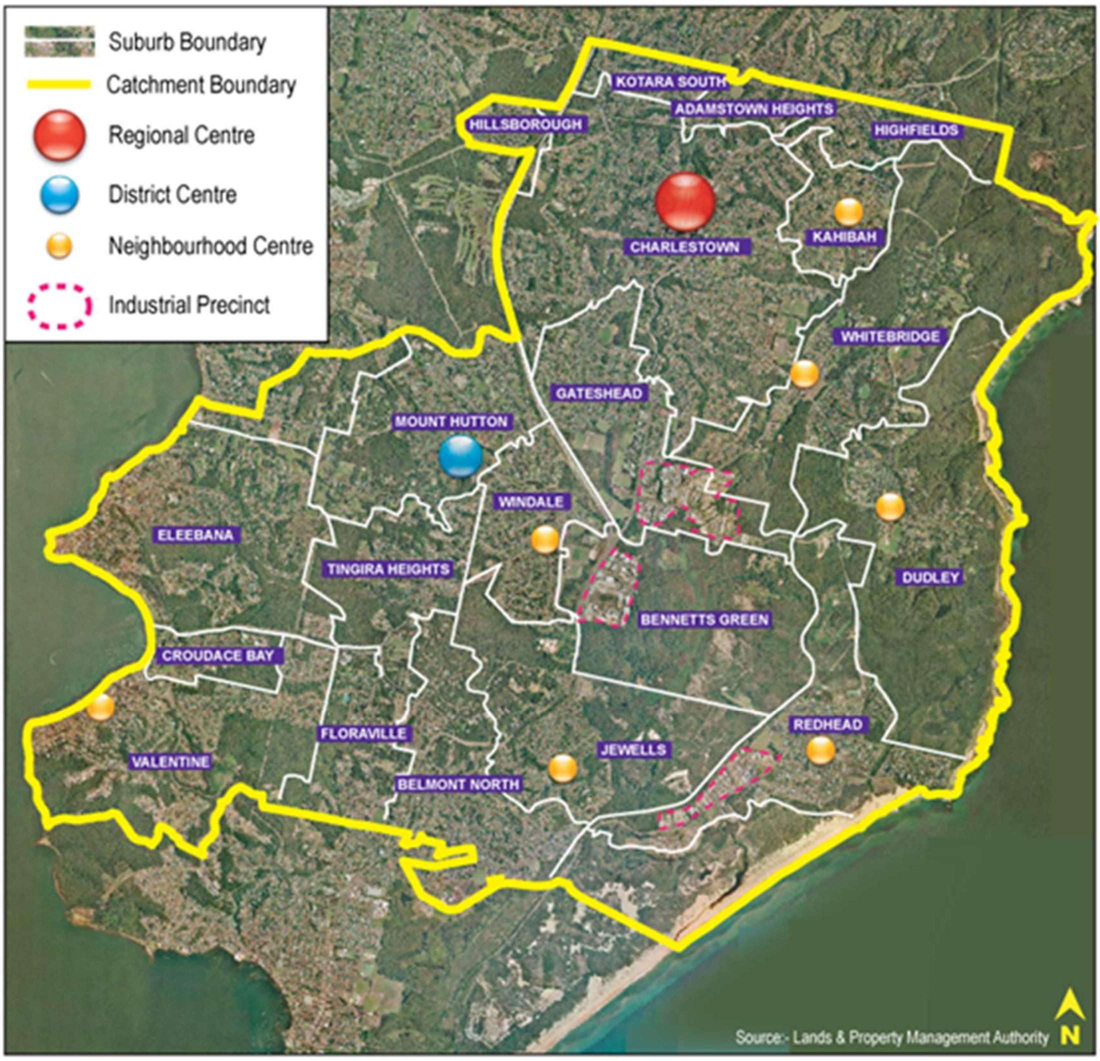
Charlestown Contribution Catchment Plan

Traffic and Transport Study



May 2015

Executive Summary

<u>Introduction</u>

Traffic and Transport Infrastructure is a key supporting element to the future growth planned in the Charlestown s94 Contributions Catchment. The Study Area includes and is focussed on, the major Regional Centre of Charlestown as identified in the Lower Hunter Regional Strategy. The Charlestown town centre has recently undergone significant expansion that provides the local area with the necessary level of local facilities to service the existing and planned growth of the Charlestown catchment.

The study has included a review of previous traffic investigations completed for a number of development and rezoning proposals, and has included assessment of all local road intersection, pedestrian, cyclist and public transport facilities required to support the community.

<u>The Study Area</u>

The study area covers the Charlestown s94 Contributions Catchment (**Figure 1.1)** divided into nine sub catchments **(Figure 1.2).**

<u>Study Objectives</u>

The study has considered the following objectives:

- The full range of local traffic and transport facilities justified to meet the technical demands of future development activity;
- Achieve a cost effective, safe and efficient transport system for all users;
- Satisfy the technical requirements for provision of traffic and transport facilities to agreed service levels and standards.

<u>Approach to Technical Assessment</u>

The local traffic and transport facilities covered by this investigation have included the performance of local:

- Roads
- Intersections
- Cycling and pedestrian facilities
- Public transport facilities

The emphasis is clearly on the provision of acceptable service levels on local infrastructure. However, traffic analysis has been performed, for example, on critical intersections where local roads meet the main road network, where these have influence on the adjacent local road performance.

In all cases, the following approach to technical assessment of performance has been adopted.

1. Agreement on Acceptable Performance Standards (Levels of Service)
2. Agreement on Acceptable Minimum Service Levels
3. Assessment of Existing Situation Performance
4. Upgrade of existing situation to meet Acceptable Performance Standard (where applicable)
5. Assessment of Agreed Growth Scenarios against Base Facilities
6. Assessment of Upgrade Scenarios to meet Acceptable Performance Standards (where applicable)

The emphasis in the analysis has been to test threshold or incremental upgrades to facilities so that over design (and hence over investment) of facilities is minimised. This approach has been particularly important in the assessment of local road upgrades required to satisfy the adopted service levels.

These works and their estimated costs are summarised in Table 0-1 'Summary of Identified Works and Capital Cost Estimates'.

Table 0-1 Summary of Identified Works and Capital Cost Estimates

Reference #	Charlestown Catchment - Facility Name	Capital Cost Estimate
	Charlestown Sub-Catchment	
Roads and Intersections		
L22	Kahibah Road – Hexham Street – Wallsend Road – single lane roundabout	$2,000,000
L25	Smith Street - Smart Street – Traffic Signals – Single Lane approach	$600,000
L26	Smith Street - Frederick Street - Traffic Signals – Single Lane approach	$600,000
L27	Smith Street - Ridley Street Traffic Signals – Single Lane approach	$600,000
	Sub-Total	**$3,800,000**
	Pedestrian / Bicycle Facilities	
C1	Warners Bay Road from Bypass to Moto Street - Off Road Shared Pathway – 1.8km	$1,250,000
	Sub-Total	**$1,250,000**
	Public Transport Facilities	
	New Bus Shelters x 7	$210,000
	Sub-Total	**$210,000**
	Mount Hutton / Windale Sub-Catchment	
Roads and Intersections		
L23	Warners Bay Road – Bayview Street – Dunkley Road – single lane roundabout	$1,700,000*
L24	Violet Town Road – Wilsons Road – single lane roundabout	$2,000,000
L30	South Street – Merrigum Street – traffic signals dual lane aproach	$2,060,000
	Langdon Way extension	$491,368
	Sub-Total	**$6,251,368**
*L23 is on boundary of Charlestown and Glendale catchment, with 50/50 distribution of costs		
	Eleebana Sub-Catchment	
Pedestrian / Bicycle Facilities		
C7	Eleebana – Bareki Road - Toonibal Avenue to Eleebana Lions	$4,254,000

Reference #	Charlestown Catchment - Facility Name	Capital Cost Estimate
	Park – Off Road Shared Pathway – 0.45km	
C6	Tingira Drive from Violet Town Road to Macquarie Drive, Eleebana – Off Road Shared Pathway – 4.0km	$950,000
	Sub-Total	**$5,240,000**
	Dudley Sub-Catchment	
	Pedestrian / Bicycle Facilities	
C2	Fernleigh Track to Dudley – Off Road Shared Pathway – 2.0km	$2,000,000
	Sub-Total	**$2,000,000**
	TOTAL	**$18,751,368**

*Cost for Bayview Street, Dunkley Parade and Warners Bay Road distributed 50/50 between Charlestown and Glendale catchments as the intersection is on the boundary of the two catchments.

In addition to local road and intersection works, the work schedule includes items under the categories of local public transport, pedestrian and cycle facilities, to meet nominated minimum service levels on collector roads.

The analysis conducted seeks to justify any works put forward for inclusion in the plan against the agreed performance levels. As such, not all works nominated for consideration in the study brief has been found to be required to meet the nominated service levels.

Road & Intersection Upgrades

Local Road and Intersection Upgrades have been considered within the nominated sub-catchments. In many cases, road upgrades can be attributed to a specific development need, and hence upgrading has been assumed to be required as a condition of that development, rather than for multiple sites. The Itemised Work Schedule summarises the works with nominated upgrade sites illustrated and is described in more detail under the nominated project descriptions in **Section 3 – Concept Plans and Costings.**

Public Transport, Pedestrian & Cycle Facilities

In terms of local public transport, pedestrian and cycling needs there is a fundamental assumption that new developments will provide works and facilities in accordance with Council policies where these relate specifically to the individual development. Additionally in order to complete a network of facilities to meet a minimum service level for connectivity, a series of works along collector routes has been nominated. These works are particularly focussed on connections to the Charlestown Town Centre. The extent of these facilities is related to the nominated sub-catchment within the study area.

Works Concepts and Engineering Estimates

The works identified as part of this study have been developed as concepts only. The level of assumed knowledge and the subsequent accuracy of estimates of costs reflect this early stage of project development.

The procedures utilised to develop concept estimates have been established to allow the inclusion and updating of information as the concepts are developed through more detailed phases of design and implementation.

Cost Apportionment

Having justified the items for inclusion in the works schedule to deliver acceptable performance levels, and identified estimates of costs for the concepts, apportionment of costs has been calculated as follows:

- Where the need for a particular facility can be attributed as 100% to one development activity, the work is noted as such, and is assumed would be a condition imposed on that development activity.
- Where the need for upgrade to a facility or for a new facility is derived from multiple development activities (including existing development) the cost is apportioned between the contributing developments.
- Where the need for a particular facility is related to provision of a minimum service level across the study area, consideration has been given to implementing a study area wide contribution (per unit of development activity).

The works schedule has been prepared taking into consideration the transport needs of the nominated sub-catchments, to arrive at a contribution amount for each sub-catchment.

Next Steps

Having established a contribution framework derived from a first principles assessment of transport needs, operational performance, and targeted upgrades to arrive at acceptable service levels to accommodate planned growth, the basis of the plan will be subject to consultation and review prior to being finalised and presented to Council for its consideration and adoption.

Section 1: Contribution Plan

1. Introduction

Council's Transportation Planning Section has reviewed and updated the initial transport study and report, prepared as part of the Don Fox Planning (DFP) team, commissioned to prepare the Charlestown Contributions Catchment Development Contributions Plan (The Plan). This updated report focuses on traffic and transport infrastructure needs for The Plan.

1.1 Purpose of Study

The Charlestown Traffic and Transport Study (The Study) is a supporting document of The Plan. The study identifies the traffic and transport infrastructure that is required to meet the transport demands of new development within the Charlestown Contributions Catchment to the year 2025.

This is based on a Council endorsed estimate of an economic and development scenario prepared by Council's Integrated Planning Section and DFP.

1.2 Objectives

The study includes the following tasks, with a focus on traffic and transport matters:

- a review of existing studies for a number of rezoning and planning and development application submissions in the Charlestown Contributions Catchment;
- need for basic road and intersection upgrades to support development in the area;
- additional investigations of pedestrian/cycle links; and
- need for upgrades to local bus infrastructure.

The overall traffic and transport objectives to be achieved were to arrive at a cost effective, safe and efficient transport system that addresses the expected increase in demand for private car travel, goods movement, public transport, pedestrian and cycle trips across the study area.

1.3 Land to Which the Study Applies

The Study Area is the Charlestown s94 Contributions Catchment, as illustrated in **Figure 1-1,** which is also broken down into nine (9) sub-catchments as follows:

- Charlestown;
- Dudley;
- Mount Hutton
- Windale;
- Eleebana;
- Valentine;
- Belmont North
- Floraville; and
- Redhead.

1.4 Approach to the Study

Lake Macquarie City Council (LMCC) is faced with a dynamic planning environment, where there are applications and submissions for development at all stages of the planning process.

Within the Charlestown Contributions Catchment, in recent years, this has included:

- Development consents subject to conditions. Examples include the redevelopment of the Charlestown Square shopping centre in the Charlestown CBD as well as large residential developments.
- Environmental Studies and Investigations.

Wherever possible and relevant the conditions relating to these and other completed plans and development consents, have been considered in this review.

The Plan is a local plan and hence focuses on local street facilities:

- Roads
- Intersections
- Pedestrian and cycling facilities
- Local public transport facilities

It does not include works or services relating to non-local assets, such as State roads, regional bus and rail facilities and services. It also does not include projects, which relate strictly to the Town Centre Upgrade projects, such as the Charlestown Square Development, pedestrian improvements and urban design improvements.

Figure 1.1 Charlestown Contributions Catchment

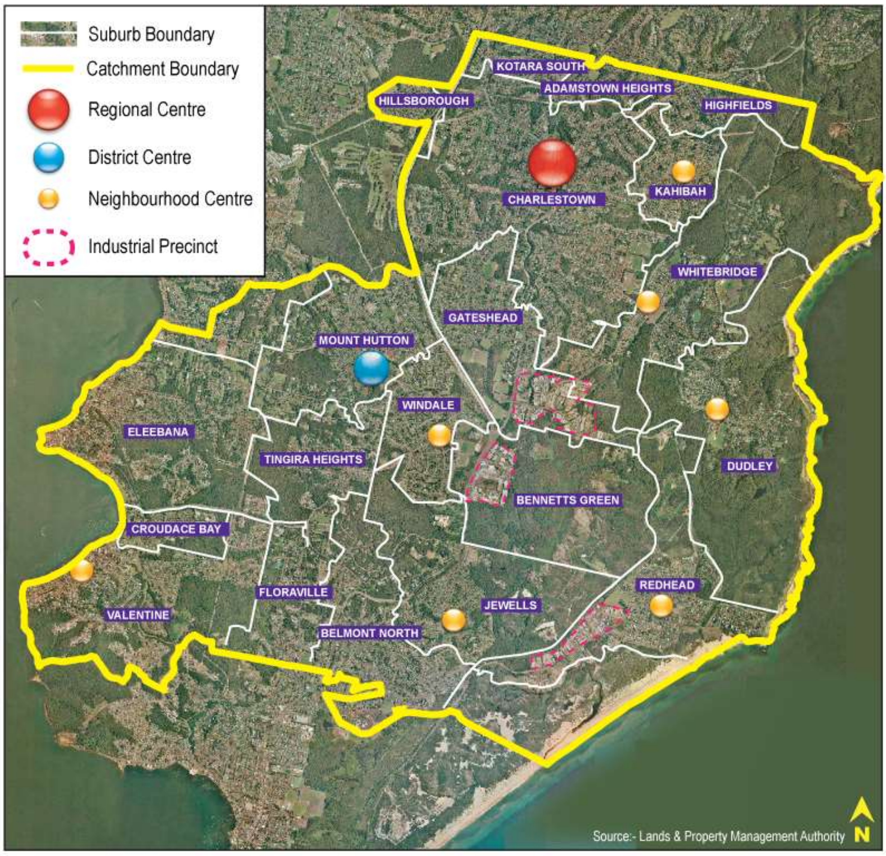
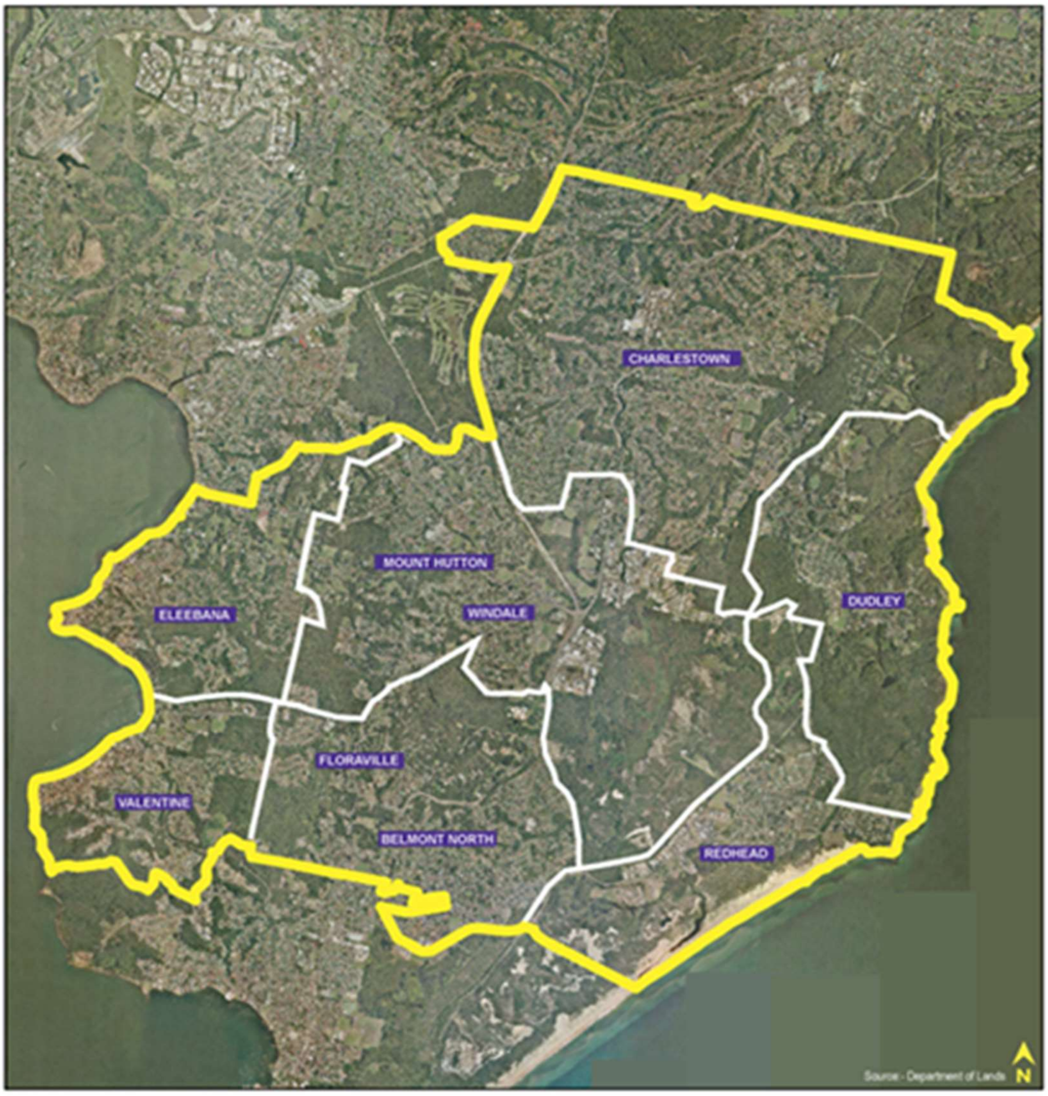


Figure 1.2 Charlestown Transport sub-catchments



2. Discussion on Performance Standards

2.1 Introduction

A fundamental keystone of all infrastructure planning requires the adoption of specific performance standards with regard to the operation of the transport network. The adoption requires consideration of such concepts as levels of service, where it is possible to achieve a range of passenger and vehicle flow scenarios, depending on the capacity and delay considerations adopted. The following sections discuss the issue of performance standards and guidelines in relation to the adopted performance criteria, as they relate to the local infrastructure provision that is the focus of this study.

2.2 Level of Service Assumptions

The concept of Levels of Service (LoS) has been applied in transport planning for many years. Austroads has defined a range of traffic conditions associated with a scale of A to F for urban and suburban arterial roads with interrupted flow conditions based on average travel speeds when related to free flow conditions.

Clarification has been sought recently as to the Roads and Maritime Services (RMS) interpretation of transport planning thresholds relating to level of service when being applied to road planning investigations.

The confirmed current policy of the RMS is the application of Level of Service D, being the defined boundary between stable and unstable flow, as the appropriate threshold to apply in these circumstances. The RMS also explained that:

"Given that road capacity varies for each road depending upon the road's function, attributes (posted speed limit, lane width, intersection spacing, clearway, etc.) and environment, each road should be assessed individually"

Based on this statement, the Austroads Guidelines and the RMS application of Level of Service D confirm the conclusion that it is considered appropriate to examine each road and indeed each differing segment of a road, to assess its function, operating conditions and traffic carrying capacity.

The Austroads LoS definitions and evaluation is based on the 1985 US Highway Capacity Manual (HCM) methods. The Austroads guide quotes Average Travel Speeds (ATS) based on the HCM 1985 definition of Road Classes. For a Level of Service D on a Class I road (the highest standard) the Average Travel Speed is quoted as greater than or equal to 25 km/hr and less than 35 km/hr. For other Classes of road the Average Travel Speed reduces to as low as 15 km/hr.

In terms of evaluation of performance it is useful to first compare performance to the typical values as described in the guide, and only consider segments of road where these criteria are exceeded. In practical terms this may mean that some sections of road are operating at higher service levels than for a "typical" road because they demonstrate some of the characteristics that allow higher lane capacity.

The RMS Guide to Traffic Generating Developments, another often quoted guide used in determining traffic engineering matters relating to development traffic impacts, references the Austroads Guide Part 2 and states that the quoted peak hour flows for different service levels are *"based on volume / capacity ratios applicable for rural roads in level terrain with no sight distance restrictions on overtaking".*

This assumption regarding overtaking restrictions becomes significant when considering urban travel conditions where the prospect of overtaking on two lane roads is very limited. Indeed, in many cases this opportunity is removed from drivers by the road authorities preventing overtaking for safety reasons by line marking roads with double barrier centrelines.

The comment noted in the RMS guide and the restrictions placed on overtaking also reaffirm the Austroads guide's statement that capacities at times may increase under ideal conditions to 1200-1400 veh/hr (see below). The base assumption of rural road capacity in defining levels of service becomes significant in terms of assessing true urban road conditions. Indeed the correct interpretation of Levels of Service for Urban Roads with interrupted flow comes from the definitions relating to Average Travel Speeds as described above.

The analysis of critical road segments in these investigations has taken the above criteria and definitions of Levels of Service (LoS) into consideration.

2.3 Road Capacity Concepts

Road capacities have been derived from a number of sources from two important flow rates. The **ultimate capacity** of a road is used to predict the volumes that would use the road given the number of lanes and type of road assumed. From these, the roads where volumes were predicted as exceeding a **maximum service flow rate** for a level of service (LoS) D are flagged as requiring investigation for upgrading. Upgrades may include adding lanes, changing the type of road or a reconsideration of the operating conditions on that section of road.

The graphs below illustrate the concept that the ultimate road capacity is higher than the maximum service flow rate for a particular LoS D. Sensitivities relating to level of service assumptions have also been conducted.

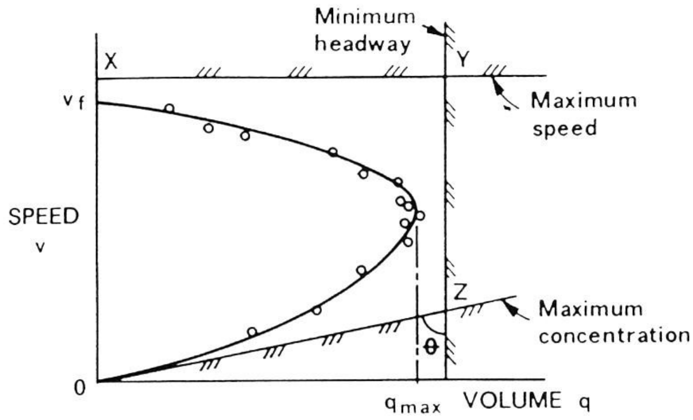


Figure 2.1 Speed-Volume Relationship

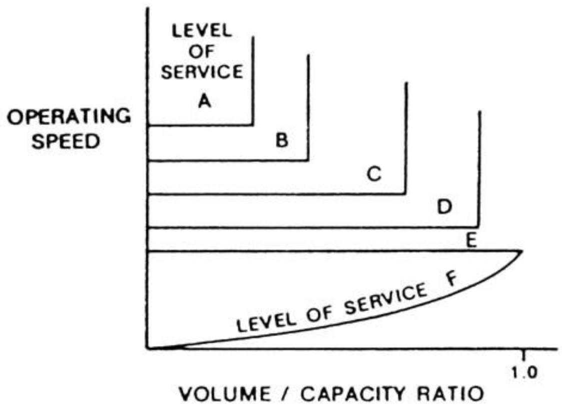


Figure 2.1 Levels of Service

Source: Ogden, K.W., Bennett, D.W. (eds), *Traffic Engineering Practice* (4th Edition), Melbourne, 1989

The RMS Guide to Traffic Generating Developments, 2002, makes references to the Austroads Guide to Traffic Engineering Practice – Part 2 Roadway Capacity (1988) which in turn references to US Highway Capacity Manual (TRB 1985).

The Highway Capacity Manual (HCM) recommends that the capacity for a two lane highway is 1,700 passenger cars per hour per lane (pcphpl).

The Austroads Guide to Traffic Engineering Part 2, 1988, recommends that 1,200 to 1,400 vehicles per hour per lane is the capacity of urban arterial roads with interrupted flow.

There are many examples within the Hunter and Sydney urban areas where such lane flows are regularly observed. The flows on these roads are achieved through higher capacities relating to their physical design, but also with traffic management such as parking restrictions, signal coordination and flaring at intersections.

The Austroads Guide quotes typical mid-block capacities with interrupted flow and without intersection flaring and with interruptions from cross and turning traffic at minor intersections. This is the often quoted capacity of 900 vehicles per hour per lane. The guide continues to explain this issue of capacity as follows:

"Peak period mid-block traffic volumes may increase to 1,200 to 1,400 vehicles per lane per hour on any approach road when the following conditions exist or can be implemented:

- *Adequate flaring at upstream junctions*
- *Uninterrupted flow from a wider carriageway upstream of an intersection approach and flowing at capacity*
- *Control or absence of crossing or entering traffic at minor intersections by major road priority controls*
- *Control or absence of parking*
- *Control or absence of right turns by banning turning at difficult intersection*
- *High volume flows of traffic from upstream intersections occurs during more than one phase of a signal cycle*
- *Good co-ordination of traffic signals along the route"*

What this means in practical terms is that it is very possible to achieve lane capacities of up to 1,400 vehicles per lane per hour if some or all of the above conditions apply to a particular stretch of road. Based on these conditions and evidence from practical examples the capacity of principle traffic carrying routes in the study area was taken as 1,200 vehicles per hour per lane. This value is conservative and in the mid-range of those suggested by the Austroads, HCM and RMS guides, and also from surveyed road volumes.

2.4 Road Capacity Thresholds

While the capacities of the roads have been used to determine the amount of traffic, which would use the road, a maximum service flow rate for LoS D has been used to determine whether or not a road requires upgrading. The RMS has confirmed recently that this is the appropriate thresholds to use in urban conditions.

The traffic flow conditions, which have been used as the threshold for predicting upgrading of the roads is the estimated point where traffic flow changes from D to E. This has been assumed so that unstable flow is avoided where possible. This becomes a necessary component in supporting any potential public transport initiatives. Continuing upgrading of roads with higher levels of service will not attract drivers to change their travel mode and could even induce extra car trips.

The volumes, which have been assumed as the point of transition from LoS D to E, are included in **Table 2.1** below.

Table 2.1 Road Capacity Thresholds

Road Type	Average Travel Speed for Urban LoS D	Typical Mid-Block Capacity for LoS D	Proposed Traffic Capacity for LoS D	Capacity (HCM)
Urban Two-way Two-lane	25 to 35	900	1600	1,700
4 lane undivided – with occasional parked cars		1500 in 2 lanes	1700	3,200
4 lane undivided – with Clearways		1800 in 2 lanes	1800	3,200
4 lane divided		1900 in 2 lanes	2200	3,200

Source: RTA, Austroads, HCM

In recent times the RMS has accepted peak period lane capacities of up to 1500 vehicles per hour per lane. This is evident in its recent decision to replace the Tourle Street Bridge over the Hunter River with a two lane bridge, thereby maintaining the existing lane capacity for this strategically important arterial road. It is concluded, that these capacities are consistent and therefore, should be applied as the basis of assessment of the critical segments of the road throughout the Charlestown Contributions Catchment.

2.5 Environmental Capacity of Local Roads

The RMS Guide to Traffic Generating Developments, 2002, recognises that *“the Environmental Capacity of an area is determined by the impact of traffic, roads and various aspects of the location”.*

Characteristics recognised as having influence include:

Traffic

- Traffic volume
- Traffic composition, in particular the proportion of heavy vehicles
- Vehicle speed

Road

- Road reserves and carriageway width
- Number of traffic lanes
- Gradient
- Road surface condition

Locality

- Distance from road carriageway to property boundary
- Nature of intervening surfaces
- Setback of building from property boundary
- Type and design of building

2.6 Intersections

In practice, it has long been agreed that the major limit on road capacity in an urban environment is intersection capacity. Requirements for intersection upgrades are generally determined using traffic modelling tools such as the SIDRA, SCATES and TRANSYT intersection modelling programs based on providing a Level of Service of D or better. In this way, the impact of intersection capacity on mid-block capacities is minimised. In this study the SIDRA traffic modelling software has been applied.

SIDRA calculates the amount of delay to vehicles using an intersection and gives a level of service rating, which indicates the relative performance of the intersection control. **Table 2.2 Intersection Level of Service Criteria** presents the level of service criteria generally applied to intersection performance. The level of service is defined in terms of delay, which is a measure of a driver’s delay, frustration, fuel consumption and lost travel time. There are six levels of service measures ranging from A (very low delay, very good operating conditions) to F (over-saturation, where arrival rate exceeds intersection capacity). SIDRA also calculates the degree of saturation for the intersection (the ratio of volume to capacity on the most critical movements).

Table 2.2 Intersection Level of Service Criteria

Level of Service	Average Delay per vehicle (sec)	Expected Delay
Signalised Intersections and Roundabouts		
A	0-14	Little or no delay
B	15-28	Minimal delays & spare capacity
C	29-42	Satisfactory delays with spare capacity
D	43-56	Satisfactory but near capacity
E	57-70	At capacity, incidents will cause excessive delays
F	>70	Extreme delay, unsatisfactory
Give Way & Stop Signs		
A	0-20	Good
B	20-40	Acceptable delays & spare capacity
C	40-60	Satisfactory
D	60-80	Near capacity
E	80-100	At capacity & requires other control mode
F	>100	Unsatisfactory & requires other control mode

Note: Based on the RTA NSW method of calculation of Level of Service

Based on the level of traffic generation determined previously and the number of access points and travel lanes assumed for development, it is possible to consider some initial concepts for operation of local road intersections under the development scenario being considered. As indicated previously the level of traffic generation may require higher orders of control such as roundabouts or traffic signals at these junctions.

The design of the road network and intersections controls would be a staged process as part of project planning, and in particular would be linked to the overall staging of the development parcels.

2.7 Local Public Transport

Section 94 can provide for the provision of transport facilities to satisfy the demands generated by new development. This would typically exclude the provision or operation of public transport facilities but can include associated infrastructure such as bus shelters, bus stops and footpath connections.

The following issues have been noted from observations and past studies as requiring consideration in developing local public transport facilities.

2.7.1 Rail Access Issues

There are currently no issues relating to railway access, as there are no railway lines in the Charlestown Catchment area.

2.7.2 Local Buses

In order to encourage the use of public transport it will be necessary to provide a viable sustainable public transport service to the new areas of development. The following planning parameters need to be considered in order to develop better public transport facilities:

- The majority of new areas of development should be within 400m of a bus stop.
- All existing bus timetables need improving. There will be a need to increase frequency of all existing services as residential, retail, commercial and industrial development progresses. Although this may not be a specific s94 cost, it has been identified as part of the overall improvements to public transport to improve patronage, which justifies other PT facilities such as improved bus stop facilities at key locations.
- The exact location of bus stops will need to be reviewed as development progresses to ensure the locations are convenient, safe and appropriate.

- No requirement for bus priority at non-RMS roads/intersections has been identified at this stage and is beyond the scope of this study. Any increase in bus services as a result of increased population and development should involve bus interchange facilities in both location and service timetables.

- Increase in general population levels in the area will increase demand to Newcastle, (Route 111) and other facilities to the north - University/Hospital (Route 100). There is an identified need to work with State Government public transport authorities to improve existing levels of service.

- Process to notify Transport NSW of increased population and whether requirement to review extensions to the kilometres of bus contracts for the area.

2.8 Cycling Facilities

The standard of cycling facilities can vary, as with public transport street furniture, depending on the importance of the location (such as at local shops, or a school) and its patronage levels. Council has considered the overall needs of the Lake Macquarie area in its Cycling Strategy, first developed as a city-wide plan in the mid 1990's, and comprehensively updated and adopted by Council in 2012. This strategy provides the framework for consideration of cycle facilities for updating and application in this study.

For the purpose of this study, cycling facilities would be dealt with in a two-tiered consideration of facilities:

- Local cycle paths – assumed to have low level signage, considered appropriate for low patronage locations and developed as dual use (cycle/ pedestrian) shared pathways.
- Collector cycle facilities– assumed to have higher levels of patronage because of location (at shops or road junctions where catchments are extended). These facilities are concentrated on the collector routes that serve the locality and link surrounding sub-catchment areas. These facilities have been assumed to be developed as dual use (cycle/ pedestrian) shared pathways.

