council spent $20 million maintaining its road network. The expenditure on unsealed roads was in the order of $9 million (Slader, I H 2013, pers. comm. 26 March).

Sufficient funds for maintenance have always been a dilemma for Councils everywhere and it cannot be assumed that additional funding will be made available to close the existing funding shortfall. More importantly, the service provided by unsealed roads must meet the communities' needs and be affordable. It is therefore essential that a well-planned, consistent approach to maintenance is implemented to ensure the community receives value for money from the expenditure of public funds.

1.2.3. Project Objective

The aim of this project was to investigate the current practices, analyse costs, extent and standards of the unsealed road network to ensure a financially sustainable future and provide recommendations that will result in consistency, certainty and compliance. This was achieved through a process that analysed a select number of roads within determined localities throughout Toowoomba Regional Council. These were classified into a predetermined classification system that outlines what construction and maintenance practices are to be applied to them.

CHAPTER 2
LITERATURE REVIEW

2.1. Road Construction Development

Lay (2009, p.3) defines a road as being, "a path or way between different places, usually one wide enough for vehicles as well as for horses and travellers on foot". Since humans started to travel, the use of convenient paths and tracks were utilised for such purposes as leading to campsites, sources of food and water, passes through mountains/swamps and to avoid dangerous areas. These paths and tracks as by definition were the early form of roads (Lay (2009)).

Many civilisations were building sound roads, mostly along trade routes, which were capable of withstanding the amount of human and animal traffic using them. But the Roman roads were by far the best produced by anyone at the time of the Roman Empire.

The Romans had recognised that the fundamentals of good road construction were to provide good drainage, good material and good workmanship. The Romans constructed their roads on a firm and formed subgrade that had longitudinal drains on both sides of the road. The roads consisted of a layer of local material to produce a raised formation, this contributed to moisture control. The layers after this consisted of stone followed by cement stabilised or mortared layer with the final surfacing comprised of large hexagonal fitted flagstones. After the demise of the Roman Empire the skills and the knowledge associated with road building were lost for over 1,000 years (Lay (2009)).

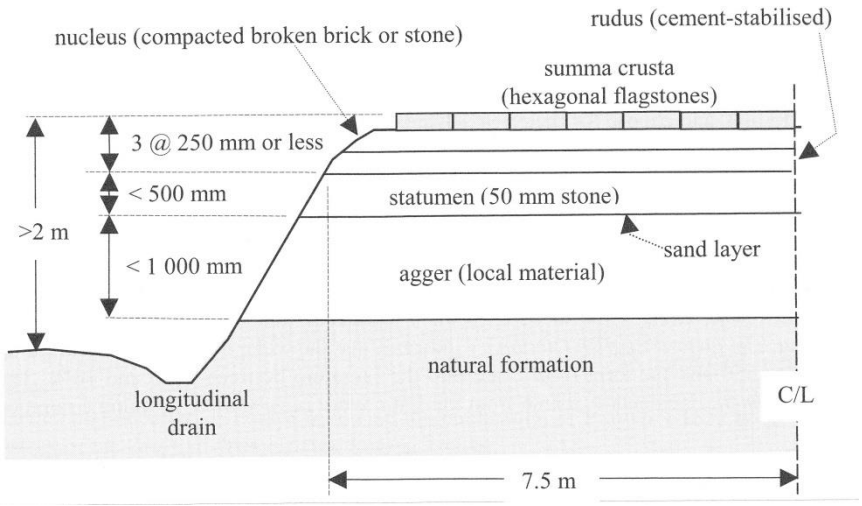

Figure 2 Typical Roman Pavement (Lay 2009)

During the 18th century three men, Trésaguet (France), Telford and MacAdam(UK) had a significant impact on the way roads were to be constructed.

Trésaguet's method involved using quarried stone which was placed on a cambered formation. Smaller pieces of stone were then compacted into the spaces between the larger stones to produce a level surface and the running surface was made with broken stone. This configuration was all placed in a trench so as the running surface was level with the surrounding landscape. To overcome the drainage issues the surface was made as impervious as possible and deep side ditches were provided (Lay (2009)).

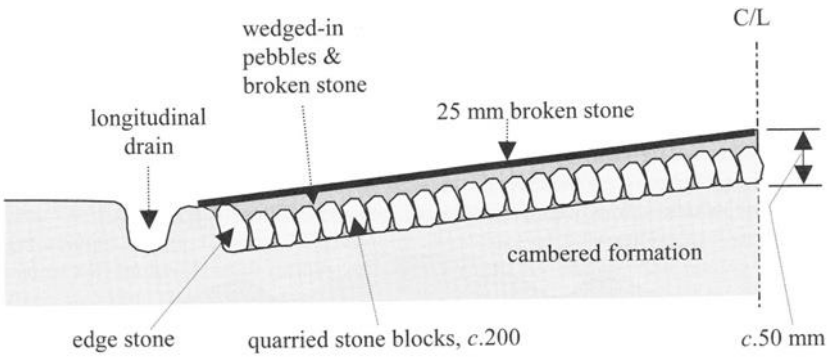

Figure 3 Typical Trésaguet Pavement (Lay 2009)

Telford expanded on what Trésaguet developed, using shaped stones with a flat face on the subgrade and the other faces more vertical, broken stone was wedged into the spacings. The formation was kept level but the upper surface of the pitches was cambered, a layer of base course stone was then covered with gravel to be used as the running surface. To avoid drainage problems the pavement would be raised above ground level where possible, but if this could not be achieved the area surrounding the roadside was drained (Lay (2009)).

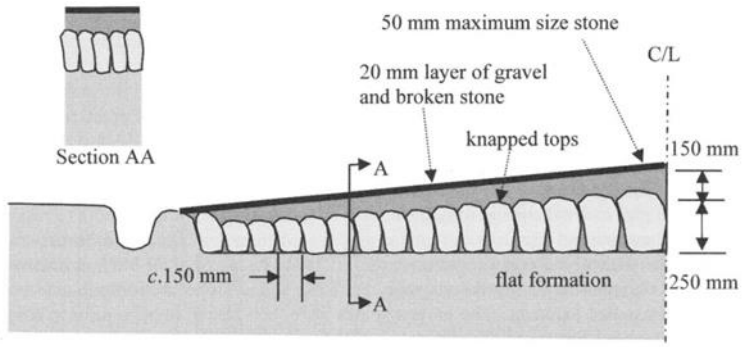

Figure 4 Typical Telford Pavement (Lay 2009)

MacAdam, through observations realised that smaller layers of well compacted, broken angular small stones would provide the same strength and stiffness and a better running surface than a pavement based on a foundation of large stone blocks. MacAdam's pavement consisted of a layer using small stone, on which another layer of smaller stone was placed. The strength and stiffness provided comes from the mechanical interlock that is developed between individual stone pieces, this principle is still used today in modern road construction (Lay (2009)).

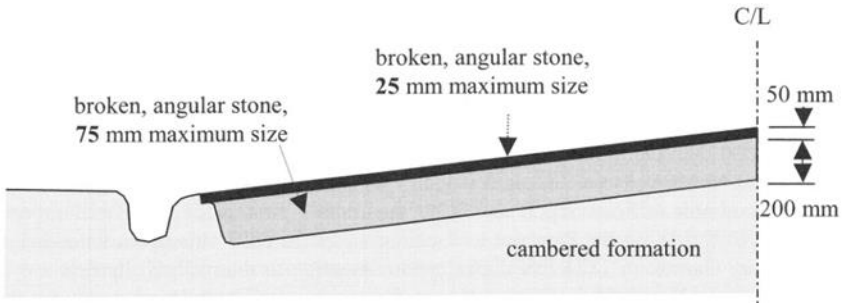

Figure 5 Typical Macadam Pavement (Lay 2009)

2.2. Road Geometrics and Construction Practices

Australia has a well-established road network, which results in the construction of very few new roads. The majority of work undertaken on the network is upgrading it to comply with the changing needs associated with increased traffic usage (Austroads (2009)). This ensures that the roads are capable of providing safe, convenient and comfortable travel with appropriate design and construction principles being applied. The elements associated with a road are of key importance to achieving this, and are shown in Figure 6.

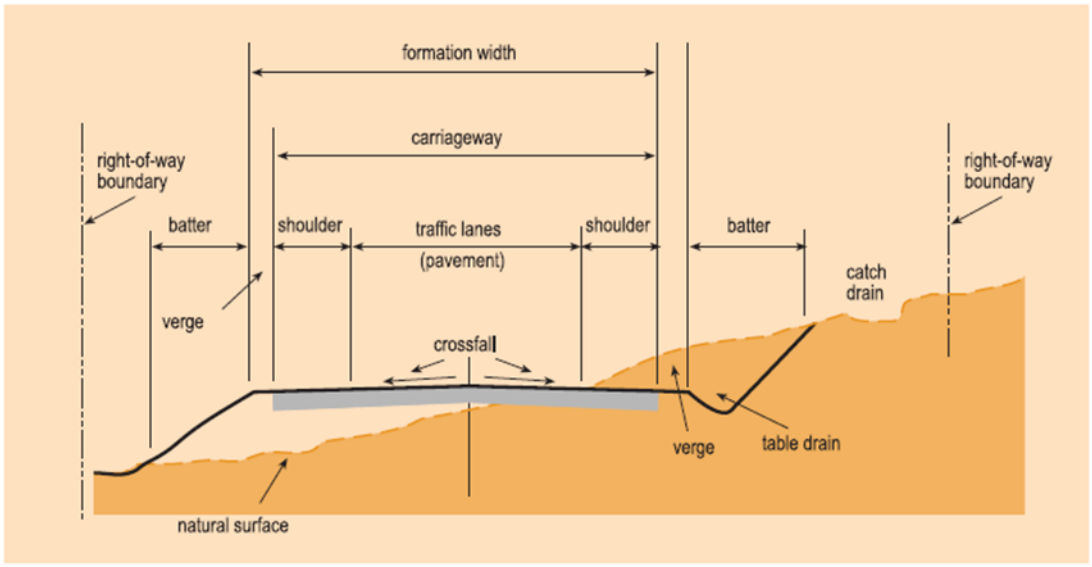

Figure 6 Road Cross Section Elements (ARRB 2009)

Traffic lanes and shoulder widths are determined by traffic volume, vehicle type, vehicle speed and the functional use of the road. One-lane two way and two-lane two way roads are mostly affiliated with unsealed roads, with the future design traffic volume being a factor in deciding which configuration to adopt (ARRB (2009)). Table 1 show widths normally assigned to road elements.

Table 1 Suggested Cross Section Widths (ARRB 2009)

Description	Two-lane two-way road	One-lane two-way road
Traffic lane	3.0m	3.5m
Shoulder	0.5m	1.0m
Carriageway	7.0m	5.5m
Table drain	1.0m	1.0m

Providing an appropriate cross fall to the road is essential to allow surface water to run off. The cross fall slope depends on the local conditions and the properties of the material used for the road, if the cross fall is to steep scouring and erosion can occur and if the cross fall is too flat, water will not run off producing potholes. Road cross falls of between 4% and 6% have been used with success. Typically roads have a two way cross fall that should meet at the road crown; for a single lane carriageways it may be best to have a single cross fall (ARRB (2009)). Some cross fall configurations typically used are shown in Figure 7.

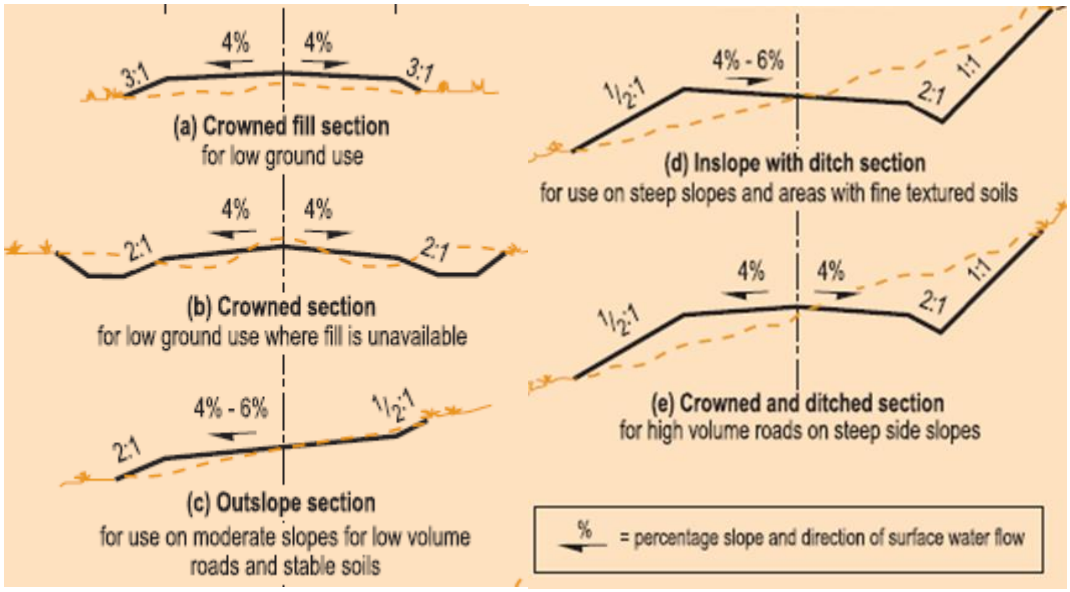

Figure 7 Typical Crossfall Configurations (ARRB 2009)

Draining the road is the most important aspect of designing and constructing a road. The function of drainage includes removing water from the carriageway and road formation, interception of surface water flowing towards the formation and the interception and disposal of ground water (CIV 3703 Transport Engineering 2012). As an eminent engineer has put it:

No Drains, No Brains.

Techniques used in draining the road include providing appropriate cross fall to the road to shed surface water as quickly as possible, provide catch drains and banks to intercept overland flow and construct table drains to drain the water that has been collected alongside the road (CIV3703 Transport Engineering 2012). Table drains can be in the form of either V or trapezoidal drains; V drains are more suited to areas where there are no prolonged periods of heavy rain, whereas trapezoidal drains provide for a greater capacity and reduce scouring. Table drains should be constructed so the lowest point in the pavement is well above the free water level in the table drain (ARRB (2009)). Trapezoidal and V drains are shown in Figure 8 and Figure 9 respectively.

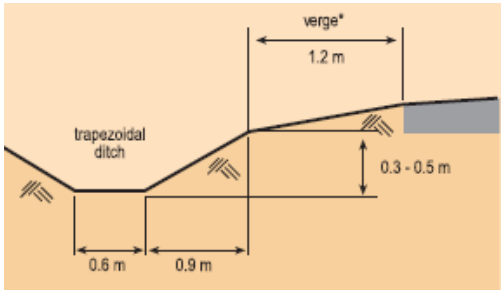

Figure 8 Typical Trapezoidal Drain (ARRB 2009)

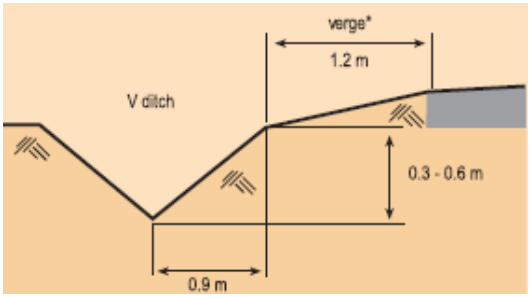

Figure 9 Typical V Drain (ARRB 2009)

Unsealed roads are developed through three stages, from unformed roads to formed roads to formed and gravelled roads. An unformed road consists of clearing vegetation to produce a trafficable road alignment; this form of road is only used by light traffic volumes and mostly in dry weather. Formed roads consist of earthworks being carried out to improve road geometry and provide adequate drainage. Formed and gravelled roads involve applying a pavement to the formation. The recommended pavement structure to be used involves the use of a base and a wearing course, but the more commonly found configuration involves only a base course (ARRB (2009)).

The wearing course should be durable and of consistent quality to ensure that it wears away evenly. Characteristics associated with the wearing course, from ARRB 2009, include:

- Skid resistance
- Smooth riding characteristics
- Cohesive properties
- Resistance to ravelling and scouring
- Low permeability
- Load spreading ability

The base course layer is used to give strength to the pavement, which consists of crushed aggregate that is placed in layers of which the thickness varies according to the volume of commercial vehicles using the road. ARRB (2009) provides information on determination of pavement thickness and specifications to achieve the required characteristics for both the base and wearing course.

2.3. Road Maintenance Practices

Like all roads, unsealed roads need to be maintained to achieve their intended design life and to provide a safe and user friendly environment. Unsealed roads are more prone to deterioration than sealed roads causing the road to lose its shape, have a loss of wearing course material and be damaged by water. To achieve the intended design life and have a safe and user friendly environment, maintenance of unsealed roads aims at providing a good riding, free draining surface and to minimise safety hazards.

Maintenance can be approached in two ways, corrective maintenance (when defects arise) and preventative maintenance (stops, rather than reverses, deterioration). Maintenance on unsealed roads is conducted to rectify numerous defects, which include: Loss of surface material, surface scour, rutting, corrugations and potholes (ARRB 2009). Images of the more common defects and causes are shown in Appendix C.

There are three main methods in maintaining unsealed roads; Patrol Grading, Scarifying and Reshaping as well as Gravel Resheeting.

Patrol Grading involves the use of a grader to keep the road well drained and maintain a satisfactory running surface. The practice generally involves cutting a small slice off the surface of the road and spreading the material evenly across it filling in any discrepancies such as corrugations and pot holes. The road surface can be significantly improved by compacting it after grading; this can be achieved by either tow behind rollers or separately by steel or rubber tyred rollers. Increased wear to the surface may occur if grading is conducted in dry conditions as wind and or vehicular traffic can disperse the fine material before it has had a chance to bond to the underlying surface. To avoid this from happening applying water to the surface after grading and then rolling helps bring the fine material to the surface which assists in retaining the aggregate fractions in place through cohesion (CIV3703 Transport Engineering 2012).

Scarifying and Reshaping is the process of loosening the existing road material, remixing the material, reshaping it and then compacting it to achieve a proper blending of fines and aggregate and to reinstate the crowned road surface. This

technique is dependent on the thickness of the existing pavement material, combining the existing material with the subgrade material may cause the pavement to become unsatisfactory to use thus generating more issues. The material should be loosened across the full width of the road to a depth of no less than 75mm to ensure that all the discrepancies are removed and then reshaped and compacted (CIV3703 Transport Engineering 2012).

Gravel resheeting involves the application of new material over the full width of the road to restore the thickness of the pavement. Usually the wearing course on unsealed roads lasts about 8-12 years; the loss of the wearing course can be due to patrol grading, climatic conditions (wind and rain causing scour and erosion), traffic abrasion and the degradation of the material. Gravel resheeting is usually performed before the road starts to show signs of distress and normally involves tyning the existing surface, spreading the new gravel material and then compacting the full layer (CIV3703 Transport Engineering 2012).

2.4. Road Classification Systems

The principal purpose of road classification is to

- Establish logical integrated systems that, because of their particular service, should be administered by the same jurisdiction;
- Relate geometric design control and other design standards to the roads in each class, and
- Establish a basis for developing long range programmes, improvement priorities and financial plans.

(Geometric Design Guide Chapter 3)

Generally there are two forms of road classification systems used throughout the world, these being an Administrative system and a Functional System. The administrative system sets out which authorities are responsible for specific roads, being Federal, State or Local governments to manage funding and administration of the roads (Traffic Engineering Manual (2010)). The functional classification system sets out the traffic function for each road, Austroads (2009(c)) suggests two essential needs that need to be met from a functional viewpoint.

- The traffic movement, or mobility function – providing the means by which people and goods can move from one place to another
- The access function – providing access to properties and land uses adjacent to the road

These two functional needs associated with the roads within the network can be categorised into a hierarchy that defines the level of access or mobility that the road provides. The relationship between the road hierarchy and mobility/access is illustrated in Figure 10. From Figure 10 it is clear to see that the mobility function is associated more with arterial and distributor roads, whereas the access function is more closely related to collector and local roads.

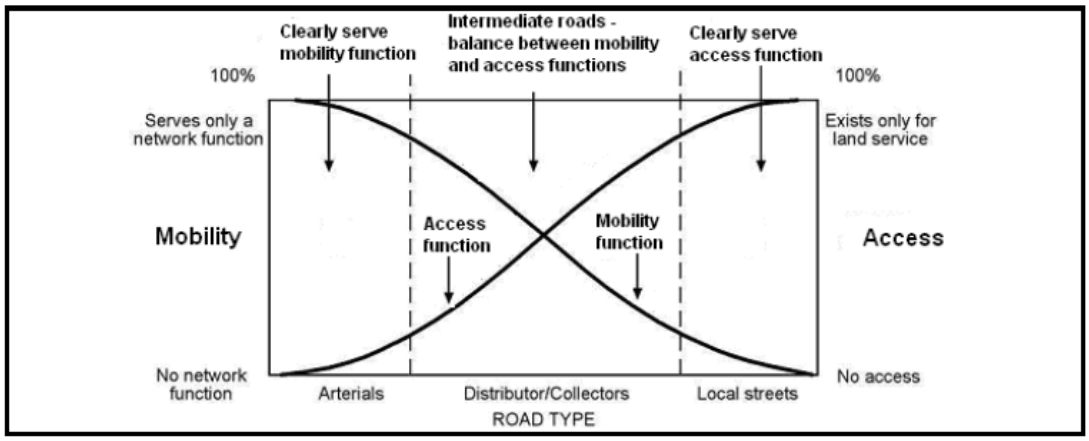

Figure 10 Mobility/Access Function and Road Hierarchy Relationship (Austroads 2009(d))

Austroads has developed a functional classification system that can be used nationally for rural and urban roads. This classification system groups both the rural and urban roads into arterial and local roads, with a number of classes in each group. The Austroads Functional Classification System is shown in Table 2.