The extent to which these facilities can be attributed to new or to existing development activity is discussed in section 5 of this report.

2.9 Pedestrian Facilities

Council's Standards and Guidelines require all new development to include minimum standards of pedestrian facilities. In the past, this has not always been the case, so there are inconsistencies in the provisions in some parts of the study area's network. Council has also recently adopted its Footpath Strategy 2013-2023 for the LGA. All footpath facilities required as part of any development consent conditions will be assessed in accordance with the objectives of the Footpath Strategy, as well as Council's DA guidelines.

For the purpose of this study, pedestrian facilities would be dealt with in a two-tiered consideration of facilities:

- Local pedestrian paths – assumed to have low level signage, considered appropriate for low patronage locations and developed as standard footpaths.
- Collector facilities– assumed to have higher levels of patronage because of location (at shops or road junctions where catchments are extended). These facilities are concentrated on the collector routes that serve the locality and link surrounding sub-catchment areas. Again these facilities have been assumed to be developed as dual use (cycle/ pedestrian) paths.

The extent to which these facilities can be attributed to new or to existing development activity is discussed in section 5 of this report.

2.10 Parking

The demands and requirements of parking in and around the Charlestown town centre will be significantly influenced by completed/under construction developments within the Charlestown CBD. Once completed and operational the additional parking supply will change the nature of parking in the town centre. Consequently, Council has decided to defer any consideration of parking in this study until a time when observations covering the new parking regime can be made, and an assessment made of any further need for parking.

Until such time as Council adopts a Development Contributions parking scheme, any new development will need to individually satisfy relevant parking supply requirements on-site or via a Voluntary Planning Agreement (VPA).

3 Existing Transportation Situation

3.1 Introduction

Charlestown is identified as a Major Regional Centre in the NSW Government's Lower Hunter Regional Strategy (LHRS), produced in October 2006. The NSW Department of Planning has recently completed its review of the LHRS. One of the findings of the study has indicated that Charlestown has been forecast to experience an increase in housing development in the order of 6600 dwellings over the 25 year life of the strategy. This is based on the assumption that, there will be comparable levels of employment generating activity, primarily focussed on the Charlestown town centre. This has been evident for example with the redevelopment of the Charlestown Square Shopping precinct within in the town centre.

It is within this context that the existing situation of transport assets in the study area, has been considered.

3.2 Roads

The existing road network is made up of a series of arterial, sub arterial road and local collector roads (see **Figure 3.1** Study Area Roads), linking the suburbs of the Charlestown Contribution Catchment to the wider regional road network. This includes State Highway 10 (Pacific Highway) which links Charlestown to Newcastle in the north and the Central Coast in the south. Any construction on this route will require concurrence from the RMS. The key roads that make up the Charlestown road network include:

1. **Dudley Road (R01)**: A two lane two-way road with a width in the order of 12 metres. Dudley Road has a lane's width of approximately 5.5 metres. Dudley Road forms part of MR325, linking Charlestown to the north and Dudley in the south via Whitebridge. Dudley Road currently operates under a posted 60km/h speed limit.
2. **Warners Bay Road (R02):** Warners Bay Road forms part of MR325 between the Pacific Highway (SH10) in the east and The Esplanade on the Lake Macquarie foreshore in the west. Warners Bay Road operates under a posted 60km/h speed limit, while during the school morning and afternoon periods there are sections with posted speed limits of 40km/h. Lane configuration for Warners Bay Road varies from two lane two way sections to four lane two way sections, with lane widths of approximately 3.5 metres.
3. **Charlestown Road (R03):** A two way four lane road in the order of 12 metres wide. Charlestown Road has a lane width in the order of 3 metres. Charlestown Road forms part of MR674, which links Charlestown in the east to Warners Bay in the west. Charlestown Road terminates at a roundabout north of Charlestown, adjacent to the Newcastle City Bypass and Park Road and currently operates under a posted 60km/h speed limit.
4. **Pacific Highway (R04):** The Pacific Highway forms SH10 and links Sydney in the south to Brisbane in the north. The Pacific Highway is the major roadway in the locality and provides at least two lanes of travel in each direction throughout the locality. The Pacific Highway operates under varying posted speed limits (40-80 km/h) throughout the Charlestown locality.
5. **The Newcastle City Western Bypass (R05):** The Newcastle City Western Bypass is a dual carriageway, which operates under a posted 90km/h speed limit. The Bypass consists of four lanes with a lane width of approximately 3.6 metres.
6. **Lonus Avenue (R06): –** A two lane two way road with a width in the order of 8 metres. Lonus Avenue has a lane's width of approximately 3.2 metres. Lonus Avenue links Whitebridge to Charlestown to the north and Dudley to the south. Lonus Avenue currently operates under a posted 50km/h speed limit.
7. **Waran Road (R07):** - A two lane two way road with a width in the order of 9 metres Waran Road has a lane's width of approximately 3.3 metres. Waran Road forms part of MR325, linking Charlestown to the north and Dudley in the south via Whitebridge. Waran Road currently operates under a posted 50km/h speed limit.
8. **Bayview Street (R08)**: A two lane two way road with a width in the order of 9 metres. Bayview Street has a lane's width of approximately 3.5 metres. Bayview Street forms part of a major link between Warners Bay and Charlestown. Bayview Street currently operates under a posted 50km/h speed limit

9. **Violet Town Road (R09):** A two lane two way road with a width in the order of 9 metres. Violet Town Road has a lane's width of approximately 3.5 metres. Violet Town Road is a collector road linking Belmont North to the south and Mount Hutton to the north. Violet Town Road currently operates under a posted 60km/h speed limit.
10. **New Road linking Wilsons Road to Willow Road (R10):** A new two lane two way road with a width in the order of 10 metres. The new road will have a lanes width of approximately 3.5 metres. The new road will be a local road connecting Wilson's Road and Willow Road and will operate with a 50km/hr speed limit.
11. **Smith Street (R11):** A two lane two way road with a width in the order of 10 metres. Smith Street has a lane's width of approximately 3.5 metres. Smith Street is a local road located within the Charlestown CBD area and operates under a posted 50km/h speed limit.
12. **Smart Street (R12):** A two lane two way road with a width in the order of 10 metres. Smart Street has a lane's width of approximately 3.5 metres. Smart Street is a local road located within the Charlestown CBD area and operates under a posted 50km/h speed.
13. **Ridley Street (R13):** A two lane two way road with a width in the order of 10 metres. Ridley Street has a lane's width of approximately 3.5 metres. Ridley Street is a local road located within the Charlestown CBD area and operates under a posted 50km/h speed.
14. **Extension of Langdon Way (R14)**: A single lane two way road with a width of 7m.
15. **Bullsgarden Road (R15):** A two lane two way road with a width in the order of 10 metres. Bullsgarden Road has a lane's width of approximately 3.5 metres. Bullsgarden Road is a collector road Whitebridge to the north and Gateshead to the south and currently operates under a posted 60km/h speed limit.

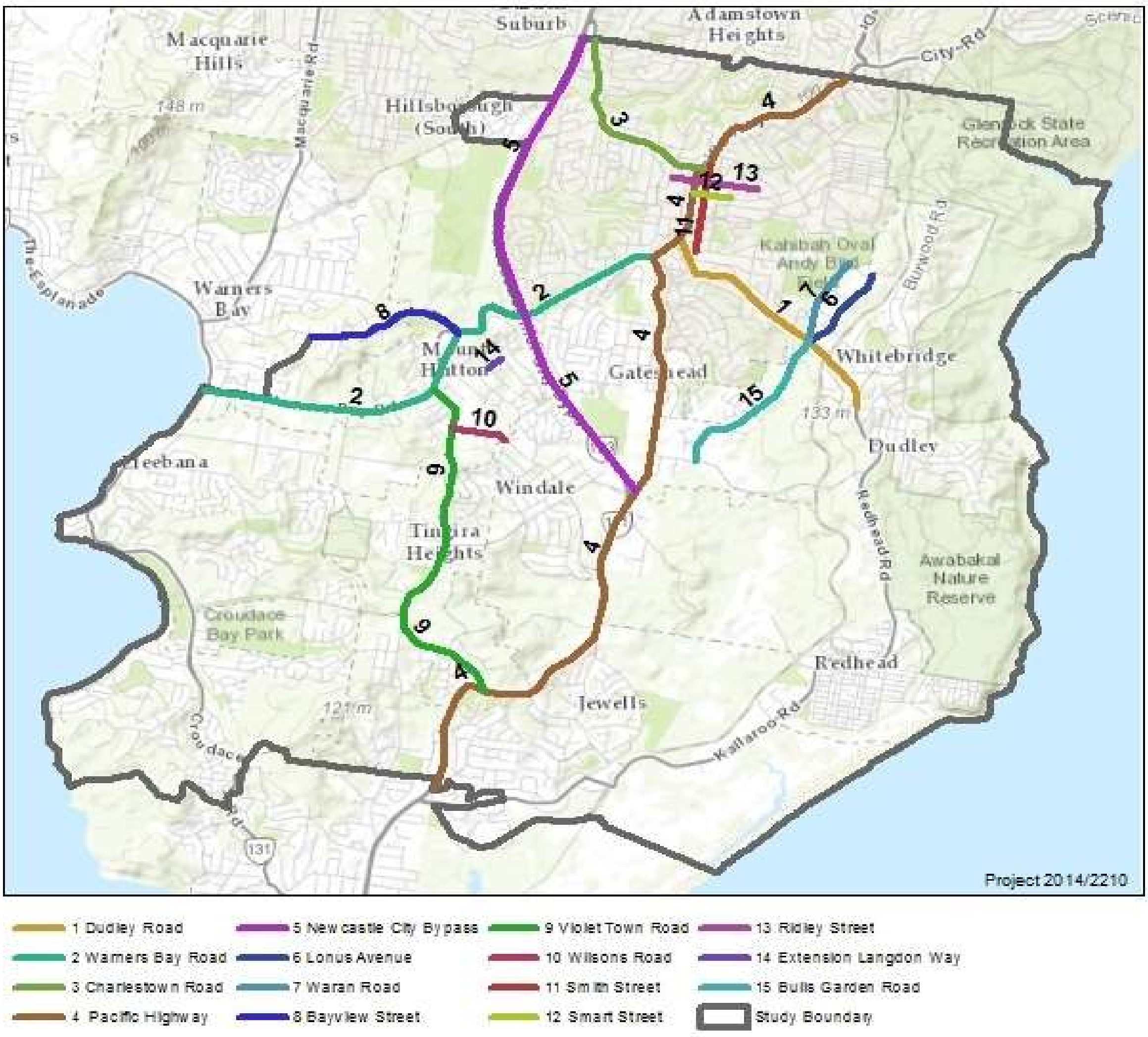


Figure 3.1 Study Area Roads

3.3 Intersections

The following intersections were identified in the early stages of the project, and in previous studies, as having capacity limitations. They have been reviewed to assess the provision of adequate capacity for the infrastructure and development upgrades. The location of these intersections is illustrated on **Figure 3-2** - Local Intersections.

1. **Charlestown Road – Powell Street – Chapman Street (L1):**
   A four leg, double lane roundabout. Charlestown Road has two lanes two ways, while Powell Street and Chapman Street have a single lane in each direction**.**

2. **Charlestown Road – Pacific Highway (L2):**
   A Signalised T intersection. The left hand turn from Charlestown Road onto the Pacific Highway is a continuous slip lane, whilst the left hand turn from the Pacific Highway onto Charlestown Road is a Give Way controlled slip lane. There are two right hand turning lanes out of Charlestown Road onto the Pacific Highway. On the Pacific Highway, the northbound through movement consists of two traffic lanes and a bus lane whilst the southbound movements consist of two through movement traffic lanes and two right turn lanes from the Pacific Highway onto Charlestown Road.

3. **Dickinson Street – James Street (L3):**
   A T intersection with James Street as the major through road. Dickinson Street operates under a signed Give Way control.

4. **Dudley Road – James Street (L4):**
   A T intersection with Dudley Road the major through road. James Street operates under Stop control.

5. **Dudley Road – Algona Road – Kalora Crescent (L5):**
   A three leg, single lane roundabout, with all roads operating as two lane two-way roads.

6. **Dudley Road – Burwood Road (L6):**
   A T intersection with Dudley Road the major through road. Burwood Road operates under a signed Give way control. There are right and left hand turning lanes out of Dudley Road onto Burwood Road.

7. **Dudley Road – Bulls Garden Road - Waran Road – Lonus Avenue (L7):**
   A five leg, single lane roundabout, with all roads operating as two lanes two-way roads.

8. **Burwood Street – Wallsend Street L08):**
   A T intersection with Wallsend Road operating as the major through road. Burwood Street operates under a signed give way control. There is a left hand turn lane off Wallsend Road into Burwood Street. Both Wallsend Street and Burwood Street are two lane two-way roads.

9. **Burwood Street – Redhead Street (L9):**
   A crossroads intersection with Burwood Street operating as the major through road. Redhead Street operates under a signed give way control. Both Burwood Street and Redhead Street operate as two lane two-way roads.

10. **Willow Road – Kestrel Avenue (L10):**
    A T intersection with Willow Road operating as the major through road. Both Willow Road and Kestrel Avenue operate as two lane two-way roads.

11. **Tennent Road – Dunkley Parade (L11):**
    A crossroads intersection with Dunkley Parade operating as the major through road. Tennent Road and its opposing Progress Road operate under a signed give way control.

12. **Croudace Road – Willandra Crescent (L12):**
    A crossroads intersection with Croudace Road operating as the major through road. Willandra Crescent operates under a Stop control. Both Croudace Road and Willandra Crescent operate as two lane two way roads.

13. **South Street – Pacific Highway (L13):**

A signalised T intersection. The Pacific Highway has two through lanes in each direction and an on road cycle lane in each direction. There is also a right-turning lane in the southbound direction, while there is a left hand turning lane in the northbound direction. South Street has a left and right turning lane plus an on road cycle lane.

14. **Burton Road – Glad Gunson Drive (L14):**
    A T intersection with Glad Gunson Drive and Burton Road (north) operating as the major through road. Both Glad Gunson Drive and Burton Road operate as a two lane two-way road.

15. **Floraville Road – Park Street (L15):**
    A T intersection with Floraville Road operating as the major through road. Both Floraville Road and Park Street operate as a two lane two-way road.

16. **Park Royal Drive – Floraville Road – Griffiths Road (L16):**
    A four leg, single lane roundabout, with all roads operating as a two lane two-way road.

17. **Floraville Road – Pacific Highway (L17):**
    A signalised T intersection with dedicated left and right turning lanes out of the Pacific Highway and into Floraville Road.

18. **O'Mara Avenue – Prince Street – Buttaba Avenue (L18):**
    Two intersections: 1st a T intersection with Wommara Avenue operating as the major through road. Prince Street operates under a signed give way control. 2nd a T intersection with Buttaba Avenue operating as the major through road. Prince Street operates under a signed give way control. All roads operate as two lane two-way roads.

19. **Collier Street – Steel Street (L19):**
    A crossroads intersection with Steel Street operating as the major through road. Steel Street operates under Stop control. Both Collier Street and Steel Street operate as a two lane two-way road.

20. **Elsdon Street – Cowlishaw Street (L20):**
    A crossroads intersection with Elsdon Street operating as the major through road. Cowlishaw Street operates under Stop control. Both Elsdon Street and Cowlishaw Street operate as a two lane two-way road.

21. **Dudley Road – Station Street (L21):**
    A crossroads intersection with Dudley Road operating as the major through road. Station Street (north) has a slip left hand turn lane onto Dudley Road. Both Station Street and Dudley Road operate as a two lane two-way road.

22. **Kahibah Road – Wallsend Street – Hexham Street (L22):**
    A three way Y-intersection with Wallsend Street operating as the major through road. Both Kahibah Road and Hexham Street operate under a signed Giveway control.

23. **Warners Bay Road – Bayview Street – Dunkley Parade (L23)**
    A three-way t-intersection with Warners Bay Road and Dunkley Parade operating as the major through roads. Bayview Street operates under a signed Stop control. Both Warners Bay Road and Dunkley Parade operate as two way, two lane roads.

24. **Violet Town Road – Wilsons Road (L24)**
    A three-way t-intersection with Violet Town Road operating as the major through road. Wilsons Road Street operates under a signed Give Way control. Both Violet Town Road and Wilsons Road operate as two way, two lane roads.
25. **Smith Street – Smart Street (L25)**
26. A four way cross roads intersection with Smith Street operating as the major road. Smart Street operates under a stop control. Smith Street and Smart Street operate as two-way, two-lane roads.
27. **Smith Street – Frederick Street (L26)**
    A four way cross roads intersection with Frederick Street operating as the major road. Smith Street operates under a stop control. Smith Street and Frederick Street operate as two-way, two-lane roads.
28. **Smith Street – Ridley Street (L27)**

A four way cross roads intersection with Smith Street operating as the major road. Ridley Street operates under a stop control. Smith Street and Ridley Street operate as two-way, two-lane roads.

29. **Wilsons Road – New Extension Road (L28)**
    a. A proposed four-way traffic signalised cross intersection with Wilsons Road operating as the main road.

30. **New Extension Road – Tennent Road (L29)**
    a. A proposed four-way traffic cross intersection with Tennent Road operating as the main road.

31. **South Street – Merrigum Road (L30)**
    a. A three-way intersection with South Street operating as the main road.

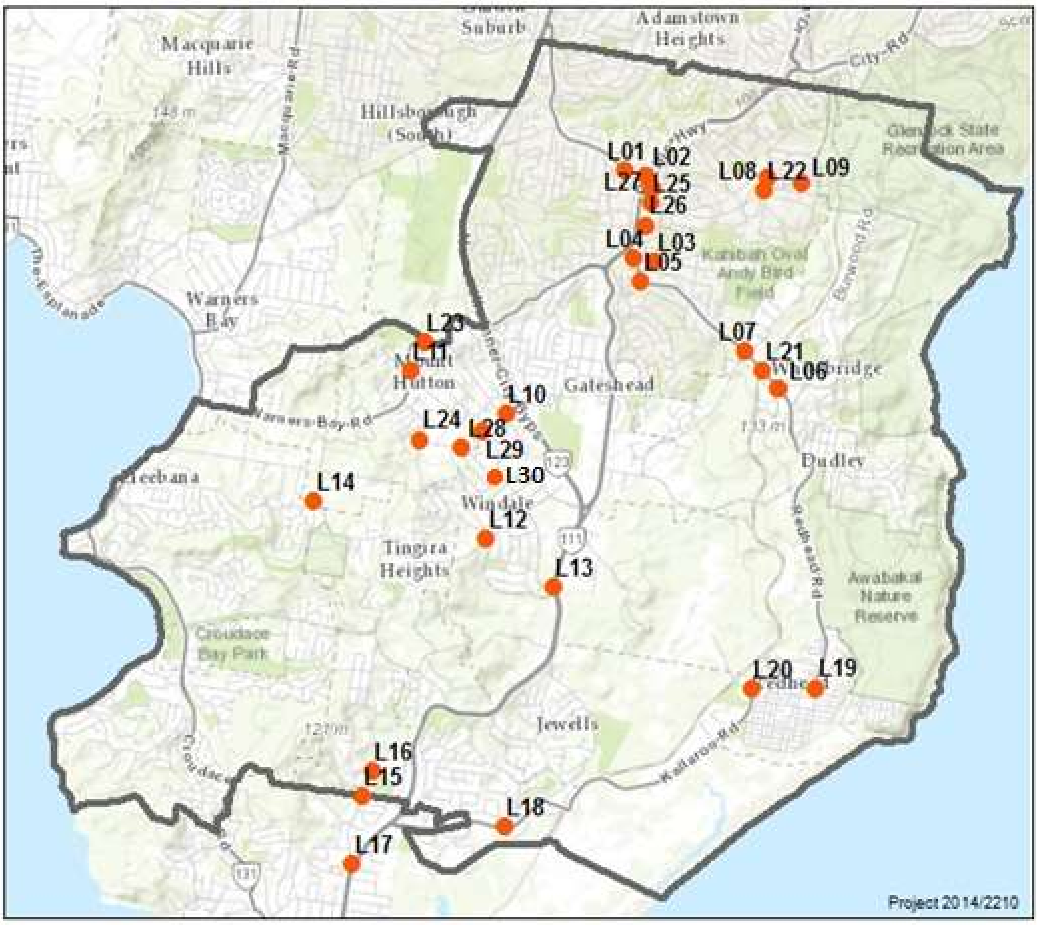
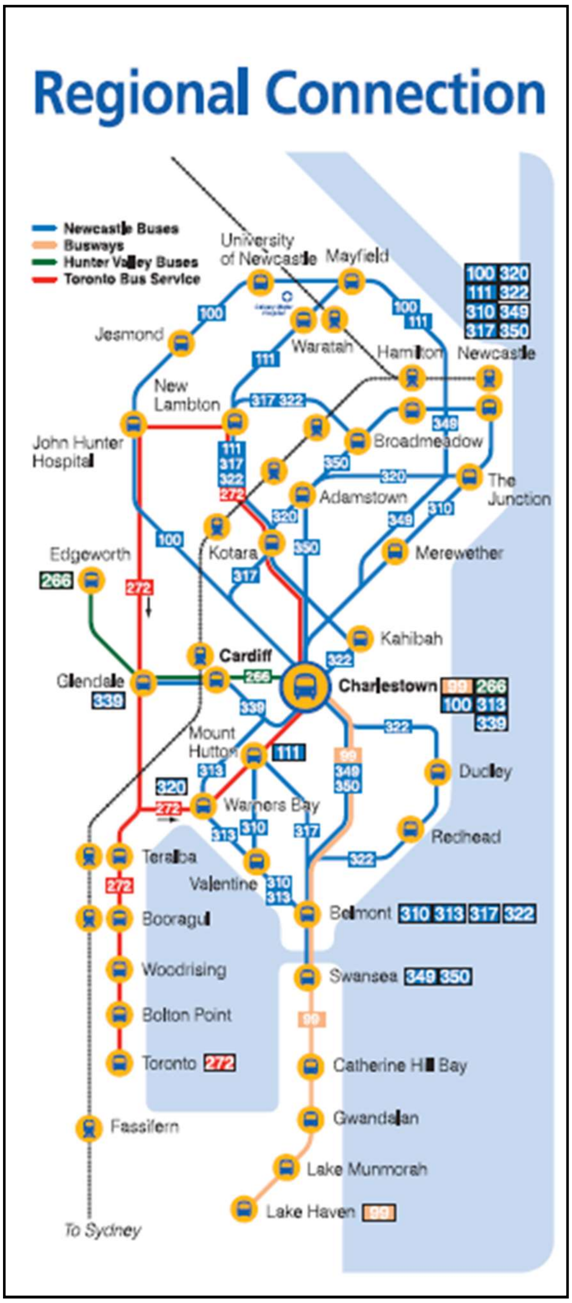


Figure 3.2 Local Intersections under review

3.4 Public Transport

Charlestown has 14 bus service routes whilst the closest rail station is Cardiff, which is served by the Newcastle – Central Coast line. Charlestown has its own Transport Access Guide effective November 2008. The regional connection routes and access to public transport within Charlestown are shown in Fig 3.3



Source: Charlestown Area Transport Access Guide 2008

Figure 3.3 Access to Public Transport in the Charlestown Area

3.4.1 Train Services

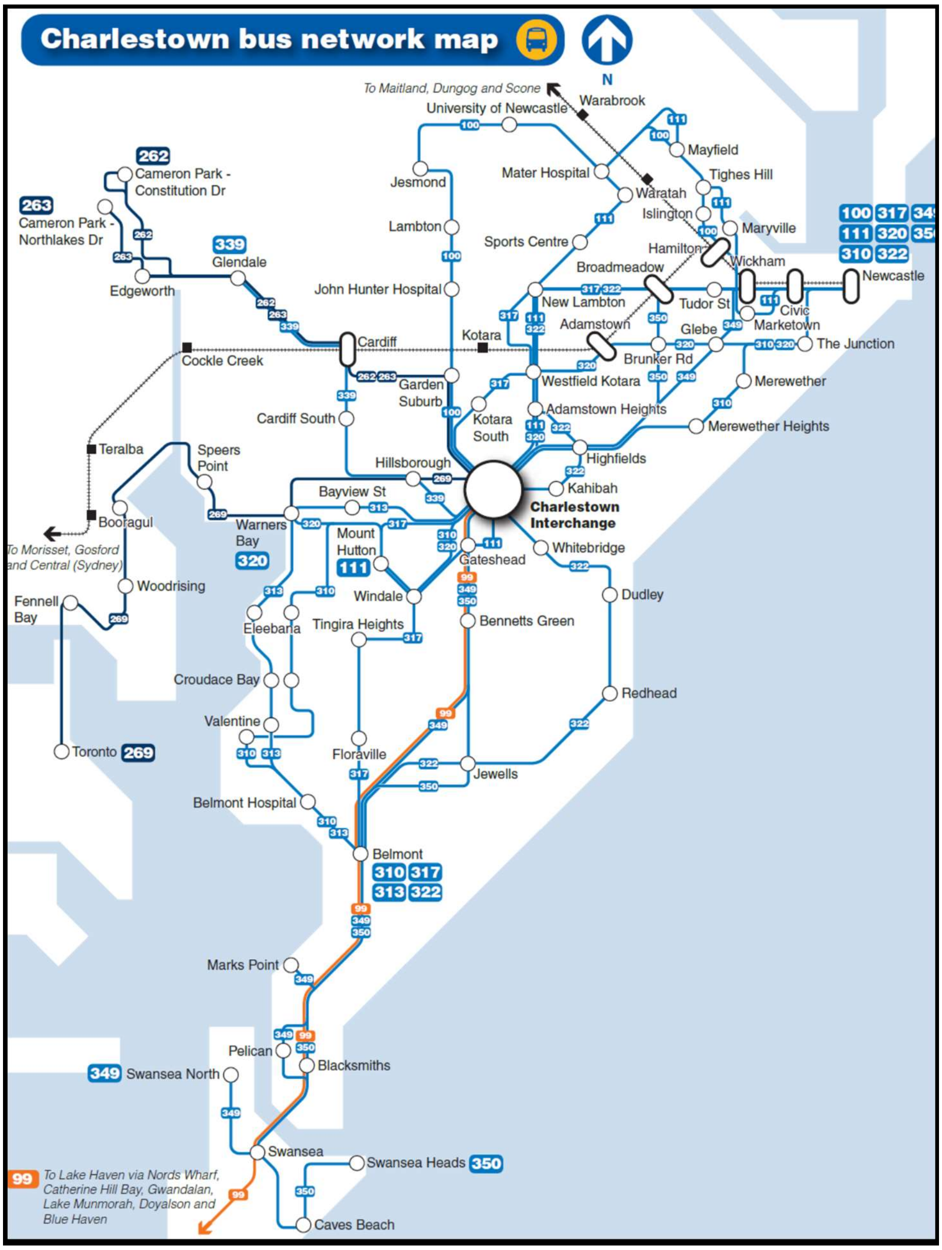
There are no train services in the Charlestown Catchment area. However, bus routes 262, 263 and 339, link Charlestown to Cardiff train station.

3.4.2 Bus Services

Charlestown is in the Outer Metropolitan Bus System Contract Region 5 and any future services must conform to the 2013 Service Planning Guidelines.

There are 13 bus service routes in the Charlestown area, linking the surrounding suburbs of Belmont, Swansea, Mount Hutton, Whitebridge, Dudley, Redhead, Kahibah, Kotara, Newcastle, Mayfield, New Lambton, Newcastle University, John Hunter Hospital, Windale, Eleebana, Valentine, Warners Bay, Cardiff and Glendale and Toronto, as well as south to Lake Haven. There are also School bus services throughout the catchment.

Access to Charlestown area by bus is shown in Fig 3.4.



Source: NSW Transport 2010

Figure 3.4 Access to Charlestown Area by Bus

3.5 Cycle Network

A review of existing and planned cycling facilities has been conducted as part of the study, using Council's Cycling Strategy 2012 -2022 as the base.

The 2004 S94 Contributions Plan (Contributions Plan No. 1 City Wide (2004)) identified the need for a cycleway from the corner of Tallawalla Road and Croudace Bay Road in Valentine, to Thomas H Halton Park in Croudace Bay. This shared cycle path has been constructed and forms part of the Booragul to Belmont shared cycle path. This cycle path provides a combined commuter, school and recreational route. A further 400m section is proposed for construction in Council's 2014/15 Footpath and Cycleways Capital Works Program connecting Croudace Bay Park to Toonibal Avenue, Eleebana. While this section will not be required to be listed in this version of the Charlestown s94 Plan the section connecting Toonibal Avenue to Eleebana Lions Park (400m) should be included.

Other cycle paths in the catchment include the Fernleigh Track, which is jointly owned by the Lake Macquarie City Council and the Newcastle City Council. The Fernleigh Track is a shared cycle path which stretches for 15.5 kilometres from Adamstown in the north to Belmont in the south (refer Fig 3-5).

To view all existing and proposed cycleways in the Charlestown s94 Contribution Catchment please refer to Fig 3.6.

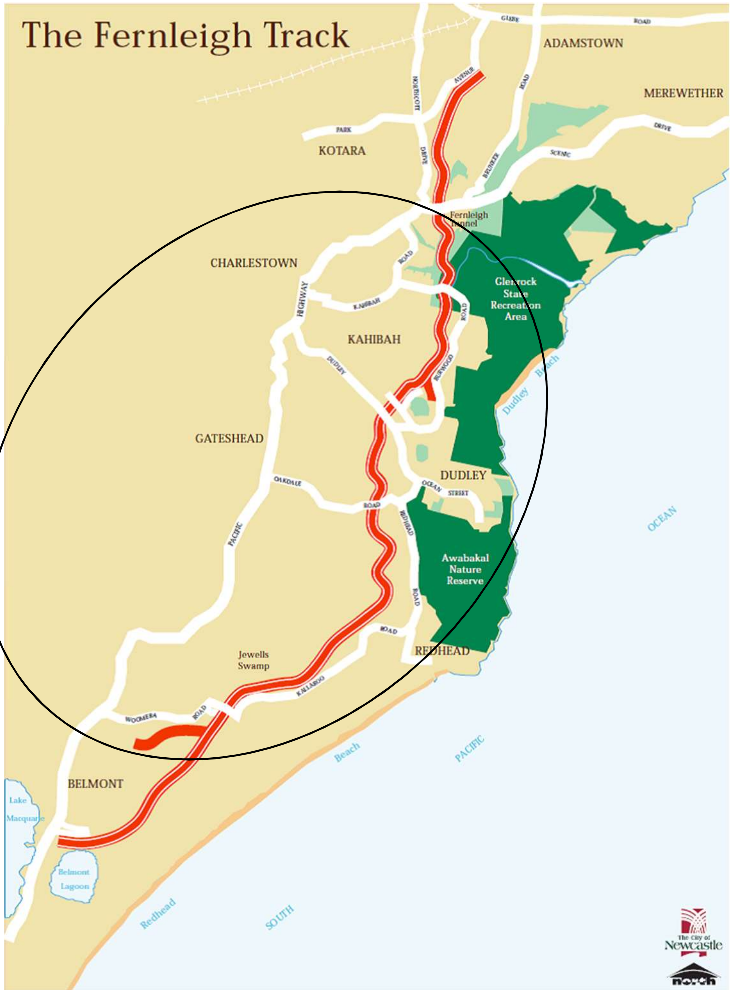
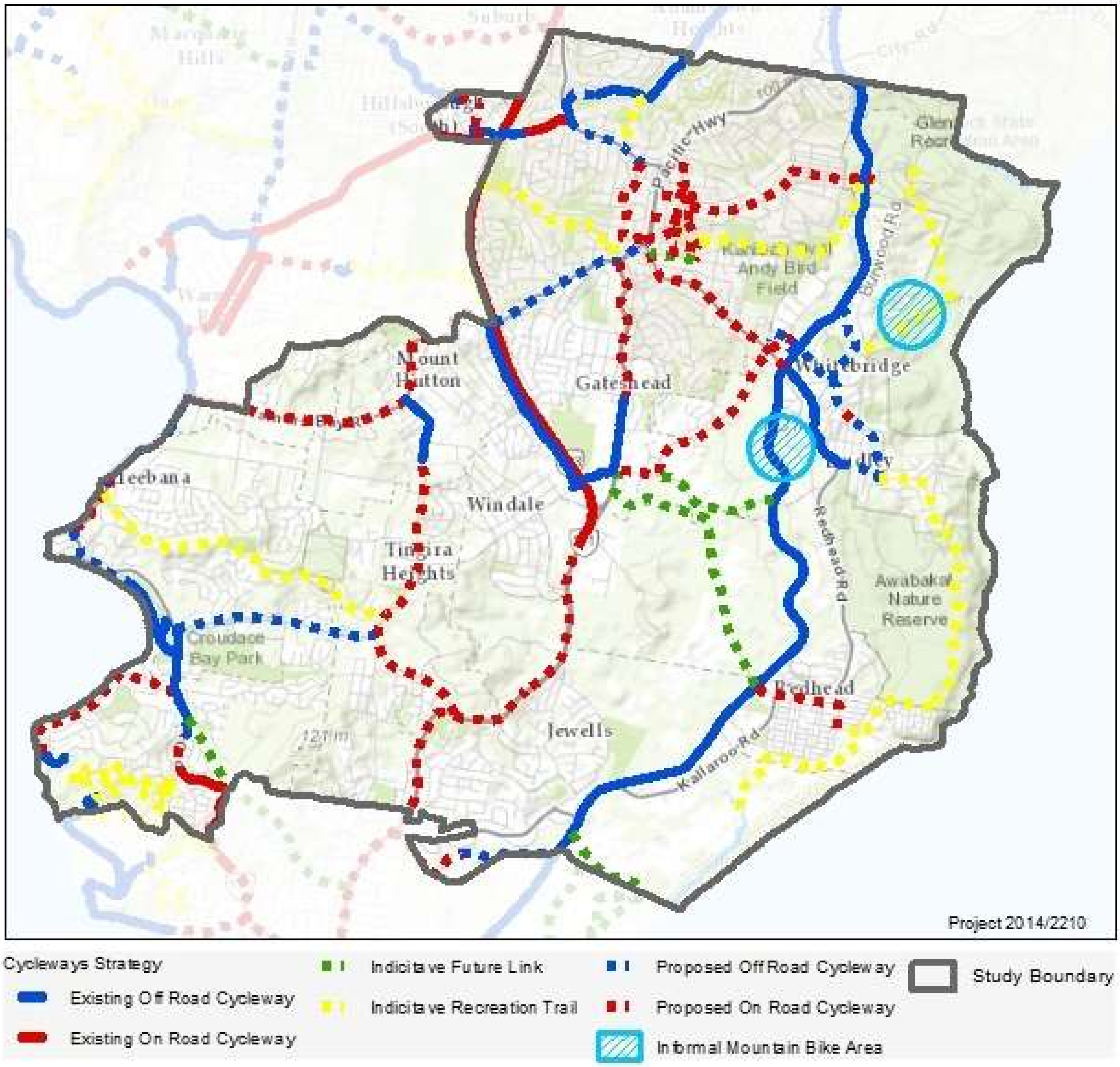


Figure 3.5 Plan of Fernleigh Track Cycleway



Source: RTA Newcastle and Lake Macquarie Area Cyclemap

Figure 3.6 Existing and Planned Cycleways in the Charlestown Area

3.6 Pedestrian Facilities

Studies undertaken as part of the development of Council's Footpath Strategy, indicated that existing pedestrian and footpath provisions are concentrated around the major collector road routes in the Charlestown S94 Contributions Catchment. Many roads and streets, which are located away from these collector routes, do not have any footpaths. There are some pedestrian crossing islands at key locations throughout the catchment while there are also signalised pedestrian crossings at key locations across the major roads in the CBD.

The guidelines and criteria to determine priority for footpath installation incorporated factors such as proximity to commercial development, schools, public transport residential density and pedestrian safety.

It is not the intention of this study to identify footpath and pedestrian facilities for inclusion in The Plan. The intent is to place the onus on footpath and traffic facility installation specifically on development, in accordance with the prescribed Council standards, planning controls and relevant legislation.

4 Future Situation

4.1 Demographics

As part of this project, Don Fox Planning, in association with Council's Strategic Land Use Planning Section, have undertaken extensive demographic assessment into the future population characteristics that can be expected in the Charlestown s94 Contributions Catchment. Four growth scenarios were identified and following consultation with Council officers, the Hybrid growth scenario was adopted for consideration in the development of the Plan. This is characterised by medium growth levels in and around Charlestown Regional Centre and low growth levels elsewhere in the catchment

4.1.1 Expected Population Increase

Table 4.1 below shows the growth in population from the current 59,200 people to 74,400 by the year 2025.

This study has been based on the traffic and transport impacts of development associated with this level of population growth.

Estimated Residential Population by Sub-Catchment 2010-2025 (DFP, 2010)					
Locality	Persons				
	2010 (Existing)	2015	2020	2025	Growth 2010-2025
Charlestown	17,350	19,480	21,460	23,720	6,370
Dudley	6,050	6,400	6,840	7,400	1,350
Mount Hutton/Windale	13,160	14,010	14,980	15,530	2,380
Eleebana	6,930	7,050	7,280	7,410	480
Valentine	6,310	6,470	6,610	6,760	450
Belmont North/Floraville	8,550	9,000	9,250	9,410	860
Redhead	3,440	3,690	3,930	4,180	750
Total	61,780	66,110	70,360	74,400	12,620

Source: Don Fox Planning: 2010

Table 4.1 Population Potential of Development Precincts (or similar)

Table 4.1 clearly shows the areas of population growth. Charlestown, Dudley, Mt Hutton/Windale show the largest population growth and therefore the most traffic and transport impacts. The growth is expected to be steady over the 15 years projected by this study with the study area population increasing by 24% between 2006 and 2025.

4.1.2 Anticipated Characteristics of the Incoming Pedestrians

Age (years)	2010		2015		2020		2025		Growth 2010-2025	
	Persons	%	Persons	%	Persons	%	Persons	%	Persons	% Change
0-4	3,350	5.6	3,590	5.7	3,990	5.9	4,280	6.1	**930**	28
5-9	3,490	5.9	3,580	5.6	3,810	5.7	4,180	5.9	**690**	20
10-14	3,900	6.5	3,760	5.9	3,830	5.7	4,020	5.7	**120**	3
15-19	4,400	7.4	4,160	6.5	4,000	6.0	4,030	5.7	**-370**	-8
20-24	4,290	7.2	4,600	7.2	4,330	6.5	4,150	5.9	**-140**	-3
25-29	3,360	5.7	4,440	7.0	4,730	7.0	4,450	6.3	**1,090**	32
30-34	2,750	4.6	3,560	5.6	4,610	6.9	4,880	6.9	**2,130**	78
35-39	3,390	5.7	2,980	4.7	3,760	5.6	4,780	6.8	**1,390**	41
40-44	3,960	6.7	3,630	5.7	3,200	4.8	3,940	5.6	**-20**	-1
45-49	4,210	7.1	4,200	6.6	3,850	5.7	3,390	4.8	**-820**	-20
50-54	4,450	7.5	4,410	6.9	4,380	6.5	4,010	5.7	**-440**	-10
55-59	4,080	6.9	4,590	7.2	4,540	6.8	4,480	6.4	**400**	10
60-64	3,760	6.3	4,150	6.5	4,630	6.9	4,550	6.5	**790**	21
65-69	3,150	5.3	3,720	5.9	4,080	6.1	4,510	6.4	**1,360**	43
70-74	2,500	4.2	3,020	4.7	3,530	5.2	3,830	5.5	**1,330**	53
75+	4,480	7.5	5,110	8.0	5,920	8.8	6,810	9.7	**2,330**	52
Totals	**59,520**	**100**	**63,500**	**100**	**67,190**	**100**	**70,290**	**100**	**10,770**	**18**
Note: Age Profile based on persons in occupied private dwellings only										

Source: Don Fox Planning Development Contributions Plan Charlestown Contribution Catchment 2010

Table 4.2 Estimated Demographic Profile – Hybrid Growth Scenario

Table 4-2 above shows the anticipated age profile of the population growth. This shows that there are going to be three distinct age brackets where growth will occur. The age groups 0-9 years, 20-39 years and the 55-75+ years all show significant signs of growth, while the age groups of 10-19 years and 40-54 years show little to no growth, particularly for the age group 45-49 years which is estimated to decrease by 22%. Overall, the population in the Charlestown Contribution Catchment will increase in the order of 24% by 2025. This profile indicates an anticipated increased need for journeys to work, school, recreation and community facilities, by all modes of transport.

4.1.3 Occupancy Rates

Table 4.3 Estimated Residential Development by Type

Estimated Residential Development 2010-2025 (DFP, 2010)						
Residential Dwelling Type	**Occupancy Rate**[A]	**# Dwellings / Beds**				**Growth**
		2010	**2015**	**2020**	**2025**	**2010-25**
Private Dwellings[B]	**2.39**	**22,540**	**24,490**	**26,360**	**28,140**	**5,600**
Dwelling House / Lot	2.70	20,350	20,870	21,360	21,680	**1,330**
Residential Accommodation[C] with 1 bedroom / bedsit	1.20	150	310	470	640	**490**
Residential Accommodation[C] with 2 bedrooms	1.59	450	920	1,400	1910	**1,460**
Residential Accommodation[C] with 3 or more bedrooms	2.44	400	820	,1240	1,700	**1,300**
Seniors Housing[D]	1.37	850	1,170	1,420	1,670	**820**
Moveable Dwellings (Long -term)	2.03	340	400	470	540	**200**
Non-Private Dwellings (Beds)[E]	**-**	**1,700**	**1,960**	**2,260**	**2,640**	**940**
Residential Care Facility	bed	500	630	790	980	**480**
Hostels/Boarding Houses/Backpacker's/Group Homes/Hospitals	2.12	850	930	1,020	1,130	**280**
Educational Establishments (residential component)	bed	120	130	140	160	**40**
Moveable Dwellings (Short -term)	2.03	30	40	40	50	**20**
Bed and Breakfast Accommodation	bed	20	30	50	70	**50**
Hotel or Motel Accommodation / Serviced Apartments	bed	180	200	220	250	**70**

Notes:
A. Forecast average occupancies across the Contributions Catchment as at 2025.
B. This is the average occupancy rate of all dwellings in the Contributions Catchment as forecast to 2025 for residential development.
C. Excluding boarding houses, dwelling houses, group homes, hostels and seniors housing.
D. Excluding residential care facilities (Estimates based on 2001 and 2006 ABS Census data).
E. NSW Average based on 2001 and 2006 ABS Census data.

Source: Don Fox Planning Development Contributions Plan Charlestown Contribution Catchment 2010

Source: Don Fox Planning Development Contributions Plan Charlestown Contribution Catchment 2010

Table 4-3 above shows a predominance of private dwellings, apartment dwellings and single dwelling houses, in the anticipated growth in the area. This Hybrid growth scenario has been interpolated into traffic volumes and transport demand and assigned to the road network.

Table 4.4 below, extracted from the NSW RMS Guide to Traffic Generating Developments Version 2.2 October 2002 Section 3,provides the following traffic generation potential of developments based on land use.

Table 4.4 Land Use Traffic Generation Rates

Table 3.7
Summary table of land use traffic generation Rates

Land Use	Traffic generation rates	
	Daily Vehicle Trips	Peak Hour Vehicle Trips
Residential		
Dwelling houses	9.0 / dwelling	0.85 per dwelling
hMedium density residential flat building	*Up to 2 bedrooms*	
	4-5 / dwelling	0.4-0.5 / dwelling
	3 bedrooms or more	
	5-6.5 / dwelling	0.5-0.65 / dwelling
High density residential flat building	*metropolitan regional centres*	
	-	0.24 / unit
	metropolitan sub-regional centre	
	-	0.29 / unit
Housing for aged and disabled persons	1-2 / dwelling	0.1-0.2 / dwelling
Casual accommodation		
Motels	3 / unit	0.4 / unit
Hotels - traditional	See section 3.4.2	-
Hotels - tourist	See Section 3.4.3	

Source: NSW RTA Guide to Traffic Generating Developments Version 2.2 October 2002

4.1.4 Expected Type of Development

Table 4.5 shown below, shows the staging for the Hybrid growth scenario for Commercial, Industrial and Retail floor space in the Charlestown Catchment.

Table 4.5 Commercial Floor Space Summary

Forecast Non-Residential Development 2010-2025 (DFP, 2010)										
Industry Sector	2010		2015		2020		2025		Growth 2010-2025	
	GFA (m^2)	Workers	GFA (m^2)	Workers	GFA (m^2)	Workers	GFA (m^2)	Workers	GFA (m^2)	Workers
Retail	**118,760**	**4,370**	**137,870**	**5,030**	**148,830**	**5,400**	**152,530**	**5,540**	**33,770**	**1,170**
Specialty Shops	99,910	4,000	113,020	4,520	120,480	4,820	124,180	4,970	24,270	970
Supermarkets	18,850	380	24,850	510	28,350	580	28,350	580	9,500	200
Commercial	**84,430**	**5,890**	**100,680**	**6,710**	**116,930**	**7,800**	**133,180**	**8,880**	**48,750**	**2,990**
Industrial	**272,330**	**3,450**	**290,790**	**3,600**	**312,940**	**3,780**	**338,780**	**4,000**	**66,450**	**550**
Small Factory Units	50,730	760	54,530	800	59,080	850	64,400	900	13,670	140
Warehouse/Manufacturing	189,020	2,450	201,270	2,550	215,970	2,670	233,110	2,810	44,090	360
Bulky Goods	32,580	240	34,990	250	37,890	260	41,260	280	8,680	40
TOTAL	**475,520**	**13,710**	**529,330**	**15,340**	**578,690**	**16,970**	**624,480**	**18,420**	**148,960**	**4,710**

Note:

Future workers based on *Employment Monitoring of Commercial Centres and Industrial Areas* (DoP, 1991) as follows:

- one worker per $25m^2$ GFA of specialty retail.
- one worker per $50m^2$ GFA of supermarket retail.
- one worker per $15m^2$ GFA of commercial.
- one worker per $95m^2$ GFA of small factory unit.
- one worker per $120m^2$ GFA of warehouse/manufacturing.
- one worker per $225m^2$ GFA of bulky goods.
- one worker per $200m^2$ GFA of storage.

The above table shows the development growth in commercial, (67,035m^2 increase), industrial, (70,730m^2 increase), and retail, (79,129m^2 increase) floor space. It is the growth in commercial and retail floor area, which is particularly significant as it will provide local employment and reduce overall trips on the road network.

4.2 Alternate Development Contribution Methods

Over recent years, the methods available for funding local infrastructure have been amended to include:

- s94 development contributions
- s94 levy
- voluntary planning agreements (VPA's)

Within the Charlestown Contributions Catchment, there are examples of two methods currently in existence:

- s94 development contributions- the subject of this study
- planning agreements – such as applied to the approved Charlestown Square redevelopment

This study focuses on the calculation of s94 development contributions considering the other methods where applicable.

4.3 Determining Nexus

Nexus means the relationship between the expected types of development within an area and the demand for additional public facilities generated. In terms of transport facilities, it is the relationship between the expected types of development in the plan area and the demand for additional traffic and transport facilities generated.

4.4 Determining Apportionment

There is no apportionment between the existing and future users, as the analysis indicates that currently all intersections operate at an acceptable level of service. All upgrades are a direct result of the proposed developments and all costs should therefore be borne by these future developments.

4.5 Threshold Analysis

Our approach to determining the requirement for new local infrastructure uses a threshold analysis approach, whereby the capacity of an infrastructure item (road or intersection predominately) is reached triggering the requirement for provision of more capacity, or an alternate facility.

In this way, the utilisation of existing assets is best matched to their potential acceptable performance criteria.

Section 2 of this study report details the analysis conducted in line with this approach.

The threshold analysis was completed for the existing design year and the future design year of 2025. Sensitivity testing was also undertaken to determine the actual year, if applicable, where each intersection reaches a LOS E on any one leg. Further analysis was then undertaken for a projected time horizon of ten years to determine the appropriate life of the intersection upgrade. Where a road or intersection upgrade has been identified, there is a direct correlation between that road/intersection upgrade and a development sub catchment, and this sub catchment drives the requirement for the identified works. It is also recognised that the timetable for development of the sub catchments cannot be defined and will be market driven.

The threshold analysis has been completed for the base case (existing scenario) for both the AM and PM peak periods. This analysis has then been completed for the future scenario in 2025 for the AM and PM peak periods.

4.6 Possible Alternate Transport Facilities

The Plan highlights a range of local roads and intersections for consideration in the study and these are incorporated into the existing and future development scenarios for threshold analysis.

In addition to this base level of infrastructure, the following items were specifically raised for consideration as alternate facilities to possibly support acceptable traffic and transport performance under the future (2025) development scenario.

These items are (in no particular order):

- Intersection upgrades
- Road upgrading/new road construction (considering future bus routes).
- Pedestrian paths and cycleways network linking the proposed population with key destinations within the catchment area.
- Public transport services and facilities. Investigate appropriate locations for shelter bus stops.

The traffic and transport study has considered each of the above items in terms of nexus, threshold analysis and role in maintaining satisfactory performance levels, in determining the recommended upgrades, their cost estimates and apportionment between existing and new development.

5 Assessment of Future Traffic and Transport Requirements

5.1 Introduction

This section considers the performance of the local transport network under the future demand scenarios and comments on adequacy of existing facilities and makes recommendations on (nexus justified) improvements to meet the adopted performance criteria.

5.2 Roads

Within the context of the Charlestown Contributions Catchment, the extent of flows generated using traditional levels of traffic generation has been applied to the road network as follows:

i) Using the existing road network, assign traffic flows to the road network using the shortest path between origins and destinations within the study area.

ii) Consider the forecast mid-block capacities against agreed service level criteria as follows:
   a) As arterial and sub-arterial roads, using the mid-block capacities outlined in section **Section 2** of this report.
   b) In residential areas, using the mid-block environmental capacities outlined in the RMS Guide to Traffic Generating Development, and discussed in **Section 2** of this report.
   c) In local centres, such as Mt Hutton and Whitebridge application of the mid-block capacities outlined in **Section 2** of this report.

The subsequent analysis of mid-block capacities across the network has applied the Level of Service criteria and capacity thresholds identified and adopted in **Section 2** of this report.

Where mid-block capacity has been assessed on State Roads, these are included for information only and to assist in the consideration of network analysis at other local road and intersection locations.

The results of the road capacity analysis are summarised in the proposed works schedule at the end of this chapter.

5.3 Intersections

Intersection analysis has been repeated for forecast development levels on a range of junctions across the network with the Charlestown Contributions Catchment.

This study has adopted the agreed levels of future development provided by the study team and traffic volumes have been generated accordingly.

The existing situation analysis has been repeated here, taking forecast development levels into account as follows:

a) Existing situation analysis (plus deficiency upgrades) applied as base.
b) Add forecast development flows to existing.
c) Confirm acceptable service levels.
d) Apply upgrade where necessary to achieve acceptable service levels.
e) Confirm acceptable service levels.
f) Apply additional future time base factor to ensure viability

The analysis in points d) and e) is repeated until a solution is achieved that delivers an acceptable service level.

The analysis in part f) is then applied.

The results of this analysis are summarised in the proposed works schedule at the end of this chapter.

5.3.1 Recommendations

Through the theoretical analysis of the proposed intersections, the following intersections listed below failed to reach the required performance level necessary for the intersection to function at an acceptable level by 2025. These intersections however, have not been included in the Plan based on the fact that:

- planned intersection upgrades have either been approved/completed by Council as part of its future Capital Works Program
- the intersection(s) form part of the State Road network;

- **Pacific Highway/Charlestown Road (I02)**
  This intersection is a major State Road intersection.

- **Tennent Road/ Dunkley Parade (I11)**
  This intersection has been upgraded to traffic signals as part of Council's Capital Works Program.

- **Pacific Highway/South Street (I13)**
  This intersection is a major State Road intersection.

5.4 Local Public Transport

The assessment of local public transport facilities has been undertaken as follows:

a) Confirmation of minimum service levels (MSL).
b) Application of MSL to the appropriate collector road/local road network.
c) All new development to include MSL's within development.

This approach allows development of MSLs on the nominated road routes that serve as the principal local bus routes in the study area. **Figure 5.1** below summarises the provision of the two levels of facilities across the road network, and against existing facilities.

5.4.1 Recommendations

- Upgrade sign posted bus stops to sheltered bus stops. Since there is forecast of approximately 6600 future residential dwellings, allow for one shelter per 1000 residential dwellings. Giving a total of 7 new bus shelters to be distributed throughout the Charlestown Catchment. The location of the shelters should reflect the location of the highest used bus stops, based on data that can be provided by NSW Transport in conjunction with the contracted bus operator (Newcastle BuseS). The study area currently has a good level of service provided by Newcastle Buses and the provision of upgraded facilities at existing bus stops will provide a significant benefit to the future residents in the study area.

5.5 Pedestrian and Cycle Facilities

5.5.1 Pedestrian and Cycle Facilities Assessment

The assessment of pedestrian and cycle facilities has followed the same Minimum Service Levels (MSL) approach and is applied in conjunction with the projects as listed in Council's Cycling and Footpath Strategies.

a) All new development areas to provide standard footpath facilities on one side of roads, as per Council's engineering specification drawings (refer Council Standard Drawing EGSD-301).
b) Where required, all new on and off-road cyleways/shared pathways to be installed as per the prescribed guidelines and priority listing as highlighted in Council's Cycling Strategy (refer Figure 3-6).
c) In town and local centres, footpaths to be provided to both sides of roads as per Council's engineering specification drawings (refer Council Standard Drawing EGSD-301).
d) All new pedestrian crossing facilities will be conditioned on development subject to Council's Local Traffic Facilities Committee recommendation and Council approval.

5.5.2 Cycle Network Assessment

Fig 5.1 shows the local cycle/pedestrian concepts for the Charlestown catchment.

Charlestown (C1)

Council's Cycling Strategy has highlighted:

- Warners Bay Road from Bypass to Dudley Road - Off Road Shared Pathway – 1.8km

The significant cycle route here is the connection of the Charlestown CBD to the West Charlestown by-pass.

Dudley (C2)

The Fernleigh Track is a shared cycle path providing a commuter and recreational route from Adamstown in the north to Belmont in the south. It forms part of the NSW Coastline Cycleway.

Council's Cycling Strategy has highlighted:

- Fernleigh Track (Whitebridge) to Dudley

Redhead (C3)

The Fernleigh Track is a shared cycle path providing a commuter and recreational route currently from Adamstown in the north to Belmont in the south, (having been completed in March 2011). It forms part of the NSW Coastline Cycleway. No new connections

Belmont North (C4)

The Fernleigh Track is a shared cycle path providing a commuter and recreational route currently from Adamstown in the north to Belmont in the south, (having been completed in March 2011). It forms part of the NSW Coastline Cycleway. Further extensions of the pathway from the end of Fernleigh Track are proposed south, to connect to Blacksmiths, and to the west, to connect to Brooks Parade.

Mount Hutton/Windale (C5)

There is currently a shared cycle path linking Charlestown and Windale, which runs alongside the western edge of the Newcastle bypass. The cycle path runs for 2.7 kilometres and starts at the Hunter Sports High School on the Pacific Highway and runs over the Newcastle Bypass to Windale and then north to Warners Bay Road. There is a 3.8 kilometres section of shared cycle path from Warners Bay Road to Park Avenue, Charlestown, earmarked for future development.

Other studies recommendations have include:

- Warners Bay to Charlestown CBD
- Fernleigh Track to the Booragul to Belmont cycle path.

An important link here is the Fernleigh Track to the Booragul to Belmont cycle path; this will provide an important east/west link between the two major north/south cycle paths of the Fernleigh Track and the Booragul to Belmont cycle paths. There is potential to provide this link into a parcel of land earmarked for future residential development in the Dudley sub catchment. This route will also be able to link the industrial areas of Gateshead into the cycle network. Council's future Capital Works Program lists the construction of a section of the link from the end of the Fernleigh Track to the Belmont Foreshore. It also identifies a link from the end of the Fernleigh Track extending to Blacksmiths to the south.

Eleebana (C6)

Council's Cycling Strategy identifies an off-road shared pathway on Tingira Drive linking Macquarie Drive to Violet Town Road.

A section of the Booragul to Belmont cycle path is also identified on Bareki Road between Toonibal Avenue and the Eleebana Lions Park.

Valentine (C7)

A section of the Booragul to Belmont cycle path runs through this sub-catchment and incorporates part of the Bareki bends route currently under investigation.

5.5.3 Pedestrian Facilities Assessment

- It is important that all facilities are coordinated, e.g. crossing points with logical pedestrian routes, especially around the station/interchange and schools. Town centre plans must be coordinated with the public transport and pedestrian and cyclist routes in terms of links to any proposed local, district and regional facilities;
- Plans for Pedestrian facilities and improvements have to allow for manoeuvring of buses in key areas;
- Previous studies have recommended wider footpaths on most roads and improved pedestrian crossing facilities of roads. Wider footpaths will allow the use of street furniture to be more carefully managed, to reduce obstructions to pedestrians;
- Intersection improvements, including roundabouts at Dudley Road/James Street and Kahibah Road/Wallsend Road/Hexham Road, and upgrading the roundabout at Bulls Garden Road/ Dudley Road/ Lonus Avenue. All proposals will take pedestrian requirements into account.

5.5.4 Recommendations

When considering the pedestrian and cycle network the following needs to be considered:

- Provision of combined off road footpaths /cycleways to minimum service levels;
- Key pedestrian and cycling routes to Charlestown CBD;
- Off road routes to connect key destinations;
- Connections to Public Transport;
- Provision of support facilities /bike parking etc.

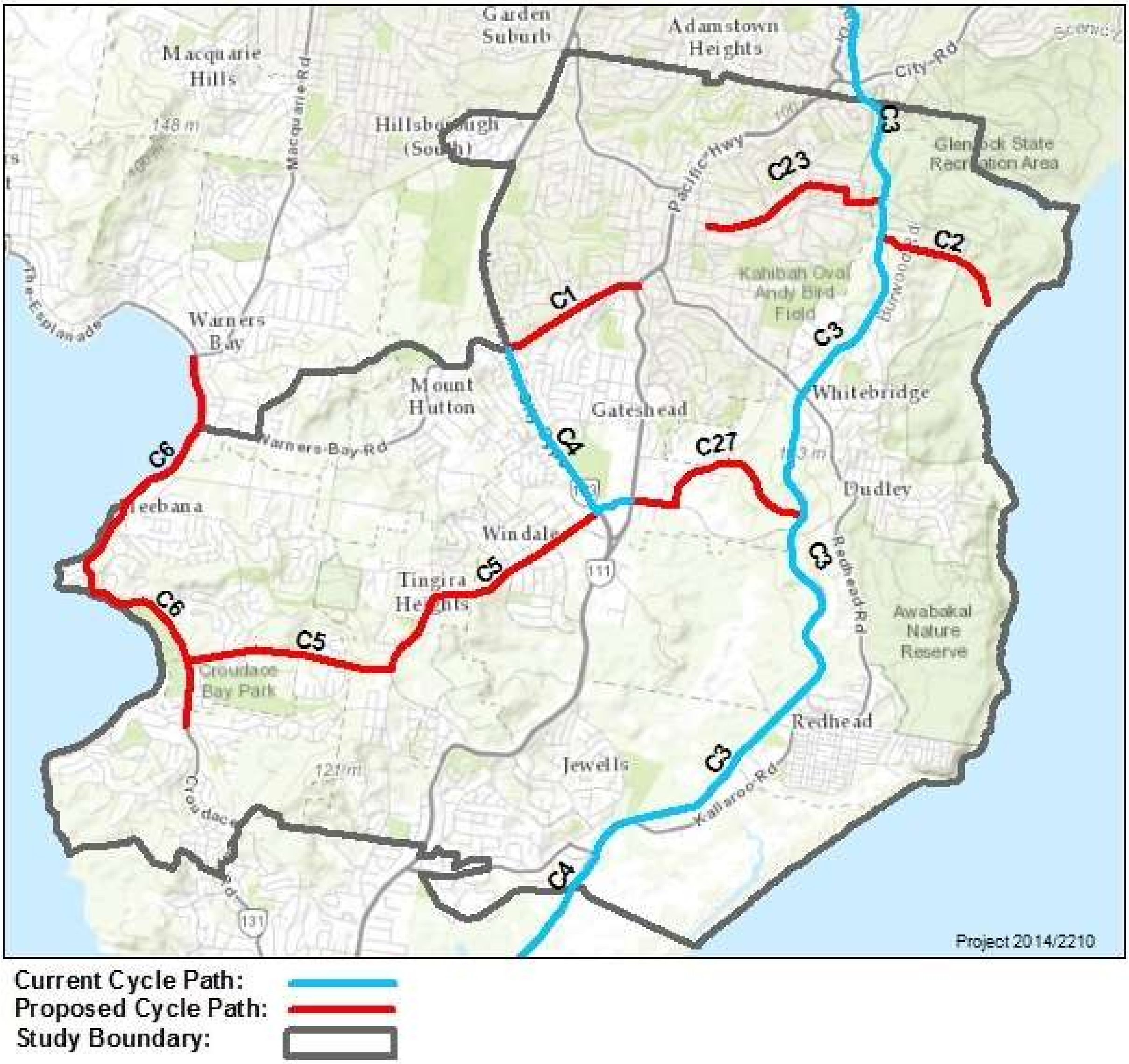


Figure 5.1 Local Cycle/Pedestrian Concepts

6 Proposed Works

The Combined Proposed Works Schedule for Local Road, Intersection, Public Transport, Cycling and Pedestrian Facilities is illustrated in **Figure 6-1** below and described in full in **Volume 3.**

6.1 Project Description

The assessment of potential land infrastructure upgrades has been conducted on a project-by-project basis. Where an existing piece of infrastructure is identified for upgrading, or a new facility is required to meet demand from more than one site, the works have been compiled using the project template. This template includes descriptions of the works, its status (e.g.: concept, preliminary etc.) as well as reference to supporting plans and estimates information and funding mechanisms applied.

The Project Description has been prepared for each nominated item of work under the plan. Details are contained in Section 3**.**

6.2 Summary of Works Schedule

The itemised Work Schedule contains a summary of the works recommendations to deliver traffic and transport facilities to meet the nominated performance and minimum service levels. Details are contained in **Volume 3.**

6.3 Comments and Recommended Local Road Works

In general, the local and collector road network was assessed as providing satisfactory levels of performance, for the planned level of growth in the study area. The exceptions were:

Mount Hutton sub-catchment:

- **Extension of Langdon Way**
  Purpose: 1. To provide direct and adequate pedestrian and vehicular connectivity between the existing and developable catchment off Auklet Road and Tennent Road.

- **Warners Bay Road, Bayview Street and Dunkley Parade – roundabout (L23)**
  Purpose: 1. To maintain traffic flows on the Mount Hutton collector road network at an acceptable Level of Service.

- **Violet Town Road and Wilsons Road – roundabout (L24)**
  Purpose: 1. To maintain traffic flows on the Mount Hutton collector road network at an acceptable Level of Service.
- **Merrigum Street and South Street, Windale – Traffic Signals (L30)**
  Purpose: 1. To maintain traffic flows on the Mount Hutton collector road network at an acceptable Level of Service.

Charlestown sub-catchment

- **Kahibah Road/ Wallsend Street/ Hexham Road - Roundabout (L22)**
  Purpose: 1. To reinforce Kahibah Road/Wallsend Street as an alternative access route to the Pacific Highway.
  2. To maintain traffic flows on the local Charlestown local and collector road network at acceptable environmental capacity levels

- **Smith Street/Smart Street – Traffic Signals – Single lane approach (L25)**
  Purpose: 1. To maintain traffic flows on the local Charlestown local and collector road network at acceptable environmental capacity levels

- **Smith Street/Frederick Street – Traffic Signals – Single Lane approach (L26)**
  Purpose: 1. To maintain traffic flows on the local Charlestown local and collector road network at acceptable environmental capacity levels

- **Smith Street/Ridley Street – Traffic Signals – Single Lane Approach (L27)**
  Purpose: 1. To maintain traffic flows on the local Charlestown local and collector road network at acceptable environmental capacity levels

7 Concept Design and Cost Estimates

7.1 Introduction

Council has required development of cost estimates for each item of upgrade works that is a component of the traffic and transport sub set of the Charlestown Contributions Catchment Development Contributions Plan. This section outlines the approach taken to developing firstly concept designs, and then matching engineering (concept design) estimates for the basis of developing contributions and then apportionment.

7.2 Concept Designs

For the purpose of this study, a concept design has been defined as an engineering concept plan only, with sufficient detail to allow calculation of concept stage engineering estimates based on Council's Schedule of Rates for Civil Engineering Work. It does not allow for any detailed consideration of ground conditions including underground or overhead service relocations, drainage calculations or any detailed level of geometric design (including 3-dimensional modelling) and hence earthworks calculations. It relies on the principle of deriving strategic estimates for engineering road works and traffic facilities as illustrated in **Figures 7.1 and 7.2** below.

7.3 Criteria for Concept Level Engineering Estimates

As a project moves through its various phases the objective is to ensure that it's agreed, outturn cost estimate is maintained below an agreed value established early in the project's life cycle.