ARRB (2009) has developed a road classification for unsealed roads that has been based on the Austroads classification system. The system developed further subdivides the Austroads class 4 roads into a further four categories which describes the various types of unsealed roads found within Australia. The classification system is shown in Table 3

Table 2 Austroads Functional Classification System (Giummarra 2003)

Rural Areas – Arterial Roads	
Class 1	Those roads that form the principal avenue for communications between major regions of Australia, including direct connections between capital cities.
Class 2	Those roads, not being class 1, whose main function is to form the principle avenue of communication for movements between • A capital city and adjoining states and their capital cities; or • A capital city and key towns; or • Key towns
Class 3	Those roads, not being class 1 or 2, whose main function is to form an avenue of communication for movements • Between important centres and Class 1 and Class 2 roads and/or key towns; or • Between important centres; or • Of an arterial nature within a rural area
Rural Areas – Local Roads	
Class 4	Those roads, not being Class 1, 2 or 3 whose main function is to provide access to abutiing property (including property within a town in a rural area)
Class 5	Those roads that provide almost extensively for one activity or function and that cannot be assigned to Classes 1 to 4.
Urban Areas – Arterial Roads	
Class 6	Those roads whose main function is to perform the principal avenue of communication for massive traffic movements.
Class 7	Those roads, not being Class 6, whose main function is to supplement the Class 6 roads in providing for traffic mkovements or to ditribute traffic to local street systems.
Urban Areas – Local Roads	
Class 8	Those roads, not being Class 6 or 7, whose main function is to provide access to abutting property.
Class 9	Those roads that provide almost exclusively for one activity or function and that cannot be assigned to Classes 6, 7 or 8.

Table 3 ARRB Unsealed Road Classification System (ARRB 2009)

Road Class	Class Type	Service function description	Road type description
4A	Main road >150ADT	This type of road is used for major movements between population centres and connection to adjacent areas. High traffic volumes occur and the road can carry large vehicles.	• All weather road predominantly two-lane and unsealed. Can be sealed if economically justified. • Operating speed standard of 50-80km/h according to terrain. • Minimum carriageway width is 7m
4B	Minor road 150 – 50 ADT	This type of road is used for connection between local centres of population and links to the primary network. Roads may or may not be sealed depending on the importance and function of the road.	• All weather two-lane road formed and gravelled or single-lane sealed road with gravel shoulders. • Operating speed standard of 30-70km/h according to terrain. • Minimum carriageway width is 5.5m.
4C	Access road 50 – 10 ADT	Provides access to low use areas or individual rural property sites and forest areas. Caters for low travel speed and a range of vehicles and may be seasonally closed.	• Substantially a single lane two-way generally dry-weather, formed (natural materials) track/road. • Operating speeds standard of <20-40km/h according to terrain. • Minimum carriageway width is 4m. • May be restricted to four wheel drive vehicles.
4D	Tracks <10 ADT	Provides primarily for four-wheel drive vehicles. Mainly used for fire protection purposes, management access and limited recreational activities.	• Predominately a single-lane two way earth track (unformed) at or near the natural surface level. • Predominately not conforming to any geometric design standards. • Minimum cleared width is 3m.

2.5. Construction and Maintenance Standards

Numerous construction and maintenance standards are used throughout Australia and the world, and these standards vary according to the class and standard of road being constructed or maintained. To compare the standards applied, a number of road authority design manuals and maintenance procedures were viewed.

A summary showing construction standards for a number of organisations is shown in Appendix D.

A general overview of maintenance practices conducted, mainly from local governments across Australia, found that patrol grading was the only form of maintenance that is routinely performed on the unsealed road network.

The frequency for which patrol grading occurs varied depending on the road classification and the road authority's maintenance policy, with grading occurring from as often as 3-5 times a year for high level roads (District Council of Mallala Roads Manual (2005)) to reactive grading on lower level roads (Blue Mountains City Council Protocol Maintenance of Unsealed Roads(2010)).

Repair of potholes, corrugations and surface scour were found to be more reactive maintenance, whereas determining when resheeting a road is to be conducted was based on regular assessment of the road surface condition.

2.6. Review Summary

Roads have been in existence and use ever since humans began to travel and have developed over time to the type of road seen throughout the world today. Roads that have lasted over the years have had one key element associated with them, good drainage conditions. This is achieved by providing adequate road crossfall in conjunction with longitudinal drains along the road.

To ensure the roads achieve their intended design life, maintenance is conducted. The maintenance of roads can be conducted a number of ways, with the most common being Patrol Grading, Scarifying and Reshaping as well as gravel resheeting. The frequency at which these activities take place varies across the authorities responsible for maintaining the roads.

Road classification systems are used to define which authorities are responsible for certain roads, link design and other standards and establish a basis for producing and improving long term financial plans. A road classification system can be either an administrative or functional system. The administrative systems outlines who is responsible for the road, so as to deal with financial and administrative aspects, while a functional system outlines what function the road should provide with regards to mobility or access. Austroads along with the Australian Road Research Board have both developed classification systems that can be used nationally.

Numerous classification systems have been developed by various road authorities throughout Australia, each having modifications to suit their requirements, with regards to geometric stands, maintenance activities and the frequency at which these activities are applied. These classification systems have been developed as different geographic, demographic and social characteristics are experienced throughout Australia and having a generic classification system for all road authorities may not be best suited to their requirements.

CHAPTER 3
METHODOLOGY

3.1. Outline

The following tasks will have to be completed in order to achieve the outcomes specified for the project.

- Identification of Council's current construction and maintenance practices
- Identification of attributes associated with the roads
- Determine roads to be included in the analysis
- Gather additional data on the roads
- Conduct an inspection of the roads identified
- Analyse the data obtained to produce a classification system
- Class each road included in the analysis accordingly
- Produce a cost estimate for maintenance, based on the classification system

3.2. Councils Current Construction and Maintenance Practices

To determine acceptable construction and maintenance practices that will produce a consistent and cost effective procedure, a review of council's current practices will have to be undertaken. The review will determine if current practices across Tooowoomba Regional Council are consistent.

This review will be conducted by obtaining the required information from council employees who are responsible for the construction and maintenance of the unsealed road network. This involved liaising with Plant Operators, Works Co-ordinators, Technical Officers and Engineers from the Construction and Maintenance branches.

3.3. Road Attributes

Attributes associated with the roads were identified. The attributes were used in determining how to structure the road classification system, and to provide a description of what the class of road should possess. Attributes identified reflected the demographic use of the road and geometric standards that are to be applied.

3.4. Roads Included in Analysis

Selecting appropriate roads within Toowoomba Regional Council was necessary to develop the road classification system. Due to the large area that Tooowoomba Regional Council covers, five varying localities across the region were chosen with a number of roads selected in order to apply the classification system.

Currently Tooowoomba Regional Council's construction and maintenance branch is divided into three precincts, North, Central and South. Each precinct contains different geographic, demographic and social characteristics that are needed to develop the classification system. A number of localities (containing roads possessing varying characteristics) were chosen from each precinct. These requirements were necessary to see how well the road classification system worked for varying characteristics.

3.5. Additional Road Information

Additional information associated with the roads, which could not be sourced through council employees or from the inspections, was obtained through the use of council's GIS data base and consultation with other relevant authorities.

3.6. Road Inspections

An inspection of the roads identified, was conducted to identify current conditions the roads are in and assisted in determining if current construction and maintenance practices used by council were satisfactory or needed improvement.

3.7. Road Classification System

To identify what construction and maintenance standards need to be applied to each road, a road classification system was developed. The classification system provided information on the standards to be implemented for construction and maintenance. A number of categories were developed for classifying the roads, with each category specifying different construction and maintenance standards.

The construction and maintenance standards included in the classification system were developed from current Australian practices. Austroads design manuals as well as the ARRB Unsealed Roads Manual was used in developing construction standards. These were used due to their widespread acceptance on current design standards across Australia.

Maintenance standards were developed through the use of maintenance guidelines that have been implemented by local councils across Australia together with the maintenance practices currently used throughout Toooowoomba Regional Council.

3.8. Classification of Roads

Classifying each road into its respective class involved matching the identified attributes associated with the road to the road class that best describes the attributes.

3.9. Maintenance Cost Estimate

The frequency at which each class of road is to receive maintenance was established from the road classification system. By using this frequency and obtaining financial information, an estimate was produced showing the projected cost to maintain each of the unsealed roads that were used in the analysis at the proposed frequencies.

CHAPTER 4
DATA COLLECTION

4.1. General

To produce a road classification system that suited Toowoomba Regional Council, a range of data related to the roads throughout the region was obtained. The range of data is identified in Chapter 3. The following sections identify how the data was obtained together with the findings.

4.2. Construction and Maintenance Practices

Council's current construction and maintenance practices were identified to obtain an overview of how each Construction and Maintenance Branch operates. This information was essential for determining which practices were best suited to provide consistent and cost effective maintenance practices.

The information was gathered through a survey that was presented to key personnel responsible for construction and maintenance; the survey is located in Appendix E. The findings from the survey are documented below, with the complete set of responses in Appendix F.

Maintenance activities that are currently performed on the unsealed road network throughout Toowoomba Regional Council include:

- Light and heavy maintenance grading
- Gravel resheeting
- Pavement repairs
- Vegetation clearing
- Culvert maintenance
- Road furniture maintenance

Maintenance carried out on the unsealed roads throughout Tooowoomba Regional Council varies through each Construction and Maintenance precinct. Maintenance grading occurs between one to two times a year and even up to as many as four times on high volume roads. Gravel resheeting is based on the allocation made within the budget. Other maintenance activities are also carried out after requests have been made and sometimes only when it is required.

The frequency at which maintenance is carried is determined a number of ways. This includes inspections being carried out by roads inspectors who determine whether reactive maintenance needs to be carried out. This may be generated by customer requests or internal requests for Councillors or other staff. The frequency is also determined by planned maintenance which is based on budget requirements and done in conjunction with management.

The engineering standard applied to the roads is reasonably consistent throughout the region. The wearing surface width varies from 3.0m to 6.0m, but the most common widths range between 4.0m and 5.0m. After a resheet the thickness of the wearing surface is to be 150mm, while the crossfall of the roads is maintained at 4% – 5%

4.3. Road Attributes

A number of attributes were identified that could be associated with the roads included in the analysis. These attributes were selected as they have a vital influence on the number of classes that were included in the road classification system. The attributes also have an important role in determining the geometric and maintenance standards that will be associated with the classification system, in relation to safety, accessibility and comfort.

The following attributes were identified for use:

- School bus route
- Mail service run
- Number of residential dwellings having access from road
- Is road a “No Through Road”
- Type of vehicles that would generally use road

- Does road lead to place of frequent use
- Does road form a valuable link in the road network

4.4. Roads Included in Analysis

To produce a classification system that would be appropriate for use throughout Tooowoomba Regional Council, roads selected had to provide a general overview that represented geographic, demographic and social aspects throughout the council.

Finding ideal locations to conduct the analysis on was completed by selecting a number of localities within each of council's Construction and Maintenance precincts, (North, Central and South). Focusing on the land usage within the precincts, five areas were identified that provided varying features. Each area can be described as:

- Typical rural community situated in close proximity to a township with some high intensive farming.
- Typical rural community situated some distance from a township consisting of low intensity farming.
- Typical crop farming environment.
- Rural residential community consisting of property greater than 4000m^2, use as lifestyle blocks or hobby farms.
- Urban community consisting of residential blocks less than 4000m^2.

These five areas are in the localities of Quinalow, Geham, Jondaryan, Cambooya and Clifton. Figure 11 shows their locality within Toowoomba Regional Council.

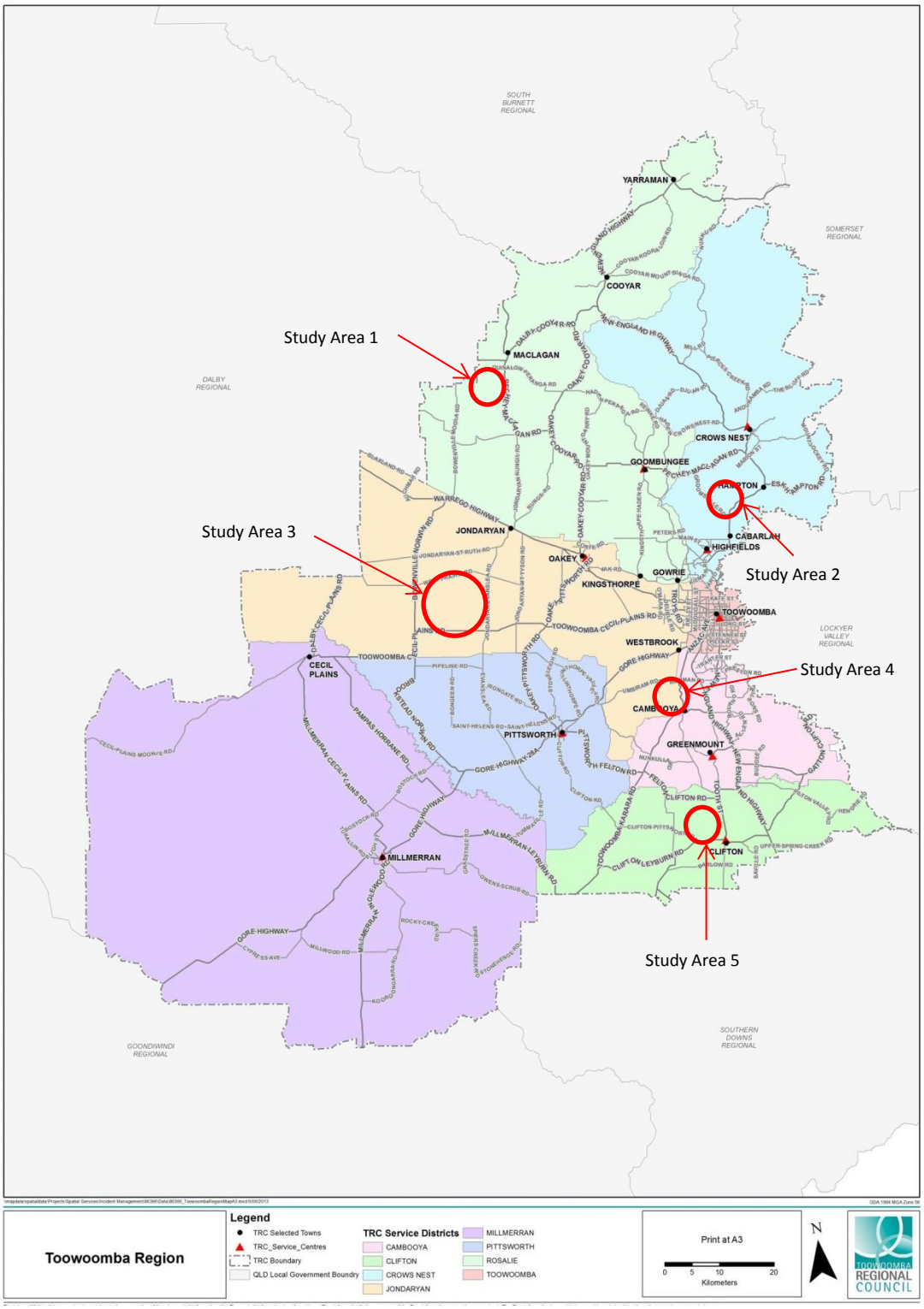

Figure 11 Study Area Localities (Toowoomba Regional Council Area 2013)

4.5. Additional Road Information

Councils GIS database was used to obtain additional information required on the roads. This information could not be sourced from the inspections completed on each of the roads.

Additional information included:

- School Bus route's
- Road Chainages

The aerial imagery associated with the GIS was also utilised to identify farming operations in the area. The number of residential dwellings having access to the roads under consideration was also determined from the aerial imagery.

A summary of the data collected for each road can be found under their respective section in chapter 5.

CHAPTER 5
STUDY AREA INSPECTIONS AND RESULTS

5.1. Overview

An inspection of the roads was carried out approximately every 1,000m for small road lengths and 2,000m for long road lengths. This was done so as to provide an overall view on the condition of each road. At each inspection point data recorded included:

- Type of Surface
- Surface width (m)
- Number of visible traffic lanes
- Crossfall (%)
- Drainage (visual)
- Overall condition

A summary of the data recorded for each road is included in the following sections under the relevant study area.

5.2. Study Area 1 – Quinalow

5.2.1. Inspection Area Overview

Study Area 1 is located in Construction and Maintenance North Precinct, in the Quinalow District approximately 60km northwest of Toowoomba. This was selected as it contains the township of Quinalow which is in close proximity to a mixed environment of cattle and crop farming, along with the high intensity operation of a feedlot. This represented a typical rural community.

Five roads were selected within the Quinalow study area ie. Cauleys Rd, Hartwigs Rd, Lees Rd, Quinalow Edgefield Rd and Wonga Plains South Rd. Refer Figure 12.

Figure 12 Study Area 1 - Quinalow

Table 4 shows the information associated with each of the roads.

Table 4 Study Area 1 - Road Information

Road Name	Road Information
Cauleys Road CH 00 – 5,415	• Not a designated school bus route • One residential dwelling along entire road • Mail is delivered to dwelling • Farm machinery, light and heavy vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network
Hartwigs Road CH 00 – 2,860	• Is a designated school bus route • Three residential dwellings along entire road • Mail is delivered to dwellings • Farm machinery, light and heavy vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network
Lees Road CH 00 – 3,255	• Not a designated school bus route • One residential dwelling along entire road • Mail is delivered to dwelling • Farm machinery, light and heavy vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network
Quinalow Edgefield Road CH 3,325 – 6,445	• Partly designated school bus route • Four residential dwellings along entire road • Mail is delivered to dwellings • Farm machinery, light and heavy vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network
Wonga Plains South Road CH 4,670 – 9,835	• Is a designated school bus route • One residential dwelling along study section • Mail is delivered to dwelling • Farm machinery, light and heavy vehicles use road • Road does lead to place of frequent use • Road is a valuable link in the network

5.2.2. Inspection Results

Inspections for each of the roads were carried out collecting data as identified in section 5.1. A summary of the results for each road is shown in Table 5. Figure 13 includes pictures of each road taken during the inspection.

Table 5 Study Area 1 - Inspection Results

Road Name	Surface Type	Surface Width (m)	Traffic Lanes	Crossfall (%)	Drainage Condition
Cauleys Road	Gravel	5.5 – 6.0	1	4.6 – 0.7	Satisfactory
Hartwigs Road	Gravel	5.0 – 6.0	1	3.1 – 0.0	Satisfactory
Lees Road	Gravel	3.5 – 4.5	1	2.9 – 0	Satisfactory
Quinalow Edgefield Road	Gravel	5.0 – 5.5	1	3.9 – 0.8	Satisfactory
Wonga Plains South Road	Gravel	7.5	2	1.7 – 0.5	Satisfactory

Figure 13 Study Area 1 - Road Pictures

5.3. Study Area 2 – Geham

5.3.1. Inspection Area Overview

Study Area 2 is situated in the Construction and Maintenance North Precinct, within the locality of Geham approximately 20km north of Toowoomba. This area was selected as it contains a number of small size rural residential properties that are primarily hobby farms along with some working farms. Study Area 2 produces an environment that represents the rural residential aspect throughout Toowoomba Regional Council.

Eleven roads were selected within the Geham study area ie August Rd, Bushell Rd, Connolly Rd, Creek Crossing Rd, Doug Rd, Kahler Rd, Mervyn Rd, Patzwald Rd, Pioneer Rd, Strack Rd and Valewood Rd. Refer Figure 14.

Figure 14 Study Area 2 - Geham

Table 6 shows information associated with each of the roads.

Table 6 Study Area 2 - Road Information

Road Name	Road Information
August Road CH 00 – 455	• Not a designated school bus route • One residential dwelling along entire road • Mail is delivered to dwelling • Light vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network
Bushell Road CH 00 – 1,630	• Not a designated school bus route • Four residential dwellings along entire road • Mail is delivered to dwellings • Light vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network
Connolly Road CH 00 – 815	• Not a designated school bus route • Two residential dwellings along entire road • Mail is delivered to dwellings • Light vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network
Creek Crossing Road CH 1,265 – 1,700	• Not a designated school bus route • Two residential dwellings along entire road • Mail is delivered to dwellings • Light vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network
Doug Road CH 00 – 1,810	• Is a designated school bus route • One residential dwelling along entire road • Mail is delivered to dwelling • Light vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network

Kahler Road CH 00 – 1,920	• Not a designated school bus route • Four residential dwellings along entire road • Mail is delivered to dwellings • Light and heavy vehicles use road • Section of road leads to place of frequent use (dairy) • Road is a valuable link in the network
Mervyn Road CH 00 – 1,030	• Not a designated school bus route • Four residential dwellings along entire road • Mail is delivered to dwellings • Light vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network
Patzwald Road CH 00 – 990	• Not a designated school bus route • Four residential dwellings along entire road • Mail is delivered to dwellings • Light vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network
Pioneer Road CH 835 – 2,200	• Not a designated school bus route • Four residential dwellings along entire road • Mail is delivered to dwellings • Light and heavy vehicles use road • Road does lead to place of frequent use (dairy) • Road is a valuable link in the network
Strack Road CH 00 – 2,875	• Not a designated school bus route • Three residential dwellings along entire road • Mail is not delivered to dwellings • Light vehicles use road • Road does not lead to place of frequent use. • Road is not a valuable link in the network.
Valewood Road CH 00 – 1,650	• Not a designated school bus route • Four residential dwellings along entire road • Mail is delivered to dwellings • Light vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network

5.3.2. Inspection Results

Inspections for each of the roads were carried out collecting data as identified in section 5.1. A summary for each road is shown in Table 7. Figure 15 includes pictures of each road taken during the inspection.

Table 7 Study Area 2 - Inspection Results

Road Name	Surface Type	Surface Width (m)	Traffic Lanes	Crossfall (%)	Drainage Condition
August Road	Gravel	3.0	1	0.9 – 0.5	Reasonable
Bushell Road	Gravel	3.0 – 4.5	1	6.3 – 1.2	Satisfactory
Connolly Road	Gravel	4.5 – 5.5	1	3.9 – 1.8	Satisfactory
Creek Crossing Road	Formed	3.5	1	-	Satisfactory
Doug Road	Gravel	4.5	1	3.9 – 0.6	Satisfactory
Kahler Road	Gravel	6.0 – 6.5	2	5.2 – 2	Satisfactory
Mervyn Road	Gravel	3.0 – 3.5	1	3.4 – 0.8	Satisfactory
Patzwald Road	Gravel	4.5 – 5.5	1	3.9 – 2.9	Satisfactory
Pioneer Road	Gravel	4.5 – 6.0	2	5.2 – 1.1	Satisfactory
Strack Road	Gravel/ formed	3.0 – 3.5	1	3.0 – 0.9	Satisfactory
Valewood Road	Gravel	4.5	1	3.5 – 1.7	Satisfactory

Figure 15 Study Area 2 - Road Pictures

5.4. Study Area 3 – Jondaryan

5.4.1. Inspection Area Overview

Study Area 3 is situated in the Construction and Maintenance Central Precinct, within the locality of Jondaryan approximately 50km west of Toowoomba. This area was selected as the land is utilised for crop farming which results in the seasonal use of the roads within. Due to the large land area required for this type of farming operation there is a minimal number of residential dwellings directly associated with the use of the roads. This study area produces an environment that represents the rural cropping community throughout Toowoomba Regional Council.