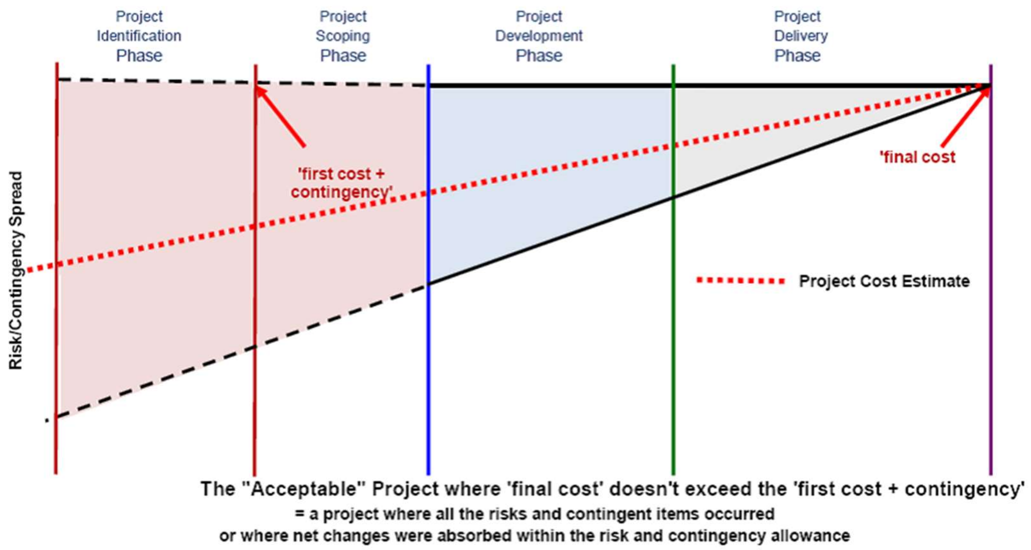


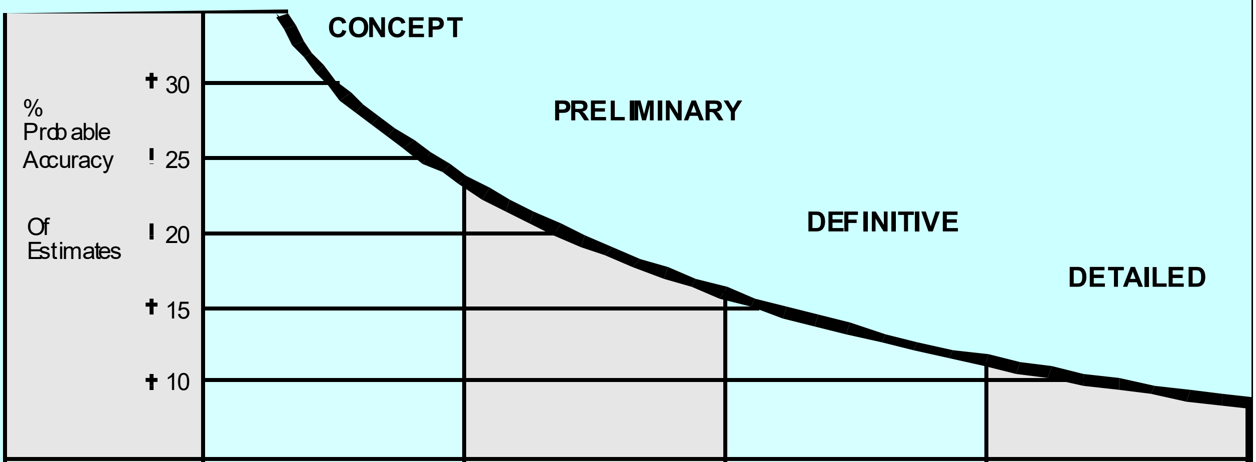
Figure 7.1: Cost Estimating Phases

Source: Evans and Peck 2008

The criteria applied for developing concept level engineering estimate is outlined overleaf:

Road Infrastructure Cost Planning

- Concept
- Preliminary
- Definitive
- Detailed



Type of Estimate	Order of Magnitude	Preliminary	Definitive	Detailed
Documentation Provided	- Project capacity and Location - Cost Data on Similar Projects - Major Component List	- Preliminary Bill of Quantities - Engineering Line Diagram - General Arrangement - Maps and Surveys - Bench Test Results - Nature of Facilities	- Equipment Specifications and Vendor Quotations - Construction Schedule - Electrical One Lines - Piping and Instrumentation Flow Diagrams - Soil Data and Architect Features - Site Survey and Labour Complete	- Bulk Material Specifications and Vendor Quotes - Construction Specification and Sub Contractor Quotations - Engineering Advanced Approximately 10%
Definition of Scope of Work	Conceptual	Approximate	Clearly Described Essentially Complete	Complete. Well Detailed
Estimating Procedure	Factoring	Combination of Factoring and Quantity Take-Off	Most Quantity Take-Off. Very little Factoring	Complete Quantity Take-Off
Use of Study	Comparison/ Rejection	Final Feasibility	Budget	Funding

Figure 7.2: Cost-estimating Criteria

The accuracy of estimates at each stage of the design process is reflected by the extent of detailed knowledge of site conditions known at the time.

The process of preparing engineering estimates is iterative, and dependent on the level of detail information available. Types of information that can affect the estimate include the following items;

1. Existing services information
2. Relocation of existing services
3. Earthworks
4. Pavement design
5. Prepare a basic drainage layout for pipes and pit details
6. Type of traffic control (signals, priority, roundabout)
7. Traffic management control during construction
8. Cost of survey

9. Cost of design and project management
10. Cost of geotechnical investigations
11. Liaison with Council (and RTA if applicable)
12. Project management

The estimating process can be staged as follows:

1. **Concept Development** based on initial considerations such as planning capacity and functional requirements, costs based on strategic estimates (from comparable works)
2. **Preliminary Design Costing** based on the existing concept layouts; no further design but enquiries to utility providers; a "kick dirt" appraisal of ground conditions; drainage network estimated and a basic layout added to the concept; use standard cost rates and surface area measurements.

   Note: At this stage, we will include a program and a fee estimate for detailed design and for construction.
3. **Detailed Design** ; This will cover services information, geotechnical investigation and pavement design; ground survey; roads and drainage design; utilities relocation agreements with providers; traffic signal design; road safety audit of design; design certification; preparation of bills of quantities.
4. **Contract Stage** will require preparation of tender documents; inviting tenders; assessment of tenders, negotiations and arranging signing the contract; negotiations and agreement with RTA and Council on certifying and approving procedures; contract administration and inspections; Contract Completion procedures and Works as Executed drawings.

Our guide for engineering works cost estimations are outlined in **Table 7.1** below

Stage	**Confidence Limits**	**Comments**
Concept Design	**+ 40% to – 20%**	Scope of works defined in outline & global estimates made for groups of elements.
Preliminary Design	**+ 25% to – 15%**	Most works identified & sized; global estimates made for some groups of elements; a detailed bill prepared for other elements.
Detailed Design Review	**+ 20% to - 10%**	All works sized & identified with some quantities at preliminary level, and some work methods not specified; a detailed estimate made for all elements.
Pre tender	**+ 15% to - 5%**	All elements, which have been designed & identified, are quantified. A cost is estimated for each element taking into account issues related to methods of construction.
Contract Agreement	**+ 10%**	Prices for all identified works agreed between owner & constructor
Construction completed	**+/- 0%**	All costs known & agreed & works accepted by owner

Table 7.1. Engineering Works Cost Estimations

Notes

1. An estimate is just that, an estimate. The actual cost of works can only be known when the works have been finished and accepted as meeting the requirements specified by the owner. It is useful to make this clear by stating that an estimate is an "opinion" of the likely cost.

2. If an element of the works is identified, it can be quantified and an estimate of cost applied to this element. Not all elements can be identified during the design stages resulting in omissions from the estimates. As the design is developed in detail so is the precision of identifying and estimating each element.
3. If the cost opinion is of a global nature, it may have plus or minus error. This approach is only applicable in early stages of project development and its use should be limited to the Concept Stage and possibly to the Preliminary Design.
4. If the opinion of cost is derived from the elements of the works, it will usually only have plus errors of estimate. Minus errors (reductions) are rare because it is rare to identify elements, which are later not, required as part of the works.
5. If the rates in the schedule exclude “Overheads and Profit”, this is added as a separate item of the bill expressed as a percentage and its effect is as a proportionate increase to every other item. It is distinct from and does not alter the selected contingency factor.
6. A contingency sum is provided to cover the upwards (plus) range of the confidence limits, i.e. add a contingency amount equal in value to the relevant percentage of the estimated items.
7. It is not usual to have minus cost estimate error and the range is therefore shown as skewed.
8. In presenting the opinion of cost, the actual amount to be stated should be the total amount including the plus percentage amount for the contingency.

7.4 Basis of Applied Unit Rates for Construction

For the purpose of this study concept, level engineering estimates have been derived from available industry data and a comparison of unit rates for civil engineering works, a copy of which is attached in **Section 2.**

This approach provides for reasonable average costs estimates. Final costs determined at contract stage may be higher or lower but overall will be consistent with the average costs so that individual contribution rates for transport facilities are appropriately determined.

7.5 Basis of Concept Level Engineering Estimates

This study has applied Benchmark estimating software, utilising Council’s schedule of rates as the basis of delivering concept estimates for each item of recommended works. This tool allows for the systematic upgrade of estimates at each stage of the design process, as new and more accurate dates become available.

7.6 Quality Review of Estimate

A quality review of the process and derived concept level estimates has been conducted by various sections within Lake Macquarie City Council. This review provided an acceptable correlation with the works identified in the plan. The unit rates applied against each project to determine its cost were the same rates used by Council’s Civilake to cost its projects.

7.7 Land Value

Where an item of upgrade works identifies the need for land acquisition as part of the design process, Council’s Property Services Department will provide land valuations to enable land costs to be incorporated into the relevant works schedules and contributions calculations.

Table 7.2 below provides a summary of the estimated land area to be acquired for each identified facility

Reference #	Charlestown Catchment - Facility Name	Land Area to be acquired (m2)
Charlestown Sub-Catchment		
Roads and Intersections		
L22	Kahibah Road – Hexham Street – Wallsend Road - Roundabout	0
L25	Smith Street - Smart Street – Traffic Signals – Single Lane approach	0
L26	Smith Street - Frederick Street - Traffic Signals – Single Lane approach	0
L27	Smith Street - Ridley Street Traffic Signals – Single Lane approach	0
	Sub-Total	**0**
Pedestrian / Bicycle Facilities		
C1	Warners Bay Road from Bypass to Dudley Road - Off Road Shared Pathway – 1.8km	0
	Sub-Total	**0**
Public Transport Facilities		
	New Bus Shelters x 7	0
	Sub-Total	**0**
Mount Hutton / Windale Sub-Catchment		
Roads and Intersections		
L23	Warners Bay Road – Bayview Street – Dunkley Road - Roundabout	500
L24	Violet Town Road – Wilsons Road - Roundabout	0
L30	South Street – Merrigum Street – traffic signals dual lane approach	0
	Sub-Total	**500**
Eleebana Sub-Catchment		
Pedestrian / Bicycle Facilities		
C7	Eleebana – Bareki Road - Toonibal Avenue to Eleebana Lions Park – Off Road Shared Pathway – 0.45km	0
C6	Tingira Drive from Violet Town Road to Macquarie Drive, Eleebana – Off Road Shared Pathway – 4.0km	
	Sub-Total	**0**
Dudley Sub-Catchment		
Pedestrian / Bicycle Facilities		
C2	Fernleigh Track to Dudley – Off Road Shared Pathway – 2.0km	100
	Sub-Total	**100**
	TOTAL	**600**

Table 7.2 Summary of Identified Works Land Acquisition

7.8 Monitoring and Review

7.8.1 Review Requirements

The Legislation governing the application of s94 Contribution Plans require plans to apply to 'reasonable' timeframes, and to include review mechanisms to ensure contributions collected and works planned are delivered with the prescribed timeframe of the plan. Council has therefore proposed regular reviews of the plan, so that any time and monetary adjustments can be made.

7.8.2 Indexation

All contribution rates will be subject to indexation, the rate to be agreed with Council as appropriate for application to the proposed works.

8 References

- Stages 1 and 2 Report: Residential Population and Non-Residential Development Growth Forecasts, Don Fox Planning, 2010
- Charlestown Square Shopping Centre Transport Report (2007) Prepared by Masson Wilson Twiney
- Draft Charlestown Major Regional Centre Area Plan (2010) Prepared by LMCC
- Charlestown Draft Master Plan (2007) Prepared by ARUP
- Draft East Charlestown Traffic Study (2010) Prepared by URaP – TTW Pty Ltd
- Charlestown Transportation Study (2007) URaP – TTW Pty Ltd
- Lake Macquarie Cycling Strategy 2012-2022
- Lake Macquarie Footpath Strategy 2033
- Lake Macquarie City Council Development Control Plan No 1
- LMCC Section 94 Contributions Plan No's 1 (Citywide, 2004),
- The RMS's Guide to Traffic Generating Developments Version 2.2 October 2002
- *NSW RMS Action for Bikes*
- *Planning Guidelines for Walking and Cycling 2004* prepared by NSW Government
- *BikePlan 2010* prepared by NSW Government
- LMCC Black Spot Report (Mark Waugh Pty Ltd – 2006)

Section 2: Traffic and Transportation Assessment

9 Charlestown S94 Catchment Intersection Analysis

9.1 Assessment of Traffic and Transport Requirements, 2010 to 2025

Between 2010 and 2025, the population of the Charlestown catchment is projected to increase between 6.9 and 36.7%. The commercial floor space is projected to increase at similar rates. Table 9.1 shows the projected population growth and commercial floor space growth for the Charlestown catchment for the period 2010 – 2025.(Source: Don Fox Planning).

Table 9.1: Projected population growth and commercial floor space growth, Charlestown catchment, 2010 - 2025

Estimated Residential Population by sub catchment 2010 - 2025 (Don Fox Planning, 2010)							
Locality	Persons						
	2010 (Existing)	2015	2020	2025	Growth 2010 - 2025	% growth 2010 - 2025	% growth population and floor space combined
Charlestown	17,350	19,480	21,460	23,720	6,370	36.70%	37.00%
Dudley	6,050	6,400	6,840	7400	1,350	22.30%	25.00%
Mount Hutton / Windale	13,160	14,010	14,980	15,530	2,380	18.00%	21.00%
Eleebana	6,930	7,050	7,280	7,410	480	6.90%	6.90%
Valentine	6,310	6,470	6,610	6,760	450	7.10%	7.10%
Belmont North / Floraville	8,550	9,000	9,250	9,410	860	10.00%	10.00%
Redhead	3,440	3,690	3,930	4,180	750	21.50%	21.50%
Total	61,780	66,110	70,360	74,400	12,620	20.40%	

For the purpose of the traffic analysis conducted as part of this report, the projected population and commercial floor space increases, were used for the relevant sub-catchment to analyse the traffic impacts on key intersections within the catchment.

9.2 Intersections and Road Links

Within the Charlestown catchment, 25 intersections were investigated and analysed, based on the projected population growth rates, to determine if they fail prior to the 2025 horizon year. For an intersection to fail, it is considered that the Level of Service (LoS) of any one movement at that intersection is to reach a LoS E.

The following are a list of the intersections that were modelled for the study. Those that reached the LoS E on any one movement were further investigated. Details and results of this analysis is further contained in Section 10 of this report. State roads, under the control of the Roads and Maritime Services (RMS,) were not included in the analysis.

1. **Smith Street and Ridley Street, Charlestown** – Four-leg intersection with Stop control on Ridley Street at Smith Street. The right turn from Ridley Street (western side) has a LoS E in 2025, at which time the intersection will require upgrade to traffic signals. (Section 10.1)
2. **Smith Street and Smart Street, Charlestown** - Four-leg intersection with the western side of Smart Street designated one-way towards the Pacific Highway. Smith Street has priority with Stop

control and a raised Pedestrian Crossing on Smart Street, and a raised Pedestrian Crossing installed across on the northern side of Smith Street. The eastern approach to Smart Street reaches a LoS E in 2019 at which time the intersection will require upgrading to traffic signals. (Section 10.2)

3. **Smith Street and Frederick Street, Charlestown** – Four-leg intersection with Stop control on Smith Street, and a Pedestrian Crossing installed on the northern side of Smith Street and eastern side of Frederick Street. The northern approach to Smith Street reaches a LoS E in 2023 at which time the intersection will require upgrading to traffic signals. (Section 10.3).

4. **Smith Street and Charles Street, Charlestown** – Four-leg intersection with Stop control across Smith Street. The intersection continues to operate at an acceptable level of service across all legs beyond 2025. No upgrade considered warranted.

5. **Dickinson Street and James Street, Charlestown** – Three-leg T-intersection with priority given to James Street. The intersection continues to operate at an acceptable level of service on all approaches beyond 2025. No upgrade considered warranted.

6. **Dudley Road and James Street, Charlestown** – Three-leg T-intersection with Stop control on James Street at Dudley Road. By 2025, the right turn from James Street to Dudley Road reaches a LoS D. No upgrade considered warranted.

7. **Dudley Road, Algona Road and Kalora Crescent, Charlestown** – Four-leg intersection with existing roundabout control. The roundabout continues to operate at a LoS A in 2025. No upgrade considered warranted.

8. **Dudley Road and Burwood Road, Whitebridge** – Three-leg T-intersection with priority given to Dudley Road. The intersection continues to operate at a LoS B in 2025.

9. **Dudley Road, Bulls Garden Road, Waran Road and Lonus Avenue, Whitebridge** – Five-leg intersection with existing roundabout control. The roundabout operates at a LoS B in 2025.

10. **Dudley Road and Station Street, Whitebridge** – Four-leg intersection with priority given to Dudley Road. The intersection continues to operate at LoS B in 2025.

11. **Burwood Street and Wallsend Street, Kahibah** – Three-leg T-intersection with priority given to Wallsend Street. The intersection continues to operate at LoS in 2025.

12. **Kahibah Road, Wallsend Street and Hexham Street, Kahibah** – Three-leg Y-intersection. The intersection approaches failure (LoS E) on the Hexham Street approach the AM peak. The intersection will require an upgrade to a roundabout with two lanes on the Kahibah Road approach (Section 2.6)

13. **Burwood Street and Redhead Street, Kahibah** – Four-leg intersection with Burwood Street having priority. The intersection continues to operate at Los B in 2025.

14. **Willow Road and Kestral Avenue, Mount Hutton** – Three-leg T-intersection with Willow Road having priority. The intersection continues to operate at LoS B in 2025.

15. **Burton Road and Glad Gunson Drive, Mount Hutton** – Three-leg Y-intersection. The intersection continues to operate at LoS B in 2025.

16. **Violet Town Road and Wilsons Road, Mount Hutton** – Three-leg T-intersection. Wilsons Road westbound approach fails in 2015 and requires upgrade to a roundabout, Section 10.5.

17. **Bayview Street, Warners Bay Road and Dunkley Parade, Mount Hutton** – Three-leg intersection with priority along Dunkley Parade and Warners Bay Road. Bayview Street right turn movement is a LoS E in 2014 and requires upgrade to a roundabout, Section 10.4.

18. **Wilsons Road to Willow Road proposed road link**, including analysis of **South Street and Merrigum Street** Windale, and **Willow Road and Merrigum Street**, Mount Hutton. Section 10.7.

19. **Croudace Road, Lake Street and Willandra Crescent, Windale** - Four-way intersection with priority on Croudace Road / Willandra Crescent. The intersection continues to operate at LoS B in 2025.

20. **Floraville Road and Park Street, Floraville** – Three-way T-intersection. The intersection continues to operate at LoS B in 2025.

21. **Park Royal Drive, Floraville Road and Griffiths Road, Floraville** – Four-leg roundabout. The intersection continues to operate at LoS B in 2025.

22. **Wommara Avenue, Prince Street and Buttaba Avenue, Belmont North** – Four-leg intersection with priority given to Wommara Avenue. The intersection continues to operate at LoS B in 2025.

23. **Oakdale Road and Redhead Road, Redhead** – Three-leg T-intersection with priority given to Redhead Road. The intersection continues to operate at LoS B in 2025.

24. **Redhead Road and Steel Street, Redhead** – Three-leg Y-intersection with priority along Redhead Road. The intersection continues to operate at LoS B in 2025.

25. **Elsdon Street and Cowlishaw Street, Redhead** – Four-leg cross intersection with priority given to Elsdon Street. The intersection continues to operate at LoS B in 2025.

The 7 intersections identified as requiring upgrade are shown below in Figure 9.1.

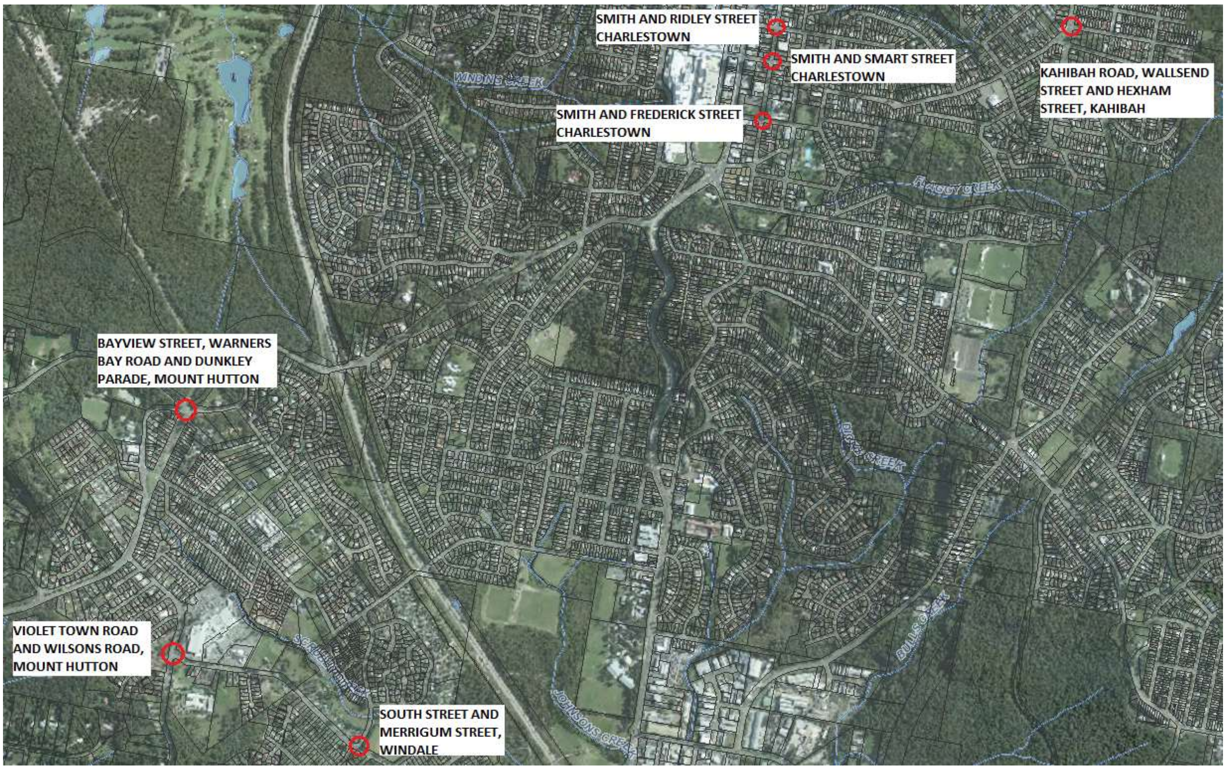


Figure 9.1: Locality Plan of the intersections requiring upgrade catchment wide

The intersections requiring upgrade were analysed using Sidra Intersection 6.0. Table 9.2 shows the intersections requiring upgrade, year of failure, and additional PVT's.

Table 9.2: Intersections requiring upgrade, timing and cost estimate

Suburb	Intersection	Existing PVTs	Additional PVTs for failure	Year upgrade required	Estimated cost
Mount Hutton	Warners Bay Road, Bayview Street and Dunkley Parade	2181	0	2015	$1,700,000*
Mount Hutton	Violet Town Road and Wilsons Road	2625	67	2018	$2,000,000
Windale	Merrigum Street and South Street	1296	72	2018	$2,060,000
Charlestown	Smith Street and Smart Street	928	176	2019	$600,000
Kahibah	Kahibah Road, Wallsend Street and Hexham Street	923	212	2020	$2,000,000
Charlestown	Smith Street and Frederick Street	819	212	2023	$600,000
Charlestown	Smith Street and Ridley Street	799	362	2025	$600,000

*Cost for Bayview Street, Dunkley Parade and Warners Bay Road distributed 50/50 between Charlestown and Glendale catchments as the intersection is on the boundary of the two catchments.

9.3 Assumptions

The following are a list of assumptions used for each intersection requiring upgrade:

- LOS E on any movement is not acceptable and the intersection may require upgrading. For example, the right turn out of a side street into a more major road at a LOS E may make the driver take greater risks due to increased delay.
- Sidra Intersection software does not model Marked Pedestrian Crossings (MPC) at intersections. A 10% volume increase was added to account for the additional delay caused by the MPC's. The Smith and Smart Street, and Smith and Frederick Street intersections both have Marked Pedestrian Crossing's (MPC's) located on the north and east intersection legs. It is considered that 10% is sufficient as the pedestrian peak occurs between 3pm and 4pm, and does not coincide with the traffic peak (Figure 9.2, source BTF report). During the PM traffic peak, the pedestrian volumes were significantly lower.

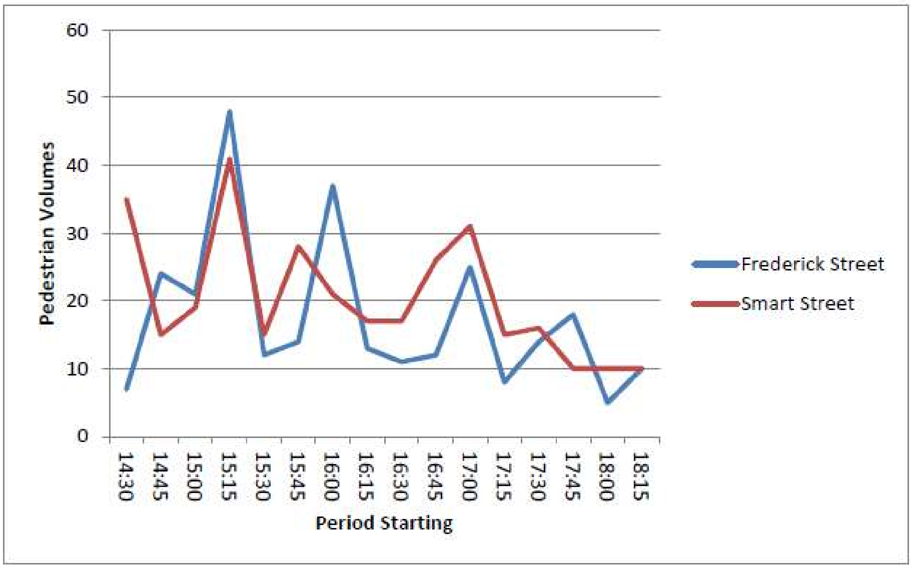


Figure 9.2: Smith and Smart Street, and Smith and Frederick Street pedestrian activity (source BTF report)

- Intersections proposed to be signalised are modelled for a 10 year life, unless the intersection is being directly compared to a roundabout as an upgrade option. In that case, they will both be modelled with a 20 year life.
- Intersections proposed to be upgraded to a roundabout are modelled for a 20 year life.
- A 20% sensitivity test was applied to the intersection additional to the life cycle year traffic volume, to determine the intersection susceptibility to failure if the traffic volumes increase above the projected increases.
- It is preferred that the intersection Level of Service (LoS) is improved within the existing road reserve constraints before consideration of land acquisition.
- If the analysis year is above 2025 (for the life cycle projection), it is considered that the yearly growth increases at the same rate as the 2010 to 2025 projections.

10 Upgraded Intersections

10.1 Smith and Ridley Street intersection, Charlestown

Smith and Ridley Street intersection is a Stop sign controlled intersection, with no pedestrian facilities installed (Figure 10.1).

Figure 10.1: Smith and Ridley Street intersection.

Sidra was used to model the existing intersection using 2012 traffic survey data, with the results tabled below (Table 10.1).

Table 10.1: Smith and Ridley Street intersection, existing geometry and 2012 traffic volumes

Site: Ridley and Smith PM

Ridley Street and Smith Street
2012 traffic volumes - PM Peak
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Smith Street - South											
1	L2	25	0.0	0.049	10.2	LOS B	0.3	2.1	0.46	0.37	48.5
2	T1	26	0.0	0.049	2.0	LOS A	0.3	2.1	0.46	0.37	48.5
3	R2	20	0.0	0.049	10.4	LOS B	0.3	2.1	0.46	0.37	48.5
Approach		72	0.0	0.049	7.2	NA	0.3	2.1	0.46	0.37	48.5
East: Ridley Street - East											
4	L2	56	0.0	0.207	16.1	LOS C	0.8	5.5	0.58	0.97	42.5
5	T1	3	0.0	0.207	15.6	LOS C	0.8	5.5	0.58	0.97	42.5
6	R2	45	0.0	0.207	15.9	LOS C	0.8	5.5	0.58	0.97	42.5
Approach		104	0.0	0.207	16.0	LOS C	0.8	5.5	0.58	0.97	42.5
North: Smith Street - North											
7	L2	21	0.0	0.235	8.5	LOS A	1.7	12.0	0.18	0.11	55.4
8	T1	389	0.0	0.235	0.3	LOS A	1.7	12.0	0.18	0.11	55.4
9	R2	32	0.0	0.235	8.7	LOS A	1.7	12.0	0.18	0.11	55.4
Approach		442	0.0	0.235	1.3	NA	1.7	12.0	0.18	0.11	55.4
West: Ridley Street - West											
10	L2	21	0.0	0.424	20.4	LOS C	2.3	16.2	0.45	1.03	39.1
11	T1	54	0.0	0.424	20.0	LOS C	2.3	16.2	0.45	1.03	39.1
12	R2	106	0.0	0.424	20.2	LOS C	2.3	16.2	0.45	1.03	39.1
Approach		181	0.0	0.424	20.2	LOS C	2.3	16.2	0.45	1.03	39.1
All Vehicles		799	0.0	0.424	8.0	NA	2.3	16.2	0.32	0.45	48.3

The intersection currently operates satisfactorily. The intersection traffic volumes were projected to 2025 to determine the operation of the existing intersection. These results are tabulated in Table 10.2.

Table 10.2: Smith and Ridley Street intersection, existing geometry and 2025 traffic volumes

Site: Ridley and Smith PM - 2025

Ridley Street and Smith Street
Projected 2025 traffic volumes - PM Peak
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Smith Street - South											
1	L2	35	0.0	0.019	8.2	LOS A	0.0	0.0	0.00	0.67	48.9
2	T1	36	0.0	0.054	3.0	LOS A	0.3	2.2	0.53	0.37	48.5
3	R2	27	0.0	0.054	11.3	LOS B	0.3	2.2	0.53	0.37	48.5
Approach		98	0.0	0.054	7.2	NA	0.3	2.2	0.34	0.48	48.6
East: Ridley Street - East											
4	L2	78	0.0	0.129	14.7	LOS B	0.5	3.2	0.54	0.99	43.7
5	T1	4	0.0	0.286	27.4	LOS D	1.1	7.7	0.80	1.04	34.9
6	R2	62	0.0	0.286	27.6	LOS D	1.1	7.7	0.80	1.04	34.9
Approach		144	0.0	0.286	20.6	LOS C	1.1	7.7	0.66	1.01	39.2
North: Smith Street - North											
7	L2	29	0.0	0.055	8.2	LOS A	0.0	0.0	0.00	0.26	56.4
8	T1	541	0.0	0.273	0.3	LOS A	2.1	15.0	0.20	0.11	55.2
9	R2	44	0.0	0.273	8.7	LOS A	2.1	15.0	0.23	0.08	55.0
Approach		615	0.0	0.273	1.3	NA	2.1	15.0	0.19	0.11	55.2
West: Ridley Street - West											
10	L2	29	0.0	0.146	16.7	LOS C	0.5	3.8	0.26	0.93	41.6
11	T1	75	0.0	0.728	27.4	LOS D	4.8	33.4	0.57	1.10	34.7
12	R2	147	0.0	0.728	39.9	LOS E	4.8	33.4	0.91	1.28	29.2
Approach		252	0.0	0.728	33.5	LOS D	4.8	33.4	0.73	1.18	31.8
All Vehicles		1108	0.0	0.728	11.6	NA	4.8	33.4	0.39	0.50	44.8

The delay on the western right turn approach to Ridley Street reaches a LoS E at 2025. The intersection will require an upgrade, as the delay associated with the LoS E may result in people accepting more risky gaps in the traffic stream on the priority road, which may result in increased crashes. Due to the geometry of the intersection and CBD location, it is recommended that the intersection be considered for upgrade to traffic signals rather than roundabout. Figure 10.2 shows the proposed geometry of the intersection, and Table 10.3 shows the result of the upgrade to signals.

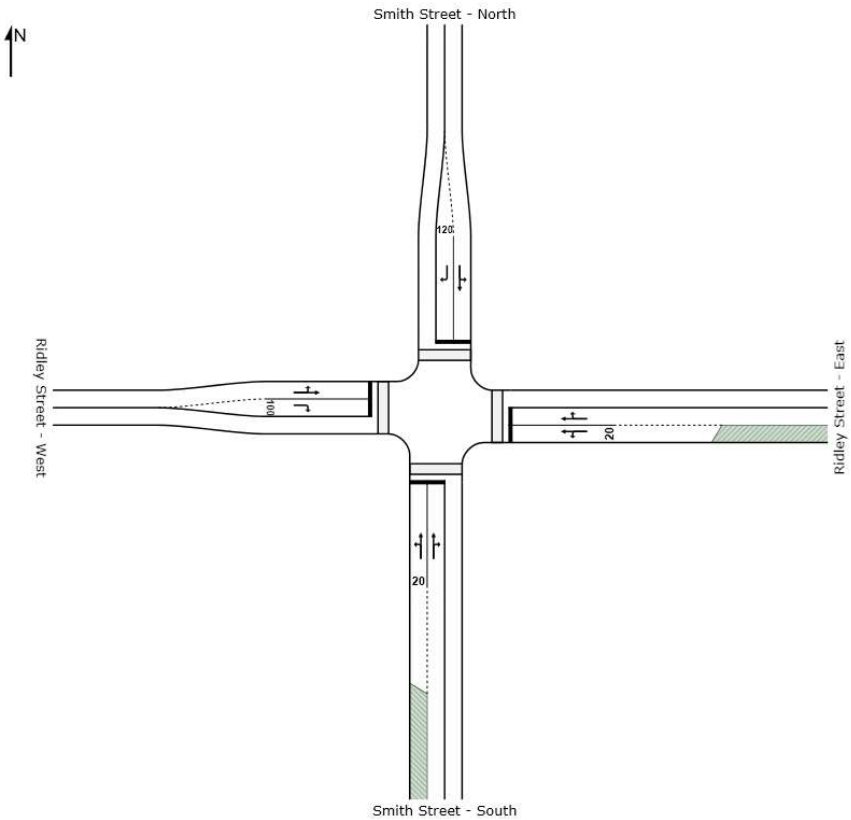


Figure 10.2: Smith and Ridley Street – Layout of signals.

Table 10.3: Smith and Ridley Street signalised intersection, 2025 projected traffic volumes

Site: Ridley and Smith PM - 2025

Ridley Street and Smith Street
Projected 2025 traffic volumes - PM Peak
Signals - Actuated Cycle Time = 45 seconds (Practical Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Smith Street - South											
1	L2	35	0.0	0.042	16.1	LOS B	0.4	3.0	0.57	0.71	41.5
2	T1	36	0.0	0.162	14.8	LOS B	1.1	7.8	0.78	0.68	38.6
3	R2	27	0.0	0.162	23.1	LOS C	1.1	7.8	0.78	0.68	38.6
Approach		98	0.0	0.162	17.6	LOS B	1.1	7.8	0.71	0.69	39.6
East: Ridley Street - East											
4	L2	78	0.0	0.145	21.8	LOS C	1.3	9.2	0.76	0.75	37.4
5	T1	4	0.0	0.164	13.9	LOS B	1.1	8.0	0.76	0.75	37.4
6	R2	62	0.0	0.164	22.2	LOS C	1.1	8.0	0.76	0.75	37.4
Approach		144	0.0	0.164	21.8	LOS C	1.3	9.2	0.76	0.75	37.4
North: Smith Street - North											
7	L2	29	0.0	0.660	19.5	LOS B	10.1	70.9	0.82	0.73	42.8
8	T1	541	0.0	0.660	11.3	LOS B	10.1	70.9	0.82	0.73	42.8
9	R2	44	0.0	0.106	22.7	LOS C	0.8	5.3	0.77	0.73	36.9
Approach		615	0.0	0.660	12.5	LOS B	10.1	70.9	0.82	0.73	42.4
West: Ridley Street - West											
10	L2	29	0.0	0.188	22.0	LOS C	1.8	12.5	0.77	0.66	40.0
11	T1	75	0.0	0.188	13.9	LOS B	1.8	12.5	0.77	0.66	40.0
12	R2	147	0.0	0.352	24.0	LOS C	2.8	19.4	0.83	0.79	36.1
Approach		252	0.0	0.352	20.8	LOS C	2.8	19.4	0.80	0.73	37.6
All Vehicles		1108	0.0	0.660	16.1	LOS B	10.1	70.9	0.80	0.73	40.3

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	11	19.4	LOS B	0.0	0.0	0.88	0.88
P2	East Full Crossing	11	19.4	LOS B	0.0	0.0	0.88	0.88
P3	North Full Crossing	11	19.4	LOS B	0.0	0.0	0.88	0.88
P4	West Full Crossing	11	19.4	LOS B	0.0	0.0	0.88	0.88
All Pedestrians		42	19.4	LOS B			0.88	0.88

The intersection operates at an overall LOS B under signalised control. The delay on the western right turn approach to Ridley Street, with signals, now operates at a LoS C. The intersection was modelled for the 10 year life (to 2035) based on the projected 2010 – 2025 average annual growth figures, with the results in Table 10.4.

Table 10.4: Smith and Ridley Street signalised intersection, 2035 traffic volumes

Site: Ridley and Smith PM - 2035

Ridley Street and Smith Street
Projected 2035 traffic volumes
Signals - Actuated Cycle Time = 53 seconds (Practical Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Smith Street - South											
1	L2	43	0.0	0.052	16.6	LOS B	0.6	4.5	0.55	0.71	41.4
2	T1	45	0.0	0.262	20.0	LOS B	1.8	12.4	0.83	0.72	35.1
3	R2	35	0.0	0.262	29.0	LOS C	1.8	12.4	0.85	0.72	34.8
Approach		123	0.0	0.262	21.4	LOS C	1.8	12.4	0.74	0.72	37.0
East: Ridley Street - East											
4	L2	97	0.0	0.173	23.7	LOS C	1.9	13.2	0.75	0.76	36.3
5	T1	5	0.0	0.214	16.9	LOS B	1.7	12.0	0.78	0.76	35.6
6	R2	78	0.0	0.214	25.2	LOS C	1.7	12.0	0.78	0.76	35.6
Approach		180	0.0	0.214	24.2	LOS C	1.9	13.2	0.76	0.76	35.9
North: Smith Street - North											
7	L2	37	0.0	0.776	21.5	LOS C	15.6	109.5	0.88	0.79	41.1
8	T1	675	0.0	0.776	13.4	LOS B	15.6	109.5	0.88	0.79	41.1
9	R2	56	0.0	0.175	29.3	LOS C	1.3	8.9	0.85	0.75	33.1
Approach		767	0.0	0.776	14.9	LOS B	15.6	109.5	0.88	0.79	40.4
West: Ridley Street - West											
10	L2	37	0.0	0.225	24.0	LOS C	2.6	18.2	0.77	0.67	38.6
11	T1	94	0.0	0.225	15.9	LOS B	2.6	18.2	0.77	0.67	38.6
12	R2	184	0.0	0.453	27.4	LOS C	4.2	29.3	0.86	0.80	34.1
Approach		315	0.0	0.453	23.6	LOS C	4.2	29.3	0.82	0.75	35.8
All Vehicles		1385	0.0	0.776	18.7	LOS B	15.6	109.5	0.84	0.77	38.3

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	13	20.9	LOS C	0.0	0.0	0.89	0.89
P2	East Full Crossing	13	20.9	LOS C	0.0	0.0	0.89	0.89
P3	North Full Crossing	13	20.9	LOS C	0.0	0.0	0.89	0.89
P4	West Full Crossing	13	20.9	LOS C	0.0	0.0	0.89	0.89
All Pedestrians		51	20.9	LOS C			0.89	0.89

The intersection continues to operate at a LoS B in 2035. The queue length on the northern apoproach to Smith Street is expected to exceed 100 metres at this time. This queue must not exceed 150 metres or it will impact on the Pacific Highway southbound. The intersection was modelled with 20% sensitivity (Table 10.5) to determine if the intersection is susceptible to failure if the traffic volumes increase above the projected level.

Table 10.5: Smith and Ridley Street signalised intersection, 2035 traffic volumes + 20%

Site: Ridley and Smith PM - 2035 + 20%

Ridley Street and Smith Street
Projected 2035 traffic volumes + 20%
Signals - Actuated   Cycle Time = 69 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Smith Street - South											
1	L2	52	0.0	0.078	17.8	LOS B	1.3	9.0	0.52	0.66	41.7
2	T1	54	0.0	0.392	22.2	LOS C	2.4	16.7	0.75	0.71	33.6
3	R2	42	0.0	0.392	40.2	LOS D	2.4	16.7	0.92	0.75	29.2
Approach		147	0.0	0.392	25.8	LOS C	2.4	16.7	0.72	0.71	34.5
East: Ridley Street - East											
4	L2	117	0.0	0.197	27.5	LOS C	2.9	20.3	0.74	0.77	34.1
5	T1	6	0.0	0.268	22.6	LOS C	2.7	19.1	0.80	0.77	32.5
6	R2	94	0.0	0.268	30.9	LOS C	2.7	19.1	0.80	0.77	32.5
Approach		217	0.0	0.268	28.8	LOS C	2.9	20.3	0.77	0.77	33.4
North: Smith Street - North											
7	L2	44	0.0	0.865	26.2	LOS C	26.4	184.5	0.93	0.87	37.7
8	T1	809	0.0	0.865	18.0	LOS B	26.4	184.5	0.93	0.87	37.7
9	R2	66	0.0	0.296	39.3	LOS D	2.1	14.8	0.91	0.76	28.8
Approach		920	0.0	0.865	19.9	LOS B	26.4	184.5	0.93	0.86	36.9
West: Ridley Street - West											
10	L2	44	0.0	0.256	27.9	LOS C	4.0	27.8	0.76	0.68	36.1
11	T1	113	0.0	0.256	19.7	LOS B	4.0	27.8	0.76	0.68	36.1
12	R2	220	0.0	0.557	33.2	LOS C	6.6	46.2	0.88	0.82	31.3
Approach		377	0.0	0.557	28.5	LOS C	6.6	46.2	0.83	0.76	33.1
All Vehicles		1661	0.0	0.865	23.5	LOS C	26.4	184.5	0.87	0.81	35.3

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	16	28.8	LOS C	0.0	0.0	0.91	0.91
P2	East Full Crossing	16	28.8	LOS C	0.0	0.0	0.91	0.91
P3	North Full Crossing	16	28.8	LOS C	0.0	0.0	0.91	0.91
P4	West Full Crossing	16	28.8	LOS C	0.0	0.0	0.91	0.91
All Pedestrians		63	28.8	LOS C			0.91	0.91

The queue on the northern approach to Smith Street exceeds 150 metres under this scenario. This is a worst case scenario, where the traffic volumes exceed the projected level by 20%. If this scenario were to occur, the intersection can be altered with a right turn ban on the northern approach to Smith Street which will allow two through lanes on this approach. The scenario is shown in Table 10.6 below, and both improves the queue on Smith Street southbound to 107 metres and improves the intersection LoS to B overall.

Table 10.6: Smith and Ridley Street signalised intersection, 2035 traffic volumes + 20%, plus right turn ban on Smith Street north

Site: Ridley and Smith PM - 2035 + 20% - right turn ban Smith Street southbound

Ridley Street and Smith Street
Projected 2035 traffic volumes + 20%
Signals - Actuated   Cycle Time = 55 seconds (Practical Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Smith Street - South											
1	L2	52	0.0	0.064	17.6	LOS B	0.8	5.8	0.57	0.71	40.6
2	T1	54	0.0	0.321	20.7	LOS C	2.2	15.6	0.84	0.73	34.8
3	R2	42	0.0	0.321	29.6	LOS C	2.2	15.6	0.86	0.73	34.5
Approach		147	0.0	0.321	22.2	LOS C	2.2	15.6	0.75	0.73	36.5
East: Ridley Street - East											
4	L2	117	0.0	0.192	23.3	LOS C	2.3	16.1	0.73	0.76	36.5
5	T1	6	0.0	0.250	17.4	LOS B	2.1	15.0	0.78	0.77	35.3
6	R2	94	0.0	0.250	25.6	LOS C	2.1	15.0	0.78	0.77	35.3
Approach		217	0.0	0.250	24.1	LOS C	2.3	16.1	0.76	0.76	35.9
North: Smith Street - North											
7	L2	44	0.0	0.207	18.4	LOS B	3.0	20.7	0.62	0.60	43.4
8	T1	809	0.0	0.758	13.6	LOS B	15.3	107.2	0.83	0.75	41.0
Approach		854	0.0	0.758	13.8	LOS B	15.3	107.2	0.82	0.74	41.2
West: Ridley Street - West											
10	L2	44	0.0	0.249	23.6	LOS C	3.2	22.1	0.75	0.67	38.9
11	T1	113	0.0	0.249	15.5	LOS B	3.2	22.1	0.75	0.67	38.9
12	R2	220	0.0	0.522	27.4	LOS C	5.2	36.3	0.86	0.81	34.1
Approach		377	0.0	0.522	23.4	LOS C	5.2	36.3	0.82	0.75	36.0
All Vehicles		1595	0.0	0.758	18.3	LOS B	15.3	107.2	0.81	0.75	38.6

To ensure that the intersection also operates well for the AM peak in 2035 with 20% sensitivity, it has been modelled (Table 10.7). This model does not include the turn ban implemented on the previous example.

Table 10.7: Smith and Ridley Street signalised intersection, AM peak, 2035 traffic volumes + 20%

Site: Ridley and Smith AM - 2035 + 20%

Ridley Street and Smith Street
Projected 2035 traffic volumes + 20%
Signals - Actuated   Cycle Time = 42 seconds (Practical Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Smith Street - South											
1	L2	46	0.0	0.062	16.8	LOS B	0.6	4.1	0.62	0.72	41.0
2	T1	66	0.0	0.253	13.6	LOS B	1.8	12.8	0.79	0.70	39.6
3	R2	43	0.0	0.253	21.9	LOS C	1.8	12.8	0.79	0.70	39.6
Approach		156	0.0	0.253	16.8	LOS B	1.8	12.8	0.74	0.71	40.0
East: Ridley Street - East											
4	L2	51	0.0	0.088	20.0	LOS B	0.8	5.3	0.72	0.73	38.7
5	T1	7	0.0	0.134	13.0	LOS B	0.9	6.5	0.75	0.73	38.2
6	R2	51	0.0	0.134	21.3	LOS C	0.9	6.5	0.75	0.73	38.2
Approach		108	0.0	0.134	20.1	LOS C	0.9	6.5	0.74	0.73	38.5
North: Smith Street - North											
7	L2	48	0.0	0.607	19.6	LOS B	8.0	55.9	0.82	0.73	42.5
8	T1	428	0.0	0.607	11.4	LOS B	8.0	55.9	0.82	0.73	42.5
9	R2	38	0.0	0.090	21.9	LOS C	0.6	4.3	0.77	0.73	37.4
Approach		515	0.0	0.607	13.0	LOS B	8.0	55.9	0.82	0.73	42.1
West: Ridley Street - West											
10	L2	54	0.0	0.196	20.5	LOS C	1.8	12.7	0.75	0.69	40.4
11	T1	62	0.0	0.196	12.3	LOS B	1.8	12.7	0.75	0.69	40.4
12	R2	144	0.0	0.310	22.1	LOS C	2.4	17.1	0.80	0.78	37.2
Approach		260	0.0	0.310	19.4	LOS B	2.4	17.1	0.78	0.74	38.6
All Vehicles		1039	0.0	0.607	15.9	LOS B	8.0	55.9	0.79	0.73	40.5

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	16	15.4	LOS B	0.0	0.0	0.86	0.86
P2	East Full Crossing	16	15.4	LOS B	0.0	0.0	0.86	0.86
P3	North Full Crossing	16	15.4	LOS B	0.0	0.0	0.86	0.86
P4	West Full Crossing	16	15.4	LOS B	0.0	0.0	0.86	0.86
All Pedestrians		63	15.4	LOS B			0.86	0.86

10.1.1 Conclusion

Using the projected population increase, it is expected that the intersection of Smith and Ridley Street will require upgrading from a Stop sign controlled intersection to a signalised intersection by the year 2025, due to unacceptable delay (LoS E) on the western right turn approach to Ridley Street. It is expected that following upgrade to signals, the intersection will perform with acceptable delays for at least 10 years. Population has not been projected between 2025 and 2040, and if it increases above the anticipated 2010 to 2025 trend, then it is considered that amendments can be made to the intersection (such as turn bans) in order to improve the LoS.

10.2 Smith and Smart Street intersection, Charlestown

The intersection of Smith and Smart Street has raised Marked Pedestrian Crossings (MPC's) located on the north and east side of the intersection (Figure 10.3). Sidra is not able to model MPC's at unsignalised intersections. The traffic volumes have been increased 10% to account for the delay that the MPC's may cause.

Figure 10.3: Smith and Smart Street intersection, 2012.

More pedestrians cross Smith Street than Smart Street, which may improve the LoS on Smart Street as it stops / creates gaps in the Smith Street traffic, allowing traffic to exit Smart Street east.

Table 10.8 shows the results of the Sidra analysis with the current traffic volumes, and Table 10.9 has the 10% increase to account for the pedestrian crossings.

Table 10.8: Smith and Smart Street intersection, existing geometry and 2012 traffic volumes

Site: Smart and Smith PM

Smart Street and Smith Street
Existing Volumes 2012 - PM Peak
Stop (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Smith Street - South											
1	L2	135	0.0	0.134	9.7	LOS A	1.0	6.7	0.42	0.33	48.8
2	T1	77	0.0	0.134	1.5	LOS A	1.0	6.7	0.42	0.33	48.8
3	R2	23	0.0	0.134	9.8	LOS A	1.0	6.7	0.42	0.33	48.8
Approach		235	0.0	0.134	7.0	NA	1.0	6.7	0.42	0.33	48.8
East: Smart Street - East											
4	L2	15	0.0	0.225	21.3	LOS C	0.9	6.1	0.68	0.98	38.9
5	T1	118	0.0	0.225	21.9	LOS C	0.9	6.1	0.72	1.00	38.3
6	R2	7	0.0	0.225	23.2	LOS C	0.9	6.0	0.76	1.02	37.6
Approach		140	0.0	0.225	21.9	LOS C	0.9	6.1	0.72	1.00	38.3
North: Smith Street - North											
7	L2	81	0.0	0.378	9.6	LOS A	2.7	19.1	0.46	0.44	48.6
8	T1	212	0.0	0.378	1.4	LOS A	2.7	19.1	0.46	0.44	48.6
9	R2	261	0.0	0.378	10.3	LOS B	2.7	19.1	0.46	0.44	48.6
Approach		554	0.0	0.378	6.8	NA	2.7	19.1	0.46	0.44	48.6
All Vehicles		928	0.0	0.378	9.1	NA	2.7	19.1	0.49	0.49	46.8

Table 10.9: Smith and Smart Street intersection, existing geometry with 10% additional traffic

MOVEMENT SUMMARY

Site: Smart and Smith PM - 2012 + 10%

Smart Street and Smith Street
Existing Volumes 2012 + 10% - PM Peak
Stop (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Smith Street - South											
1	L2	148	0.0	0.149	9.9	LOS A	1.1	7.7	0.45	0.32	48.5
2	T1	84	0.0	0.149	1.7	LOS A	1.1	7.7	0.45	0.32	48.5
3	R2	26	0.0	0.149	10.0	LOS B	1.1	7.7	0.45	0.32	48.5
Approach		259	0.0	0.149	7.3	NA	1.1	7.7	0.45	0.32	48.5
East: Smart Street - East											
4	L2	16	0.0	0.291	25.0	LOS C	1.2	8.2	0.74	1.01	36.6
5	T1	129	0.0	0.291	25.8	LOS D	1.2	8.2	0.78	1.02	35.9
6	R2	8	0.0	0.291	27.3	LOS D	1.2	8.1	0.81	1.04	35.2
Approach		154	0.0	0.291	25.8	LOS D	1.2	8.2	0.77	1.02	35.9
North: Smith Street - North											
7	L2	89	0.0	0.422	10.0	LOS B	3.6	25.3	0.51	0.44	48.1
8	T1	233	0.0	0.422	1.9	LOS A	3.6	25.3	0.51	0.44	48.1
9	R2	287	0.0	0.422	10.7	LOS B	3.6	25.3	0.51	0.44	48.1
Approach		609	0.0	0.422	7.2	NA	3.6	25.3	0.51	0.44	48.1
All Vehicles		1022	0.0	0.422	10.0	NA	3.6	25.3	0.53	0.50	45.9

The result of the 10% additional traffic volume decreases the LoS on Smart Street east to a LoS D, with a small increase in delay. It is considered that the second scenario with the 10% additional traffic volume is a more accurate representation of the intersection.

The intersection was modelled until any one movement altered to LoS E, which is considered failure based on the delay to motorists. The Smart Street leg changes to a LoS E in the year 2019. The results are shown in Table 10.10.

Table 10.10: Smith and Smart Street intersection, existing geometry with additional traffic to LoS E

Site: Smart and Smith PM - 2019

Smart Street and Smith Street
Existing Volumes + 10%, incremented to year 2019 - PM Peak
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Smith Street - South											
1	L2	174	0.0	0.176	10.4	LOS B	1.4	9.9	0.51	0.29	48.0
2	T1	99	0.0	0.176	2.2	LOS A	1.4	9.9	0.51	0.29	48.0
3	R2	31	0.0	0.176	10.5	LOS B	1.4	9.9	0.51	0.29	48.0
Approach		303	0.0	0.176	7.7	NA	1.4	9.9	0.51	0.29	48.0
East: Smart Street - East											
4	L2	19	0.0	0.474	36.3	LOS E	2.1	14.6	0.84	1.09	30.8
5	T1	152	0.0	0.474	37.8	LOS E	2.1	14.6	0.87	1.09	30.0
6	R2	9	0.0	0.474	40.0	LOS E	2.0	13.9	0.90	1.09	29.2
Approach		180	0.0	0.474	37.8	LOS E	2.1	14.6	0.87	1.09	30.0
North: Smith Street - North											
7	L2	105	0.0	0.508	11.2	LOS B	6.0	41.7	0.62	0.47	46.8
8	T1	273	0.0	0.508	3.0	LOS A	6.0	41.7	0.62	0.47	46.8
9	R2	337	0.0	0.508	11.9	LOS B	6.0	41.7	0.62	0.47	46.8
Approach		715	0.0	0.508	8.4	NA	6.0	41.7	0.62	0.47	46.8
All Vehicles		1198	0.0	0.508	12.6	NA	6.0	41.7	0.63	0.51	43.4

From the results in Table 10.10, it is considered that the intersection requires upgrading in the year 2019. The intersection was modelled as signals (refer to Figure 10.4 and Table 10.11). The road geometry for the signal upgrade is constrained by the existing development.

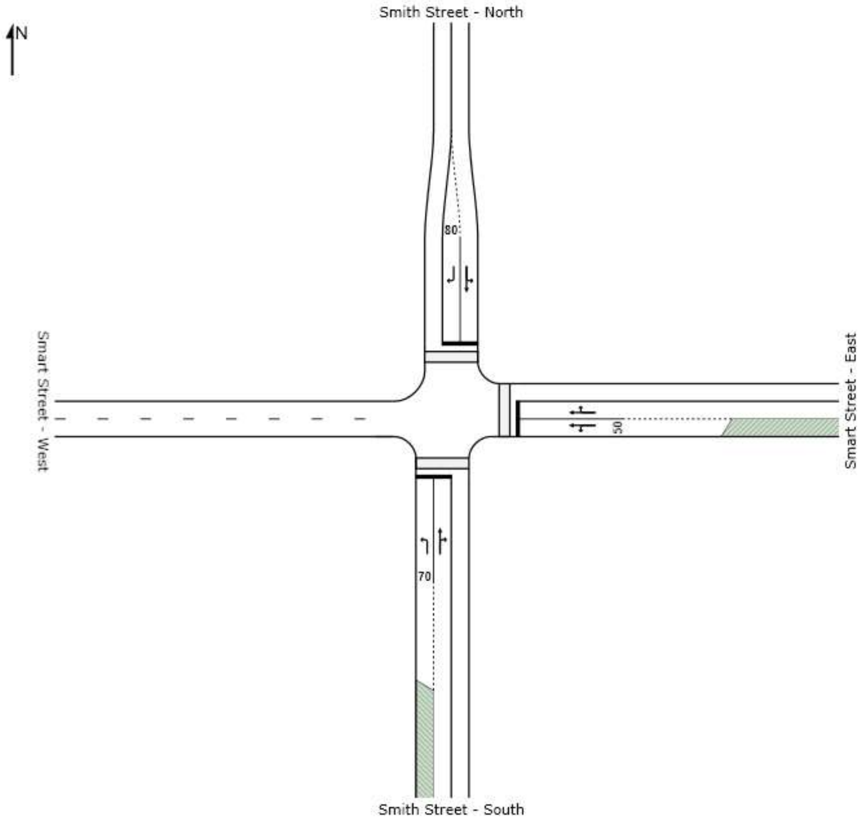


Figure 10.4: Smith and Smart Street Charlestown - layout of traffic signals

Table 10.11: Smith and Smart Street signalised intersection, 2019 projected traffic volumes

Site: Smart and Smith PM - 2019

Smart Street and Smith Street
Projected 2019 traffic volumes - PM Peak
Signals - Fixed Time Cycle Time = 60 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Smith Street - South											
1	L2	174	0.0	0.432	31.0	LOS C	4.6	32.1	0.91	0.80	32.4
2	T1	99	0.0	0.310	22.0	LOS C	3.3	23.1	0.88	0.73	34.7
3	R2	31	0.0	0.310	30.3	LOS C	3.3	23.1	0.88	0.73	34.7
Approach		303	0.0	0.432	28.0	LOS C	4.6	32.1	0.90	0.77	33.3
East: Smart Street - East											
4	L2	19	0.0	0.215	29.6	LOS C	2.2	15.6	0.86	0.70	35.2
5	T1	152	0.0	0.215	21.5	LOS C	2.2	15.7	0.86	0.69	35.3
6	R2	9	0.0	0.215	29.8	LOS C	2.2	15.7	0.86	0.68	35.5
Approach		180	0.0	0.215	22.8	LOS C	2.2	15.7	0.86	0.69	35.3
North: Smith Street - North											
7	L2	105	0.0	0.737	32.3	LOS C	11.0	77.2	0.97	0.90	33.3
8	T1	273	0.0	0.737	24.2	LOS C	11.0	77.2	0.97	0.90	33.3
9	R2	337	0.0	0.680	31.7	LOS C	9.4	65.9	0.95	0.86	32.0
Approach		715	0.0	0.737	28.9	LOS C	11.0	77.2	0.96	0.88	32.7
All Vehicles		1198	0.0	0.737	27.7	LOS C	11.0	77.2	0.93	0.82	33.2

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	42	24.3	LOS C	0.1	0.1	0.90	0.90
P2	East Full Crossing	18	24.3	LOS C	0.0	0.0	0.90	0.90
P3	North Full Crossing	53	24.4	LOS C	0.1	0.1	0.90	0.90
All Pedestrians		113	24.3	LOS C			0.90	0.90

The intersection when signalised using the projected 2019 traffic volumes performs at a LoS C, which is satisfactory.

The intersection is modelled with 10 years growth (Table 10.12). The model year for this scenario is 2029, which is above the 2025 horizon year.

Table 10.12: Smith and Smart Street signalised intersection, 2029 projected traffic volumes

Site: Smart and Smith PM - 2029

Smart Street and Smith Street
2029 projected traffic volumes - PM Peak
Signals - Fixed Time Cycle Time = 70 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Smith Street - South											
1	L2	211	0.0	0.610	37.8	LOS D	6.9	48.5	0.97	0.82	29.4
2	T1	120	0.0	0.441	28.3	LOS C	5.0	34.8	0.93	0.77	31.5
3	R2	38	0.0	0.441	36.6	LOS D	5.0	34.8	0.93	0.77	31.5
Approach		368	0.0	0.610	34.6	LOS C	6.9	48.5	0.95	0.80	30.3
East: Smart Street - East											
4	L2	22	0.0	0.303	35.6	LOS D	3.3	23.2	0.90	0.73	32.1
5	T1	184	0.0	0.303	27.4	LOS C	3.3	23.3	0.90	0.73	32.2
6	R2	12	0.0	0.303	35.7	LOS D	3.3	23.3	0.90	0.72	32.3
Approach		218	0.0	0.303	28.7	LOS C	3.3	23.3	0.90	0.73	32.2
North: Smith Street - North											
7	L2	127	0.0	0.641	28.0	LOS C	13.1	91.7	0.88	0.80	35.9
8	T1	331	0.0	0.641	19.8	LOS B	13.1	91.7	0.88	0.80	35.9
9	R2	408	0.0	0.592	28.3	LOS C	11.4	80.0	0.86	0.85	33.6
Approach		866	0.0	0.641	25.0	LOS C	13.1	91.7	0.87	0.82	34.8
All Vehicles		1453	0.0	0.641	28.0	LOS C	13.1	91.7	0.90	0.80	33.1

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	29.3	LOS C	0.1	0.1	0.92	0.92
P2	East Full Crossing	24	29.3	LOS C	0.0	0.0	0.92	0.92
P3	North Full Crossing	56	29.3	LOS C	0.1	0.1	0.92	0.92
All Pedestrians		133	29.3	LOS C			0.92	0.92

The intersection continues to perform at a LoS C with the 10 year (2029) projected growth after signalisation. The queue lengths on the northern approach to Smith Street are lengthy and exceed the lane lengths. However, lane lengths can be increased with additional No Stopping restrictions, and the signal phasing allows the delay to be minimised with the queue lengths clearing relatively quickly.

As a test to determine if the intersection is sensitive to failure, a sensitivity analysis was undertaken by adding 20% to the volumes. The results table is shown below (Table 10.13).

Table 10.13: Smith and Smart Street signalised intersection, 2029 plus 20% sensitivity test

Site: Smart and Smith PM - 2029 20%

Smart Street and Smith Street
2029 projected traffic volumes + 20% sensitivity test - PM Peak
Signals - Fixed Time Cycle Time = 70 seconds (Practical Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Smith Street - South											
1	L2	253	0.0	0.732	40.2	LOS D	8.9	62.2	1.00	0.88	28.4
2	T1	143	0.0	0.527	28.8	LOS C	6.0	42.3	0.95	0.79	31.2
3	R2	45	0.0	0.527	37.1	LOS D	6.0	42.3	0.95	0.79	31.2
Approach		441	0.0	0.732	36.2	LOS D	8.9	62.2	0.98	0.84	29.6
East: Smart Street - East											
4	L2	27	0.0	0.366	36.0	LOS D	4.1	28.4	0.92	0.75	31.8
5	T1	221	0.0	0.366	27.8	LOS C	4.1	28.6	0.92	0.74	32.0
6	R2	15	0.0	0.366	36.1	LOS D	4.1	28.6	0.92	0.74	32.1
Approach		263	0.0	0.366	29.1	LOS C	4.1	28.6	0.92	0.74	32.0
North: Smith Street - North											
7	L2	153	0.0	0.769	31.6	LOS C	17.9	125.1	0.94	0.90	33.8
8	T1	397	0.0	0.769	23.4	LOS C	17.9	125.1	0.94	0.90	33.8
9	R2	489	0.0	0.710	30.1	LOS C	14.8	103.9	0.91	0.87	32.7
Approach		1039	0.0	0.769	27.8	LOS C	17.9	125.1	0.93	0.89	33.3
All Vehicles		1743	0.0	0.769	30.1	LOS C	17.9	125.1	0.94	0.85	32.0

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	29.3	LOS C	0.1	0.1	0.92	0.92
P2	East Full Crossing	24	29.3	LOS C	0.0	0.0	0.92	0.92
P3	North Full Crossing	56	29.3	LOS C	0.1	0.1	0.92	0.92
All Pedestrians		133	29.3	LOS C			0.92	0.92

With the extra 20% load, the queue lengths are lengthy on the Smith Street north leg, however the delays and LoS are acceptable. The queue length almost reaches the next intersection north (Smith and Ridley Street), however this is an extreme case where the traffic volumes exceed the anticipated volume by 20%.

To confirm that the AM peak operates well in 2029 with 20% sensitivity loading, it was modelled (Table 10.14).

Table 10.14: Smith and Smart Street signalised intersection, AM peak, 2029 plus 20% sensitivity test

Site: Smart and Smith AM - 2029 + 20%

Smart Street and Smith Street
2029 projected traffic volumes + 20% sensitivity test - PM Peak
Signals - Fixed Time Cycle Time = 60 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Smith Street - South											
1	L2	194	0.0	0.481	31.3	LOS C	5.2	36.2	0.92	0.80	32.2
2	T1	182	0.0	0.614	24.0	LOS C	7.1	49.8	0.95	0.81	33.4
3	R2	74	0.0	0.614	32.3	LOS C	7.1	49.8	0.95	0.81	33.4
Approach		449	0.0	0.614	28.5	LOS C	7.1	49.8	0.94	0.81	32.9
East: Smart Street - East											
4	L2	56	0.0	0.389	30.7	LOS C	4.2	29.4	0.90	0.76	34.1
5	T1	234	0.0	0.389	22.5	LOS C	4.2	29.6	0.90	0.75	34.3
6	R2	35	0.0	0.389	30.8	LOS C	4.2	29.6	0.90	0.75	34.5
Approach		324	0.0	0.389	24.8	LOS C	4.2	29.6	0.90	0.75	34.3
North: Smith Street - North											
7	L2	179	0.0	0.815	35.7	LOS D	13.2	92.5	1.00	0.99	31.4
8	T1	236	0.0	0.815	27.5	LOS C	13.2	92.5	1.00	0.99	31.4
9	R2	120	0.0	0.242	27.9	LOS C	2.8	19.8	0.82	0.78	33.8
Approach		535	0.0	0.815	30.3	LOS C	13.2	92.5	0.96	0.94	31.9
All Vehicles		1308	0.0	0.815	28.3	LOS C	13.2	92.5	0.94	0.85	32.8

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	24.4	LOS C	0.1	0.1	0.90	0.90
P2	East Full Crossing	24	24.3	LOS C	0.0	0.0	0.90	0.90
P3	North Full Crossing	56	24.4	LOS C	0.1	0.1	0.90	0.90
All Pedestrians		133	24.3	LOS C			0.90	0.90

The intersection operates at a satisfactory level in both the AM and PM peaks.

10.2.1 Conclusion

The intersection of Smith and Smart Street will require upgrading from a Stop sign controlled intersection to a signalised intersection by the year 2019, based on unacceptable delay (LoS E) on the eastern approach to Smart Street. As it is not possible for Sidra to model pedestrians, additional volume was added to account for this. It is expected that the intersection will perform with acceptable delays based on the projected population increase for at least 10 years after the signals are installed.

10.3 Smith and Frederick Street intersection, Charlestown

Similar to the Smith and Smart Street intersection, Smith and Frederick Street intersection (Figure 10.5) has MPC's on the north and eastern sides of the intersection. A 10% increase to traffic volumes will be added to account for these MPC's.

Figure 10.5: Smith and Frederick Street intersection, 2012

Table 10.15 shows the results of the intersection with the surveyed (2012) traffic volumes, and Table 10.19 has the 10% increase to account for the pedestrian volumes.