Seven roads were selected within the Jondaryan study area ie F. Kent Rd, Knapdale Rd, Matthews Rd, McIntyre Rd, Pedlar Rd, Peters Rd and Ruhle Rd. Refer Figure 16.

Figure 16 Study Area 3 - Jondaryan

Table 8 shows information associated with each of the roads.

Table 8 Study Area 3 - Road Information

Road Name	Road Information
F. Kent Road CH 00 – 5,505	• Not a designated school bus route • Three residential dwellings along entire road • Mail is delivered to dwellings • Farm machinery, light and heavy vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network
Knapdale Road CH 00 – 6,460	• Not a designated school bus route • Three residential dwellings along entire road • Mail is delivered to dwellings • Farm machinery, light and heavy vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network
Matthews Road CH 00 – 3,640	• Not a designated school bus route • No residential dwellings along entire road • Farm machinery, light and heavy vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network
McIntyre Road CH 00 – 4,005	• Not a designated school bus route • No residential dwellings along entire road • Farm machinery, light and heavy vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network
Pedlar Road CH 00 – 7,550	• Not a designated school bus route • One residential dwelling along entire road • Mail is delivered to dwelling • Farm machinery, light and heavy vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network
Peters Road CH 00 – 5,635	• Not a designated school bus route • Four residential dwellings along entire road • Mail is delivered to dwellings • Farm machinery, light and heavy vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network
Ruhle Road CH 00 – 4,045	• Not a designated school bus route • Two residential dwellings along entire road • Mail is delivered to dwellings • Farm machinery, light and heavy vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network

5.4.2. Inspection Results

Inspections for each of the roads were carried out collecting data as identified in section 5.1. A summary for each road is shown in Table 9. Figure 17 includes pictures of each road taken during the inspection.

Table 9 Study Area 3 - Inspection Results

Road Name	Surface Type	Surface Width (m)	Traffic Lanes	Crossfall (%)	Drainage Condition
F. Kent Road	Gravel	4.5 – 5.0	1	4.4 – 0	Satisfactory
Knapdale Road	Gravel	4.0 – 5.0	1	2.2 – 0.7	Satisfactory
Matthews Road	Gravel and unformed	3.0 – 3.5	1	2.7 – 0.8	Reasonable
McIntyre Road	Gravel	3.5 – 4.0	1	1.4 – 0.3	Satisfactory
Pedlar Road	Gravel	4.05 – 5.0	1	6.7 – 0	Satisfactory
Peters Road	Gravel	4.5 – 5.0	1	2.4 – 0	Satisfactory
Ruhle Road	Gravel and unformed	4.0	1	4.2 – 2.7	Satisfactory

Figure 17 Study Area 3 - Road Pictures

5.5. Study Area 4 – Cambooya

5.5.1. Inspection Area Overview

Study Area 4 is situated in the Construction and Maintenance South Precinct, within the locality of Cambooya approximately 20km south of Toowoomba. This study area was selected as it is a partly urbanised environment with residential dwellings situated on approximately 3000m^2 - 6000m^2 blocks. This type of environment produces different road usage compared to rural environments, and represents the urban aspect for unsealed roads within Toowoomba Regional Council.

Eight roads were selected within the Cambooya study area ie Bourne Rd, Cambooya Felton Rd, Hoffman Rd, Lysaght Rd, Railway Pd, Rosenberger Rd, Utz Rd and Wyreema Cambooya Rd. Refer to Figure 18.

Figure 18 Study Area 4 - Cambooya

Table 10 shows information associated with each of the roads.

Table 10 Study Area 4 - Road Information

Road Name	Road Information
Bourne Road CH 00 – 700	• Not a designated school bus route • Four residential dwellings along entire road • Mail is delivered to dwellings • Light vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network
Cambooya Felton Road CH 11,155 – 13,895	• Not a designated school bus route • Five residential dwellings along entire road • Mail is delivered to dwellings • Farm machinery, light and heavy vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network
Hoffman Road CH 00 – 1,505	• Not a designated school bus route • Four residential dwellings along entire road • Mail is delivered to dwellings • Farm machinery, light and heavy vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network
Lysaght Road CH 00 – 920	• Not a designated school bus route • Eight residential dwellings along entire road • Mail is delivered to dwellings • Light vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network
Railway Parade CH 00 – 1,020	• Not a designated school bus route • Four residential dwellings along entire road • Mail is delivered to dwellings • Light vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network

Rosenberger Road CH 50 – 1,035	• Not a designated school bus route • Four residential dwellings along entire road • Mail is delivered to dwellings • Farm machinery, light and heavy vehicles use road • Road does lead to place of frequent use (Horse stud) • Road is a valuable link in the network
Utz Road CH 00 – 1,225	• Not a designated school bus route • One residential dwelling along entire road • Mail is delivered to dwelling • Farm machinery, light and heavy vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network
Wyreema Cambooya Road CH 430 – 6,325	• Not a designated school bus route • 22 residential dwellings along entire road • Mail is delivered to dwellings • Light and heavy vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network

5.5.2. Inspection Results

Inspections for each of the roads were carried out collecting data as identified in section 5.1. A summary for each road is shown in Table 11. Figure 19 includes pictures of each road taken during the inspection.

Table 11 Study Area 4 - Inspection Results

Road Name	Surface Type	Surface Width (m)	Traffic Lanes	Crossfall (%)	Drainage Condition
Bourne Road	Gravel	4.0	1	0.9 – 0.4	Satisfactory
Cambooya Felton Road	Gravel	5.0 – 7.0	2	2.5 – 0.3	Satisfactory
Hoffman Road	Gravel	5.0 – 6.0	1	2.5 – 0.3	Satisfactory
Lysaght Road	Gravel	4.0	1	1.1 – 0	Satisfactory
Railway Parade	Gravel	4.5 – 6.0	1	3.8 – 1.4	Satisfactory
Rosenberger Road	Gravel	6.0 – 6.5	1	2.2 – 0.6	Satisfactory
Utz Road	Gravel	4.0	1	1.4 – 0	Satisfactory
Wyreema Cambooya Road	Gravel	6.0 – 8.0	2	3.5 – 0.8	Satisfactory

Figure 19 Study Area 4 - Road Pictures

5.6. Study Area 5 – Clifton

5.6.1. Inspection Area Overview

Study Area 5 is situated in the Construction and Maintenance South Precinct, within the locality of Clifton approximately 40km south of Toowoomba. This study area was selected as the utilisation of the surrounding land is predominately cattle farming. As the nearest township of Clifton is considered to be some distance from the study area, usage of the roads within would be used mainly by the residents in the area. This study area produces an environment that represents a more isolated rural community.

Six roads were selected within the Clifton study area ie Doolan Rd, Holley Rd, Lorenz Rd, Roeseller Rd, Ted Mengel Rd and Venz Rd. Refer to Figure 20.

Figure 20 Study Area 5 - Clifton

Table 12 shows the information associated with each of the roads.

Table 12 Study Area 5 - Road Information

Road Name	Road Information
Doolan Road CH 00 – 6,035	• Partly designated school bus route • Seven residential dwellings along entire road • Mail is delivered to dwellings • Light and heavy vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network
Holley Road CH 430 – 6,350	• Partly designated school bus route • Two residential dwellings along entire road • Mail is delivered to dwellings • Light and heavy vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network
Lorenz Road CH 00 – 2,880	• Is a designated school bus route • Four residential dwellings along entire road • Mail is delivered to dwellings • Light and heavy vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network
Roeseller Road CH 00 – 1,420	• Not a designated school bus route • No residential dwellings along entire road • Light and heavy vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network
Ted Mengel Road CH 2,790 – 3,875	• Not a designated school bus route • Three residential dwellings along entire road • Mail is delivered to dwellings • Light and heavy vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network
Venz Road CH 00 – 3,980	• Not a designated school bus route • Three residential dwellings along entire road • Mail is delivered to dwellings • Light and heavy vehicles use road • Road does not lead to place of frequent use • Road is not a valuable link in the network

5.6.2. Inspection Results

Inspections for each of the roads were carried out collecting data as identified in section 5.1. A summary for each road is shown in Table 13. Figure 21 includes pictures of each road taken during the inspection.

Table 13 Study Area 5 - Inspection Results

Road Name	Surface Type	Surface Width (m)	Traffic Lanes	Crossfall (%)	Drainage Condition
Doolan	Gravel	4.5 – 6.5	1 & 2	2.4 – 0.4	Satisfactory
Holley	Gravel	4.0 – 6.0	1	4.1 – 0.2	Satisfactory
Lorenz	Gravel	4.0 – 5.0	1	4.3 – 0.4	Satisfactory
Roeseller	Gravel	5.0 – 6.0	1	2.7 – 2.0	Satisfactory
Ted Mengel	Grave/Formed/ Unformed	3.0 – 4.0	1	4.5 – 1.0	Satisfactory
Venz	Gravel/Formed /Unformed	3.0 – 4.5	1	4.7 – 0.2	Satisfactory

Figure 21 Study Area 5 - Road Pictures

5.7. Conclusion

From the road inspections carried out, it was found that the majority of the roads had a gravel surface, with the remainder of them either being formed or unformed. The ratio of gravel surfaced roads to the formed and unformed roads was within expectations.

The surface widths of the gravel roads were found to be inconsistent along most of the roads. From the majority of measurements taken, widths varied from as little as 0.5m to as much as 2.0m in some instances. The road crossfall was another element that proved to be inconsistent, as detailed in the inspection results tables. The most common reason for this occurrence was a combination of the surface not being graded at the correct crossfall when maintenance is carried out, and the amount of traffic using the road, causing it to lose its shape.

A comparison of the roads in the Study Areas with respect to the road information obtained a number of common characteristics as follows:

- Roads that provide a through travel route, provide access to and collect traffic from minor roads. These roads also provide access to properties that contain residential dwellings and vacant property.
- Roads that are contained within major sealed and unsealed roads that provide access to residential dwellings. These roads are most likely to be used by residents in the area and provide a non-direct route through the network.
- Roads that are contained within major sealed and unsealed roads that contain non-residential dwellings but provide access to vacant property. These roads also provide a non-direct route through the network.
- Roads that are contained within major sealed and unsealed roads that don't form a through road. Their sole purpose is to provide access to residential dwellings and vacant property only.

CHAPTER 6
OUTCOMES

6.1. Road Classification System

6.1.1. Overview

The proposed road classification system has been developed to provide information about the unsealed road network within Toooowoomba Regional Council. The information provided is intended to produce standards and levels of service Toooowoomba Regional Council applies to its unsealed roads regarding construction and maintenance.

A four tier road classification system has been developed to suit Toowoomba Regional Council's unsealed road network, which is located in Figure 22. The classification system has been developed to account for the various characteristics encountered on each of the roads within the Study Areas defined in section 5.7. The classes developed are intended to represent all the unsealed roads within Toowoomba Regional Council.

Toooowoomba Regional Council's proposed classification system has been mostly based on the unsealed road classification system developed by ARRB in the Unsealed Roads Manual. The proposed classification system includes a numbered road class, the hierarchy associated with the class, a description identifying what characteristics the road in the class should possess, in relation to service and a description of characteristics the road should possess in relation to the level of service required i.e. safety, accessibility and comfort. In addition, a geometric design standard and maintenance frequency has been incorporated into the classification system.

Appendix G shows how each of the roads within the five Study Areas have been classed based on the classification system developed. The roads have been classed based on the data obtained on each road as discussed in section 5.7.

Figure 22 Road Classification System

Road Class	Class Type	Service Function	Road Features	Geometric Standard	Maintenance Frequency
4A	Distributor	Roads intended to provide access to and from type 4B – Collector roads. It is generally used for access to properties that contain residential dwellings and vacant land. It is considered to be a valuable link in the network and generally provides a through travel Route.	• All weather road capable of travel speeds 50 – 80km/h. • Unsealed two way two lane road. • High level of safety, accessibility and comfort.	• Carriageway width = 7.0m – 8.0m • Lane width = 3.0m – 3.5m • Road Cross fall = 4% – 6% • Table drain invert 500mm below shoulder • Wearing surface = min 150mm	1 per 5 months
4B	Collector	Roads intended to provide access to and from type 4C – Access roads. These roads are also intended to primarily provide access to property that contains residential dwellings, usually greater than three. Road is used to access places of significant/frequent use and provides a non-direct route through the network.	• All weather road capable of travel speeds 50 – 80km/h. • Unsealed two way one lane road. • High level of safety and accessibility. • Medium level of comfort	• Carriageway width = 4.0m • Lane width = 3.0m – 3.5m • Road Cross fall = 4% – 6% • Table drain invert 500mm below shoulder • Wearing surface = min 150mm	1 per 10 months
4C	Access	Roads that are intended to primarily provide access to vacant property and/or property that contains residential dwellings, usually less than three. The road is expected to cater for higher volumes of farm machinery and heavy vehicles or seasonal traffic. The road also provides a non-direct route through the network.	• Generally all-weather road, can be subject to minor periods of non-use. • Capable of travel speeds 50 – 80km/h. • Unsealed two way one lane road • May cater for a higher percentage of heavy vehicle usage • High level of safety. • Medium level of accessibility and comfort.	• Carriageway width = 4.0m • Lane width = 3.5m • Road Cross fall = 4% – 6% • Table drain invert 500mm below shoulder • Wearing surface = min 150mm	1 per 20 months
4D	Local	Road that don't form a through road and are used to provide access to properties that contain residential dwellings and vacant property. It is expected that only property owners will utilise these roads.	• Normally all-weather road, can be subject to long periods of non-trafficable use or access only by four wheel drive. • Capable of travel speeds 40 – 60km/h Unsealed two way one lane road. • Medium level of safety, accessibility and comfort.	• Carriageway width, if gravel = 3.5m – 4.0m • Lane width = 3.0m • Road cross fall = 4% – 6% (can be one way) • Table drain invert 300mm – 500mm below shoulder • Wearing surface, if gravel = min 100mm	1 per 30 months

6.1.2. Road Class, Hierarchy and Service Function

Austroads has its own function road classification system as shown in Table 2. The roads in the Study Areas can be all grouped into the Rural Class 4 Roads which is defined as 'Those roads, not being class 1, 2 or 3 whose main function is to provide access to abutting property (including property within a town in a rural area'. To link the proposed classification system with the Austroads classifications, the prefix 4 has been added to each class of road, which has been allocated the letters A to D.

The hierarchy associated with each class was based on the level of mobility and or access the class of road is intended to provide. Figure 10 was used to assist in assigning the hierarchy that coincided with the four main characteristics associated with the roads that have been identified in section 5.7. The hierarchy associated with each class includes:

- Class 4A = Distributor
- Class 4B = Collector
- Class 4C = Access
- Class 4D = Local

The service function description was developed by using the characteristics of the roads identified. These characteristics were then further analysed with regards to the number of residential dwellings needing access to the roads. From this it was found that the majority of roads had dwelling numbers ranging from three or less to greater than three. The service function description associated with each class is:

Class 4A

- Roads intended to provide access to and from Class 4B – Collector Roads. It is generally used for access to properties that contain residential dwellings and vacant land. The road is considered to be a vital link in the network and generally provides a through travel route.

Class 4B

- Roads intended to provide access to and from Class 4C – Access roads. These roads are also intended to primarily provide access to property that contains residential dwellings, usually greater than three. Road is used to access places of significant/frequent use and provides a non-direct route through the network.

Class 4C

- Roads that are intended to primarily provide access to vacant property and/or property that contains residential dwellings, usually less than three. The road is expected to cater for higher volumes of farm machinery and heavy vehicles or seasonal traffic. The road also provides a non-direct route through the network.

Class 4D

- Roads that don't form a through road and are used to provide access to properties that contain residential dwellings and vacant property. It is expected that only property owners will utilise these roads.

6.1.3. Road Type Features

Each road class has a brief description associated which describes what features the road should possess to achieve the desired level of service. Features that each class of road should possess have been identified from existing features that were encountered from the inspections conducted in the study areas. The features associated with each road class are:

Class 4A

- All weather road capable of travel speeds 50km/h – 80km/h.
- Unsealed two way two lane road.
- High level of safety, accessibility and comfort

Class 4B

- All weather road which is capable of travel speeds 50km/h – 80km/h.
- Unsealed two way one lane road.
- High level of safety and accessibility.
- Medium level of comfort.

Class 4C

- Generally all-weather road which can be subject to minor periods of limited use.
- Capable of travel speeds 50km/h – 80km/h.
- Unsealed two way one lane road.
- May cater for a higher percentage of heavy vehicles.
- High level of safety.
- Medium level of accessibility and comfort.

Class 4D

- Normally all-weather road which can be subject to longer periods of non-trafficable use or limited vehicle access.
- Capable of travel speeds 40km/h – 60km/h
- Unsealed two way one lane road.
- Medium level of safety, accessibility and comfort.

6.1.4. Geometric Standards

Over time, geometrics of a road may change. The width of a carriageway may increase or decrease in width, the cross fall of a road becomes too flat or too steep and the thickness of wearing material could vary. This could occur due to maintenance operators not being aware of the geometric standard that needs to be applied, and thus different standards are applied whenever maintenance is conducted.

To ensure consistent geometrics are achieved and maintained over the useful life of the road a set of geometric standards has been proposed for each of the road classes. The standards developed are based on requirements that Toooowoomba Regional Council currently have in place, along with information obtained from the road inspections conducted in the study and responses received through the survey. The standards applied to each road class are:

Class 4A

- Carriageway width = 7.0 – 8.0m
- Lane width = 3.0m – 3.5m
- Road Crossfall = 4% – 6%.
- Table drain invert 500mm below shoulder.
- Wearing surface = minimum 150mm

Class 4B

- Carriageway width = 4.0m
- Lane width = 3.0m – 3.5m.
- Road Crossfall = 4% – 6%.
- Table drain invert 500mm below shoulder.
- Wearing surface = minimum 150mm

Class 4C

- Carriageway width = 4.0m
- Lane width = 3.5m
- Road Crossfall = 4% – 6%.
- Table drain invert 500mm below shoulder
- Wearing surface = minimum 150mm

Class 4D

- Carriageway width (if gravel surface) = 3.5m – 4.0m.
- Lane width = 3.0m
- Road Crossfall = 4% – 6% (can be one way)
- Wearing surface (if gravel surface) = minimum 100mm

6.1.5. Maintenance Cycle Frequency

To provide a consistent and cost effective maintenance program, which includes light and medium grading along with resheeting work, the frequency for when the maintenance works are carried out will be dependent on the classification of the road. This has been proposed as a simply way of identifying which roads in the network require maintenance and when the maintenance is to be conducted. This results in producing a more consistent maintenance program making it more accurate to cost a maintenance budget.

The frequency for when maintenance works are carried out on the road network will vary for each road class. The road classes that provide more for traffic movement will have a higher maintenance frequency than that for roads that cater for access. Tooowoomba Regional Council is currently in the process of developing maintenance frequencies, which have been used as a basis in determining a maintenance cycle. Tooowoomba Regional Council's proposed maintenance frequencies are shown in Table 14(Maintenance Performance Criteria and Responses 2013).

Table 14 Tooowoomba Regional Council's Proposed Maintenance Frequencies

Road Hierarchy	Distributor	Collector	Access	Local
Maintenance Frequency	1 per 4 months	1 per 6 months	1 per 12 months	1 per 24 months

The maintenance frequencies shown in Table 14 were further looked at with regards to how they would be applied to the road network. If the frequencies proposed were put into practice, maintenance would be conducted unevenly, meaning that maintenance could not be conducted at the same time to roads within the same area. From these observations Table 15 shows frequencies that can be applied to the road network so that maintenance can be applied to the roads in a single area at the same time, these frequencies are also more spread apart, thus resulting in less expenditure over a period of time.

Table 15 Revised Maintenance Frequencies

Road Hierarchy	Distributor	Collector	Access	Local
Maintenance Frequency	1 per 5 months	1 per 10 months	1 per 20 months	1 per 30 months

There has been an assumption made on the maintenance cycle, that the roads will be subjected to normal weather conditions, traffic conditions and that they have been maintained appropriately throughout the cycle.

If the roads have been exposed to abnormal conditions, resulting in unsafe conditions for the road user, an out of cycle maintenance activity can be conducted on the road to rectify the defects. These maintenance activities along with a response time are discussed in the following sections.

The proposed maintenance cycle is considered to be the minimum frequency at which maintenance may be applied. Before any maintenance is applied to the road an inspection should be conducted to determine firstly if any maintenance is required, and if so will minor maintenance need to be conducted or will a light or heavy grade be required? The maintenance activity required and how to determine that activity are discussed in the following sections.

6.2. Maintenance Activities

6.2.1. Overview

To maintain the unsealed road network four maintenance activities have been identified for use. These activities have been identified from the information obtained in the surveys conducted from each construction and maintenance branch. The activities used will vary from road to road as needed depending on how severe the defects along the roads are. Minor maintenance, light grading, medium grading and gravel resheeting are the four maintenance activities that are to be used on the roads. The following sections involve a description of the maintenance activities used. These descriptions will accompany the road classification system to ensure that everyone involved with maintenance knows the full extent of each activity.

6.2.2. Minor Maintenance

Minor maintenance work involves repairing small areas of defects encountered on the road. The type of maintenance would normally involve gravel patching of potholes, filling in scours and smoothing of corrugations. As the defects on the road would normally be in small isolated sections the use of heavy machinery such as a grader and roller is not feasible or warranted. It is expected that the defects can be repaired by use of a small maintenance crew that consists of a maintenance vehicle in conjunction with either a skid steer or backhoe to assist with any issues.

6.2.3. Light Grade

Light grading is used to repair minor defects that are consistent throughout the whole road. The repair of defects is achieved by pulling in fines won from the batters of the road and cutting a small slice from the current wearing surface. This material is spread evenly across the road and filling in any potholes, corrugations and scours. Use of a water cart and roller is incorporated into this process as well so as to provide a smooth wearing surface upon completion and increase the level of service the road provides. The light grading process does not involve the reinstatement of table drains and only improves the geometrics of the road by a small margin.

6.2.4. Medium Grade

Medium grading is used to repair minor defects as well as a moderate number of major defects. The process of repairing defects along the road is the same for light grading. There may also be small sections of the road that can have the crossfall corrected. Medium grading involves the correction or reinstatement of any longitudinal drains that are required along the length of road.

6.2.5. Heavy Grade

Heavy grading is used to repair major defects that are encountered consistently throughout the whole road and to reinstate the geometric properties of the road as stated within the road classification system. The heavy grading process involves ripping the remaining gravel material from the wearing surface and incorporating this with additional material that has been dislodged from the batters. The material is then spread evenly across the road at the width specified in the road classification system along with producing the required crossfall. The road is watered and compacted to achieve the desired smooth wearing surface so as to maintain the level

of service required. Heavy grading also involves reinstating table drains, and road furniture and ensuring any cross drainage structure are free from blockage.

6.2.6. Gravel Resheet

Gravel resheeting is to be conducted over the entire length of the road. This involves importing new material and spreading it to produce the required wearing surface width and crossfall as specified in the road classification system. The gravel resheeting activity also removes excess spoil from the table drains as well as re-establishment. The reinstatement of any road furniture such as guide posts and signs is conducted at the completion of resheeting.

6.2.7. Activity Application

Normally it will be the responsibility of the Maintenance Engineers or Works Coordinators to make a judgement as to which maintenance activity, listed in sections 6.2.2 to 6.2.6, will be conducted on the roads. To aid in determining which of the activities should be used, a defect and severity table has been developed, that is used on conjunction with a maintenance activity table. Table 16 lists the defects of potholes, corrugations, scouring and wearing surface. Each of these defects has associated with it four severity levels which are used to describe the condition of the road under inspection.

Table 16 Defects and Severities

Defect and Severity				
Score	**Potholes**	**Corrugations**	**Scouring**	**Wearing Surface**
0	No Potholes.	No Corrugations.	No Scour	Excellent
1	Covering less than 10% of road.	Covering less than 10% of road.	Covering less than 10% of road.	Good: 100 – 150mm wearing surface.
2	Covering between 10% and 30% of road.	Covering between 10% and 30% of road.	Covering between 10% and 30% of road.	Average: 50 – 100mm wearing surface.
3	Covering greater than 30% of road.	Covering greater than 30% of road.	Covering greater than 30% of road.	Poor: 0 – 50mm wearing surface

The intended process for using the table in determining which maintenance activity to use is as follows:

1. Conduct an inspection of the road in question listing the defects observed along the road, how often they occur or how much of the road surface they occupy.

2. From the inspection match the defects and their occurrence with the table, noting which row the severity of the defect falls into.

3. After all the defects have been matched with the table, add the severity scores associated with the defects, this is the total defect score.

4. This defect score is used to determine which maintenance activity is to be applied to the road.

The defect scores associated with the maintenance activities are shown in Table 17

Table 17 Maintenance Activity

Total Defect Score	Maintenance Activity
0	No maintenance required, note road condition and monitor.
1 – 3	Minor maintenance
4 – 6	Light grade
>6	Medium grade.

6.3. Intervention Scores and Response Times

6.3.1. Overview

As previously mentioned in section 6.1.5, in the event that roads have been exposed to any abnormal conditions, such as extreme weather events or unexpected peaks in traffic volume, an out of cycle maintenance activity can be conducted. To maintain an organised maintenance program, the out of cycle maintenance activity will have to be programmed in with other works, while at the same time not leaving the road in an unsafe state for a long period of time. To assist in determining when the road should be repaired a response time table has been developed, this table is used in conjunction with an intervention score.

6.3.2. Intervention Score

The intervention score is a score of the road in relation to safety, accessibility and comfort. A table has been developed to calculate the intervention score, and shown in Figure 23.

Road Name:											
Assessment Chainage:		Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route											
Mail Service Route											
Dwelling Presence											
Frequent Usage											
Road Class											
Total											

Figure 23 Intervention Score Template

A select number of parameters have been identified to assess safety, accessibility and comfort of the road. These parameters include:

- Is a school bus route located on the road?
- Is a mail service route located on the road?
- Are there any residential dwellings located along the road?
- Does the road lead to a place of frequent usage? eg. Refuse facility, intensive farming operation, and recreational facility.
- What is the class of road?

Each of these is assessed individually, with respect to safety, accessibility and comfort, and are allocated high, medium or low. These are weighted to achieve a total score, which is then used in the Response Time table.

The completed intervention scores for each of the roads within the study areas are located in Appendix H.

6.3.3. Response Times

The response time is the time allocated to perform the required maintenance task on the selected road. Roads that are important in the road network will have a quicker response time than those that are less important. To decide on the response times Table 18 has been developed.

Table 18 Maintenance Response Times

	Road Score		
Maintenance Activity	**<80**	**80 – 110**	**>110**
Minor Maintenance	Within 6 months	Within 4 months	Within 2 months
Light Grade	Within 6 months	Within 2 months	Within 1 month
Medium Grade	Within 6 months	Within 2 months	Within 1 month
Heavy Grade	No timeframe – conducted as part of maintenance cycle		
Gravel Resheet	No timeframe – conducted as part of maintenance cycle		

This table is used in conjunction with the intervention scores as discussed in section 6.3.2. Three intervention score ranges have been have been created, these have been based on the intervention scores obtained for each of the roads covered on the study areas. Associated with each score range is a response time to carry out maintenance. Following discussion with relevant Council staff, it was considered that these times were reasonable for the nominated activity. If response times are found to be not appropriate, they can be lengthened or shortened as necessary.

The response times are only allocated to the maintenance activities of Minor Maintenance and Light Grading, because the activities of Heavy Grading and Gravel Resheeting are conducted as cyclical maintenance.

CHAPTER 7
ECONOMIC ANALYSIS

7.1. Overview

To determine if the proposed maintenance frequencies are ideal for use, a comparison between previous year's maintenance expenditure and the estimated expenditure (based on the maintenance frequencies shown in the road classification system) was carried out. The comparison was based over a period of 36 months for previous expenditure and 40 months for the estimated expenditure.

7.2. Previous Maintenance Expenditure

7.2.1. Overview

Maintenance figures associated with each selected road was obtained through Council's financial management system E1. The data for the financial year 2011/12 was not a true reflection of maintenance expenditure, as emergent repairs associated with the flood events for that year were booked under maintenance codes.

Under the E1 system there are numerous activity codes and some of these activities are not related to the maintenance activities used in the classification system, and have been discounted in the comparison.

The graphs in the following sections show the total maintenance expenditure for each road within the years 2010/11, 2011/12 and 2012/13.

7.2.2. Study Area 1 – Quinalow

Figure 24 shows the previous three financial years of maintenance expenditure for Study Area 1. Some key observations about the expenditure include:

Expenditure for Cauleys Road appears to be consistent throughout the review period, although the amount spent appears to be low when compared to other roads of the same length. Hartwigs Road expenditure has decreased over the years; a possible explanation is that a resheet occurred in 2010/11, resulting in less maintenance needing to be done in subsequent years. This also explains the higher expenditure in 2010/11. Lees Road has a consistent expenditure, but the amount spent on the road raised a concern, as there is minimal expenditure over the three year period. Both Quinalow Edgefield and Wonga Plains South Roads have a consistent expenditure, although the increase in 2011/12 is likely to be related to flood recovery work.

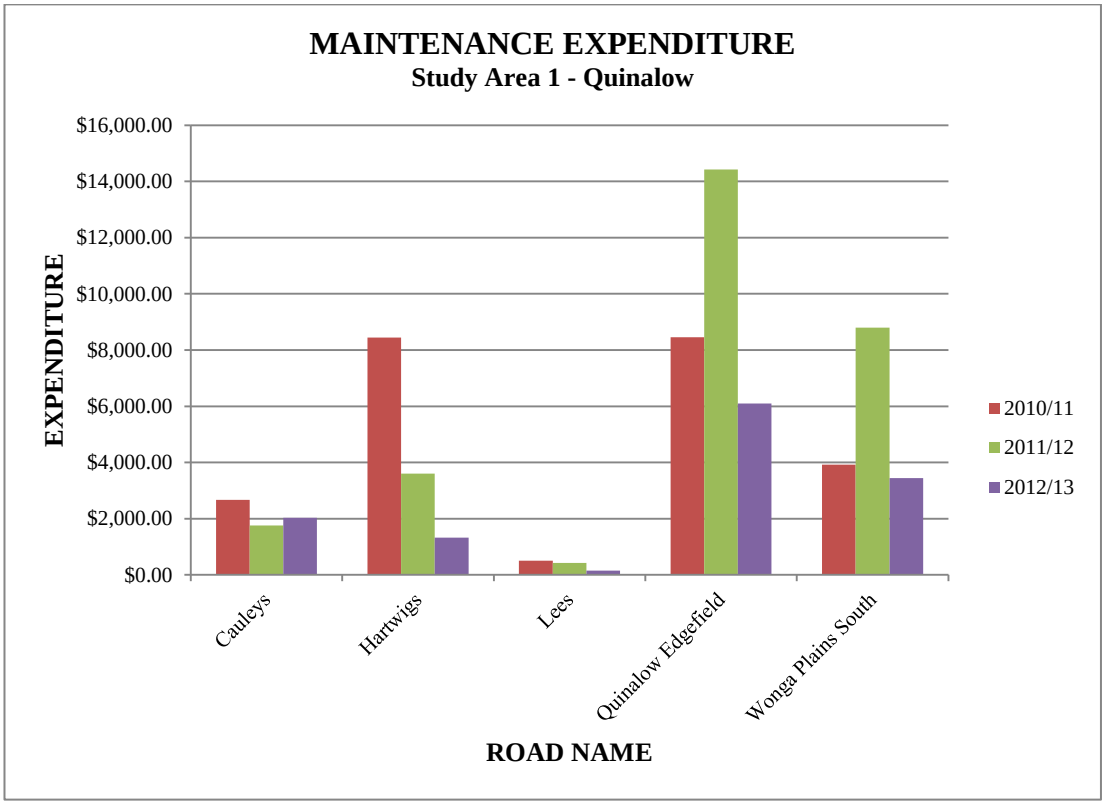

Figure 24 Study Area 1 - Previous Maintenance Expenditure

7.2.3. Study Area 2 – Geham

Figure 25 shows the previous three financial years of maintenance expenditure for Study Area 2. Some key observations about the expenditure include:

A large amount of maintenance has been conducted on the roads for the 2011/12 financial year; it is assumed that this is associated with the flood recovery work. There is also some data missing for a number of the roads, August road has no financial data associated with it, an explanation for this could be that it is located at the end of Doug Road, and any maintenance conducted on August Road may have been booked to Doug Road. From the data that is complete, approximately half of the roads show some consistency with expenditure.

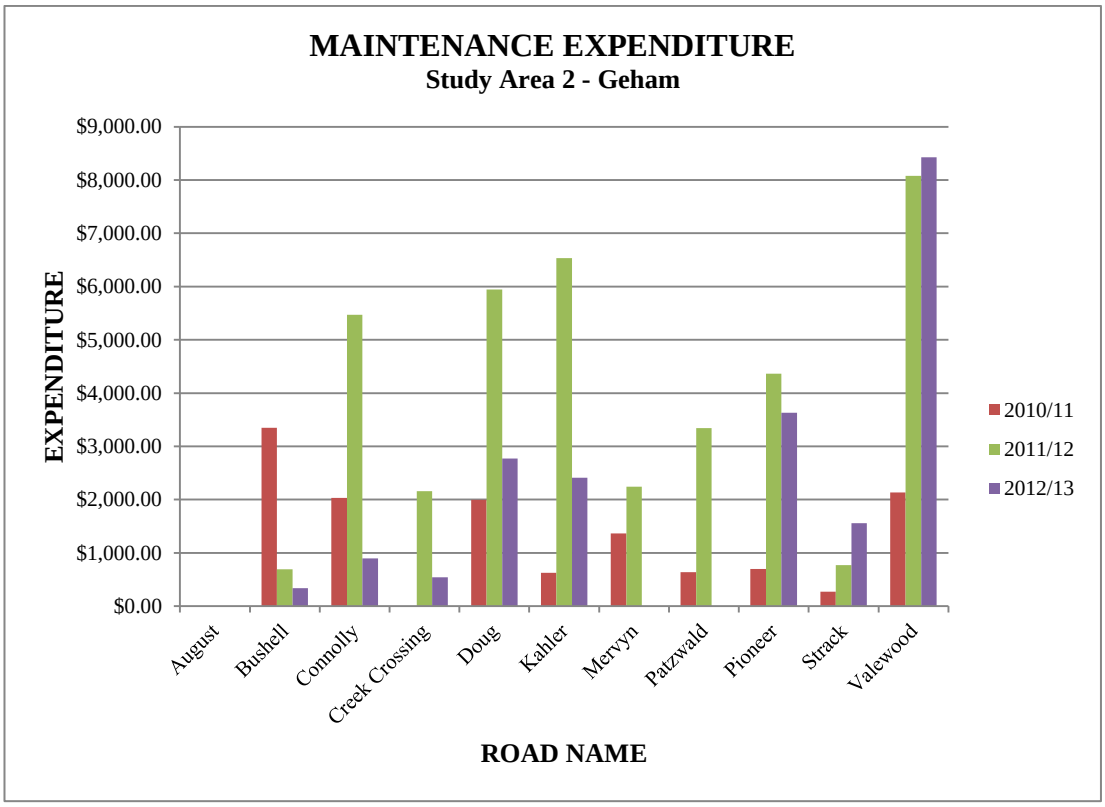

Figure 25 Study Area 2 - Previous Maintenance Expenditure

7.2.4. Study Area 3 – Jondaryan

Figure 26 shows the previous three financial years of maintenance expenditure for Study Area 3. Some key observations about the expenditure include:

A limited amount of financial information was available for the roads within Study Area 3. Reasons for this are unclear, as from the inspections conducted the roads appear to be in a good condition, thus some form of maintenance has been conducted on the roads. From the data that is available, there is a large variance in expenditure for Pedlar and Peters Roads between the 2011/12 and 2012/13 financial years, this could be associated with the flood recovery work conducted in 2011/12. McIntyre Road has a reasonable consistent expenditure between the 2010/11 and 2012/13 financial years, whereas F. Kent Road has had a jump in expenditure for 2012/13 when compared to the 2011/12 financial year.

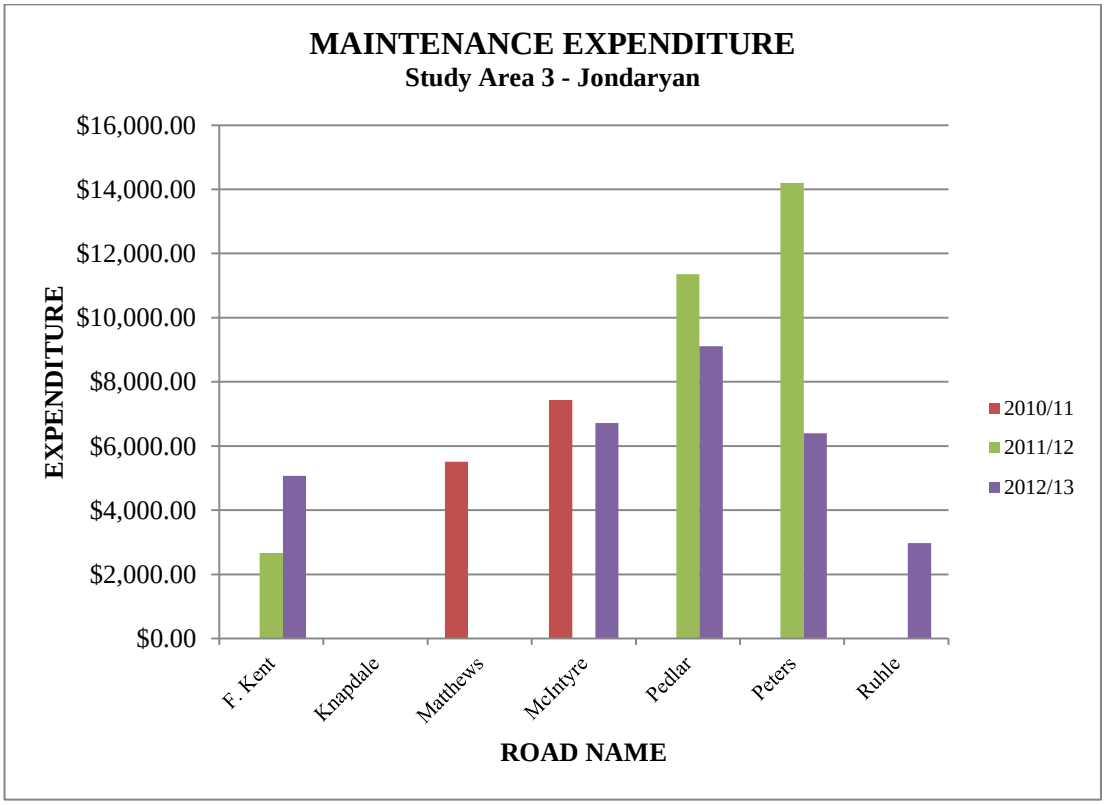

Figure 26 Study Area 3 - Previous Maintenance Expenditure

7.2.5. Study Area 4 – Cambooya

Figure 27 shows the previous three financial years of maintenance expenditure for Study Area 4. Some key observations about the expenditure include:

Wyreema Cambooya Road has a high maintenance expenditure associated with it when compared to the other roads in the area; this is due to the large length of road in comparison to the other roads in the study area. It can also be that more maintenance is conducted on this road due to it being a link between Wyreema and Cambooya, which has a number of horse stud properties along it, producing high traffic volumes. The majority of the roads in this study area, apart from Wyreema Cambooya Road, have consistent maintenance expenditure. Reasons for this could be that the roads are located in an urban type environment; road lengths are short and along with the amount and type of maintenance work conducted, all contribute to consistent expenditure.

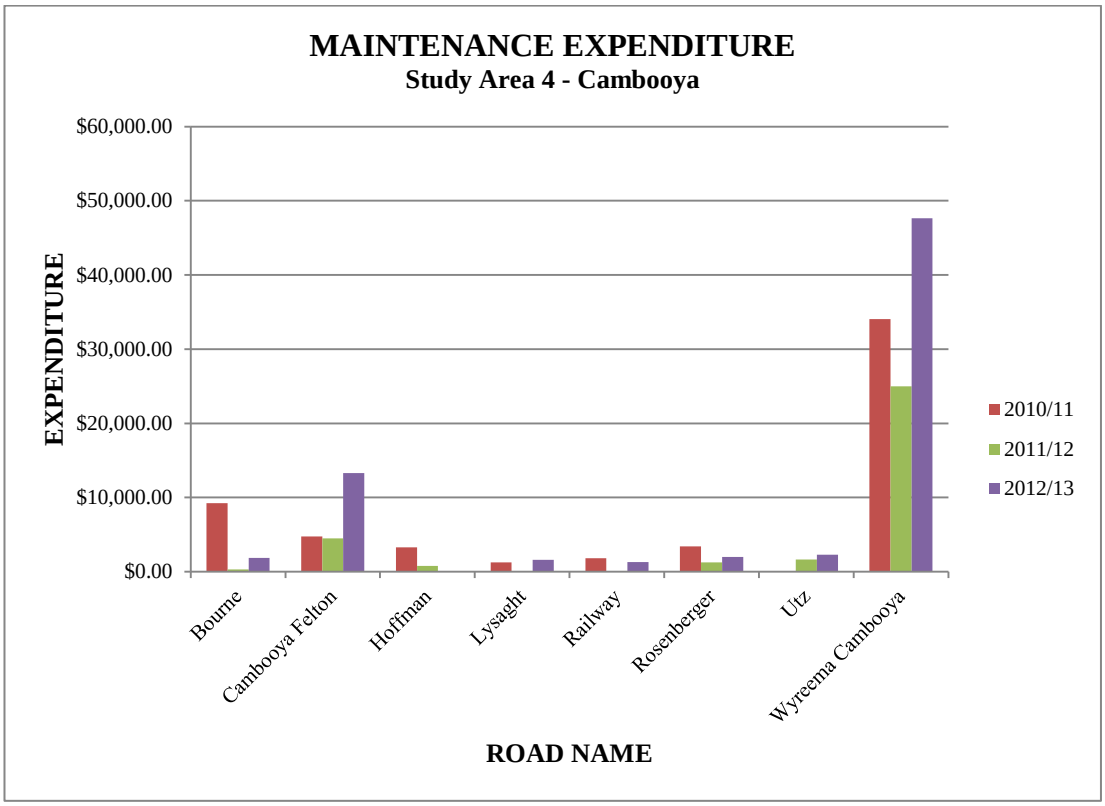

Figure 27 Study Area 4 – Previous Maintenance Expenditure

7.2.6. Study Area 5 – Clifton

Figure 28 shows the previous three financial years of maintenance expenditure for Study Area 5. Some key observations about the expenditure include:

A reasonably consistent expenditure across the majority of the roads, exceptions include Doolan and Ted Mengel Roads. The increase in expenditure for the 2012/13 financial year for Doolan and Ted Mengel Roads could be attributed to a resheet undertaken along these roads. There is no maintenance expenditure for Ted Mengel Road in 2010/11 and Venz Road in 2012/13; this is the norm as both roads are 'no through roads' and only have two residential dwellings, indicating that only minimal maintenance would be required.