Table 10.18: Smith and Frederick Street intersection, existing geometry and 2012 traffic volumes

Site: Frederick and Smith PM

Frederick Street and Smith Street
2012 Volumes - PM Peak
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Smith Street - South											
1	L2	58	0.0	0.056	11.3	LOS B	0.2	1.4	0.25	0.88	46.2
2	T1	101	0.0	0.186	14.1	LOS B	0.8	5.6	0.53	0.93	44.1
3	R2	12	0.0	0.186	14.3	LOS B	0.8	5.6	0.53	0.93	44.1
Approach		171	0.0	0.186	13.1	LOS B	0.8	5.6	0.44	0.91	44.8
East: Frederick Street - East											
4	L2	9	0.0	0.100	9.0	LOS A	0.7	4.8	0.30	0.19	52.7
5	T1	136	0.0	0.100	0.8	LOS A	0.7	4.8	0.30	0.19	52.7
6	R2	31	0.0	0.100	9.2	LOS A	0.7	4.8	0.30	0.19	52.7
Approach		176	0.0	0.100	2.7	NA	0.7	4.8	0.30	0.19	52.7
North: Smith Street - North											
7	L2	40	0.0	0.476	17.5	LOS C	3.3	23.4	0.57	1.03	41.5
8	T1	129	0.0	0.476	17.1	LOS C	3.3	23.4	0.57	1.03	41.5
9	R2	107	0.0	0.476	17.3	LOS C	3.3	23.4	0.57	1.03	41.5
Approach		277	0.0	0.476	17.2	LOS C	3.3	23.4	0.57	1.03	41.5
West: Frederick Street - West											
10	L2	74	0.0	0.108	8.8	LOS A	0.6	4.0	0.22	0.32	51.9
11	T1	104	0.0	0.108	0.6	LOS A	0.6	4.0	0.22	0.32	51.9
12	R2	18	0.0	0.108	8.9	LOS A	0.6	4.0	0.22	0.32	51.9
Approach		196	0.0	0.108	4.5	NA	0.6	4.0	0.22	0.32	51.9
All Vehicles		819	0.0	0.476	10.2	NA	3.3	23.4	0.40	0.65	46.6

Table 10.19: Smith and Frederick Street intersection, existing geometry with 10% additional traffic

Site: Frederick and Smith PM - 10%

Frederick Street and Smith Street
2012 volumes + 10% - PM Peak
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Smith Street - South											
1	L2	64	0.0	0.063	11.4	LOS B	0.2	1.6	0.26	0.88	46.2
2	T1	112	0.0	0.217	14.7	LOS B	0.9	6.6	0.56	0.95	43.6
3	R2	13	0.0	0.217	14.9	LOS B	0.9	6.6	0.56	0.95	43.6
Approach		188	0.0	0.217	13.6	LOS B	0.9	6.6	0.46	0.93	44.5
East: Frederick Street - East											
4	L2	11	0.0	0.111	9.1	LOS A	0.8	5.4	0.32	0.19	52.4
5	T1	149	0.0	0.111	0.9	LOS A	0.8	5.4	0.32	0.19	52.4
6	R2	34	0.0	0.111	9.3	LOS A	0.8	5.4	0.32	0.19	52.4
Approach		194	0.0	0.111	2.8	NA	0.8	5.4	0.32	0.19	52.4
North: Smith Street - North											
7	L2	44	0.0	0.557	19.7	LOS C	4.4	31.0	0.62	1.09	39.9
8	T1	142	0.0	0.557	19.2	LOS C	4.4	31.0	0.62	1.09	39.9
9	R2	118	0.0	0.557	19.5	LOS C	4.4	31.0	0.62	1.09	39.9
Approach		304	0.0	0.557	19.4	LOS C	4.4	31.0	0.62	1.09	39.9
West: Frederick Street - West											
10	L2	81	0.0	0.119	8.9	LOS A	0.7	4.6	0.23	0.31	51.7
11	T1	115	0.0	0.119	0.7	LOS A	0.7	4.6	0.23	0.31	51.7
12	R2	20	0.0	0.119	9.0	LOS A	0.7	4.6	0.23	0.31	51.7
Approach		216	0.0	0.119	4.6	NA	0.7	4.6	0.23	0.31	51.7
All Vehicles		902	0.0	0.557	11.1	NA	4.4	31.0	0.43	0.68	45.7

The result of the additional 10% traffic volume does not affect the LoS, and alters the delay by a few seconds in Smith Street north. It is considered that the second scenario with the 10% additional traffic volume is a more accurate representation of the intersection, and these results will be used to determine if any movement of the intersection falls to a LoS E using the projected traffic volume increase. Through incrementing the traffic volumes, Smith Street north reaches a LoS E (Table 10.20) in 2023.

Table 10.20: Smith and Frederick Street intersection, existing geometry, 2023 traffic volumes

Site: Frederick and Smith PM - 2023

Frederick Street and Smith Street
Projected 2023 Volumes including 10% additional - PM peak
Stop (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Smith Street - South											
1	L2	81	0.0	0.083	11.7	LOS B	0.3	2.1	0.31	0.88	46.0
2	T1	141	0.0	0.327	17.6	LOS C	1.6	11.5	0.65	1.04	41.3
3	R2	16	0.0	0.327	17.9	LOS C	1.6	11.5	0.65	1.04	41.3
Approach		238	0.0	0.327	15.6	LOS C	1.6	11.5	0.53	0.99	42.8
East: Frederick Street - East											
4	L2	14	0.0	0.143	9.4	LOS A	1.1	7.5	0.39	0.18	51.6
5	T1	189	0.0	0.143	1.2	LOS A	1.1	7.5	0.39	0.18	51.6
6	R2	43	0.0	0.143	9.7	LOS A	1.1	7.5	0.39	0.18	51.6
Approach		246	0.0	0.143	3.1	NA	1.1	7.5	0.39	0.18	51.6
North: Smith Street - North											
7	L2	56	0.0	0.857	36.8	LOS E	12.5	87.8	0.80	1.56	30.5
8	T1	181	0.0	0.857	36.3	LOS E	12.5	87.8	0.80	1.56	30.5
9	R2	149	0.0	0.857	36.6	LOS E	12.5	87.8	0.80	1.56	30.5
Approach		386	0.0	0.857	36.5	LOS E	12.5	87.8	0.80	1.56	30.5
West: Frederick Street - West											
10	L2	103	0.0	0.152	9.2	LOS A	0.9	6.3	0.28	0.30	51.3
11	T1	145	0.0	0.152	1.0	LOS A	0.9	6.3	0.28	0.30	51.3
12	R2	25	0.0	0.152	9.3	LOS A	0.9	6.3	0.28	0.30	51.3
Approach		274	0.0	0.152	4.8	NA	0.9	6.3	0.28	0.30	51.3
All Vehicles		1144	0.0	0.857	17.4	NA	12.5	87.8	0.53	0.84	40.4

Smith Street north is constrained by an existing concrete median. This concrete median cannot be removed to improve the lane usage on approach to this intersection as the existing MPC is located on the northern side of the intersection, and the Roads and Maritime Services (RMS) no longer permit MPC's with more than one lane on approach.

The intersection was upgraded to signals (refer to Figure 10.6 and Table 10.21) and modelled for 10 year growth (Table 10.22) using the same projected yearly increase.

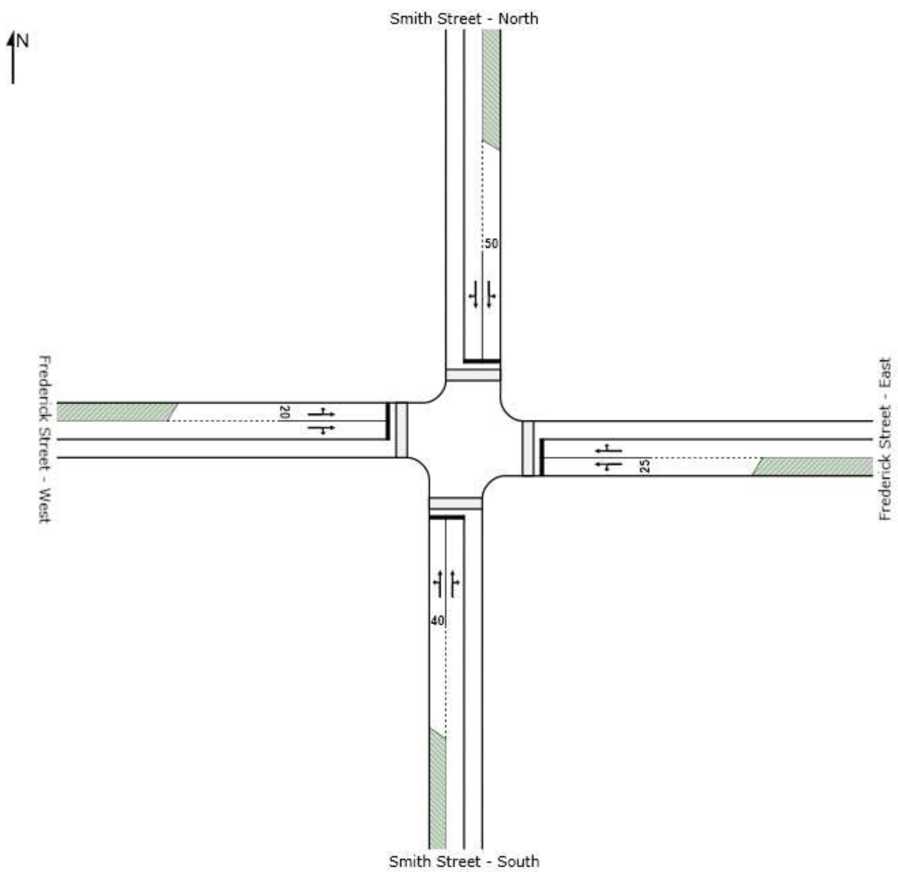


Figure 10.6: Smith and Frederick Street – layout of signals

Table 10.21: Smith and Frederick Street signalised intersection, 2023 projected traffic volumes

Site: Frederick and Smith PM - 2023

Frederick Street and Smith Street
Projected 2023 Volumes including 10% additional - PM peak
Signals - Fixed Time   Cycle Time = 40 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Smith Street - South											
1	L2	81	0.0	0.118	17.2	LOS B	1.1	7.4	0.68	0.74	40.7
2	T1	141	0.0	0.232	9.5	LOS A	2.2	15.2	0.72	0.61	44.5
3	R2	16	0.0	0.232	17.8	LOS B	2.2	15.2	0.72	0.61	44.5
Approach		238	0.0	0.232	12.7	LOS B	2.2	15.2	0.71	0.66	43.1
East: Frederick Street - East											
4	L2	14	0.0	0.073	18.5	LOS B	0.6	4.4	0.72	0.61	42.8
5	T1	189	0.0	0.365	11.5	LOS B	3.2	22.1	0.79	0.69	42.0
6	R2	43	0.0	0.365	20.0	LOS B	3.2	22.1	0.81	0.70	41.8
Approach		246	0.0	0.365	13.3	LOS B	3.2	22.1	0.79	0.69	42.0
North: Smith Street - North											
7	L2	56	0.0	0.108	17.2	LOS B	1.0	7.0	0.68	0.70	41.9
8	T1	181	0.0	0.541	10.9	LOS B	5.0	35.0	0.82	0.77	41.1
9	R2	149	0.0	0.541	19.4	LOS B	5.0	35.0	0.83	0.78	41.0
Approach		386	0.0	0.541	15.1	LOS B	5.0	35.0	0.80	0.76	41.2
West: Frederick Street - West											
10	L2	103	0.0	0.171	18.9	LOS B	1.5	10.4	0.75	0.76	39.4
11	T1	145	0.0	0.299	11.4	LOS B	2.6	18.2	0.79	0.67	42.4
12	R2	25	0.0	0.299	19.7	LOS B	2.6	18.2	0.79	0.67	42.4
Approach		274	0.0	0.299	15.0	LOS B	2.6	18.2	0.77	0.70	41.2
All Vehicles		1144	0.0	0.541	14.2	LOS B	5.0	35.0	0.77	0.71	41.8

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	45	14.5	LOS B	0.0	0.0	0.85	0.85
P2	East Full Crossing	22	14.5	LOS B	0.0	0.0	0.85	0.85
P3	North Full Crossing	12	14.5	LOS B	0.0	0.0	0.85	0.85
P4	West Full Crossing	7	14.5	LOS B	0.0	0.0	0.85	0.85
All Pedestrians		86	14.5	LOS B			0.85	0.85

Table 10.22: Smith and Smart Street signalised intersection, 2033 projected traffic volumes

Site: Frederick and Smith PM - 2033

Frederick Street and Smith Street
Projected 2033 Volumes including 10% additional - PM peak
Signals - Fixed Time   Cycle Time = 40 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Smith Street - South											
1	L2	97	0.0	0.141	17.3	LOS B	1.3	9.0	0.69	0.75	40.6
2	T1	168	0.0	0.282	9.8	LOS A	2.7	18.6	0.74	0.63	44.2
3	R2	19	0.0	0.282	18.1	LOS B	2.7	18.6	0.74	0.63	44.2
Approach		284	0.0	0.282	12.9	LOS B	2.7	18.6	0.72	0.67	42.9
East: Frederick Street - East											
4	L2	16	0.0	0.088	18.6	LOS B	0.8	5.4	0.72	0.62	42.8
5	T1	226	0.0	0.440	11.8	LOS B	3.9	27.0	0.81	0.71	41.7
6	R2	51	0.0	0.440	20.4	LOS C	3.9	27.0	0.83	0.73	41.5
Approach		293	0.0	0.440	13.6	LOS B	3.9	27.0	0.81	0.71	41.7
North: Smith Street - North											
7	L2	66	0.0	0.135	17.3	LOS B	1.3	8.8	0.69	0.70	42.0
8	T1	216	0.0	0.677	13.1	LOS B	6.8	47.5	0.88	0.84	39.4
9	R2	179	0.0	0.677	22.0	LOS C	6.8	47.5	0.91	0.86	39.0
Approach		461	0.0	0.677	17.1	LOS B	6.8	47.5	0.86	0.83	39.6
West: Frederick Street - West											
10	L2	123	0.0	0.204	19.1	LOS B	1.8	12.6	0.76	0.76	39.3
11	T1	174	0.0	0.360	11.6	LOS B	3.2	22.2	0.81	0.69	42.2
12	R2	29	0.0	0.360	20.0	LOS B	3.2	22.2	0.81	0.69	42.2
Approach		326	0.0	0.360	15.2	LOS B	3.2	22.2	0.79	0.72	41.0
All Vehicles		1364	0.0	0.677	15.0	LOS B	6.8	47.5	0.80	0.74	41.0

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	55	14.5	LOS B	0.1	0.1	0.85	0.85
P2	East Full Crossing	26	14.5	LOS B	0.0	0.0	0.85	0.85
P3	North Full Crossing	14	14.5	LOS B	0.0	0.0	0.85	0.85
P4	West Full Crossing	8	14.5	LOS B	0.0	0.0	0.85	0.85
All Pedestrians		103	14.5	LOS B			0.85	0.85

The intersection operates at a LoS B when signalised, and this LoS does not change with 10 years growth. As a test to determine if the intersection is sensitive to failure, a sensitivity analysis was undertaken by adding 20% to the volumes. The results table is shown below (Table 10.23).

Table 10.23: Smith and Smart Street signalised intersection, 2033 traffic volumes plus 20% sensitivity test

Site: Frederick and Smith PM - 2033 + 20%

Frederick Street and Smith Street
Projected 2033 Volumes including 10% additional plus 20% sensitivity test - PM peak
Signals - Fixed Time   Cycle Time = 50 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Smith Street - South											
1	L2	116	0.0	0.132	16.0	LOS B	1.6	11.1	0.58	0.75	41.6
2	T1	202	0.0	0.269	8.5	LOS A	3.3	23.4	0.63	0.57	45.7
3	R2	23	0.0	0.269	16.8	LOS B	3.3	23.4	0.63	0.57	45.7
Approach		341	0.0	0.269	11.6	LOS B	3.3	23.4	0.62	0.63	44.2
East: Frederick Street - East											
4	L2	19	0.0	0.131	23.1	LOS C	1.3	9.3	0.78	0.65	39.3
5	T1	272	0.0	0.657	18.6	LOS B	6.7	46.6	0.91	0.81	36.7
6	R2	61	0.0	0.657	27.8	LOS C	6.7	46.6	0.94	0.84	36.1
Approach		352	0.0	0.657	20.5	LOS C	6.7	46.6	0.91	0.80	36.7
North: Smith Street - North											
7	L2	80	0.0	0.133	16.0	LOS B	1.6	11.5	0.58	0.68	43.3
8	T1	259	0.0	0.663	11.6	LOS B	8.8	61.5	0.79	0.80	40.5
9	R2	215	0.0	0.663	20.6	LOS C	8.8	61.5	0.83	0.82	40.1
Approach		554	0.0	0.663	15.7	LOS B	8.8	61.5	0.78	0.79	40.7
West: Frederick Street - West											
10	L2	147	0.0	0.283	23.9	LOS C	2.9	20.4	0.82	0.78	36.2
11	T1	208	0.0	0.547	18.0	LOS B	5.4	37.7	0.91	0.77	37.3
12	R2	36	0.0	0.547	26.3	LOS C	5.4	37.7	0.91	0.77	37.3
Approach		392	0.0	0.547	21.0	LOS C	5.4	37.7	0.88	0.77	36.9
All Vehicles		1638	0.0	0.663	17.2	LOS B	8.8	61.5	0.80	0.76	39.5

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	65	19.4	LOS B	0.1	0.1	0.88	0.88
P2	East Full Crossing	32	19.4	LOS B	0.0	0.0	0.88	0.88
P3	North Full Crossing	17	19.4	LOS B	0.0	0.0	0.88	0.88
P4	West Full Crossing	11	19.4	LOS B	0.0	0.0	0.88	0.88
All Pedestrians		124	19.4	LOS B			0.88	0.88

The results of Table 10.23 show that the intersection is not sensitive to failure, maintaining the overall intersection LoS B, with minimal queues and delay.

It was mentioned previously that it was not possible to maintain the intersection as a Stop sign controlled intersection, as the existing MPC was located on the northern side of the intersection across Smith Street. Modelling was undertaken on the intersection (un-signalised) with this MPC removed or relocated, and the northern approach to Smith Street was a LoS D in 2025. The same approach fails the 20% sensitivity test with a LoS F indicating that the intersection may require signals even with the MPC relocated or removed.

To confirm that the AM peak operates well in 2029 with 20% sensitivity loading, it was modelled with the result given in Table 10.24.

Table 10.24: Smith and Smart Street signalised intersection, AM peak, 2033 plus 20%

Site: Frederick and Smith AM - 2033 + 20%

Frederick Street and Smith Street
Projected 2033 Volumes including 10% additional plus 20% sensitivity test - PM peak
Signals - Fixed Time   Cycle Time = 40 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Smith Street - South											
1	L2	76	0.0	0.121	18.0	LOS B	1.1	7.4	0.71	0.74	40.2
2	T1	399	0.0	0.607	12.1	LOS B	6.9	48.0	0.88	0.76	42.2
3	R2	8	0.0	0.607	20.4	LOS C	6.9	48.0	0.88	0.76	42.2
Approach		483	0.0	0.607	13.2	LOS B	6.9	48.0	0.85	0.75	41.8
East: Frederick Street - East											
4	L2	33	0.0	0.130	18.0	LOS B	1.2	8.3	0.71	0.65	42.8
5	T1	293	0.0	0.648	13.1	LOS B	6.3	44.0	0.87	0.80	40.2
6	R2	105	0.0	0.648	22.1	LOS C	6.3	44.0	0.91	0.83	39.6
Approach		431	0.0	0.648	15.7	LOS B	6.3	44.0	0.87	0.80	40.2
North: Smith Street - North											
7	L2	59	0.0	0.096	17.9	LOS B	0.8	5.9	0.70	0.73	40.4
8	T1	115	0.0	0.480	13.9	LOS B	3.4	23.5	0.87	0.77	39.1
9	R2	81	0.0	0.480	22.3	LOS C	3.4	23.5	0.88	0.77	39.1
Approach		255	0.0	0.480	17.5	LOS B	3.4	23.5	0.84	0.76	39.4
West: Frederick Street - West											
10	L2	107	0.0	0.165	18.2	LOS B	1.5	10.5	0.72	0.76	40.0
11	T1	137	0.0	0.356	12.4	LOS B	3.0	20.8	0.83	0.72	41.0
12	R2	47	0.0	0.356	20.7	LOS C	3.0	20.8	0.83	0.72	41.0
Approach		292	0.0	0.356	15.9	LOS B	3.0	20.8	0.79	0.73	40.6
All Vehicles		1460	0.0	0.648	15.2	LOS B	6.9	48.0	0.84	0.76	40.7

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	65	14.5	LOS B	0.1	0.1	0.85	0.85
P2	East Full Crossing	32	14.5	LOS B	0.0	0.0	0.85	0.85
P3	North Full Crossing	17	14.5	LOS B	0.0	0.0	0.85	0.85
P4	West Full Crossing	11	14.5	LOS B	0.0	0.0	0.85	0.85
All Pedestrians		124	14.5	LOS B			0.85	0.85

10.3.1 Conclusion

Based on the results of the above analysis it is anticipated that the intersection of Smith and Frederick Street will require upgrading from a Stop sign controlled intersection to a signalised intersection by the year 2023, based on unacceptable delay (LoS E) on the northern approach to Frederick Street. As it is not possible for Sidra to model pedestrians, additional traffic volumes (10%) were added to the survey data. It is expected that once the intersection is upgraded to signals, that it will perform with acceptable delays based on the projected population increase for at least 10 years.

10.4 Bayview Street, Dunkley Parade, Warners Bay Road intersection, Mount Hutton

The intersection of Bayview Street, Dunkley Parade and Warners Bay Road is located on the boundary of the Charlestown and Glendale catchments. Between 2010 and 2025, the population and commercial floor space of the Mount Hutton sub-catchment is projected to increase 21% through the Charlestown plan. Between 2015 and 2030 the population and commercial floor space of the Warners Bay suburb sub-catchment is projected to increase 24.4% through the Glendale plan.

Council upgraded the intersection of Tennent Road, Progress Road, Dunkley Parade and Warners Bay Road in 2011. When approving the upgrade, Council at their ordinary meeting dated 15 June 2010 recommended that the design and construction of the Warners Bay Road extension, as a long term option, proceed. This extension is the southern leg (currently closed) at the Warners Bay Road, Dunkley Parade and Bayview Street intersection (Figure 10.7).

Figure 10.7: Warners Bay Road, Bayview Street, and Dunkley Parade intersection, 2014

Crash Statistics

The Roads and Maritime Services have provided the crash statistics for this intersection. In the 5 year period 1 September 2009 to 1 September 2014, there were 7 reported crashes at this intersection, 6 of which were injury crashes. The crashes are summarised as follows:

1. Two rear end crashes in Bayview Street for left turning vehicles into Warners Bay Road;
2. Two right turning vehicle crashes from Bayview Street with eastbound Dunkley Parade motorists;
3. Two right turning vehicle crashes from Warners Bay Road with eastbound Dunkley Parade motorists;
4. One left turning vehicle crash from Bayview Street with eastbound Dunkley Parade motorist.

Existing intersection – Seagull

The existing seagull intersection was inspected during the AM and PM peak hours, and it was noted that most right turning motorists from Bayview Street are not utilising the seagull storage lane, possible due to it being painted and undersized which does not provide any protection for the motorists to feel safe to use the storage area. Because of this, the gap acceptance for the right turning traffic was kept as the default, and not altered to suit the lesser gap usually accepted at seagull intersections. The current delay, queue length and LoS was modelled for the right turn from Bayview Street into Dunkley Parade (with a queue in the seagull), and for the seagull storage area into the traffic stream for the AM peak (Table 10.25 and Table 10.26) and the PM peak (Table 10.27 and Table 10.28).

Table 10.25: Bayview Street, Dunkley Parade and Warners Bay Road, right turn from Bayview Street – AM 2015

Site: Bayview Street, Dunkley Parade and Warners Bay Road, Mount Hutton - right turn from Bayview AM 2015

Stop (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Warners Bay Road											
6	R2	262	1.5	0.765	25.3	LOS B	4.1	29.0	0.93	1.25	41.4
Approach		262	1.5	0.765	25.3	NA	4.1	29.0	0.93	1.25	41.4
North: Bayview Street											
7	L2	387	1.5	1.006	74.2	LOS F	19.1	135.3	1.00	2.37	27.1
9	R2	63	1.5	1.053	217.6	LOS F	7.0	49.8	1.00	1.49	13.0
Approach		451	1.5	1.053	94.3	LOS F	19.1	135.3	1.00	2.24	23.6
West: Dunkley Parade											
10	L2	189	1.5	0.557	5.6	LOS A	0.0	0.0	0.00	0.11	57.2
11	T1	876	1.5	0.557	0.1	LOS A	0.0	0.0	0.00	0.11	58.8
Approach		1065	1.5	0.557	1.1	NA	0.0	0.0	0.00	0.11	58.6
All Vehicles		1778	1.5	1.053	28.3	NA	19.1	135.3	0.39	0.82	40.7

Table 10.26: Bayview Street, Dunkley Parade and Warners Bay Road, merge lane into Dunkley Parade – AM 2015

Site: Bayview Street, Dunkley Parade and Warners Bay Road - merge lane AM 2015

Stop (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Merge lane											
21a	L1	63	1.5	0.069	9.4	LOS A	0.3	1.8	0.45	0.90	50.8
Approach		63	1.5	0.069	9.4	LOS A	0.3	1.8	0.45	0.90	50.8
East: Warners Bay Road											
5	T1	403	1.5	0.209	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
6	R2	262	1.5	0.765	25.2	LOS B	4.1	29.0	0.93	1.25	41.2
Approach		665	1.5	0.765	9.9	NA	4.1	29.0	0.37	0.49	50.8
North: Bayview Street											
7	L2	387	1.5	1.006	74.2	LOS F	19.1	135.3	1.00	2.37	27.1
Approach		387	1.5	1.006	74.2	LOS F	19.1	135.3	1.00	2.37	27.1
West: Dunkley Parade											
10	L2	189	1.5	0.557	5.6	LOS A	0.0	0.0	0.00	0.11	57.2
11	T1	876	1.5	0.557	0.1	LOS A	0.0	0.0	0.00	0.11	58.8
Approach		1065	1.5	0.557	1.1	NA	0.0	0.0	0.00	0.11	58.5
All Vehicles		2181	1.5	1.006	17.0	NA	19.1	135.3	0.30	0.65	46.6

Table 10.27: Bayview Street, Dunkley Parade and Warners Bay Road, right turn from Bayview Street – PM 2015

Site: Bayview Street, Dunkley Parade and Warners Bay Road, Mount Hutton - right turn from Bayview PM 2015

Stop (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Warners Bay Road											
6	R2	458	1.5	0.730	16.7	LOS B	6.2	44.2	0.83	1.24	45.8
Approach		458	1.5	0.730	16.7	NA	6.2	44.2	0.83	1.24	45.8
North: Bayview Street											
7	L2	216	1.5	0.381	14.4	LOS A	1.8	12.9	0.64	1.06	48.3
9	R2	80	1.5	0.786	78.6	LOS F	3.5	25.0	0.97	1.22	26.0
Approach		296	1.5	0.786	31.7	LOS C	3.5	25.0	0.73	1.11	39.2
West: Dunkley Parade											
10	L2	135	1.5	0.347	5.6	LOS A	0.0	0.0	0.00	0.12	57.2
11	T1	529	1.5	0.347	0.0	LOS A	0.0	0.0	0.00	0.12	58.8
Approach		664	1.5	0.347	1.2	NA	0.0	0.0	0.00	0.12	58.5
All Vehicles		1418	1.5	0.786	12.6	NA	6.2	44.2	0.42	0.69	49.1

Table 10.28: Bayview Street, Dunkley Parade and Warners Bay Road, merge lane into Dunkley Parade – PM 2015

Site: Bayview Street, Dunkley Parade and Warners Bay Road - merge lane PM 2015

Stop (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Merge lane											
21a	L1	80	1.5	0.215	17.0	LOS B	0.8	5.3	0.78	1.01	46.3
Approach		80	1.5	0.215	17.0	LOS B	0.8	5.3	0.78	1.01	46.3
East: Warners Bay Road											
5	T1	928	1.5	0.481	0.1	LOS A	0.0	0.0	0.00	0.00	59.8
6	R2	458	1.5	0.730	16.7	LOS B	6.2	44.2	0.83	1.24	45.6
Approach		1386	1.5	0.730	5.6	NA	6.2	44.2	0.27	0.41	54.3
North: Bayview Street											
7	L2	216	1.5	0.381	14.4	LOS A	1.8	12.9	0.64	1.06	48.3
Approach		216	1.5	0.381	14.4	LOS A	1.8	12.9	0.64	1.06	48.3
West: Dunkley Parade											
10	L2	135	1.5	0.347	5.6	LOS A	0.0	0.0	0.00	0.12	57.2
11	T1	529	1.5	0.347	0.0	LOS A	0.0	0.0	0.00	0.12	58.8
Approach		664	1.5	0.347	1.2	NA	0.0	0.0	0.00	0.12	58.5
All Vehicles		2346	1.5	0.730	5.5	NA	6.2	44.2	0.25	0.41	54.4

The AM peak is the critical peak. The left and right turn from Bayview Street is at capacity (LoS F) with long delays. This was noted when the site was inspected during the peak hours.

The options available for upgrade are signals and a roundabout.

Proposed upgrade - Roundabout

As the intersection is located across the boundary of the Charlestown (Mount Hutton sub-catchment) and Glendale (Warners Bay suburb sub-catchment) catchments, the traffic volumes will be distributed as follows:

2030 AM – 80% of the 24.42% growth from the Warners Bay suburb sub-catchment travel to / from Mount Hutton sub-catchment

20% of the 21% growth from the Mount Hutton sub-catchment travel to / from Warners Bay sub-catchment

100% of the Mount Hutton sub-catchment (21%) travel on Warners Bay Road.

2030 PM - 20% of the 24.42% growth from the Warners Bay sub-catchment travel to / from the Mount Hutton sub-catchment

80% of the 21% growth from the Mount Hutton sub-catchment travel to / from the Warners Bay sub-catchment

100% of the Mount Hutton sub-catchment (21%) travel on Warners Bay Road.

*The Warners Bay Road and Dunkley Parade route is considered a regional road, however it is removed from the higher growth Charlestown sub-catchment so it is considered that the growth from the Mount Hutton sub-catchment is considered an appropriate growth rate.

*The installation of a roundabout in this location may require either a retaining wall to be placed along the southern edge of the road, which would exclude Warners Bay Road from being easily connected in the future, or the fourth leg could be constructed at the same time as the intersection and remain blocked until Council has the need and funding to complete the continuation of the road extension.

With the above assumptions, for the intersection to function well for the 15 year plan life, the layout (Figure 10.8) was required which resulted in the AM peak (Table 10.29) and PM peak (Table 10.30).

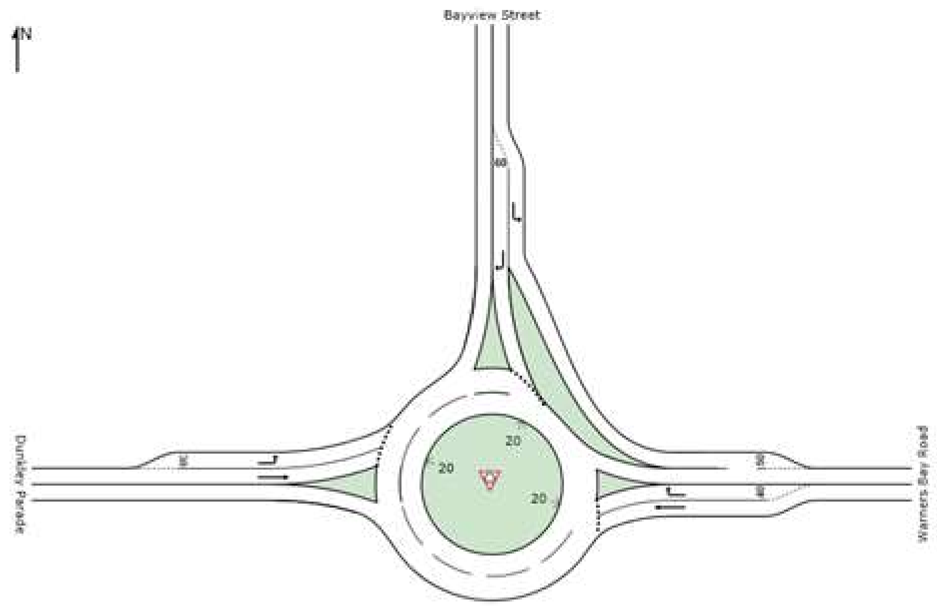


Figure 10.8: Warners Bay Road, Bayview Street, and Dunkley Parade roundabout

Table 10.29: Warners Bay Road, Bayview Street, and Dunkley Parade 2030 AM peak

Site: Bayview Street, Dunkley Parade and Warners Bay Road, Mount Hutton - AM 2030

Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Warners Bay Road											
5	T1	457	1.5	0.288	4.6	LOS A	2.5	17.8	0.34	0.42	55.3
6	R2	325	1.5	0.245	9.3	LOS A	2.0	13.9	0.34	0.59	52.2
Approach		782	1.5	0.288	6.5	LOS A	2.5	17.8	0.34	0.49	54.0
North: Bayview Street											
7	L2	480	1.5	0.261	3.5	LOS A	0.0	0.0	0.00	0.44	56.3
9	R2	79	1.5	0.209	18.5	LOS B	1.6	11.5	1.00	0.92	47.0
Approach		559	1.5	0.261	5.6	LOS A	1.6	11.5	0.14	0.51	54.7
West: Dunkley Parade											
10	L2	235	1.5	0.357	7.8	LOS A	2.0	14.5	0.62	0.72	52.5
11	T1	1060	1.5	1.005	42.5	LOS C	45.8	324.8	1.00	1.75	36.0
Approach		1295	1.5	1.005	36.2	LOS C	45.8	324.8	0.93	1.57	38.1
All Vehicles		2636	1.5	1.005	20.9	LOS B	45.8	324.8	0.59	1.02	44.9

Table 10.30: Warners Bay Road, Bayview Street, and Dunkley Parade 2030 PM peak

Site: Bayview Street, Dunkley Parade and Warners Bay Road, Mount Hutton - PM 2030

Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Warners Bay Road											
5	T1	1123	1.5	0.706	5.2	LOS A	10.1	71.5	0.60	0.47	54.1
6	R2	568	1.5	0.454	9.7	LOS A	4.3	30.2	0.46	0.60	51.8
Approach		1692	1.5	0.706	6.7	LOS A	10.1	71.5	0.56	0.51	53.3
North: Bayview Street											
7	L2	264	1.5	0.144	3.5	LOS A	0.0	0.0	0.00	0.44	56.3
9	R2	100	1.5	0.134	12.2	LOS A	0.9	6.4	0.76	0.77	50.9
Approach		364	1.5	0.144	5.9	LOS A	0.9	6.4	0.21	0.53	54.7
West: Dunkley Parade											
10	L2	167	1.5	0.316	9.9	LOS A	1.8	12.5	0.73	0.84	51.0
11	T1	641	1.5	0.721	12.9	LOS A	9.0	64.1	0.93	1.05	50.3
Approach		808	1.5	0.721	12.3	LOS A	9.0	64.1	0.89	1.01	50.5
All Vehicles		2864	1.5	0.721	8.2	LOS A	10.1	71.5	0.61	0.65	52.6

The intersection operates well in the PM peak. In the AM peak, the eastbound approach from Dunkley Parade to Warners Bay Road operates at a LoS C and has lengthy queues and delays. This indicates that at the horizon year of the plan (2030) that the intersection is approaching failure, however has not reached the LoS E upgrade limit. The intersection was modelled using the projections after the horizon year (assuming the same growth), resulting in the eastbound Dunkley Parade traffic reaching a capacity (LoS E) in 2032 (Table 10.31).