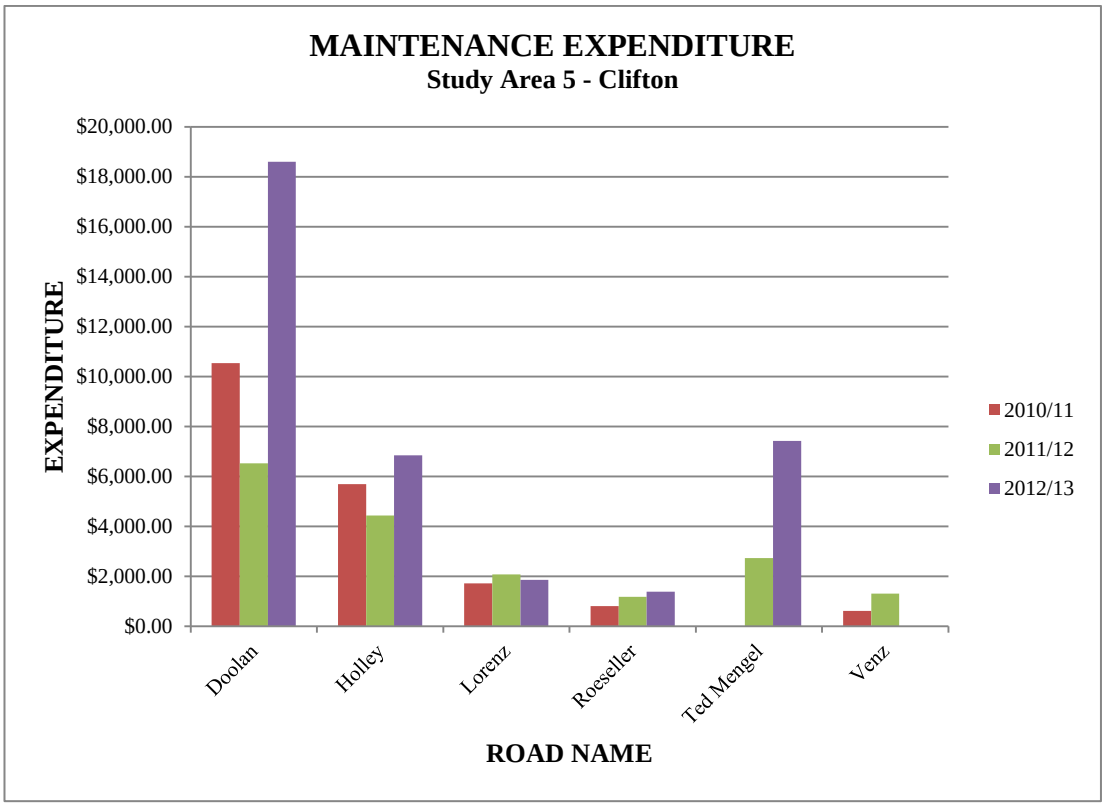

Figure 28 Study Area 5 - Previous Maintenance Expenditure

7.3. Estimated Maintenance Expenditure

7.3.1. Overview

Estimated maintenance expenditure figures for each road in their respective Study Areas was obtained by using unit rates that council currently uses for estimating purposes. A unit rate of $850/km was used for light grading, while a rate of $2085 was used for a medium grade (Slader, I H 2013, pers. comms. 26 March). These rates were applied to the roads as per their maintenance frequency. The graphs shown in the following sections capture the three year period for which the estimated expenditure was calculated. As the maintenance frequencies don't fit evenly into a year, the years have been made up as follows:

- Year 1 includes maintenance from 0 to 10 months
- Year 2 includes maintenance from 15 to 25 months, and
- Year 3 includes maintenance from 30 to 40 months.

Expenditure details for each road in the study areas are shown in Appendix I

7.3.2. Study Area 1 – Quinalow

Figure 29 shows the estimated maintenance expenditure for study area 1 over a three year period. Some key observations about the expenditure include:

Most of the roads in Study Area one have consistent maintenance expenditure. Quinalow Edgefield Road has a lower expenditure for Year 2; this is because the road has been divided into two different classes with different maintenance frequencies. Year 3 for all of the roads has a higher expenditure due to a medium grade being performed at the end of the period.

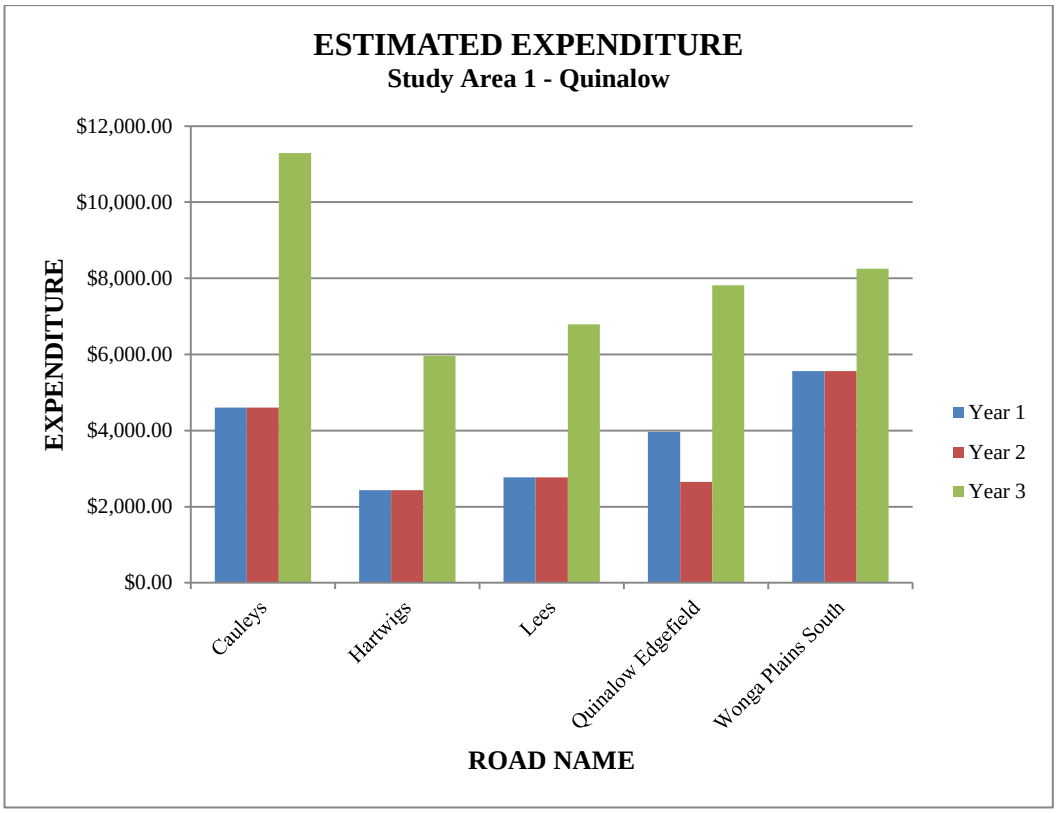

Figure 29 Study Area 1 – Estimated Maintenance Expenditure

7.3.3. Study Area 2 – Geham

Figure 30 shows the estimated maintenance expenditure for Study Area 2 over a three year period. Some key observations about the expenditure include:

Kahler and Pioneer Roads are the only roads within the study area that have consistent maintenance expenditure across the three years. August and Bushell Roads have no maintenance associated with them for Year 2 as they are classified as Local roads which have a maintenance frequency of 30 months (2.5 years).

The remainder of the roads, except for Patzwald and Valewood, have lower expenditure associated with them as they are divided into different classes which have different maintenance frequencies. Patzwald and Valewood Roads have lower maintenance expenditure in Year 2, as they only have one application in the year compared to two applications in Years 1 and 3. All the roads except for August and Bushell Road have a higher expenditure which is the result of a medium grade being applied at the end of Year 3.

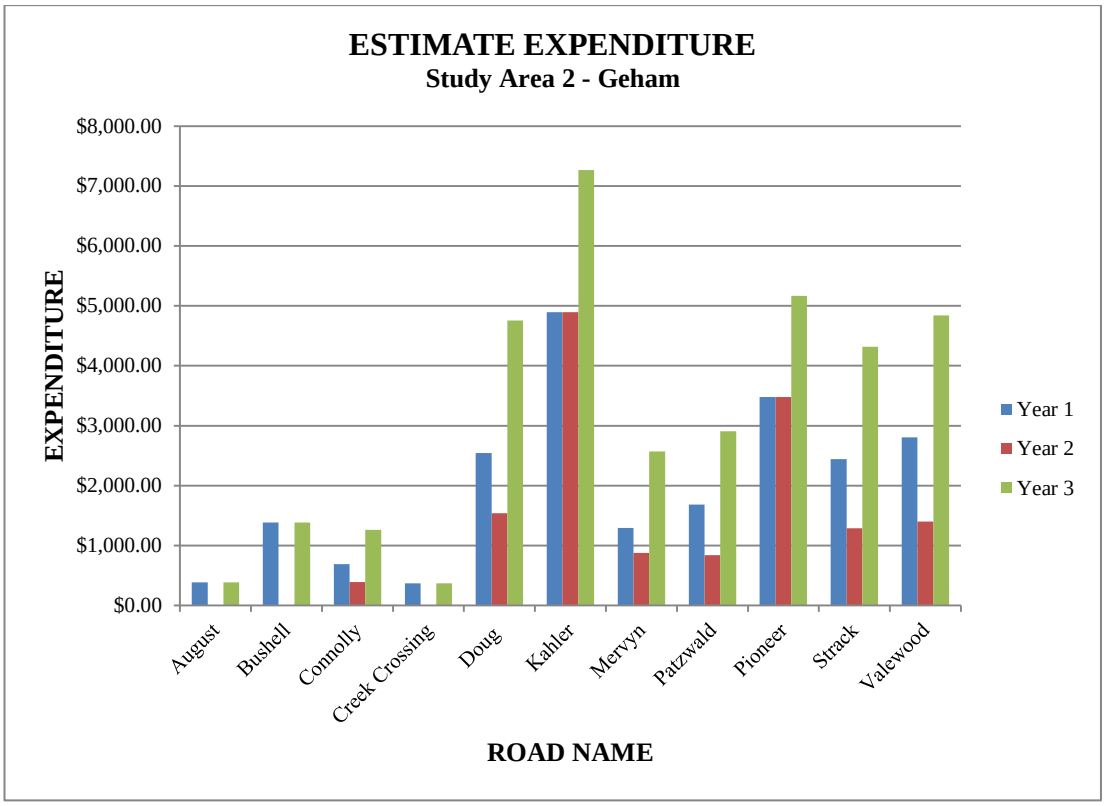

Figure 30 Study Area 2 - Estimated Maintenance Expenditure

7.3.4. Study Area 3 – Jondaryan

Figure 31 shows the estimated maintenance expenditure for Study Area 3 over a three year period. Some key observations about the expenditure include:

Every road with the exception of Matthews and Ruhle Roads has expenditure associated with it across all three years. Matthews and Ruhle Roads are classed as local roads which produces a maintenance frequency of 30 months (2.5 years).

Knapdale Road has a decrease in expenditure for Year 2; this is a result of the road having one application of maintenance within the year compared to two applications in Years 1 and 3. Year 3 for all the roads except for Matthews and Rule Roads have a higher expenditure which is associated to having a medium grade applied at the end of that year.

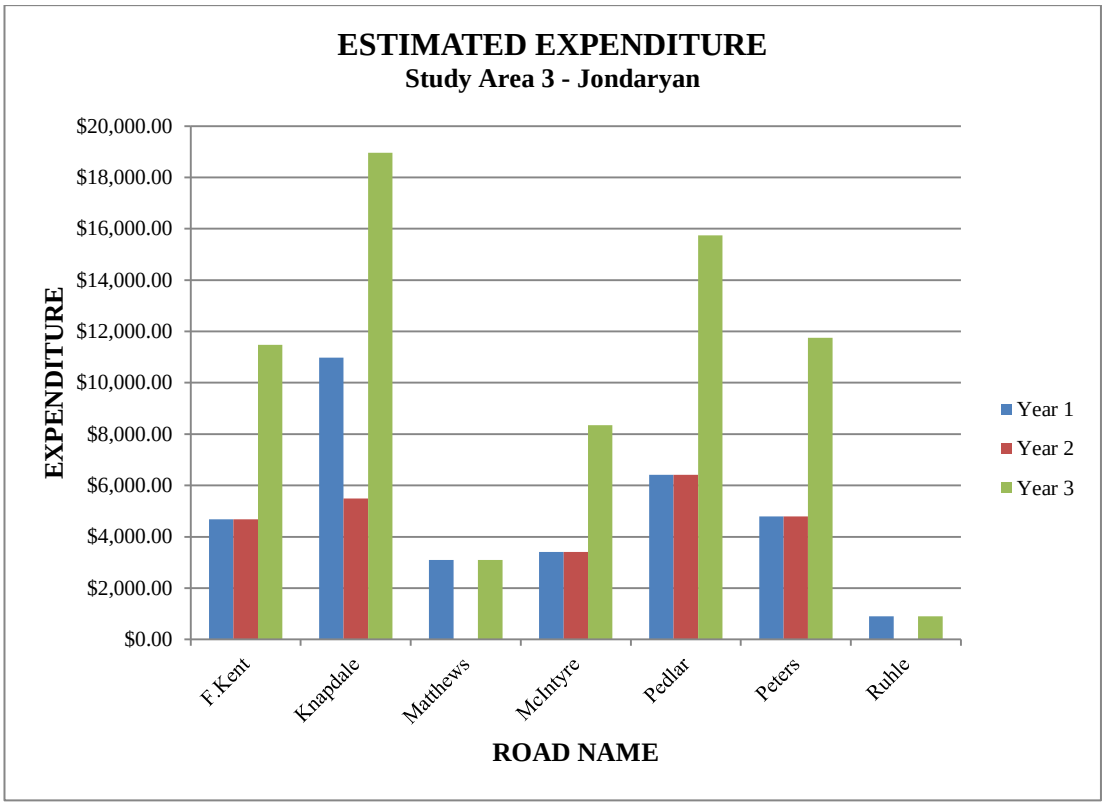

Figure 31 Study Area 3 - Estimated Maintenance Expenditure

7.3.5. Study Area 4 – Cambooya

Figure 32 shows the estimated maintenance expenditure for Study Area 4 over a three year period. Some key observations about the expenditure include:

Cambooya Felton Road is the only road that has a consistent expenditure associated with it. The only road that has two classes associated with it is Railway Parade and as a result different maintenance frequencies, thus producing the reduction in expenditure for Year 2. The remainder of the roads all have an additional maintenance application in both Years 1 and 3 compared against Year 2. All the roads except for Hoffman and Utz Roads have higher expenditure in Year 3 which is a result of having a medium grade conducted on them at the end of this year.

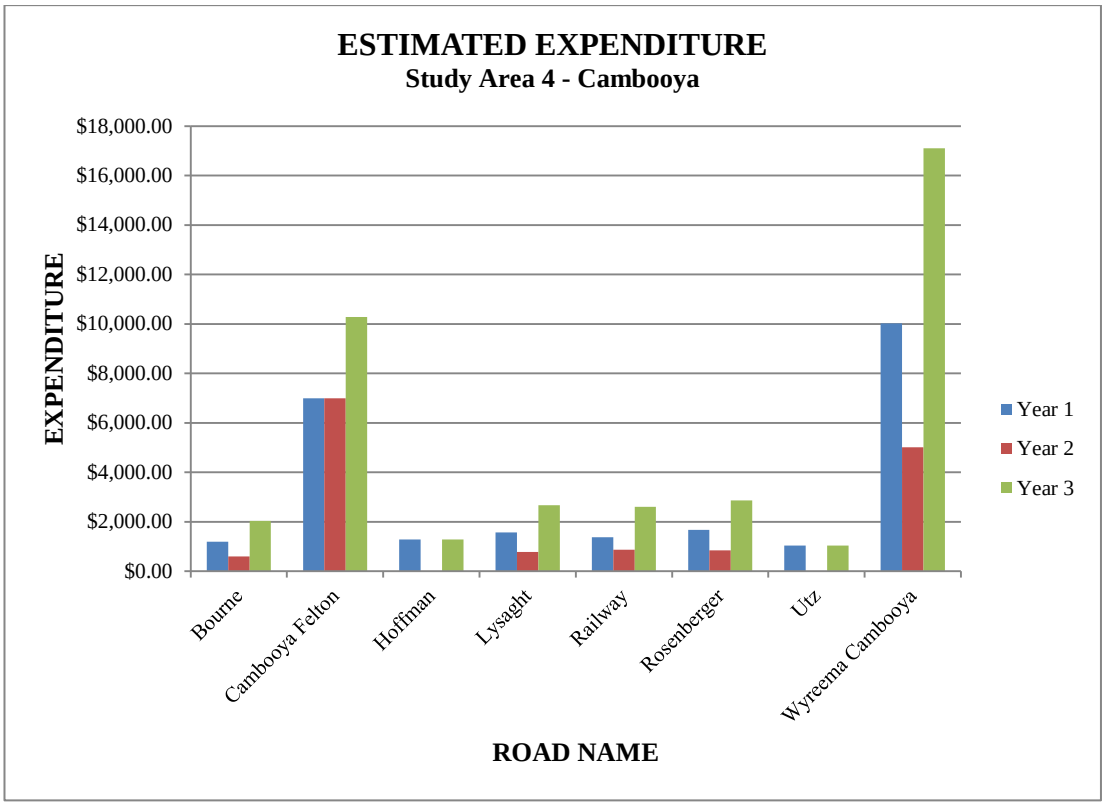

Figure 32 Study Area 4 - Estimated Maintenance Expenditure

7.3.6. Study Area 5 – Clifton

Figure 33 shows the estimated maintenance expenditure for Study Area 5 over a three year period. Some key observations about the expenditure include:

Doolan and Holley Roads are both divided into two different classes and as such have different maintenance frequencies, which is why there is a reduction in expenditure for Year 2. Lorenz Road has an additional application of maintenance in Years 1 and 3 which accounts for the reduction in maintenance for Year 2. Ted Mengel and Venz Roads are both classified as Local roads and as a result only have maintenance applied to them in Years 1 and 2. Year 3 for all the roads have higher maintenance expenditure, this is a result of having a medium grade applied at the end of this year. The higher expenditure is not evident in year three for Tend Mengel and Venz Roads as they do not warrant a medium grade within these time frames due to their classification.

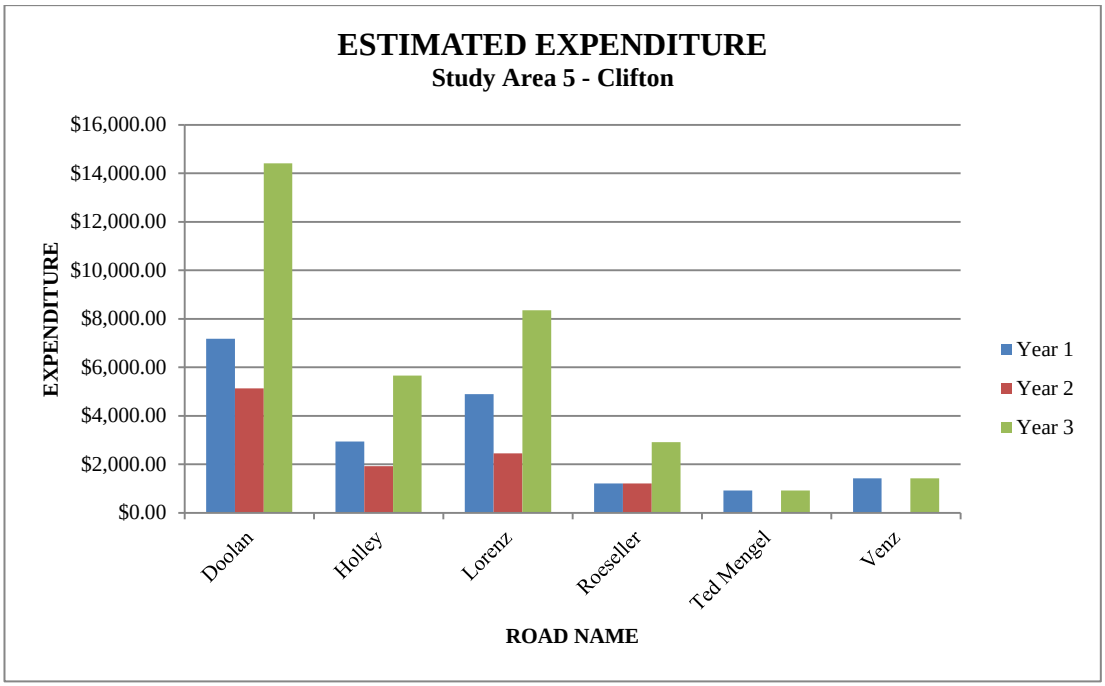

Figure 33 Study Area 5 - Estimated Maintenance Expenditure

7.4. Conclusion

7.4.1. Overview

The following series of graphs compare the total previous maintenance expenditure, for the financial years of 2010/11, 2011/12 and 2012/13, against the estimated maintenance expenditure for a period of 40 months. The data used has been obtained as discussed in sections 7.2 and 7.3.

7.4.2. Study Area 1 – Quinalow

Figure 34 shows the comparison between the previous maintenance and the estimated maintenance expenditure for Study Area 1. Some key observations about the expenditure include:

The majority of the roads have higher estimated maintenance expenditure than previous expenditure. Lees Road shows a very large difference, this is due to little being spent on the road throughout the previous three years, which has been discussed in section 7.2.2. Cauleys Road also shows a large difference, as discussed in section 7.2.2 little has been spent on maintenance in the last three years. Quinalow Edgefield Road shows the largest savings in the study area; this can be associated with the high expenditure encountered during the 2011/12 financial year as discussed in section 7.2.2.

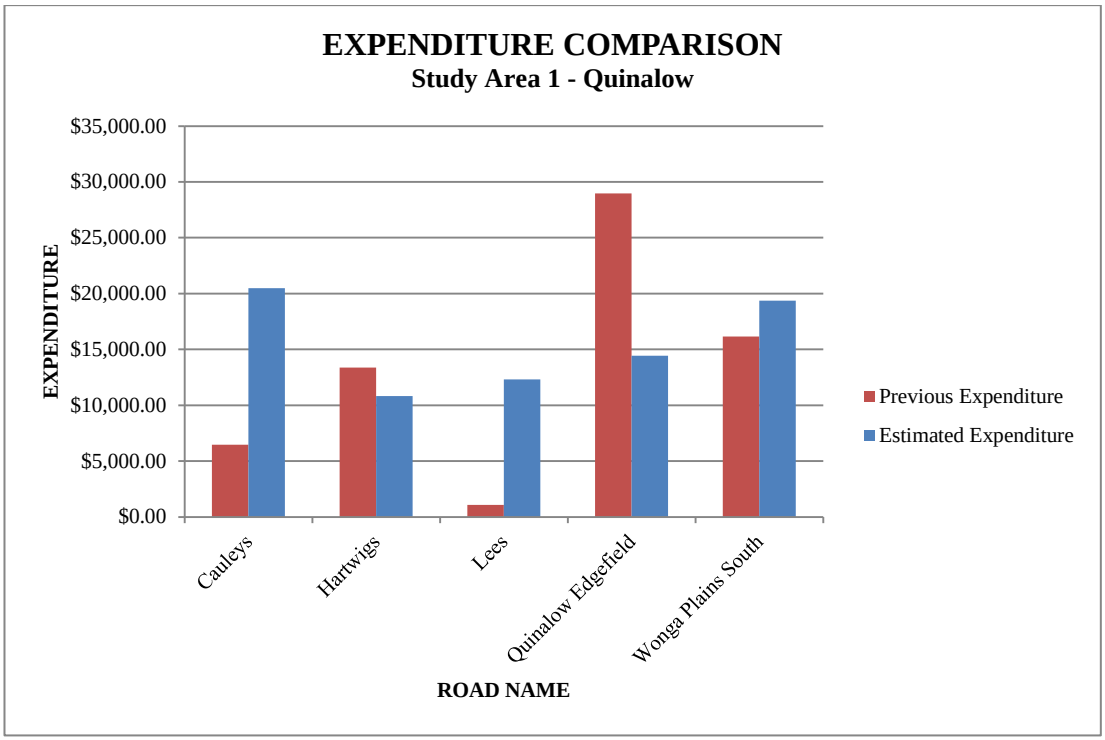

Figure 34 Study Area 1 - Maintenance Expenditure Comparison

7.4.3. Study Area 2 – Geham

Figure 35 shows the comparison between the previous maintenance and the estimated maintenance expenditure for Study Area 2. Some key observations about the expenditure include:

For the majority of the roads within study area 2, the estimated expenditure is within $2,000 of the previous maintenance expenditure. Connolly, Kahler and Pioneer Roads have large variances in the expenditures; less would be spent on Connolly Road while Kahler and Pioneer Roads will have more spent on them. From this it is evident that maintenance conducted at the frequencies proposed would achieve approximately the same expenditure as previous maintenance intervals.

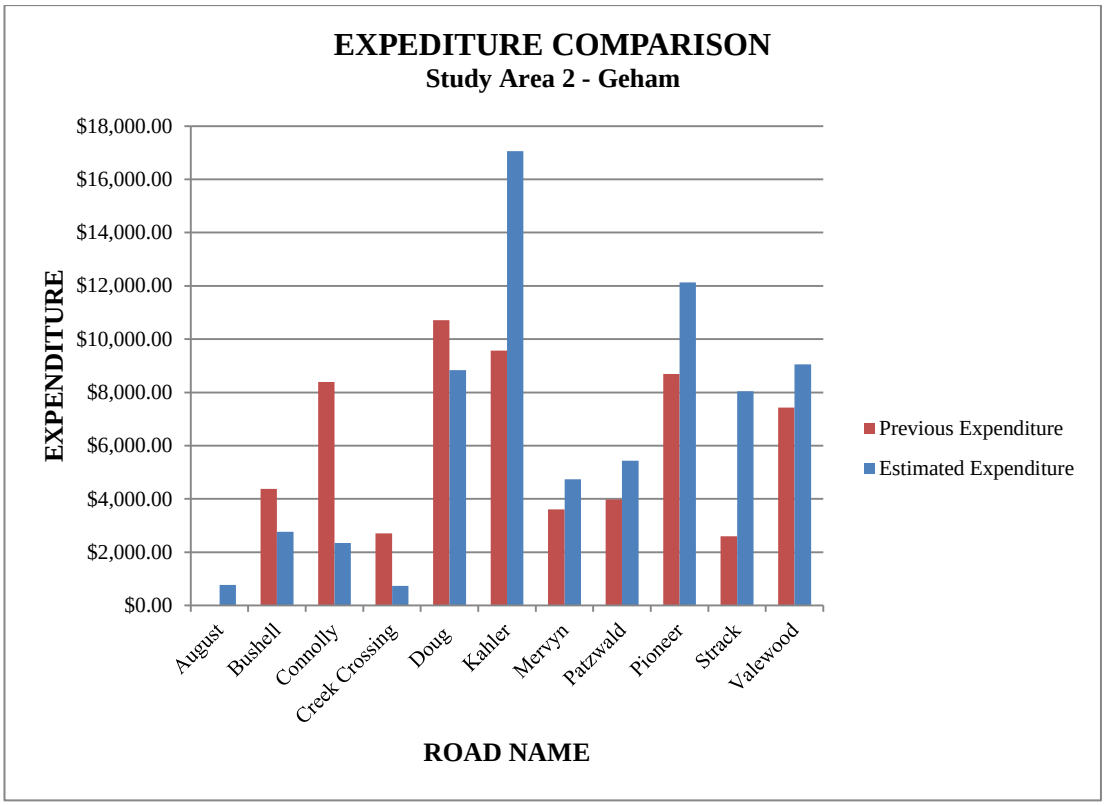

Figure 35 Study Area 2 - Maintenance Expenditure Comparison

7.4.4. Study Area 3 – Jondaryan

Figure 36 shows the comparison between the previous maintenance and the estimated maintenance expenditure for Study Area 3. Some key observations about the expenditure include:

There are large increases in expenditure for F. Kent, Knapdale and Pedlar Roads. The increase in expenditure for these three roads can be attributed to either the lack of maintenance conducted, maintenance works booked to other roads or an error entering the data into the financial management system.

From the inspections conducted, and witnessing that the roads were in a good condition, the increase in expenditure is most likely due to maintenance works being booked to other roads or has been entered incorrectly into the financial management system. The other four roads show that the maintenance conducted at the proposed frequencies would achieve approximately the same expenditure as previous maintenance intervals.

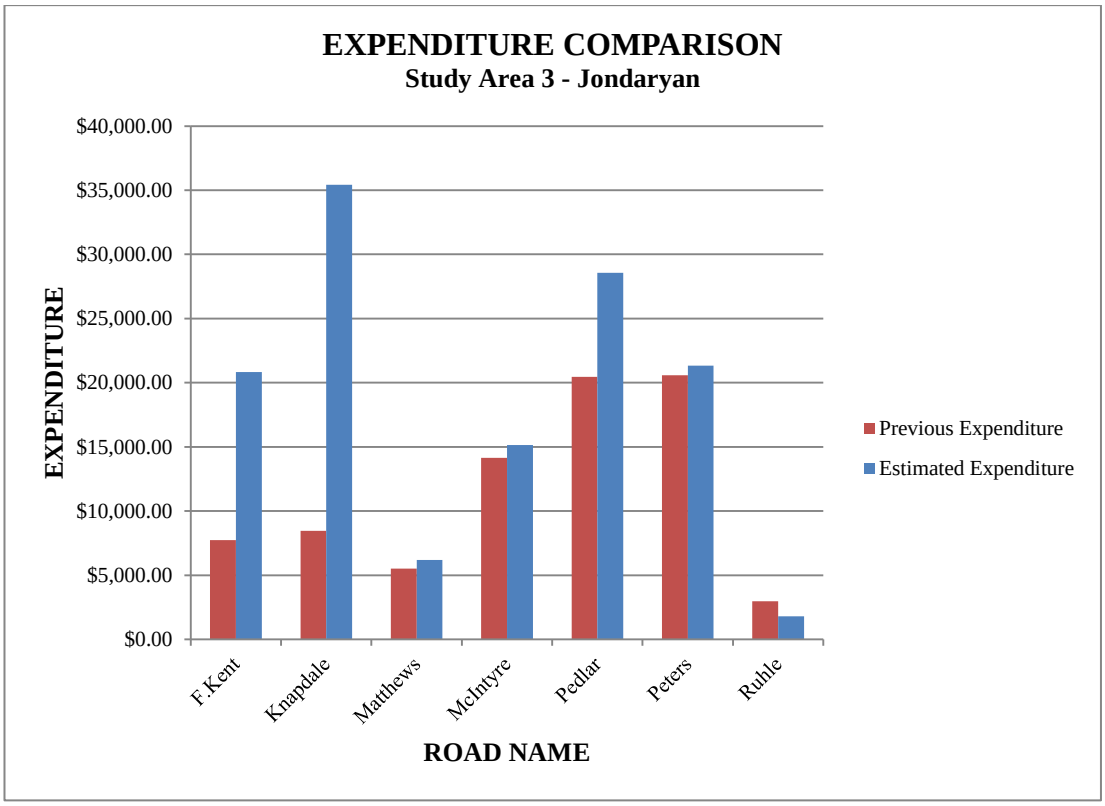

Figure 36 Study Area 3 - Maintenance Expenditure Comparison

7.4.5. Study Area 4 – Cambooya

Figure 37 shows the comparison between the previous maintenance and the estimated maintenance expenditure for Study Area 4. Some key observations about the expenditure include:

Previous expenditure and estimated expenditure is approximately the same for the majority of the roads. The exception to this is Bourne and Wyreema Cambooya Roads. Bourne Road shows a large reduction in maintenance expenditure; this can be associated with the high expenditure for the 2010/11 financial year, as discussed in section 7.2.5. Wyreema Cambooya Road also had a large decrease in expenditure, and no explanation could be found for the large decrease, as maintenance expenditure for the previous three years had been consistent as shown in section 7.2.5.

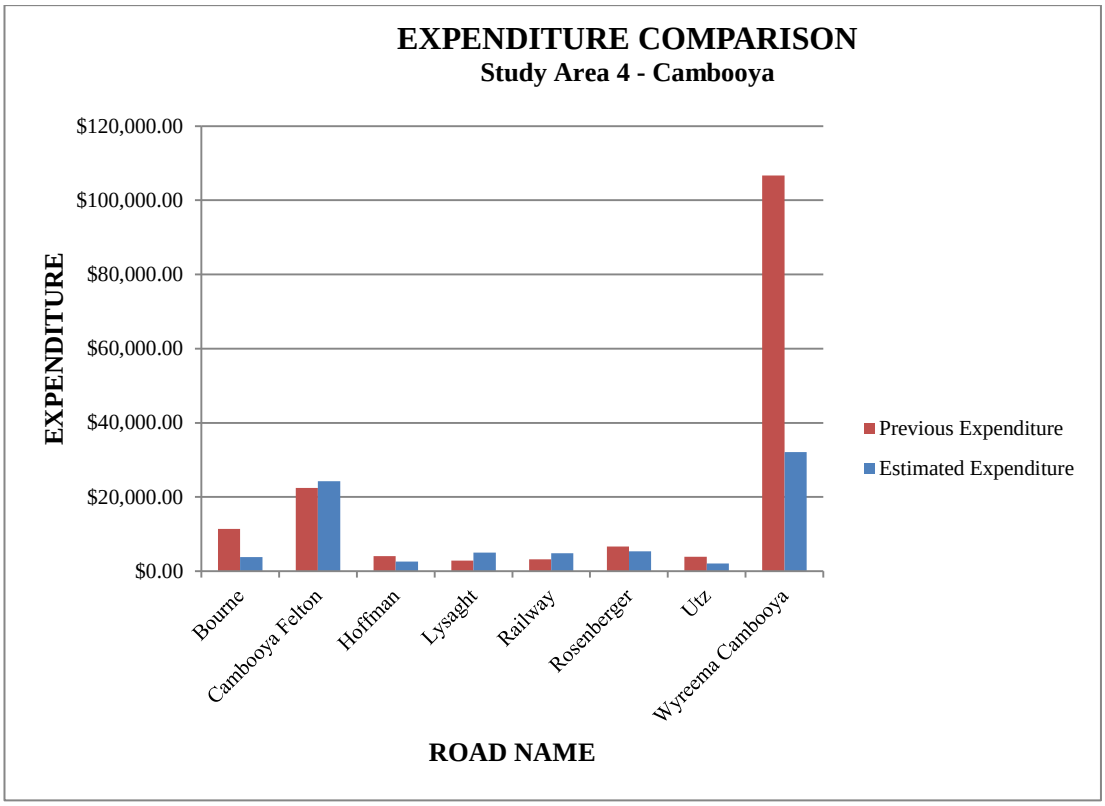

Figure 37 Study Area 4 - Maintenance Expenditure Comparison

7.4.6. Study Area 5 – Clifton

Figure 38 shows the comparison between the previous maintenance and the estimated maintenance expenditure for Study Area 5. Some key observations about the expenditure include:

There is a mix of savings and increases in expenditure. Doolan, Holley and Ted Mengel Roads show an acceptable reduction in maintenance expenditure, while Roeseller and Venz Roads are about even in comparison. Lorenz Road is the exception showing a large increase in expenditure, this would be expected as over the last three years only a minimal amount has been spent on maintenance as discussed in section 7.2.6. Overall this study area shows the benefits of the proposed maintenance frequencies with respect to reducing the amount of expenditure.

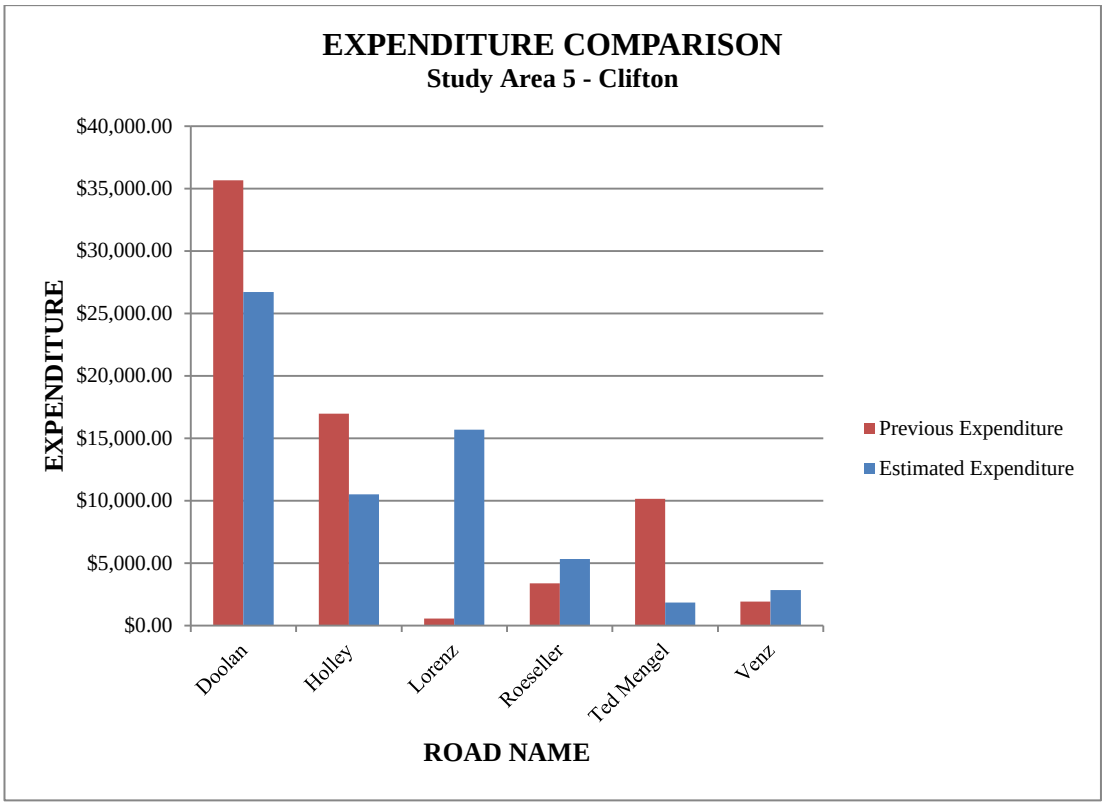

Figure 38 Study Area 5 - Maintenance Expenditure Comparison

7.4.7. All Areas

The graph shown in Figure 39 is a comparison of the total previous expenditure and total estimated expenditure for all the study areas. The most noticeable aspect of this graph is that for Study Areas 1, 2 and 5 there is only a minimal difference between the two expenditures. This has been achieved by reducing the amount of maintenance conducted on some of the roads whilst at the same time increasing the amount of maintenance performed on other roads within the same area.

The large increase in expenditure for Study Area 3 is most likely associated with an error occurring with the logging of maintenance activities to the roads within the study area, because as mentioned previously, the roads in Study Area 3 are in good condition (ie desired cross section, drainage and wearing surface) which eliminates the possibility of no maintenance being applied to them for the past three years.

Study Area 4 shows a large decrease on the amount of expenditure. This can be associated with the decrease in expenditure for the Wyreema Cambooya Road, for which no reasoning can be found.

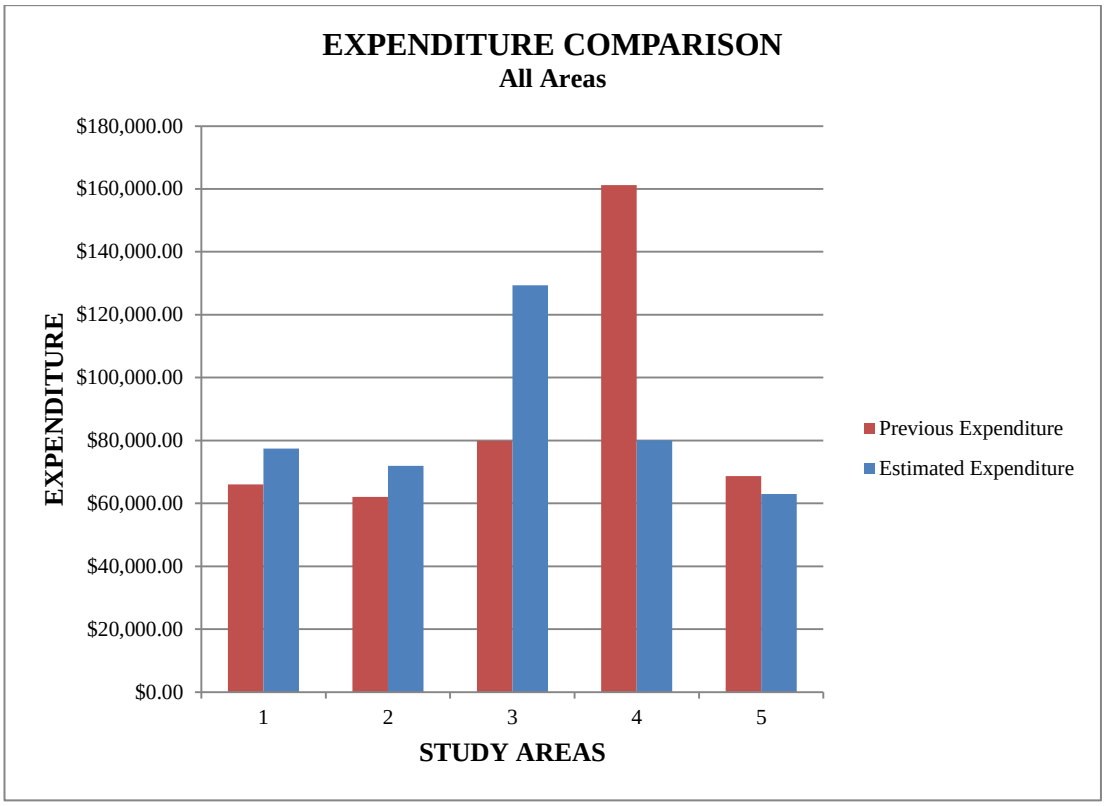

Figure 39 All Areas - Maintenance Expenditure Comparison

CHAPTER 8
CONCLUSIONS

8.1. Current Work

Australia has a vast road network in place that crosses the country linking both urban and rural communities throughout. As a result of linking these communities a portion of the road network is unsealed, by which the majority fall under the responsibility of local governments. Funding required to maintain these roads is an ongoing issue and as increasing maintenance funds for future work cannot be guaranteed, Councils have to ensure that the investment of funds in maintaining their unsealed road network is cost effective. Toowoomba Regional Council is no exception to this, as it has an extensive unsealed road network to maintain.

Currently within Toowoomba Regional Council there is no formal system in place regarding the frequency and type of maintenance activities to be performed. A key target with respect to maintenance is that 80% of the unsealed roads are graded each year to ensure the community is provided with a reasonable standard of accessibility.

The objective of this project was to investigate the current practices, standards and costs associated with the unsealed road network to ensure financially sustainable maintenance practices and provide recommendations that will result in consistency, certainty and compliance. The intended way of providing this was through the development of a road classification system.

Development of the road classification system involved reviewing council's current maintenance practices and standards, and adopting the ones that would provide the outcomes needed. To ensure that the classification system could be applied to all the roads within Toowoomba Regional Council five varying localities were chosen to give an overall representation of the characteristics and features the roads.

Maintenance practices and standards currently being performed across Toowoomba Regional Council were obtained through a survey. This survey was completed by Construction and Maintenance Engineers and Works Coordinators and provided a snapshot of what practices are being undertaken.

Inspections on the roads were carried out in each locality. and a four consistent characteristics were identified. Using these characteristics a road classification system was developed. The system outlines the hierarchy, service function, road and geometric features that would be attributed to each of the classes. Along with this a maintenance frequency was also determined for each of the classes.

To determine if the maintenance frequencies associated with the road class would provide financial savings, a comparison against previous year's maintenance and an estimated expenditure was conducted. Previous financial information was obtained through council's financial management system. Issues were encountered through this as some roads had no financial information linked to them, which appeared to be incorrect as these roads were well maintained. Estimated expenditure was calculated using unit rates that council is currently using for estimating purposes. This rate was used in conjunction with the maintenance frequencies identified in the classification system.

Comparison of the two expenditures found that there was minimal difference. This can be attributed to some roads in the study areas having less maintenance carried out, whereas other roads had more maintenance.

Until a more thorough analysis (with more accurate expenditure comparisons) can be conducted, it will be unclear if the maintenance frequencies associated with the classification system provide the funding savings necessary to continually maintain the roads at the required service levels.

The development of the classification system, while not providing a definitive answer on maintenance costs, has provided a method of adopting consistent maintenance practices and standards across the region which did not previously exist.

8.2. Further Work

As stated in section 8.1, a more thorough analysis (with more accurate maintenance expenditures) is required to determine if the maintenance frequencies proposed will provide projected cost savings to Council.

In conjunction with the financial aspect, the classification system will need to be trialled over a period of time on all roads in the Study Areas, to confirm its suitability. Ideally, the trial needs to be conducted over a minimum time period of three to five years, as this encapsulates an entire maintenance cycle. This duration would also cater for a range of weather events and other unexpected activities that could influence how the classification system operates.

From the trial, observations will have to be conducted on a regular basis to determine how the roads have responded to the proposed maintenance frequencies. If the observations find that the roads require more maintenance than specified, the maintenance frequencies within the classification system will need to be modified accordingly. A review the classification system over the trial period will also need to be made; at this point, any adjustments can be made to the classification system so it will be appropriate for Council's use.

Engagement with the community and relevant stakeholders is important for the outcomes of this project to be a success. Community and stakeholder engagement will be carried out once a trial of the classification system has been put into practice. This engagement will be continuous throughout the trial, which will be an important aspect in receiving feedback on how the classification system is working.

Once the classification system has been trialled and any modifications completed, it is anticipated that classifying each unsealed road throughout Toowoomba Regional Council will be completed. After classifying the roads, maintenance can be applied to all roads across the region at the frequencies specified in the classification system.

It is anticipated that Toowoomba Regional Council can achieve savings on future maintenance costs with the adoption of such a system, and this will provide value for money services that the community can afford.

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APPENDICES

Appendix A – Project Specification

University of Southern Queensland
FACULTY OF ENGINEERING AND SURVEYING

ENG4111/4112 Research Project
PROJECT SPECIFICATION

FOR: **Andrew Keith HARTWIG**

TOPIC: MANAGEMENT OF LOW TRAFFIC VOLUME ROADS

SUPERVISOR: Dr David Thorpe
Ian Slader, Toowoomba Regional Council

SPONSORSHIP: Toowoomba Regional Council

PROJECT AIM: To determine the standards and levels of service to be applied to construction and maintenance of unsealed low traffic volume roads.