Table 10.31: Warners Bay Road, Bayview Street, and Dunkley Parade 2032 AM peak

Site: Bayview Street, Dunkley Parade and Warners Bay Road, Mount Hutton - AM 2032

Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Warners Bay Road											
5	T1	471	1.5	0.297	4.6	LOS A	2.6	18.6	0.35	0.42	55.3
6	R2	337	1.5	0.254	9.3	LOS A	2.1	14.6	0.35	0.59	52.2
Approach		807	1.5	0.297	6.6	LOS A	2.6	18.6	0.35	0.49	53.9
North: Bayview Street											
7	L2	496	1.5	0.270	3.5	LOS A	0.0	0.0	0.00	0.44	56.3
9	R2	82	1.5	0.213	18.3	LOS B	1.7	11.8	1.00	0.92	47.1
Approach		578	1.5	0.270	5.6	LOS A	1.7	11.8	0.14	0.51	54.7
West: Dunkley Parade											
10	L2	242	1.5	0.373	8.0	LOS A	2.2	15.3	0.64	0.74	52.4
11	T1	1089	1.5	1.040	64.1	LOS E	61.2	434.0	1.00	2.27	29.8
Approach		1332	1.5	1.040	53.9	LOS D	61.2	434.0	0.93	1.99	32.3
All Vehicles		2717	1.5	1.040	29.6	LOS C	61.2	434.0	0.59	1.23	40.7

It is considered that at the time that the LoS reaches E in the AM peak, that the roundabout can be investigated for metering (signalisation) on the Warners Bay Road leg (Table 10.32) to extend its life by approximately 5 years to 2037. Alternatively the proposal to open access to the intersection from Warners Bay Road south leg can be investigated (Figure 10.9), as this proposal redistributes the traffic (assumed 90% of the Dunkley Parade traffic volume will use this new leg). The Warners Bay Road south leg has the advantage of a wide road reserve, which will allow a greater number of lanes to approach the roundabout, which spreads the queuing over the two lanes. The intersection operates well with the southern leg opened, including with the 20% sensitivity loading (Table 10.33, however the left turn from Bayview Street falls to a LoS E with the 20% loading). This matter will be investigated for later plans.

Table 10.32: Warners Bay Road, Bayview Street, and Dunkley Parade 2032 AM peak with roundabout metering on the Warners Bay Road approach

Site: Bayview Street, Dunkley Parade and Warners Bay Road, Mount Hutton - AM 2032

Roundabout Metering

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Warners Bay Road											
5	T1	471	1.5	0.812	24.2	LOS B	21.4	151.8	0.99	0.88	43.7
6	R2	337	1.5	0.702	25.0	LOS B	14.0	99.0	0.94	0.83	43.5
Approach		807	1.5	0.812	24.6	LOS B	21.4	151.8	0.97	0.86	43.6
North: Bayview Street											
7	L2	496	1.5	0.270	3.5	LOS A	0.0	0.0	0.00	NaN	NaN
9	R2	82	1.5	0.149	14.3	LOS A	1.1	7.5	0.88	NaN	NaN
Approach		578	1.5	0.270	5.0	LOS A	1.1	7.5	0.12	NaN	NaN
West: Dunkley Parade											
10	L2	242	1.5	0.265	5.1	LOS A	1.5	10.5	0.51	0.60	53.7
11	T1	1089	1.5	0.876	9.9	LOS A	16.6	117.9	0.98	0.82	52.3
Approach		1332	1.5	0.876	9.0	LOS A	16.6	117.9	0.90	0.78	52.6
All Vehicles		2717	1.5	0.876	12.8	LOS A	21.4	151.8	0.75	NaN	NaN

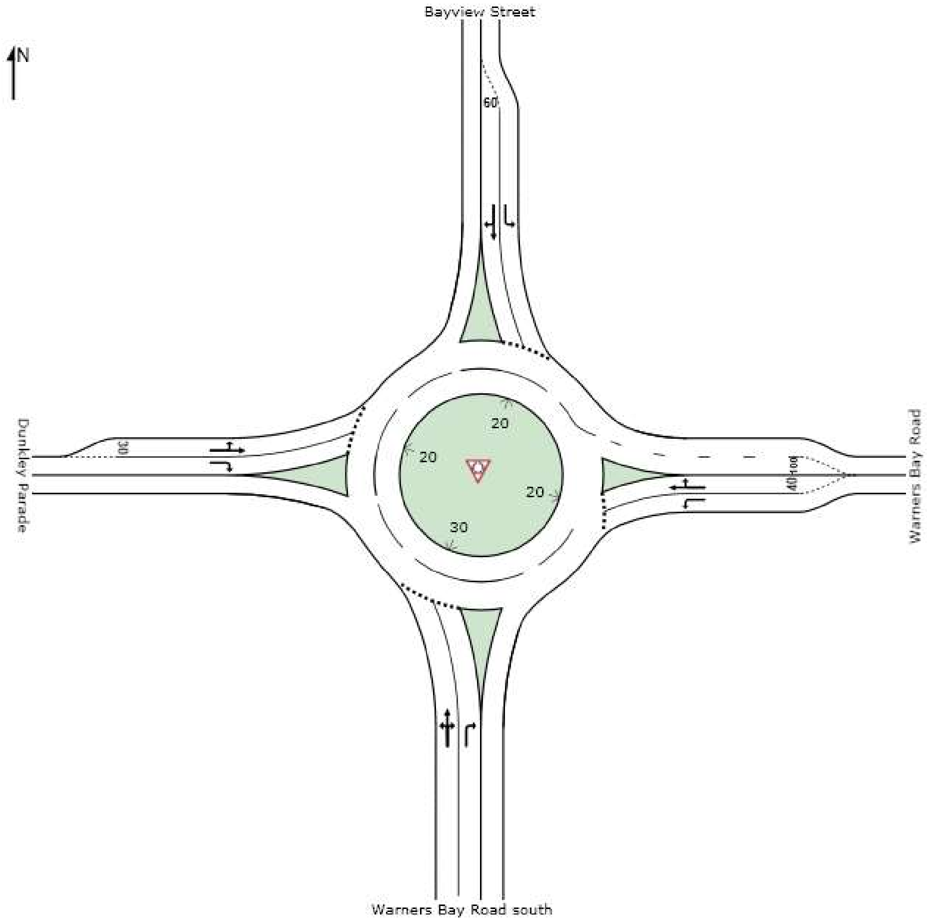


Figure 10.9: After 2030 - Future improvements with the opening of the Warners Bay Road south leg

Table 10.33: Warners Bay Road, Bayview Street and Dunkley Parade 2032 AM peak with Warners Bay Road south leg utilised, 20% sensitivity loading

Site: Bayview Street, Dunkley Parade and Warners Bay Road, Mount Hutton - AM 2032 - two lanes, WB south op

Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Warners Bay Road south											
1	L2	13	0.0	0.779	10.2	LOS A	10.6	74.3	0.88	0.98	49.0
2	T1	262	0.0	0.779	10.5	LOS A	10.6	74.3	0.88	0.98	50.1
3	R2	1175	0.0	0.779	14.6	LOS B	10.6	74.3	0.82	0.95	50.2
Approach		1449	0.0	0.779	13.8	LOS A	10.6	74.3	0.83	0.95	50.2
East: Warners Bay Road											
4	L2	126	0.0	0.121	4.9	LOS A	0.8	5.4	0.37	0.49	54.2
5	T1	60	1.5	0.302	4.4	LOS A	2.5	17.4	0.38	0.58	52.9
6	R2	404	1.5	0.302	9.5	LOS A	2.5	17.4	0.38	0.58	52.9
Approach		591	1.2	0.302	8.0	LOS A	2.5	17.4	0.38	0.56	53.1
North: Bayview Street											
7	L2	596	1.5	1.024	67.3	LOS E	29.3	207.7	1.00	2.28	28.3
8	T1	88	0.0	0.292	12.2	LOS A	1.4	9.6	0.81	0.90	50.5
9	R2	11	1.5	0.292	17.0	LOS B	1.4	9.6	0.81	0.90	50.8
Approach		695	1.3	1.024	59.5	LOS E	29.3	207.7	0.97	2.08	30.2
West: Dunkley Parade											
10	L2	29	1.5	0.428	17.2	LOS B	2.9	20.6	0.96	1.04	46.4
11	T1	132	1.5	0.428	17.3	LOS B	2.9	20.6	0.96	1.04	47.5
12	R2	13	0.0	0.052	21.7	LOS B	0.3	1.8	0.87	0.93	45.2
Approach		174	1.4	0.428	17.6	LOS B	2.9	20.6	0.96	1.03	47.1
All Vehicles		2908	0.6	1.024	23.8	LOS B	29.3	207.7	0.78	1.15	43.8

Other upgrade considered - Signals

The intersection was investigated for signals. The site is constrained by the terrain and narrow road reserve along the Warners Bay Road and Dunkley Parade corridor.

For the horizon year AM peak traffic volumes, the intersection was unable to function at an acceptable level, and the geometry created issues with multiple property acquisitions. Figure 10.10 shows the geometry, and Table 10.34 shows the delay and queues. It is considered that signals is not a viable upgrade alternative for this intersection.

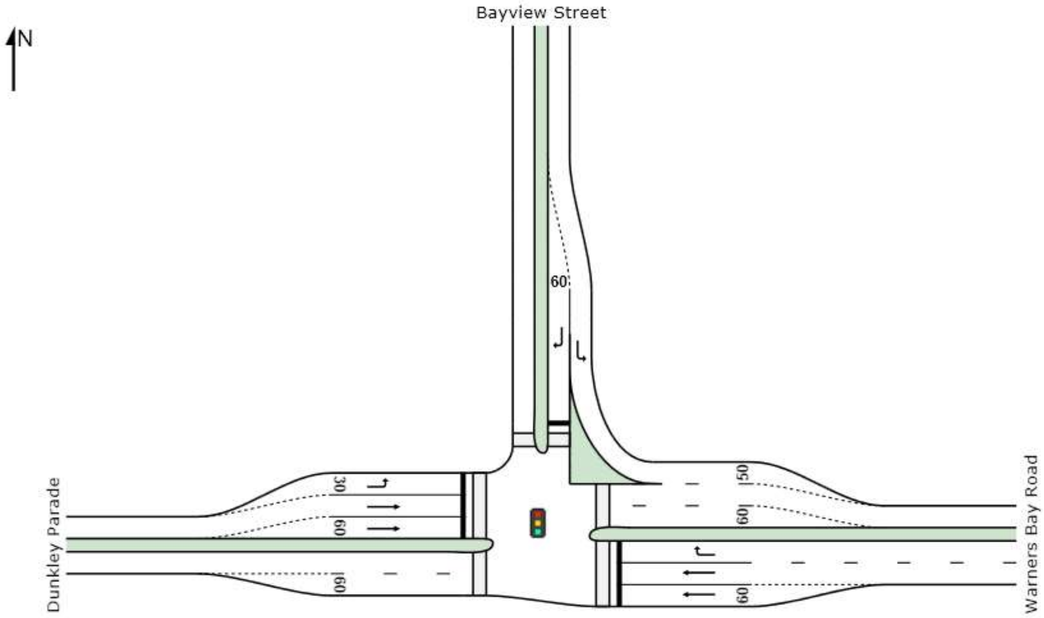


Figure 10.10: Warners Bay Road, Bayview Street, and Dunkley Parade signals

Table 10.34: Warners Bay Road, Bayview Street, and Dunkley Parade 2030 AM peak

Site: Bayview Street, Dunkley Parade and Warners Bay Road, Mount Hutton - right turn from Bayview AM 2030

Dunkley Parade, Bayview Street and Warners Bay Road intersection

Signals - Actuated   Cycle Time = 111 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Warners Bay Road											
5	T1	488	1.5	0.414	22.0	LOS B	13.1	92.6	0.68	0.58	44.1
6	R2	326	1.5	0.986	74.4	LOS F	21.7	153.6	1.00	0.98	26.8
Approach		815	1.5	0.986	43.0	LOS D	21.7	153.6	0.81	0.74	35.0
North: Bayview Street											
7	L2	517	1.5	0.281	5.7	LOS A	0.0	0.0	0.00	0.53	54.8
9	R2	84	1.5	0.221	46.7	LOS D	3.8	27.1	0.85	0.75	33.5
Approach		601	1.5	0.281	11.4	LOS A	3.8	27.1	0.12	0.56	50.4
West: Dunkley Parade											
10	L2	236	1.5	0.393	26.8	LOS B	8.0	56.5	0.65	0.75	40.9
11	T1	1063	1.5	1.070	96.0	LOS F	70.9	502.6	0.90	1.23	23.3
Approach		1299	1.5	1.070	83.4	LOS F	70.9	502.6	0.86	1.14	25.2
All Vehicles		2715	1.5	1.070	55.3	LOS D	70.9	502.6	0.68	0.89	31.4

Recommendation:

The intersection of Warners Bay Road, Bayview Street and Dunkley Parade be upgraded to a roundabout with a slip lane for the Bayview Street left turn movement.

Modelling indicates that the roundabout is operating will in the horizon year of 2030, however fails soon after in 2032 due to the increasing Dunkley Parade traffic volume towards the intersection.

The roundabout required to function for this plan can be considered as Stage 1. Stage 2 of the roundabout will be investigated for future plans if development projections are realised, with the Warners Bay Road south leg being opened at the intersection. Opening this leg will allow the traffic volume to be distributed among the four legs (estimated that 10% of the traffic will still use Dunkley Parade to access the school and small shopping area), and allow greater queuing approaching the roundabout as the Warners Bay Road south road reserve is wide enough to allow additional storage.

10.5 Wilsons Road and Violet Town Road, Mount Hutton

Between 2010 and 2025, the population and commercial floor space of Mount Hutton / Windale is projected to increase by 21%.

The intersection of Wilsons Road and Violet Town Road is a three-leg intersection with priority given to Violet Town Road and Wilsons Road north (Figure 10.11).

Figure 10.11: Violet Town Road and Wilsons Road intersection, 2010

The intersection was modelled using 2012 traffic volumes. The right turn from Wilsons Road east into Wilsons Road north has a LOS C, with lengthy queues (Table 10.35). The same leg changed to a LoS E in model year 2015, which is its failure year. As mentioned in the analysis for Bayview Street, Dunkley Parade, and Wilsons Road, Council's current intersection upgrade program may not allow for construction of these intersections until at least 2018, so the modelling year will be used as 2018 (Table 10.36).

Table 10.35: Violet Town Road and Wilsons Road intersection, PM 2012 traffic volumes

Site: Giveway 2012 Violet Town Road

Violet Town Road and Wilsons Road - PM peak 2012
Giveway / Yield (Two-Way)

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
Movement Performance - Vehicles											
South: Violet Town Road											
2	T1	154	0.0	0.079	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
3	R2	289	0.0	0.465	13.5	LOS A	2.0	13.8	0.63	0.96	43.7
Approach		443	0.0	0.465	8.8	NA	2.0	13.8	0.41	0.63	48.3
SouthEast: storage bay											
23a	R1	554	0.0	0.861	22.8	LOS B	12.3	86.1	0.86	1.53	20.4
Approach		554	0.0	0.861	22.8	LOS B	12.3	86.1	0.86	1.53	20.4
East: Wilsons Road east											
4	L2	361	0.0	0.194	8.2	LOS A	0.0	0.0	0.00	0.67	49.0
6	R2	554	0.0	0.963	35.1	LOS C	15.6	109.5	0.97	2.06	30.5
Approach		915	0.0	0.963	24.5	LOS B	15.6	109.5	0.59	1.51	35.8
North: Wilsons Road north											
7	L2	597	0.0	0.321	8.2	LOS A	0.0	0.0	0.00	0.67	48.9
8	T1	117	0.0	0.060	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		714	0.0	0.321	6.9	NA	0.0	0.0	0.00	0.56	50.4
All Vehicles		2625	0.0	0.963	16.7	NA	15.6	109.5	0.46	1.11	39.0

Table 10.36: Violet Town Road and Wilsons Road intersection, PM 2018 traffic volumes

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
Movement Performance - Vehicles											
South: Violet Town Road											
2	T1	165	0.0	0.085	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
3	R2	311	0.0	0.532	14.6	LOS B	2.4	16.8	0.69	1.01	42.8
Approach		476	0.0	0.532	9.5	NA	2.4	16.8	0.45	0.66	47.5
SouthEast: storage bay											
23a	R1	594	0.0	0.972	42.4	LOS C	23.7	166.0	0.97	2.25	13.0
Approach		594	0.0	0.972	42.4	LOS C	23.7	166.0	0.97	2.25	13.0
East: Wilsons Road east											
4	L2	387	0.0	0.209	8.2	LOS A	0.0	0.0	0.00	0.67	49.0
6	R2	594	0.0	1.102	120.2	LOS F	46.4	325.1	1.00	3.84	13.9
Approach		981	0.0	1.102	76.0	LOS F	46.4	325.1	0.61	2.59	19.4
North: Wilsons Road north											
7	L2	640	0.0	0.345	8.2	LOS A	0.0	0.0	0.00	0.67	48.9
8	T1	125	0.0	0.064	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		765	0.0	0.345	6.9	NA	0.0	0.0	0.00	0.56	50.4
All Vehicles		2816	0.0	1.102	38.9	NA	46.4	325.1	0.49	1.64	26.6

The intersection was modelled as signals and roundabout to determine the preferred option. For this location, each treatment has benefits and disadvantages. A roundabout offers better access to the east for the properties that have a left in, left out restriction on their road / access along Wilsons Road. Signals improves pedestrian access across Wilsons Road from retirement villages and residential properties to the shopping centre.

10.5.1 Roundabout

The intersection was modelled as a roundabout (Figure 10.12) for 2018 traffic (Table 10.37), and again for 2038 projected traffic volumes (Table 10.38).

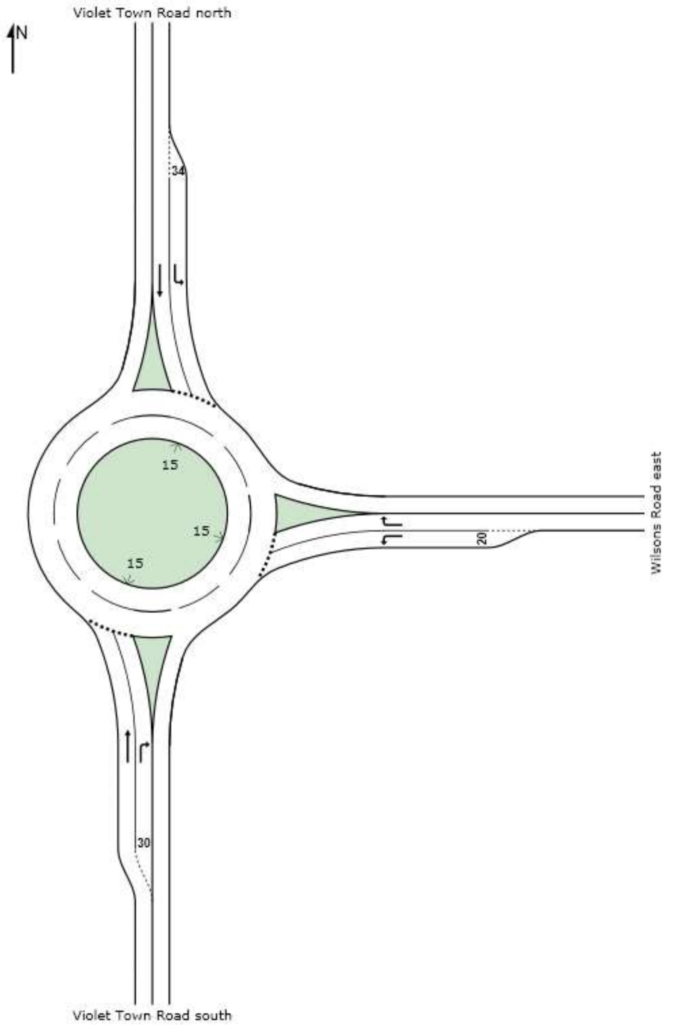


Figure 10.12: Violet Town Road and Wilsons Road upgraded to roundabout

Table 10.37: Violet Town Road and Wilsons Road roundabout, PM 2018 traffic volumes

Site: Violet Town Road and Wilsons Road - 2018

Violet Town Road and Wilsons Road - PM peak 2018
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Violet Town Road											
2	T1	165	0.0	0.253	10.5	LOS A	1.5	10.2	0.71	1.59	46.6
3	R2	311	0.0	0.379	14.9	LOS B	2.5	17.6	0.75	1.71	43.0
Approach		476	0.0	0.379	13.4	LOS A	2.5	17.6	0.73	0.83	44.1
East: Wilsons Road east											
4	L2	387	0.0	0.344	7.9	LOS A	2.3	16.3	0.40	1.18	48.1
6	R2	594	0.0	0.455	11.8	LOS A	3.6	25.3	0.43	1.31	44.8
Approach		981	0.0	0.455	10.3	LOS A	3.6	25.3	0.42	0.63	46.0
North: Wilsons Road north											
7	L2	640	0.0	0.613	10.1	LOS A	5.9	41.4	0.76	1.53	46.4
8	T1	125	0.0	0.214	9.5	LOS A	1.1	8.0	0.59	1.41	47.6
Approach		765	0.0	0.613	10.0	LOS A	5.9	41.4	0.73	0.76	46.6
All Vehicles		2222	0.0	0.613	10.8	LOS A	5.9	41.4	0.59	0.72	45.8

Table 10.38: Violet Town Road and Wilsons Road roundabout, PM 2038 traffic volumes

Site: Violet Town Road and Wilsons Road - 2038

Violet Town Road and Wilsons Road - PM peak 2038
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Violet Town Road											
2	T1	202	0.0	0.369	12.4	LOS A	2.3	16.4	0.82	1.81	44.8
3	R2	380	0.0	0.546	18.8	LOS B	4.9	34.0	0.90	2.04	40.1
Approach		582	0.0	0.546	16.6	LOS B	4.9	34.0	0.87	0.98	41.6
East: Wilsons Road east											
4	L2	474	0.0	0.435	8.2	LOS A	3.3	22.9	0.49	1.23	47.7
6	R2	726	0.0	0.574	12.2	LOS A	5.3	37.2	0.56	1.33	44.4
Approach		1200	0.0	0.574	10.6	LOS A	5.3	37.2	0.53	0.65	45.6
North: Wilsons Road north											
7	L2	783	0.0	0.812	15.5	LOS B	13.2	92.2	1.00	2.04	42.0
8	T1	154	0.0	0.288	10.4	LOS A	1.6	11.4	0.68	1.56	46.6
Approach		937	0.0	0.812	14.7	LOS B	13.2	92.2	0.95	0.98	42.7
All Vehicles		2719	0.0	0.812	13.3	LOS A	13.2	92.2	0.75	0.83	43.7

The intersection continues to operate well in 2038. A sensitivity test adding 20% traffic volume was undertaken (Table 10.39).

Table 10.39: Violet Town Road and Wilsons Road roundabout, PM 2038 volumes + 20% sensitivity

Site: Violet Town Road and Wilsons Road - 2038 + 20%

Violet Town Road and Wilsons Road - PM peak 2038 + 20%
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Violet Town Road											
2	T1	242	0.0	0.568	19.6	LOS B	4.8	33.4	0.96	2.18	39.0
3	R2	456	0.0	0.831	36.6	LOS C	12.8	89.7	1.00	2.74	30.5
Approach		698	0.0	0.831	30.7	LOS C	12.8	89.7	0.99	1.27	32.9
East: Wilsons Road east											
4	L2	568	0.0	0.541	8.7	LOS A	4.6	32.1	0.60	1.30	47.1
6	R2	872	0.0	0.711	12.9	LOS A	8.1	56.9	0.73	1.38	43.7
Approach		1440	0.0	0.711	11.2	LOS A	8.1	56.9	0.68	0.67	45.0
North: Wilsons Road north											
7	L2	940	0.0	1.067	91.6	LOS F	66.9	468.2	1.00	5.44	17.0
8	T1	184	0.0	0.382	11.8	LOS A	2.3	16.2	0.76	1.74	45.4
Approach		1124	0.0	1.067	78.5	LOS F	66.9	468.2	0.96	2.42	18.9
All Vehicles		3262	0.0	1.067	38.6	LOS C	66.9	468.2	0.84	1.40	29.1

The left turn from Wilsons Road north into Wilsons Road east reduces to a LoS F under the sensitivity test. To overcome this LoS F, a left turn lane that is continuous with merge on Wilsons Road east can be installed (Figure 10.13). Modelling (Table 10.40) indicates that this alteration would result in a LoS A for this leg. Whilst this is not required in the short or medium term, to reduce the need to upgrade the roundabout in the future this should be allowed for in the intersection when designed.

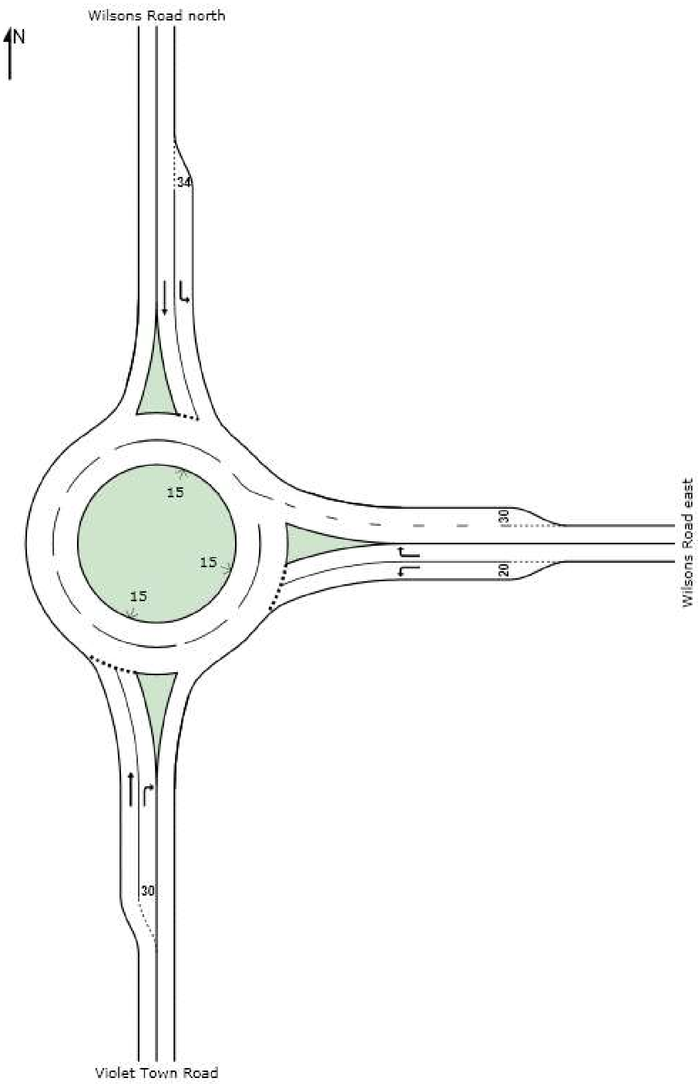


Figure 10.13: Intersection with Wilsons Road north left turn slip lane

Table 10.40: Violet Town Road and Wilsons Road roundabout, PM 2038 volumes + 20% sensitivity with Wilsons Road north leg left turn slip

Site: Violet Town Road and Wilsons Road - 2038 + 20% altered

Violet Town Road and Wilsons Road - PM peak 2038 + 20%
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Violet Town Road											
2	T1	242	0.0	0.568	19.6	LOS B	4.8	33.4	0.96	2.18	39.0
3	R2	456	0.0	0.831	36.6	LOS C	12.8	89.7	1.00	2.74	30.5
Approach		698	0.0	0.831	30.7	LOS C	12.8	89.7	0.99	1.27	32.9
East: Wilsons Road east											
4	L2	568	0.0	0.541	8.7	LOS A	4.6	32.1	0.60	1.30	47.1
6	R2	872	0.0	0.711	12.9	LOS A	8.1	56.9	0.73	1.38	43.7
Approach		1440	0.0	0.711	11.2	LOS A	8.1	56.9	0.68	0.67	45.0
North: Wilsons Road north											
7	L2	940	0.0	0.506	7.1	LOS A	0.0	0.0	0.00	1.19	50.2
8	T1	184	0.0	0.382	11.8	LOS A	2.3	16.2	0.76	1.74	45.4
Approach		1124	0.0	0.506	7.9	LOS A	2.3	16.2	0.12	0.64	49.3
All Vehicles		3262	0.0	0.831	14.2	LOS A	12.8	89.7	0.56	0.79	42.9

10.5.2 Signals

The intersection was modelled as signals (Figure 10.14), however the right turn from Violet Town Road into Wilsons Road demonstrated a LoS E in 2015, (Table 10.41).

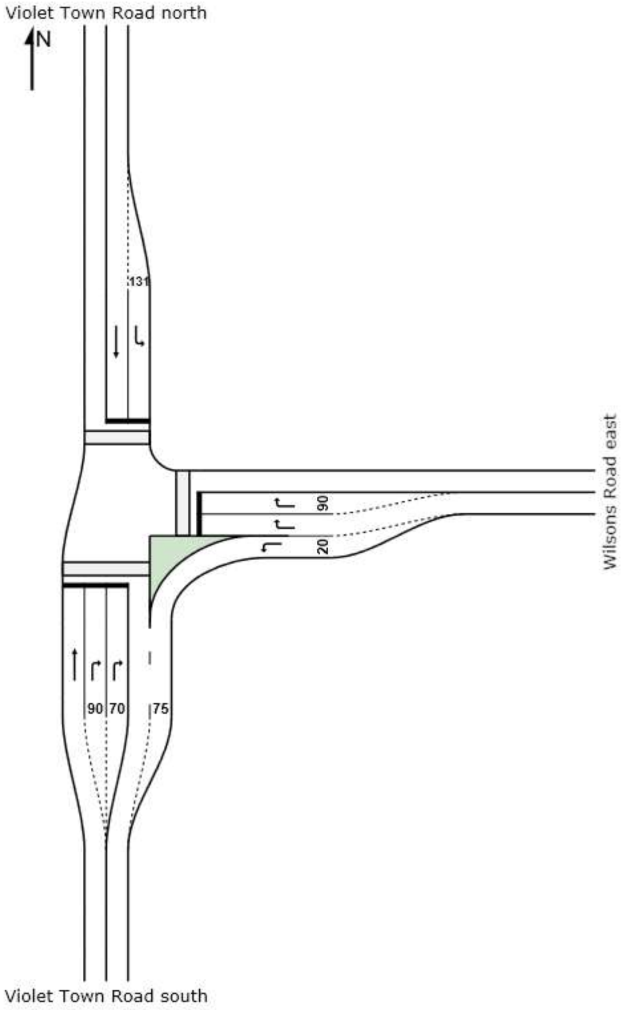


Figure 10.14: Violet Town Road and Wilsons Road upgraded to signals

Table 10.41: Violet Town Road and Wilsons Road signals, PM 2015 traffic volumes

Site: Violet Town Road and Wilsons Road - 2015

Violet Town Road and Wilsons Road - PM peak 2015
Signals - Fixed Time   Cycle Time = 100 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Violet Town Road south											
2	T1	159	0.0	0.194	19.5	LOS B	4.8	33.9	0.67	0.55	37.5
3	R2	300	0.0	0.841	57.6	LOS E	13.4	93.6	0.98	0.91	23.2
Approach		459	0.0	0.841	44.4	LOS D	13.4	93.6	0.87	0.79	26.7
East: Wilsons Road east											
4	L2	396	0.0	0.213	7.6	LOS A	0.0	0.0	0.00	0.60	49.8
6	R2	606	0.0	0.591	28.9	LOS C	18.2	127.5	0.76	0.83	33.3
Approach		1002	0.0	0.591	20.5	LOS B	18.2	127.5	0.46	0.74	38.4
North: Violet Town Road north											
7	L2	654	0.0	0.858	30.5	LOS C	19.6	137.4	0.98	0.93	32.6
8	T1	128	0.0	0.329	37.4	LOS C	5.4	38.1	0.90	0.72	28.3
Approach		782	0.0	0.858	31.6	LOS C	19.6	137.4	0.96	0.90	31.8
All Vehicles		2243	0.0	0.858	29.3	LOS C	19.6	137.4	0.72	0.81	33.1

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	5	44.2	LOS E	0.0	0.0	0.94	0.94
P2	East Full Crossing	21	37.9	LOS D	0.1	0.1	0.87	0.87
P3	North Full Crossing	21	38.8	LOS D	0.1	0.1	0.88	0.88
All Pedestrians		47	39.0	LOS D			0.88	0.88

The intersection required double right turns on the eastern approach to Wilsons Road and Violet Town Road, yet still yielded a LoS E for the southern right turn approach to Violet Town Road. It is considered that signals will not work at this intersection while retaining all vehicular and pedestrian movements.