PROGRAMME: **Issue A, 7th March 2013**

1. Conduct a literature review on current construction and maintenance practices undertaken on unsealed low traffic volume roads and determine applicable construction and maintenance standards.
2. Identify parameters that are likely to impact on the determination of the standard of construction and maintenance applied to low traffic volume roads.
3. Select approximately six localities within Toowoomba Regional Council that contain a small number of roads within each to conduct the research.
4. Gather and collate the required data, as identified in item 2, for the selected roads in each locality.
5. Develop a methodology that represent value for money construction and maintenance practices.
6. Evaluate the methodology with respect to the roads in each locality identified in item 3.
7. Write and submit an academic dissertation on the research.

As time permits:

8. Develop a pro forma to conduct stakeholder engagement.
9. Develop a model showing indicative costs associated with providing different standards and levels of service.

Agreed:

_____ (Student) _____ , _____(Supervisors)

____/____/2013 ____/____/2013 ____/____/2013

Appendix B – Local Government Boundaries

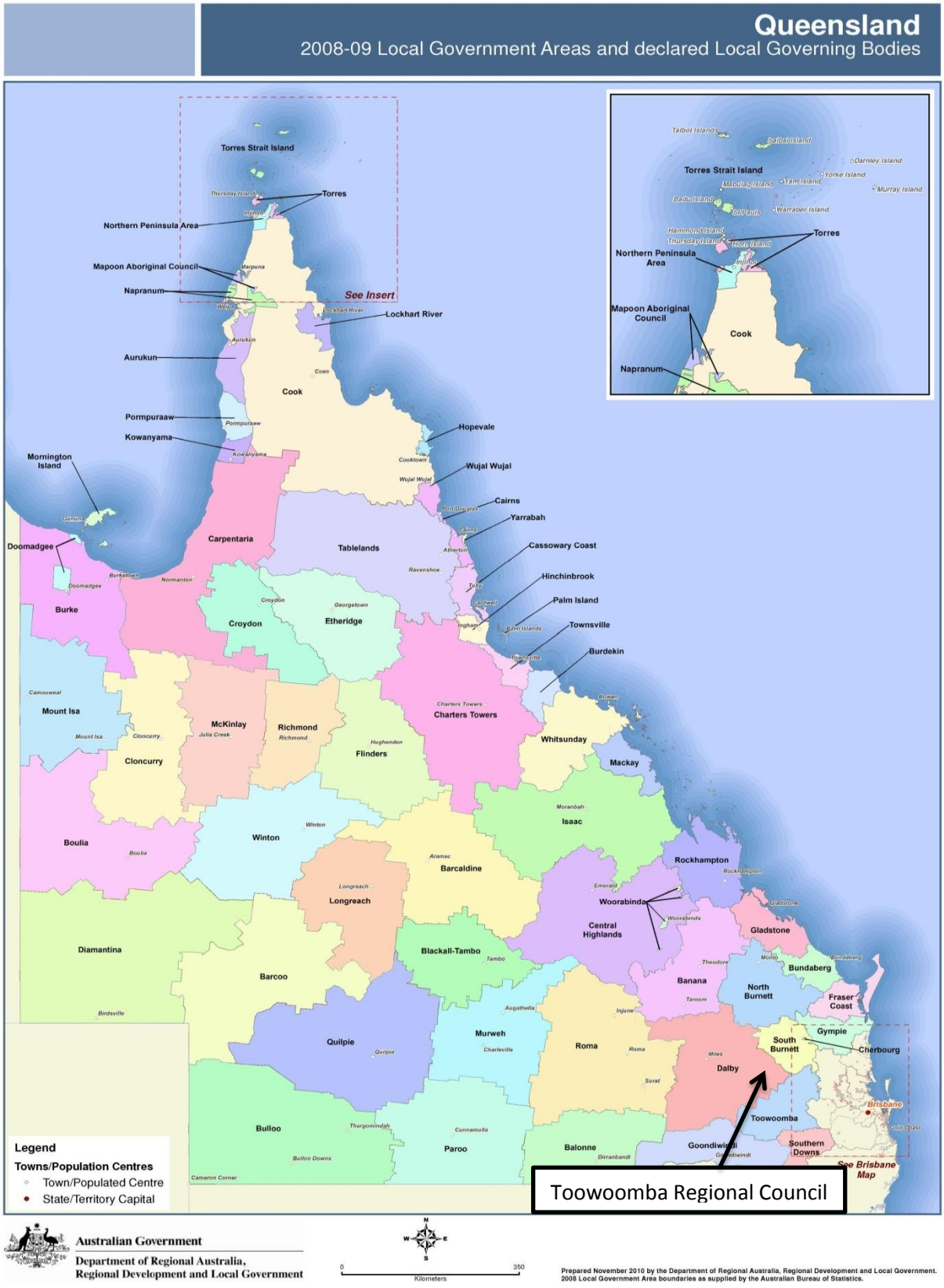

Figure 40 Local Government Boundaries - Queensland (Local Government Publications 2013)

Appendix C – Road Defects

Defect	Causes
 Corrugations	• Inadequate quality base material for prevailing climatic conditions. • Loose surface material. • Dynamic traffic impacts
 Potholes	• Ponding of water due to inadequate cross fall. • Excessive weakening of pavement by moisture. • Inadequate initial compaction. • Variable quality of pavement material.
 Rutting	• Inadequate wet strength of subgrade or pavement layer. • Wear by attrition due to traffic or erosion of surface material. • Traffic compaction of pavement or subgrade.
 Surface Scour	• Concentration of water flows owing to either blocked or inadequate drainage system or rutting. • Erodible surface material. • Lack of adequate cross fall. • Excessive cross fall and vertical grades.

Figure 41 Road Defects and Causes (ARRB 2009)

Appendix D – Construction and Maintenance Standards

Road Classification	AADT	Lane Numbers	Lane Width	Shoulder Width	Pavement Width	Cross Fall	Carriageway Width	Comments
			m	m	m	%	m	
Forest Practice Code Tasmania								
Class 1 – Primary Road				0.6 – 1.0	5.5 – 6.0			Surfaced, all weather
Class 2 – Significant Feeder				0.6	5.5			Surfaced, all weather
Class 3 – Minor Spur				0.5 – 1.0	3.7 – 4.0			Surfaced, all weather
Class 4 – Minor Spur				0.6	3.7			All weather or unsurfaced
Access Track – Temporary Track				-	3.0 – 3.7			Dry weather only, unsurfaced
State Forests of NSW								
Class 3 – Primary Access Road		2					5.5 – 7.3	Unsealed, all weather
Class 4 & 5 – Secondary Access Road		1					4.2 – 5.5	Unsealed, all weather
Class 5 – Feeder Road		1					3.7 – 4.2	Unsealed, all weather
Class 5 – Harvesting Road		Track					3.7 – 4.2	Dry weather track
Class 5 – Link Road		Track					3.7 – 4.2	Dry weather track
Class 6 – Fire Trail		Track					3.7 – 4.2	Four wheel drive track
South Australian Government – Commodity Network Route Guidelines								
	<150						6	
	>150 <500						6.5	
	>500 <1000						7	
Austroads Rural Road Design								
	1 – 150	1	3.5	2				
	150 – 500	2	3.1	1.5				
	500 – 1000	2	3.1 – 3.5	1.5		Earth/Loam = 5 Gravel = 4		
	1000 – 3000	2	3.5	2				
	>3000	2	3.5	2.5				
Austroads Guide to Road Design								
	1 – 150	1	3.7	2.5				
	150 – 500	2	3.1	1.5				
	500 – 1000	2	3.1 – 3.5	1.5		Earth/Loam = 5 Gravel = 4		
	1000 - 3000	2	3.5	2				
	>3000	2	3.5	2.5				

Figure 42 Comparison of Geometric Standards

Road Classification	AADT	Lane Numbers	Lane Width	Shoulder Width	Pavement Width	Cross Fall	Carriageway Width	Comments
Vic Roads Supplement								
M – Freeways connecting capital cities and major provincial centres		2	3.5					
A – Same role as M, less traffic		2	3.3 – 3.5	2.0 – 2.5				
B – Primary link between major regions		2	3.3 – 3.5	2				
C – Links between centres of population		2	3.1 – 3.5	2				
Local Access	51 - 150	1	4	1.5				
Private Access	Jan-50	1	3	2				
ARRB Unsealed Roads Manual								
Class 4A – Main Road	>150	2	3.0 – 3.5	0.5 – 1.0		5		Unsealed, all weather
Class 4B – Minor Road	50 – 150	2	3	0.5		5		Formed and gravelled, all weather
Class 4C – Access Road	50 – 10	1	3	0.5 – 1.5		5		Formed, dry weather
Class 4D - Tracks	<10	1	3	0		4		Earth track, unformed
South Africa – CSIR								
Class 4 – Secondary	>100			1.5	6		9	
Class 5 – District	20 – 100			1.5	6		9	
Class 6 – District	<20			1.5	3		6	
United Kingdom								
Class D – Collector	>100			1	5		7	
Class E – Access	20 – 100			1.5	3		6	
Class F – Access	<20			N/A	2.5 – 3.0			
USA – Forestry Manual								
	250 – 50	2		1.5	3		9	
	<100	1		N/A	4.2		4.2	

Appendix E – Maintenance Survey

Name: _____

Position: _____

Branch: _____

Brief Description of role: _____

Question 1:
What type of maintenance activities are currently performed on council's unsealed road network?

_____

_____

Question 2:
How often is the maintenance listed in question 1 carried out?

_____

_____

Question 3:
Who/what determines the frequency of the maintenance listed in questions 1 and 2?

_____

_____

Question 4:
How are maintenance requirements identified? ie. Programmed (Delta S), site inspections, customer/councillor requests etc.

_____

_____

Question 5:
What engineering standard is applied to the unsealed roads? ie. crossfall, lane width, gravel thickness etc.

_____

_____

Question 6:

What is the basis for determining the standard of maintenance? ie. traffic volume, function of road etc.

Question 7:

What are the factors that influence different maintenance standards (crossfalls, lane widths, gravel layer thickness etc.) for different roads?

Question 8:

Is your Maintenance Team aware of the standard of maintenance required? And what information is captured on the completed work?

Appendix F – Maintenance Survey Responses

F1 – Survey Response 1 C&M South

SURVEY FORM

Name: BRIAN MOLONEY

Position: WORKS COORDINATOR

Branch: CP (1) INFRASTRUCTURE SERVICES

Brief Description of role: OVERSEER OF WORKS, COORDINATING CAPITAL WORKS PROGRAMS, ORDINARY MAINTENANCE.

Question 1:

What type of maintenance activities are currently performed on council's unsealed road network?

Maintenance Grading; Pothole and side drainage work; Vegetation clearing as required; Gravel Road Maintenance; Culvert maintenance.

Question 2:

How often is the maintenance listed in question 1 carried out?

Normally twice year for maintenance grading, but some roads only once.
Potholes as required on inspection

SURVEY FORM

Question 3:
Who/what determines the frequency of the maintenance listed in questions 1 and 2?

Reasons :- (1) Budget (2) Pathway or carriageway needs (3) Grading needs twice yearly (4) Weather conditions (5) Date of Gd.

Question 4:
How are maintenance requirements identified? ie. Programmed (Delta 5), site inspections, customer/councillor requests etc.

All of what you mentioned all normally programmed.

Question 5:
What engineering standard is applied to the unsealed roads? ie. crossfall, lane width, gravel thickness etc.

Crossfall average 4%
Width 5 metres

Question 6:
What is the basis for determining the standard of maintenance? ie. traffic volume, function of road etc.

Standard is always the same regardless of National Roads alone

Question 7:
What are the factors that influence different maintenance standards (crossfalls, lane widths, gravel layer thickness etc.) for different roads?

1) Amount of existing pavement
2) original formation
3) Traffic the Export used

Question 8:
Is your Maintenance Team aware of the standard of maintenance required? And what information is captured on the completed work?

YES!
all work done on our awarded network is documented

F2 – Survey Response 2 C&M South

SURVEY FORM

Name: Michael Eastwell

Position: Works Coordinator

Branch: ISG C&M South.

Brief Description of role: Oversee implementation of Council's CAPITAL & Operational Plan For GREENMOUNT & CLIFTON C&M AREA's.

Question 1:

What type of maintenance activities are currently performed on council's unsealed road network?

MAIN GRADING.
Pavement Repair's
Gravel Resheeting
Dust Controll when Carting from Pit's.

Question 2:

How often is the maintenance listed in question 1 carried out?

When Required.
We have a plan & check Roads for need before doing any Main Work's.
Most roads will be graded at least once a year, some of the very high traffic & large traffic volume Roads can be done up to four time's per year.

Page 1

SURVEY FORM

Question 3:
Who/what determines the frequency of the maintenance listed in questions 1 and 2?

Works Coordinator in Consultation with.
Unsealed Network Field Supervisor.
& Inspector.
taking into account Previous History.

Question 4:
How are maintenance requirements identified? ie. Programmed (Delta S), site inspections, customer/councillor requests etc.

Previous History of TRAFFIC, Topography,
locations as our start point.
Delta S, as well as Pathways will
determine if frequency needs to be increased.
Site inspection's
Resheets are based on a ten year turnaround.

Question 5:
What engineering standard is applied to the unsealed roads? ie. crossfall, lane width, gravel thickness etc.

Resheet.
Resheet 125 mm Compacted.
GIS DATA used for lane Width.
5% from Crown. each way where possible Slope.
DRAINAGE DONE as Part of Resheet.
MAINT GRADE
DRAINAGE TO OUTSIDE OF Table DRAIN'S.
MITRE DRAIN'S, INVERT to Fence Line,
Pavement Repair's where required.
GRADING 3 over / 4 Back.
5% from crown each way where possible slope.

Question 6:
What is the basis for determining the standard of maintenance? ie. traffic volume, function of road etc.

We try to bring all Gravel ROAD'S to the same standard as this will Reduce the frequency of matin

Question 7:
What are the factors that influence different maintenance standards (crossfalls, lane widths,, gravel layer thickness etc.) for different roads?

All our Standards are the same. Some will change with location & topography Slightly.

Question 8:
Is your Maintenance Team aware of the standard of maintenance required? And what information is captured on the completed work?

Yes.
GRAVel ROAD. DATA IS Collected on Council UNsealed Road Record's.

F3 – Survey Response 1 C&M Central

SURVEY FORM

Name: Bill Wisto

Position: Foreman Road Maintenance

Branch: C&M Central

Brief Description of role: Foreman of sealed and unsealed road maintenance plus CBD street cleaning.

Question 1:

What type of maintenance activities are currently performed on council's unsealed road network?

Grading and adding material as required

Pot hole repair maintenance as required.

Spray post maintenance as required

Question 2:

How often is the maintenance listed in question 1 carried out?

All unsealed road maintenance is carried out each year or as required.

Question 3:

Who/what determines the frequency of the maintenance listed in questions 1 and 2?

All road and footpath maintenance is reported by our inspectors and is referred to an intervention level.

Question 4:

How are maintenance requirements identified? ie. Programmed (Delta 5), site inspections, customer/councillor requests etc.

By inspectors, by intervention levels and by customer requests

Question 5:

What engineering standard is applied to the unsealed roads? ie. crossfall, lane width, gravel thickness etc.

All standards are carried out from Auspec standards 41001

Question 6:
What is the basis for determining the standard of maintenance? ie. traffic volume, function of road etc.

Also grading are on two unsealed roads we like to go through the rest

Question 7:
What are the factors that influence different maintenance standards (crossfalls, lane widths, gravel layer thickness etc.) for different roads?

Grader goes through with rippers and Material is added if needed if not He will then grade and roll with Large steel drum and multi tyre Roller. adding water as required.

Question 8:
Is your Maintenance Team aware of the standard of maintenance required? And what information is captured on the completed work?

All unsealed grading is carried out as per question 7
All completed works is stored in (Delta S)

F4 – Survey Response 2 C&M Central

Name: Paul Spencer

Position: Co ordinator c/m Central

Branch: Central

Brief Description of role: Coordinator work + resources to have work completed.

Question 1:

What type of maintenance activities are currently performed on council's unsealed road network?

At the moment there is light grading of the gravel roads.

Gravel resheeting gravel shoulders on narrow bitumen road.

Question 2:

How often is the maintenance listed in question 1 carried out?

Try to grade all gravel roads + shoulders twice a year.

Resheeting gravel shoulders + roads are done to what money is allocated each year in the Council budget

SURVEY FORM

Question 3:
Who/what determines the frequency of the maintenance listed in questions 1 and 2?

It is a combine effort between the manager Exc manager, Coordinator

Question 4:
How are maintenance requirements identified? ie. Programmed (Delta 5), site inspections, customer/councillor requests etc.

It is accessed by the inspector, on routine inspection. Customer requests / Council requests.

Question 5:
What engineering standard is applied to the unsealed roads? ie. crossfall, lane width, gravel thickness etc.

There is a 100mm x 6m wearing surface. this surface is graded, rolled + watered. The cross fall is determined by what gravel is left on the road. Less gravel less x-fall. Less crossfall ~~we~~ and boggy condition would mean the need for a gravel Resheet. X-FALL 4-5%.

Question 6:
What is the basis for determining the standard of maintenance? ie. traffic volume, function of road etc.

Higher volume roads need more maintenance, but it is not possible all the time. School bus routes are a high priority for maintenance. The graders work across the areas and try and do each roads on the go.

Question 7:
What are the factors that influence different maintenance standards (crossfalls, lane widths, gravel layer thickness etc.) for different roads?

If there is a unsealed road. It must be constructed 5m wide by 150mm depth. Then put a 4m x 100mm wearing layer on top. Gravel floadways would only have 1% x-Fall from top to bottom to allow water to flow. They will also require a 300mm pavement depth.

Question 8:
Is your Maintenance Team aware of the standard of maintenance required? And what information is captured on the completed work?

They are aware to water + roller the gravel roads after grading. To clean out Table drains, they and maintain a crossfall.
They have a daily logbook to capture signage information, checks. This logbook capture how long the work takes + the length of work completed

Appendix G – Individual Road Classes

G1 – Study Area 1

Study Area	Road	Assessment Chainage	School Bus Route	Mail Service Run	Residential property access	Number of residential properties	Type of vehicles generally using road	Does road lead to place of frequent use ie dump, rec facility, intense farming		Does the road appear to be a valuable link in the road network	Road Classification
1	Cauleys Rd	00 - 3020	NO	YES	YES	1	Light & Heavy vehicles, Farm machinery	NO	-	NO	Access
		3020 - 5415	NO	YES	NO	-	Light & Heavy vehicles, Farm machinery	NO	-	NO	Access
	Hartwigs Rd	00 - 2860	YES	YES	YES	3	Light & Heavy Vehicles, Farm Machinery	NO	-	NO	Access
	Lees Rd	00 - 3255	NO	YES	YES	1	Light & Heavy Vehicles, Farm Machinery	NO	-	NO	Access
	Quinalow Edgefield RD	3325 - 4040	NO	YES	YES	1	Light & Heavy Vehicles, Farm Machinery	NO	-	NO	Collector
		4040 - 4870	YES	YES	YES	3	Light & Heavy Vehicles, Farm Machinery	NO	-	NO	Collector
		4870 - 6445	YES	YES	NO	-	Light & Heavy Vehicles, Farm Machinery	NO	-	NO	Access
	Wonga Plains South Rd	4670 - 8085	YES	YES	YES	1	Light & Heavy Vehicles, Farm Machinery	YES	Feedlot	YES	Distributor
		8085 - 9835	YES	YES	NO	-	Light & Heavy Vehicles, Farm Machinery	YES	Feedlot	YES	Distributor

G2 – Study Area 2

Study Area	Road	Assessment Chainage	School Bus Route	Mail Service Run	Residential property access	Number of residential properties	Type of vehicles generally using road	Does road lead to place of frequent use ie dump, rec facility, intense farming		Does the road appear to be a valuable link in the road network	Road Classification
2	August Rd	00 - 455	NO	YES	YES	1	Light Vehicles	NO	-	NO	Local
	Bushell Rd	00 - 1630	NO	YES	YES	4	Light Vehicles	NO	-	NO	Local
	Connolly Rd	00 - 355	NO	YES	YES	2	Light Vehicles	NO	-	NO	Local
		355 - 815	NO	YES	NO	-	Light Vehicles	NO	-	NO	Access
	Creek Crossing Rd	1265 - 1700	NO	YES	YES	2	Light Vehicles	NO	-	NO	Local
	Doug Rd	00 - 1180	YES	YES	NO	-	Light Vehicles	NO	-	NO	Collector
		1180 - 1810	YES	YES	YES	1	Light Vehicles	NO	-	NO	Access
	Kahler Rd	00 - 145	NO	YES	YES	1	Light & Heavy Vehicles	YES	Dairy	YES	Distributor
		145 - 895	NO	YES	YES	1	Light & Heavy Vehicles	YES	Dairy	YES	Distributor
		895 - 1920	NO	YES	YES	2	Light Vehicles				Distributor
	Mervyn Rd	00 - 495	NO	YES	YES	1	Light Vehicles	NO	-	NO	Collector
		495 - 1030	NO	YES	YES	3					Access
	Patzwald Rd	00 - 990	NO	YES	YES	4	Light Vehicles	NO	-	NO	Collector
	Pioneer Rd	835 - 2200	NO	YES	YES	4	Light & Heavy Vehicles	YES	Dairy	YES	Distributor
	Strack Rd	00 - 555	NO	NO	NO	-	Light Vehicles	NO	-	NO	Access
		555 - 1915	NO	NO	NO	-	Light Vehicles	NO	-	NO	Local
		1915 - 2875	NO	NO	YES	3	Light Vehicles	NO	-	NO	Access
	Valewood Rd	00 - 1650	NO	YES	YES	4	Light Vehicles	NO	-	NO	Collector

G3 – Study Area 3

Study Area	Road	Assessment Chainage	School Bus Route	Mail Service Run	Residential property access	Number of residential properties	Type of vehicles generally using road	Does road lead to place of frequent use ie dump, rec facility, intense farming		Does the road appear to be a valuable link in the road network	Road Classification
3	F. Kent Rd	00 - 4060	NO		YES	1	Light & Heavy Vehicles, Farm Machinery	NO	-	NO	Access
		4060 - 5505	NO		YES	2	Light & Heavy Vehicles, Farm Machinery	NO	-	NO	Access
	Knapdale Rd	00 - 2915	NO		YES	1	Light & Heavy Vehicles, Farm Machinery	NO	-	NO	Collector
		2915 - 3845	NO		NO	-	Light & Heavy Vehicles, Farm Machinery	NO	-	NO	Collector
		3845 - 6460	NO		YES	2	Light & Heavy Vehicles, Farm Machinery	NO	-	NO	Collector
	Matthews Rd	00 - 3640	NO		NO	-	Light & Heavy Vehicles, Farm Machinery	NO	-	NO	Local
	McIntyre Rd	00 - 4005	NO		NO	-	Light & Heavy Vehicles, Farm Machinery	NO	-	NO	Access
	Pedlar Rd	00 - 4010	NO		NO	-	Light & Heavy Vehicles, Farm Machinery	NO	-	NO	Access
		4010 - 5175	NO		NO	-	Light & Heavy Vehicles, Farm Machinery	NO	-	NO	Access
		5175 - 7550	NO		YES	1	Light & Heavy Vehicles, Farm Machinery	NO	-	NO	Access
	Peters Rd	00 - 5635	NO		YES	4	Light & Heavy Vehicles, Farm Machinery	NO	-	NO	Access
	Ruhle Rd	00 - 2985	NO		NO	-	Light & Heavy Vehicles, Farm Machinery	NO	-	NO	Local
		2985 - 4045	NO		YES	2	Light & Heavy Vehicles, Farm Machinery	NO	-	NO	Local

G4 – Study Area 4

Study Area	Road	Assessment Chainage	School Bus Route	Mail Service Run	Residential property access	Number of residential properties	Type of vehicles generally using road	Does road lead to place of frequent use ie dump, rec facility, intense farming		Does the road appear to be a valuable link in the road network	Road Classification
4	Bourne Rd	00 - 700	NO	YES	YES	4	Light Vehicles	NO	-	NO	Collector
	Cambooya Felton Rd	11155 - 12260	NO	YES	YES	1	Light & Heavy Vehicles, Farm Machinery	NO	-	NO	Distributor
		12260 - 13895	NO	YES	YES	4	Light & Heavy Vehicles, Farm Machinery	NO	-	NO	Distributor
	Hoffman Rd	00 - 1505	NO	YES	YES	4	Light & Heavy Vehicles, Farm Machinery	NO	-	NO	Local
	Lysaght Rd	00 - 920	NO	YES	YES	8	Light Vehicles	NO	-	NO	Collector
	Railway Pd	00 - 600	NO	YES	YES	4	Light Vehicles	NO	-	NO	Collector
		600 - 1020	NO	YES	YES	1	Light Vehicles	NO	-	NO	Access
	Rosenberger Rd	50 - 1035	NO	YES	YES	4	Light & Heavy Vehicles, Farm Machinery	YES	Horse Stud	YES	Collector
	Utz Rd	00 - 1225	NO	YES	YES	1	Light & Heavy Vehicles, Farm Machinery	NO	-	NO	Local
	Wyreema Cambooya Rd	430 - 3980	NO	YES	YES	9	Light & Heavy Vehicles	NO	-	NO	Collector
		3980 - 4400	NO	YES	YES	3	Light & Heavy Vehicles	NO	-	NO	Collector
		4400 - 4995	NO	YES	YES	6	Light & Heavy Vehicles	NO	-	NO	Collector
		4995 - 5910	NO	YES	YES	4	Light & Heavy Vehicles	NO	-	NO	Collector
		5910 - 6325	NO	YES	NO	-	Light & Heavy Vehicles	NO	-	NO	Collector

G5 – Study Area 5

Study Area	Road	Assessment Chainage	School Bus Route	Mail Service Run	Residential property access	Number of residential properties	Type of vehicles generally using road	Does road lead to place of frequent use ie dump, rec facility, intense farming		Does the road appear to be a valuable link in the road network	Road Classification
5	Doolan Rd	00 - 2675	YES	YES	YES	2	Light & Heavy Vehicles	NO	-	NO	Access
		2675 - 3630	NO	YES	YES	1	Light & Heavy Vehicles	NO	-	NO	Access
		3630 - 6035	NO	YES	YES	4	Light & Heavy Vehicles	NO	-	YES	Collector
	Holley Rd	430 - 1615	NO	YES	YES	1	Light & Heavy Vehicles	NO	-	NO	Local
		4080 - 6350	YES	YES	YES	1	Light & Heavy Vehicles	NO	-	NO	Access
	Lorenz Rd	00 - 2880	YES	YES	YES	4	Light & Heavy Vehicles	NO	-	NO	Collector
	Roeseller Rd	00 - 1420	NO	NO	NO	-	Light & Heavy Vehicles	NO	-	NO	Access
	Ted Mengel Rd	2790 - 3875	NO	YES	YES	3	Light & Heavy Vehicles	NO	-	NO	Local
	Venz Rd	00 - 1180	NO	YES	YES	2	Light & Heavy Vehicles	NO	-	NO	Local
		1180 - 3980	NO	YES	YES	1	Light & Heavy Vehicles	NO	-	NO	Local

Appendix H – Response Time Scores

H1 – Study Area 1

Road Name:	Cauleys Rd										
Assessment Chainage:	00 - 5415	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Access	x				x			x		
Total		30	5	2.5	10	15	2.5	20	10	2.5	97.5
Road Name:	Hartwigs Rd										
Assessment Chainage:	00 - 2860	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	Yes	x				x		x			
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Access	x				x			x		
Total		40	5	0	10	20	0	30	10	0	115
Road Name:	Lees Rd										
Assessment Chainage:	00 - 3255	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Access	x				x			x		
Total		30	5	2.5	10	15	2.5	20	10	2.5	97.5
Road Name:	Quinalow Edgefield Rd										
Assessment Chainage:	3325 - 4870	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Collector	x			x			x			
Total		30	5	2.5	20	10	2.5	30	5	2.5	107.5
Assessment Chainage:	4870 - 6445	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	Yes	x				x		x			
Mail Service Route	Yes	x				x		x			
Dwelling Presence	No		x			x			x		
Frequent Usage	No		x			x			x		
Road Class	Access	x				x			x		
Total		30	10	0	0	25	0	20	15	0	100
Road Name:	Wonga Plains South Rd										
Assessment Chainage:	4670 - 9835	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	Yes	x				x		x			
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	Yes	x			x			x			
Road Class	Distributor	x			x			x			
Total		50	0	0	30	10	0	50	0	0	140

H2 – Study Area 2

Road Name:	August Rd										
Assessment Chainage:	00 - 455	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Local		x			x			x		
Total		20	10	2.5	10	15	2.5	20	10	2.5	92.5
Road Name:	Bushell Rd										
Assessment Chainage:	00 - 1630	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Local		x			x			x		
Total		20	10	2.5	10	15	2.5	20	10	2.5	92.5
Road Name:	Connolly Rd										
Assessment Chainage:	00 - 355	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Local		x			x			x		
Total		20	10	2.5	10	15	2.5	20	10	2.5	92.5
Assessment Chainage:	355 - 815	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	No		x			x			x		
Frequent Usage	No		x			x			x		
Road Class	Access	x				x			x		
Total		20	10	2.5	0	20	2.5	10	15	2.5	82.5
Road Name:	Creek Crossing Rd										
Assessment Chainage:	1265 - 1700	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Local		x			x			x		
Total		20	10	2.5	10	15	2.5	20	10	2.5	92.5
Road Name:	Doug Rd										
Assessment Chainage:	00 - 1180	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	Yes	x				x		x			
Mail Service Route	Yes	x				x		x			
Dwelling Presence	No		x			x			x		
Frequent Usage	No		x			x			x		
Road Class	Collector	x			x			x			
Total		30	10	0	10	20	0	30	10	0	110
Assessment Chainage:	1180 - 1810	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	Yes	x				x		x			
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Access	x				x			x		
Total		40	5	0	10	20	0	30	10	0	115

Road Name:	Kahler Rd										
Assessment Chainage:	00 - 1920	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	Yes	x			x			x			
Road Class	Distributor	x			x			x			
Total		40	0	2.5	30	5	2.5	40	0	2.5	122.5
Road Name:	Mervyn Rd										
Assessment Chainage:	00 - 495	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Collector	x			x			x			
Total		30	5	2.5	20	10	2.5	30	5	2.5	107.5
Assessment Chainage:	495 - 1030	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Access	x				x			x		
Total		30	5	2.5	10	15	2.5	20	10	2.5	97.5
Road Name:	Patzwald Rd										
Assessment Chainage:	00 - 990	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Collector	x			x			x			
Total		30	5	2.5	20	10	2.5	30	5	2.5	107.5
Road Name:	Pioneer Rd										
Assessment Chainage:	835 - 2200	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	Yes	x			x			x			
Road Class	Distributor	x			x			x			
Total		40	0	2.5	30	5	2.5	40	0	2.5	122.5
Road Name:	Strack Rd										
Assessment Chainage:	00 - 555	Safety			Accessibility			Comfort			Total
	1915 - 2875	High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	No			x			x			x	
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Access	x				x			x		
Total		20	5	5	10	10	5	10	10	5	80
Assessment Chainage:	555 - 1915	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	No			x			x			x	
Dwelling Presence	No		x			x			x		
Frequent Usage	No		x			x			x		
Road Class	Local		x			x			x		
Total		0	15	5	0	15	5	0	15	5	60

Road Name:	Valewood Rd										
Assessment Chainage:	00 - 1650	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Collector	x			x			x			
Total		30	5	2.5	20	10	2.5	30	5	2.5	107.5

H3 – Study Area 3

Road Name:	F. Kent Rd										
Assessment Chainage:	00 - 5505	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Access	x				x			x		
Total		30	5	2.5	10	15	2.5	20	10	2.5	97.5

Road Name:	Knapdale Rd										
Assessment Chainage:	00 - 6460	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Collector	x			x			x			
Total		30	5	2.5	20	10	2.5	30	5	2.5	107.5

Road Name:	Matthews Rd										
Assessment Chainage:	00 - 3640	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	No			x			x			x	
Dwelling Presence	No		x			x			x		
Frequent Usage	No		x			x			x		
Road Class	Local		x			x			x		
Total		0	15	5	0	15	5	0	15	5	60

Road Name:	McIntyre Rd										
Assessment Chainage:	00 - 4005	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	No			x			x			x	
Dwelling Presence	No		x			x			x		
Frequent Usage	No		x			x			x		
Road Class	Access	x				x			x		
Total		10	10	5	0	15	5	0	15	5	65

Road Name:	Pedlar Rd										
Assessment Chainage:	00 - 7550	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	No			x			x			x	
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Access	x				x			x		
Total		20	5	5	10	10	5	10	10	5	80

Road Name:	Peters Rd										
Assessment Chainage:	00 - 5635	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	No			x			x			x	
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Access	x				x			x		
Total		20	5	5	10	10	5	10	10	5	80

Road Name:	Ruhle Rd										
Assessment Chainage:	00 - 4045	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	No			x			x			x	
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Local		x			x			x		
Total		10	10	5	10	10	5	10	10	5	75

H4 – Study Area 4

Road Name:	Bourne Rd										
Assessment Chainage:	00 - 700	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Collector	x			x			x			
Total		30	5	2.5	20	10	2.5	30	5	2.5	107.5

Road Name:	Cambooya Felton Rd										
Assessment Chainage:	11155 - 13895	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Distributor	x			x			x			
Total		30	5	2.5	20	10	2.5	30	5	2.5	107.5

Road Name:	Hoffman Rd										
Assessment Chainage:	00 - 1505	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Local		x			x			x		
Total		20	10	2.5	10	15	2.5	20	10	2.5	92.5

Road Name:	Lysaght Rd										
Assessment Chainage:	00 - 920	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Collector	x			x			x			
Total		30	5	2.5	20	10	2.5	30	5	2.5	107.5

Road Name:	Railway Pd										
Assessment Chainage:	00 - 600	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Collector	x			x			x			
Total		30	5	2.5	20	10	2.5	30	5	2.5	107.5

Assessment Chainage:	600 - 1020	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Access	x				x			x		
Total		30	5	2.5	10	15	2.5	20	10	2.5	97.5

Road Name:	Rosenberger Rd										
Assessment Chainage:	50 - 1035	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	Yes	x			x			x			
Road Class	Collector	x			x			x			
Total		40	0	2.5	30	5	2.5	40	0	2.5	122.5

Road Name:	Utz Rd										
Assessment Chainage:	00 - 1225	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Local		x			x			x		
Total		20	10	2.5	10	15	2.5	20	10	2.5	92.5

Road Name:	Wyreema Cambooya Rd										
Assessment Chainage:	430 - 6325	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Collector	x			x			x			
Total		30	5	2.5	20	10	2.5	30	5	2.5	107.5

H5 – Study Area 5

Road Name:	Doolan Rd										
Assessment Chainage:	00 - 3630	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	Yes	x				x		x			
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Access	x				x			x		
Total		40	5	0	10	20	0	30	10	0	115
Assessment Chainage:	3630 - 6035	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Collector	x			x			x			
Total		30	5	2.5	20	10	2.5	30	5	2.5	107.5
Road Name:	Holley Rd										
Assessment Chainage:	430 - 1615	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Local		x			x			x		
Total		20	10	2.5	10	15	2.5	20	10	2.5	92.5
Assessment Chainage:	4080 - 6350	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	Yes	x				x		x			
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	Access		x			x			x		
Road Class	Access	x				x			x		
Total		40	5	0	10	20	0	30	10	0	115
Road Name:	Lorenz Rd										
Assessment Chainage:	00 - 2880	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	Yes	x				x		x			
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Collector	x			x			x			
Total		40	5	0	20	15	0	40	5	0	125
Road Name:	Roeseller Rd										
Assessment Chainage:	00 - 1420	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	No			x			x			x	
Dwelling Presence	No		x			x			x		
Frequent Usage	No		x			x			x		
Road Class	Access	x				x			x		
Total		10	10	5	0	15	5	0	15	5	65

Road Name:	Ted Mengel Rd										
Assessment Chainage:	2790 - 3875	Safety			Accessibility			Comfort			Total
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Local		x			x			x		
Total		20	10	2.5	10	15	2.5	20	10	2.5	92.5

Road Name:	Venz Rd										
Assessment Chainage:	00 - 1180	Safety			Accessibility			Comfort			Total
	3480 - 3980	High	Medium	Low	High	Medium	Low	High	Medium	Low	
Paramter	Response	10	5	2.5	10	5	2.5	10	5	2.5	
School Bus Route	No			x			x			x	
Mail Service Route	Yes	x				x		x			
Dwelling Presence	Yes	x			x			x			
Frequent Usage	No		x			x			x		
Road Class	Local		x			x			x		
Total		20	10	2.5	10	15	2.5	20	10	2.5	92.5

Appendix I – Estimated Maintenance Cost

I1 – Study Area 1

Road Name			Cauleys	Hartwigs	Lees	Quinalow Edgefield		Wonga Plains South
Class			Access	Access	Access	Collector	Access	Distributor
Chainage			00 - 5415	00 - 2860	00 - 3255	3325 - 4870	4870 - 6445	7655 - 9835
Assessment Length (km)			5.415	2.86	3.255	1.545	1.575	2.18
	Months	Years	Expenditure					
Maintenance Cycle	0	1	$4,602.75	$2,431.00	$2,766.75	$1,313.25	$1,338.75	$1,853.00
	5							$1,853.00
	10					$1,313.25		$1,853.00
	15	2						$1,853.00
	20		$4,602.75	$2,431.00	$2,766.75	$1,313.25	$1,338.75	$1,853.00
	25							$1,853.00
	30	3				$1,313.25		$1,853.00
	35							$1,853.00
	40		$11,290.28	$5,963.10	$6,786.68	$3,221.33	$3,283.88	$4,545.30
Expenditure	Section		$20,495.78	$10,825.10	$12,320.18	$8,474.33	$5,961.38	$19,369.30
	Estimated		$20,495.78	$10,825.10	$12,320.18	$14,435.70		$19,369.30

I2 – Study Area 2

Road			August	Bushell	Connolly		Creek Crossing	Doug	
Class			Local	Local	Access	Local	Local	Collector	Access
Chainage			00 - 455	00 - 1630	355 - 815	00 - 355	1265 - 1700	00 - 1180	1180 - 1810
Assessment Length (km)			0.455	1.63	0.46	0.355	0.435	1.18	0.63
	Months	Years	Expenditure						
Maintenance Cycle	0	1	$386.75	$1,385.50	$391.00	$301.75	$369.75	$1,003.00	$535.50
	5								
	10							$1,003.00	
	15	2							
	20				$391.00			$1,003.00	$535.50
	25								
	30	3	$386.75	$1,385.50		$301.75	$369.75	$1,003.00	
	35								
	40				$959.10			$2,460.30	$1,291.50
Expenditure	Section		$773.50	$2,771.00	$1,741.10	$603.50	$739.50	$6,472.30	$2,362.50
	Estimated		$773.50	$2,771.00	$2,344.60		$739.50	$8,834.80	

Road			Kahler	Mervyn		Patzwald	Pioneer	Strack		Valewood
Class			Distributor	Collector	Access	Collector	Distributor	Access	Local	Collector
Chainage			00 - 1920	00 - 495	495 - 1030	00 - 990	835 - 2200	555, 1915 - 2	555 - 1915	00 - 1650
Assessment Length (km)			1.92	0.495	0.535	0.99	1.365	1.515	1.36	1.65
	Months	Years	Expenditure							
Maintenance Cycle	0	1	$1,632.00	$420.75	$454.75	$841.50	$1,160.25	$1,287.75	$1,156.00	$1,402.50
	5		$1,632.00				$1,160.25			
	10		$1,632.00	$420.75		$841.50	$1,160.25			$1,402.50
	15	2	$1,632.00				$1,160.25			
	20		$1,632.00	$420.75	$454.75	$841.50	$1,160.25	$1,287.75		$1,402.50
	25		$1,632.00				$1,160.25			
	30	3	$1,632.00	$420.75		$841.50	$1,160.25		$1,156.00	$1,402.50
	35		$1,632.00				$1,160.25			
	40		$4,003.20	$1,032.08	$1,115.48	$2,064.15	$2,846.03	$3,158.78		$3,440.25
Expenditure	Section		$17,059.20	$2,715.08	$2,024.98	$5,430.15	$12,128.03	$5,734.28	$2,312.00	$9,050.25
	Estimated		$17,059.20	$4,740.05		$5,430.15	$12,128.03	$8,046.28		$9,050.25

I3 – Study Area 3

Road Name			F.Kent	Knapdale	Matthews	McIntyre	Pedlar	Peters	Ruhle
Class			Access	Collector	Local	Access	Access	Access	Local
Chainage			00 - 5505	00 - 6460	00 - 3640	00 - 4005	00 - 7550	00 - 5635	2985 - 4045
Assessment Length (km)			5.505	6.46	3.64	4.005	7.55	5.635	1.06
	Months	Years	Expenditure						
Maintenance Cycle	0	1	$4,679.25	$5,491.00	$3,094.00	$3,404.25	$6,417.50	$4,789.75	$901.00
	5								
	10			$5,491.00					
	15	2							
	20		$4,679.25	$5,491.00		$3,404.25	$6,417.50	$4,789.75	
	25								
	30	3		$5,491.00	$3,094.00				$901.00
	35								
	40		$11,477.93	$13,469.10		$8,350.43	$15,741.75	$11,748.98	
Expenditure	Section		$20,836.43	$35,433.10	$6,188.00	$15,158.93	$28,576.75	$21,328.48	$1,802.00
	Estimated		$20,836.43	$35,433.10	$6,188.00	$15,158.93	$28,576.75	$21,328.48	$1,802.00

I4 – Study Area 4

Road Name			Bourne	Cambooya Felton	Hoffman	Lysaght	Railway		Rosenberger	Utz	Wyreema Cambooya
Class			Collector	Distributor	Local	Collector	Collector	Access	Collector	Local	Collector
Chainage			00 - 700	11155 - 13895	00 - 1505	00 - 920	00 - 600	600 - 1020	50 - 1035	00 - 1225	430 - 6325
Assessment Length (km)			0.7	2.74	1.505	0.92	0.6	0.42	0.985	1.225	5.895
	Months	Years	Expenditure								
Maintenance Cycle	0	1	$595.00	$2,329.00	$1,279.25	$782.00	$510.00	$357.00	$837.25	$1,041.25	$5,010.75
	5			$2,329.00							
	10		$595.00	$2,329.00		$782.00	$510.00		$837.25		$5,010.75
	15	2		$2,329.00							
	20		$595.00	$2,329.00		$782.00	$510.00	$357.00	$837.25		$5,010.75
	25			$2,329.00							
	30	3	$595.00	$2,329.00	$1,279.25	$782.00	$510.00		$837.25	$1,041.25	$5,010.75
	35			$2,329.00							
	40		$1,435.00	$5,617.00		$1,886.00	$1,230.00	$861.00	$2,019.25		$12,084.75
Expenditure	Section		$3,815.00	$24,249.00	$2,558.50	$5,014.00	$3,270.00	$1,575.00	$5,368.25	$2,082.50	$32,127.75
	Estimated		$3,815.00	$24,249.00	$2,558.50	$5,014.00	$4,845.00		$5,368.25	$2,082.50	$32,127.75

I5 – Study Area 5

Road Name			Doolan		Holley		Lorenz	Roeseller	Ted Mengel	Venz	
Class			Access	Collector	Local	Access	Collector	Access	Local	Local	
Chainage			00 - 3630	3630 - 6035	430 - 1615	4080 - 6350	00 - 2880	00 - 1420	2790 - 3875	00 - 1180	3480 - 3980
Assessment Length (km)			3.63	2.405	1.185	2.27	2.88	1.42	1.085	1.18	0.5
	Months	Years	Expenditure								
Maintenance Cycle	0	1	$3,085.50	$2,044.25	$1,007.25	$1,929.50	$2,448.00	$1,207.00	$922.25	$1,003.00	$425.00
	5										
	10			$2,044.25			$2,448.00				
	15	2									
	20		$3,085.50	$2,044.25		$1,929.50	$2,448.00	$1,207.00			
	25										
	30	3		$2,044.25	$1,007.25		$2,448.00		$922.25	$1,003.00	$425.00
	35										
	40		$7,441.50	$4,930.25		$4,653.50	$5,904.00	$2,911.00			
Expenditure	Section		$13,612.50	$13,107.25	$2,014.50	$8,512.50	$15,696.00	$5,325.00	$1,844.50	$2,006.00	$850.00
	Estimated		$26,719.75		$10,527.00		$15,696.00	$5,325.00	$1,844.50	$2,856.00	