10.5.3 Conclusion

The intersection of Wilsons Road and Violet Town Road was modelled with both a roundabout and signal option. The roundabout option operates satisfactorily for at least 20 years after installation, and after the 20% loading from the sensitivity test. The signals option did not operate well, failing in 2015 representing a very short life. It is recommended that a roundabout be installed at this intersection.

10.6 Kahibah Road, Wallsend Street and Hexham Street, Kahibah

Between 2010 and 2025, the population and floor space increase within the Charlestown sub-catchment is projected to increase the traffic volumes by 37%.

The intersection of Wallsend Street, Kahibah Road and Hexham Street three-leg intersection with priority given to Wallsend Street (Figure 10.15).

Figure 10.15: Kahibah Road, Wallsend Street and Hexham Street intersection

The intersection was modelled using 2012 traffic survey data, which resulted in the intersection operating at an acceptable LoS in both the AM (critical peak, Table 10.42) and PM peak. The intersection was modelled to the horizon year of 2025, with Hexham Street reaching a LoS F in the AM peak and LoS D in the PM peak. Both Wallsend Street and Kahibah Road continued to operate at an acceptable LoS. The critical peak for this intersection is the AM peak.

Table 10.42: Kahibah Road, Wallsend Street and Hexham Street intersection, AM 2012 traffic volumes

Site: 2012 AM Wallsend Road - Kahibah Road - Hexham Street

New Site
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Hexham Street													
Lane 1	149	5.0	310	0.481	100	28.4	LOS B	3.0	21.9	Full	500	0.0	0.0
Approach	149	5.0		0.481		28.4	LOS B	3.0	21.9				
North: Wallsend Street													
Lane 1	252	5.0	1842	0.137	100	7.7	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	252	5.0		0.137		7.7	NA	0.0	0.0				
SouthWest: Kahibah Road													
Lane 1	439	5.0	883	0.497	100	11.3	LOS A	3.5	25.7	Full	500	0.0	0.0
Lane 2	83	5.0	588	0.141	100	10.9	LOS A	0.6	4.1	Full	500	0.0	0.0
Approach	522	5.0		0.497		11.3	LOS A	3.5	25.7				
Intersection	923	5.0		0.497		13.1	NA	3.5	25.7				

The intersection was modelled until the LoS E was reached on any one movement, which occurred on Hexham Street in the year 2020 (Table 10.43).

Table 10.43: Kahibah Road, Wallsend Street and Hexham Street intersection, AM 2020 traffic volumes

Site: 2020 AM Wallsend Road - Kahibah Road - Hexham Street

New Site
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Hexham Street													
Lane 1	184	5.0	215	0.857	100	66.4	LOS E	8.1	59.2	Full	500	0.0	0.0
Approach	184	5.0		0.857		66.4	LOS E	8.1	59.2				
North: Wallsend Street													
Lane 1	309	5.0	1842	0.168	100	7.7	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	309	5.0		0.168		7.7	NA	0.0	0.0				
SouthWest: Kahibah Road													
Lane 1	539	5.0	820	0.657	100	13.9	LOS A	6.5	47.6	Full	500	0.0	0.0
Lane 2	102	5.0	530	0.193	100	12.0	LOS A	0.8	5.7	Full	500	0.0	0.0
Approach	641	5.0		0.657		13.6	LOS A	6.5	47.6				
Intersection	1135	5.0		0.857		20.6	NA	8.1	59.2				

The intersection was modelled using the 2020 traffic volumes as a roundabout and signals to determine the preferred treatment. Signals offered benefits of improved pedestrian access across Kahibah Road and Wallsend Street between the residential properties and the schools / shops.

10.6.1 Signals

The intersection was modelled upgraded to signals (Figure 10.16) for the year 2020, with the modelling shown in Table 10.44.

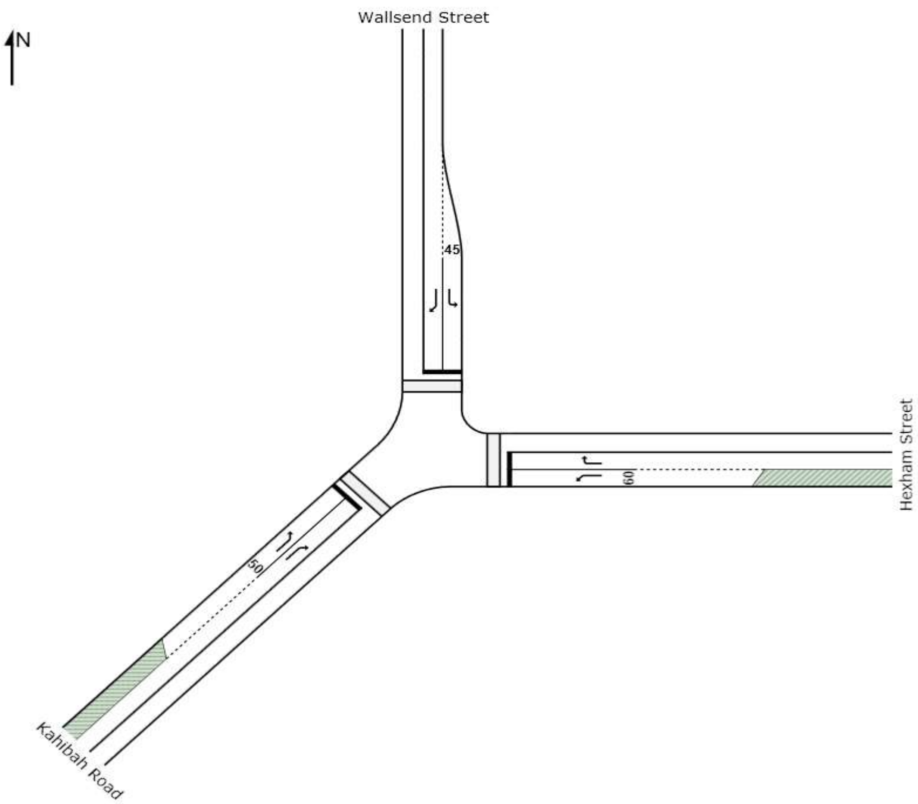


Figure 10.16: Kahibah Road, Wallsend Street and Hexham Street signalised intersection

Table 10.44: Kahibah Road, Wallsend Street and Hexham Street signalised intersection, AM 2020

Site: 2020 AM Wallsend Road - Kahibah Road - Hexham Street - extra lanes

New Site
Signals - Fixed Time   Cycle Time = 70 seconds (Practical Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Hexham Street													
Lane 1	43	5.0	338	0.128	100	34.2	LOS C	1.3	9.2	Short (P)	60	0.0	0.0
Lane 2	141	5.0	328	0.430	100	36.7	LOS C	4.4	32.5	Full	500	0.0	0.0
Approach	184	5.0		0.430		36.1	LOS C	4.4	32.5				
North: Wallsend Street													
Lane 1	27	5.0	328	0.083	100	34.2	LOS C	0.8	5.8	Short	45	0.0	0.0
Lane 2	282	5.0	338	0.835	100	44.1	LOS D	10.9	79.2	Full	500	0.0	0.0
Approach	309	5.0		0.835		43.3	LOS D	10.9	79.2				
SouthWest: Kahibah Road													
Lane 1	539	5.0	641 [1]	0.841	100	36.3	LOS C	19.6	143.3	Short (P)	50	0.0	100.0
Lane 2	102	5.0	675	0.151	100	23.5	LOS B	2.3	17.1	Full	500	0.0	0.0
Approach	641	5.0		0.841		34.2	LOS C	19.6	143.3				
Intersection	1135	5.0		0.841		37.0	LOS C	19.6	143.3				

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P2	East Full Crossing	21	29.3	LOS C	0.0	0.0	0.92	0.92
P3	North Full Crossing	21	29.3	LOS C	0.0	0.0	0.92	0.92
P8	SouthWest Full Crossing	21	29.3	LOS C	0.0	0.0	0.92	0.92
All Pedestrians		63	29.3	LOS C			0.92	0.92

The signalised intersection has a LoS D on the Wallsend Street right turn at the time of upgrade. It is considered that signals will have a short life and therefore should not be pursued as an option for upgrading this intersection.

10.6.2 Roundabout

The intersection was modelled as a roundabout (Figure 10.17) for the year of 2020 (Table 10.45) and also for the 20 year life of the upgrade in 2040 (Table 10.46).

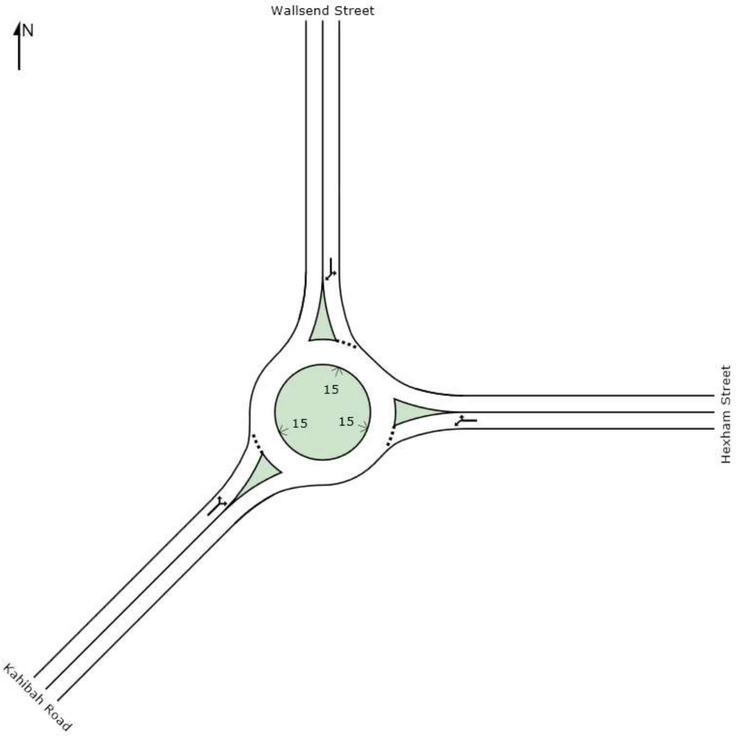


Figure 10.17: Kahibah Road, Wallsend Street and Hexham Street roundabout intersection

Table 10.45: Kahibah Road, Wallsend Street and Hexham Street roundabout intersection, AM 2020

Site: 2020 AM Wallsend Road - Kahibah Road - Hexham Street

New Site
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Hexham Street													
Lane 1[d]	184	5.0	1007	0.183	100	11.7	LOS A	1.1	8.3	Full	500	0.0	0.0
Approach	184	5.0		0.183		11.7	LOS A	1.1	8.3				
North: Wallsend Street													
Lane 1[d]	309	5.0	1264	0.245	100	10.4	LOS A	1.8	12.8	Full	500	0.0	0.0
Approach	309	5.0		0.245		10.4	LOS A	1.8	12.8				
SouthWest: Kahibah Road													
Lane 1[d]	641	5.0	1239	0.517	100	7.8	LOS A	4.9	35.6	Full	500	0.0	0.0
Approach	641	5.0		0.517		7.8	LOS A	4.9	35.6				
Intersection	1135	5.0		0.517		9.2	LOS A	4.9	35.6				

Table 10.46: Kahibah Road, Wallsend Street and Hexham Street roundabout intersection, AM 2040

Site: 2040 AM Wallsend Road - Kahibah Road - Hexham Street

New Site
Roundabout

Lane Use and Performance													
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Hexham Street													
Lane 1[d]	268	5.0	876	0.307	100	13.0	LOS A	2.1	15.5	Full	500	0.0	0.0
Approach	268	5.0		0.307		13.0	LOS A	2.1	15.5				
North: Wallsend Street													
Lane 1[d]	453	5.0	1178	0.384	100	10.9	LOS A	3.3	24.3	Full	500	0.0	0.0
Approach	453	5.0		0.384		10.9	LOS A	3.3	24.3				
SouthWest: Kahibah Road													
Lane 1[d]	938	5.0	1147	0.818	100	12.2	LOS A	15.0	109.8	Full	500	0.0	0.0
Approach	938	5.0		0.818		12.2	LOS A	15.0	109.8				
Intersection	1659	5.0		0.818		12.0	LOS A	15.0	109.8				

The intersection was modelled with 20% sensitivity, the Kahibah Road movement fails (Table 10.47). If Kahibah Road is altered to have two lanes on approach (Figure 10.18) with the left lane being a short lane, then the intersection LoS returns to an A (Table 10.48). When modelled for the 2040 PM peak plus 20% sensitivity (Table 10.49), the intersection continues to operate at an acceptable LoS.

Table 10.47: Kahibah Road, Wallsend Street and Hexham Street roundabout intersection, AM 2040 plus 20% sensitivity

Site: 2040 AM Wallsend Road - Kahibah Road - Hexham Street + 20% sensitivity

New Site
Roundabout

Lane Use and Performance													
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Hexham Street													
Lane 1[d]	323	5.0	793	0.408	100	14.0	LOS A	3.0	22.1	Full	500	0.0	0.0
Approach	323	5.0		0.408		14.0	LOS A	3.0	22.1				
North: Wallsend Street													
Lane 1[d]	538	5.0	1143	0.471	100	11.3	LOS A	4.4	32.1	Full	500	0.0	0.0
Approach	538	5.0		0.471		11.3	LOS A	4.4	32.1				
SouthWest: Kahibah Road													
Lane 1[d]	1127	5.0	1089	1.035	100	63.1	LOS E	66.8	487.7	Full	500	0.0	4.3
Approach	1127	5.0		1.035		63.1	LOS E	66.8	487.7				
Intersection	1988	5.0		1.035		41.1	LOS C	66.8	487.7				

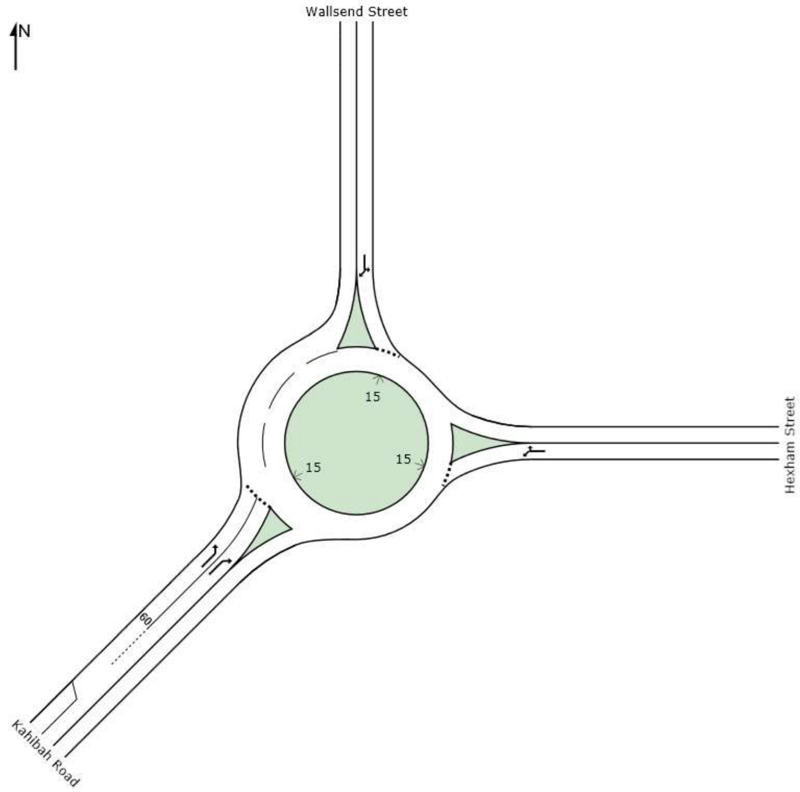


Figure 10.18: Kahibah Road, Wallsend Street and Hexham Street roundabout intersection with extra Kahibah Road lane

Table 10.48: Kahibah Road, Wallsend Street and Hexham Street roundabout intersection, AM 2040 plus 20% sensitivity and extra Kahibah Road lane

Site: 2040 AM Wallsend Road - Kahibah Road - Hexham Street + 20% sensitivity - extra lanes

New Site
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Hexham Street													
Lane 1[d]	323	5.0	799	0.404	100	14.0	LOS A	3.0	21.8	Full	500	0.0	0.0
Approach	323	5.0		0.404		14.0	LOS A	3.0	21.8				
North: Wallsend Street													
Lane 1[d]	538	5.0	1159	0.464	100	11.4	LOS A	4.0	29.3	Full	500	0.0	0.0
Approach	538	5.0		0.464		11.4	LOS A	4.0	29.3				
SouthWest: Kahibah Road													
Lane 1[d]	947	5.0	1272	0.745	100	9.4	LOS A	10.8	79.1	Short (P)	60	0.0	13.9
Lane 2	180	5.0	794	0.227	100	12.6	LOS A	1.5	10.8	Full	500	0.0	0.0
Approach	1127	5.0		0.745		9.9	LOS A	10.8	79.1				
Intersection	1988	5.0		0.745		11.0	LOS A	10.8	79.1				

Table 10.49: Kahibah Road, Wallsend Street and Hexham Street roundabout intersection, PM 2040 plus 20% sensitivity and extra Kahibah Road lane

Site: 2040 PM Wallsend Road - Kahibah Road - Hexham Street + 20% sensitivity - extra lanes

New Site
Roundabout

Lane Use and Performance													
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Hexham Street													
Lane 1[d]	229	5.0	454	0.505	100	18.4	LOS B	4.6	33.5	Full	500	0.0	0.0
Approach	229	5.0		0.505		18.4	LOS B	4.6	33.5				
North: Wallsend Street													
Lane 1[d]	924	5.0	1116	0.828	100	17.5	LOS B	15.7	114.6	Full	500	0.0	0.0
Approach	924	5.0		0.828		17.5	LOS B	15.7	114.6				
SouthWest: Kahibah Road													
Lane 1[d]	569	5.0	1583	0.360	100	6.1	LOS A	3.4	25.1	Short (P)	60	0.0	0.0
Lane 2	247	5.0	1219	0.203	100	10.5	LOS A	1.5	11.3	Full	500	0.0	0.0
Approach	817	5.0		0.360		7.4	LOS A	3.4	25.1				
Intersection	1971	5.0		0.828		13.4	LOS A	15.7	114.6				

10.6.3 Conclusion

The intersection of Kahibah Road, Wallsend Road and Hexham Street will require an upgrade to a roundabout with two lanes on the Kahibah Road approach by 2020.

10.7 Wilsons Road to Willow Road link, Mount Hutton

The Wilsons Road to Willow Road link (Figure 10.19) has previously been identified in the LEP. The proposed road link is 268 metres in length with an estimated travel time of 20 seconds at 50km/h, plus delay at either end for intersections.

The alternative to this link is travelling along Merrigum Road from Willow Road to South Street, and South Street from Merrigum Street to Wilsons Road, which at 1,030 metres takes around 80 seconds to travel, plus delay at the intersections. To determine if this road link is required within this Section 94 plan, the intersections of Merrigum Street at Willow Road, and Merrigum Street at South Street have been analysed to determine if the delay will be increased to an unacceptable level at either intersection, potentially warranting the link to be constructed.

The Mount Hutton / Windale sub-catchment is projected to increase 21% between 2010 and 2025.

Figure 10.19: Proposed Wilsons Road to Willow Road link, and Merrigum Street and South Street existing alternative

10.7.1 Merrigum Street and Willow Road intersection

The Merrigum Street and Willow Road intersection (Figure 10.20) has been analysed for the 2025 horizon year and continues to operate well with the 20% sensitivity (Table 10.50). Therefore, this intersection does not require an upgrade prior to 2025.

Figure 10.20: Merrigum Street and Willow Road intersection, 2010

Table 10.50: Merrigum Street and Willow Road, 2025 with 20% sensitivity

Site: Merrigum Street and Willow Road - 2025 PM + 20%

PM peak
Stop (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Merrigum Street													
Lane 1	79	0.0	1165	0.068	100	11.5	LOS A	0.3	1.9	Short (P)	10	0.0	0.0
Lane 2	331	1.3	456	0.725	100	26.1	LOS B	6.1	43.3	Full	500	0.0	0.0
Approach	409	1.0		0.725		23.3	LOS B	6.1	43.3				
East: Willow Road south-west bound													
Lane 1	594	1.2	1654	0.359	100	5.3	LOS A	2.2	15.6	Full	500	0.0	0.0
Approach	594	1.2		0.359		5.3	NA	2.2	15.6				
West: Willow Road north-eastbound													
Lane 1	38	2.6	1848	0.021	20[6]	0.0	LOS A	0.0	0.0	Short (P)	10	0.0	0.0
Lane 2	176	2.4	1696	0.104	100	3.3	LOS A	0.6	4.0	Full	500	0.0	0.0
Approach	215	2.5		0.104		2.7	NA	0.6	4.0				
Intersection	1218	1.4		0.725		10.9	NA	6.1	43.3				

10.7.2 Merrigum Street and South Street Intersection

The Merrigum Street and South Street intersection (Figure 10.21) currently operates at an adequate LoS, with Merrigum Street operating at a LoS of C (Table 10.51). Merrigum Street at South Street is restricted by the concrete pedestrian refuge island installed at the intersection, which makes it unable to have two lanes on approach to South Street.

Figure 10.21: Merrigum Street and South Street intersection, 2010

Table 10.51: Merrigum Street and South Street, 2014

Site: Merrigum Street and South Street - 2014 PM

New Site
Stop (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: South Street westbound													
Lane 1	101	0.6	1942	0.052	20[6]	0.0	LOS A	0.0	0.0	Short (P)	10	0.0	0.0
Lane 2	343	1.0	1315	0.261	100	6.5	LOS A	2.1	14.6	Full	500	0.0	0.0
Approach	444	0.9		0.261		5.0	NA	2.1	14.6				
North: Merrigum Street													
Lane 1	316	1.7	377	0.837	100	38.9	LOS C	9.1	64.4	Full	500	0.0	0.0
Approach	316	1.7		0.837		38.9	LOS C	9.1	64.4				
West: South Street eastbound													
Lane 1	203	1.6	1837	0.111	63[5]	8.2	LOS A	0.0	0.0	Short (P)	20	0.0	0.0
Lane 2	333	5.1	1888	0.176	100	0.0	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	536	3.7		0.176		3.1	NA	0.0	0.0				
Intersection	1296	2.3		0.837		12.5	NA	9.1	64.4				

The Merrigum Street leg reaches a LoS E in 2018 (Table 10.52), at which time it will require upgrading. Due to the constrained road width, it is recommended that signalisation is the most appropriate option (Figure 10.22).

Table 10.52: Merrigum Street and South Street, 2018. Merrigum Street reaching LoS E

Site: Merrigum Street and South Street - 2018 PM

New Site
Stop (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: South Street westbound													
Lane 1	109	0.6	1942	0.056	20[6]	0.0	LOS A	0.0	0.0	Short (P)	10	0.0	0.0
Lane 2	361	1.0	1287	0.280	100	7.0	LOS A	2.4	16.8	Full	500	0.0	0.0
Approach	469	0.9		0.280		5.4	NA	2.4	16.8				
North: Merrigum Street													
Lane 1	333	1.6	349	0.953	100	64.4	LOS E	15.8	112.1	Full	500	0.0	0.0
Approach	333	1.6		0.953		64.4	LOS E	15.8	112.1				
West: South Street eastbound													
Lane 1	215	1.5	1838	0.117	63[5]	8.2	LOS A	0.0	0.0	Short (P)	20	0.0	0.0
Lane 2	352	4.8	1891	0.186	100	0.0	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	566	3.5		0.186		3.1	NA	0.0	0.0				
Intersection	1368	2.2		0.953		18.8	NA	15.8	112.1				

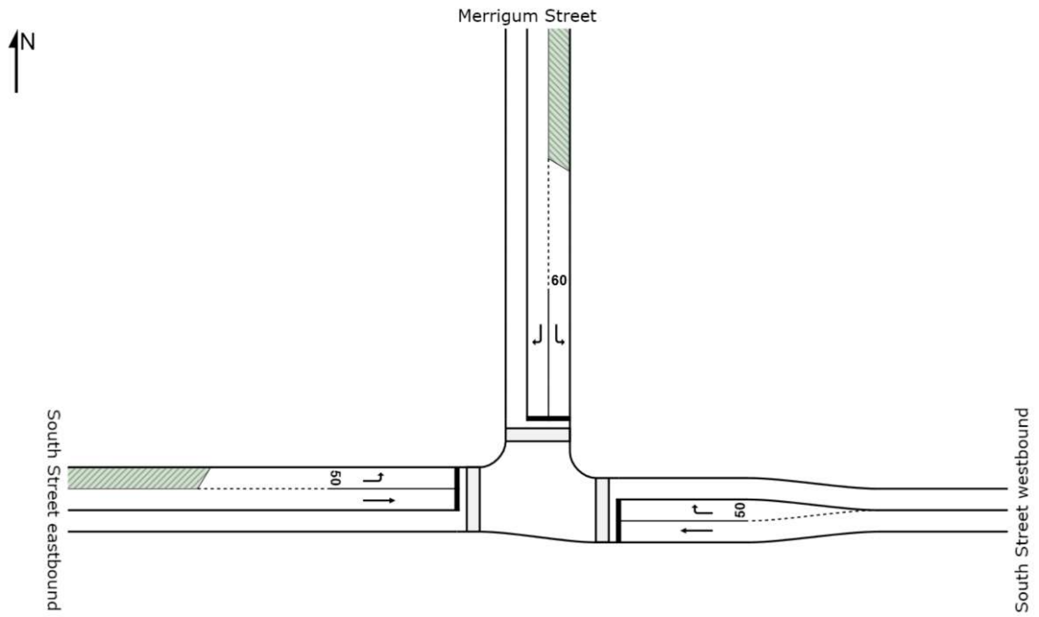


Figure 10.22: Merrigum Street and South Street proposed signalisation upgrade

The intersection was modelled as signals (Table 10.53), and with 10 year growth (Table 10.54), with the intersection operating at a LoS B. To test the sensitivity of the upgrade, 20% was added to the traffic volumes and this was modelled, with the intersection remaining at a LoS B (Table 10.55).

Table 10.53: Merrigum Street and South Street signalised, 2018

Site: Merrigum Street and South Street - 2018 PM

New Site
Signals - Actuated Cycle Time = 67 seconds (Practical Cycle Time)

Lane Use and Performance													
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: South Street westbound													
Lane 1	347	0.6	1189	0.292	100	6.8	LOS A	5.3	37.6	Full	500	0.0	0.0
Lane 2	115	1.8	261	0.440	100	34.0	LOS C	3.4	24.1	Short	50	0.0	0.0
Approach	462	0.9		0.440		13.6	LOS A	5.3	37.6				
North: Merrigum Street													
Lane 1	165	0.6	386	0.428	100	34.8	LOS C	4.9	34.3	Short (P)	60	0.0	0.0
Lane 2	163	2.6	381	0.428	100	35.0	LOS C	4.8	34.4	Full	500	0.0	0.0
Approach	328	1.6		0.428		34.9	LOS C	4.9	34.4				
West: South Street eastbound													
Lane 1	212	1.5	603	0.351	100	27.6	LOS B	5.3	37.9	Short (P)	50	0.0	0.0
Lane 2	346	4.9	1157	0.299	100	6.9	LOS A	5.4	39.1	Full	500	0.0	0.0
Approach	558	3.6		0.351		14.8	LOS B	5.4	39.1				
Intersection	1348	2.2		0.440		19.3	LOS B	5.4	39.1				

Table 10.54: Merrigum Street and South Street signalised with 10-year life, 2028

Site: Merrigum Street and South Street - 2028 PM

New Site
Signals - Actuated Cycle Time = 74 seconds (Practical Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: South Street westbound													
Lane 1	395	0.5	1182	0.334	100	7.9	LOS A	7.0	49.0	Full	500	0.0	0.0
Lane 2	131	1.6	249	0.525	100	36.3	LOS C	4.3	30.6	Short	50	0.0	0.0
Approach	525	0.8		0.525		15.0	LOS B	7.0	49.0				
North: Merrigum Street													
Lane 1	187	0.6	425	0.441	100	36.3	LOS C	6.0	42.0	Short (P)	60	0.0	0.0
Lane 2	185	2.3	420	0.441	100	36.4	LOS C	5.9	42.1	Full	500	0.0	0.0
Approach	373	1.4		0.441		36.3	LOS C	6.0	42.1				
West: South Street eastbound													
Lane 1	240	1.3	646	0.371	100	28.4	LOS B	6.5	46.3	Short (P)	50	0.0	0.0
Lane 2	394	4.3	1154	0.341	100	8.0	LOS A	7.0	50.7	Full	500	0.0	0.0
Approach	634	3.2		0.371		15.7	LOS B	7.0	50.7				
Intersection	1532	1.9		0.525		20.5	LOS B	7.0	50.7				

Table 10.55: Merrigum Street and South Street signalised, 2028, plus 20% sensitivity

Site: Merrigum Street and South Street - 2028 PM + 20% sensitivity

New Site
Signals - Actuated Cycle Time = 92 seconds (Practical Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: South Street westbound													
Lane 1	474	0.4	1226	0.386	100	9.2	LOS A	10.3	72.0	Full	500	0.0	0.0
Lane 2	157	1.3	241	0.651	100	41.1	LOS C	6.5	45.7	Short	50	0.0	0.0
Approach	631	0.7		0.651		17.1	LOS B	10.3	72.0				
North: Merrigum Street													
Lane 1	225	0.5	443	0.509	100	42.7	LOS D	8.9	62.7	Short (P)	60	0.0	9.0
Lane 2	222	1.9	438	0.507	100	42.8	LOS D	8.8	62.6	Full	500	0.0	0.0
Approach	447	1.2		0.509		42.8	LOS D	8.9	62.7				
West: South Street eastbound													
Lane 1	288	1.1	781	0.369	100	28.4	LOS B	8.8	62.4	Short (P)	50	0.0	25.1
Lane 2	472	3.6	1201	0.393	100	9.2	LOS A	10.3	74.1	Full	500	0.0	0.0
Approach	760	2.6		0.393		16.5	LOS B	10.3	74.1				
Intersection	1838	1.6		0.651		23.1	LOS B	10.3	74.1				

10.7.3 Conclusion

The link between Wilson Road and Willow Road is expected to cost approximately $6,500,000 for the 270 metre section of road including a bridge, and an intersection at Tennent Road and at Wilsons Road. The link provides the benefit of decreased travel time between the two points (saving approximately 1.5 minutes). The travel time saving is not considered to outweigh the construction costs.

The existing link along Merrigum Street and South Street between Willow Road and Wilsons Road requires a signalisation upgrade of the intersection of Merrigum Street at South Street at an estimated cost of $2.06m. This upgrade is required to be constructed in 2018, and will facilitate safe movement between Willow Road and Wilsons Road at a considerably lower construction cost.

Therefore, it is recommended that the Wilsons Road to Willow Road link not be constructed and removed from the LEP, and the upgrade of Merrigum Street at South Street be listed for construction in 2018 within the Charlestown Section 94 plan.

Section 3: Concept Plans and Costings

The works and their estimated costs are summarised in Table 11.1 'Summary of Identified Works and Capital Cost Estimates'

11.1 Charlestown Sub – Catchment – Roads and Intersections

Table 11.1 Summary of Identified Works and Capital Cost Estimates

Reference #	Charlestown Catchment - Facility Name	Capital Cost Estimate
	Charlestown Sub-Catchment	
Roads and Intersections		
L22	Kahibah Road – Hexham Street – Wallsend Road – single lane roundabout	$2,000,000
L25	Smith Street - Smart Street – Traffic Signals – Single Lane approach	$600,000
L26	Smith Street - Frederick Street - Traffic Signals – Single Lane approach	$600,000
L27	Smith Street - Ridley Street Traffic Signals – Single Lane approach	$600,000
	Sub-Total	**$3,800,000**
	Pedestrian / Bicycle Facilities	
C1	Warners Bay Road from Bypass to Moto Street - Off Road Shared Pathway – 1.8km	$1,250,000
	Sub-Total	**$1,250,000**
	Public Transport Facilities	
	New Bus Shelters x 7	$210,000
	Sub-Total	**$210,000**
	Mount Hutton / Windale Sub-Catchment	
Roads and Intersections		
L23	Warners Bay Road – Bayview Street – Dunkley Road – single lane roundabout	$1,700,000*
L24	Violet Town Road – Wilsons Road – single lane roundabout	$2,000,000
L30	South Street – Merrigum Street – traffic signals dual lane aproach	$2,060,000
	Langdon Way extension	$491,368
	Sub-Total	**$6,251,368**
*L23 is on boundary of Charlestown and Glendale catchment, with 50/50 distribution of costs		
	Eleebana Sub-Catchment	
Pedestrian / Bicycle Facilities		

Reference #	Charlestown Catchment - Facility Name	Capital Cost Estimate
C7	Eleebana – Bareki Road - Toonibal Avenue to Eleebana Lions Park – Off Road Shared Pathway – 0.45km	$4,254,000
C6	Tingira Drive from Violet Town Road to Macquarie Drive, Eleebana – Off Road Shared Pathway – 4.0km	$950,000
	Sub-Total	**$5,240,000**
	Dudley Sub-Catchment	
	Pedestrian / Bicycle Facilities	
C2	Fernleigh Track to Dudley – Off Road Shared Pathway – 2.0km	$2,000,000
	Sub-Total	**$2,000,000**
	TOTAL	**$18,751,368**

*Cost for Bayview Street, Dunkley Parade and Warners Bay Road distributed 50/50 between Charlestown and Glendale catchments as the intersection is on the boundary of the two catchments.

11.1.1 Project I22 – Kahibah Road – Hexham Street – Wallsend Road - Roundabout

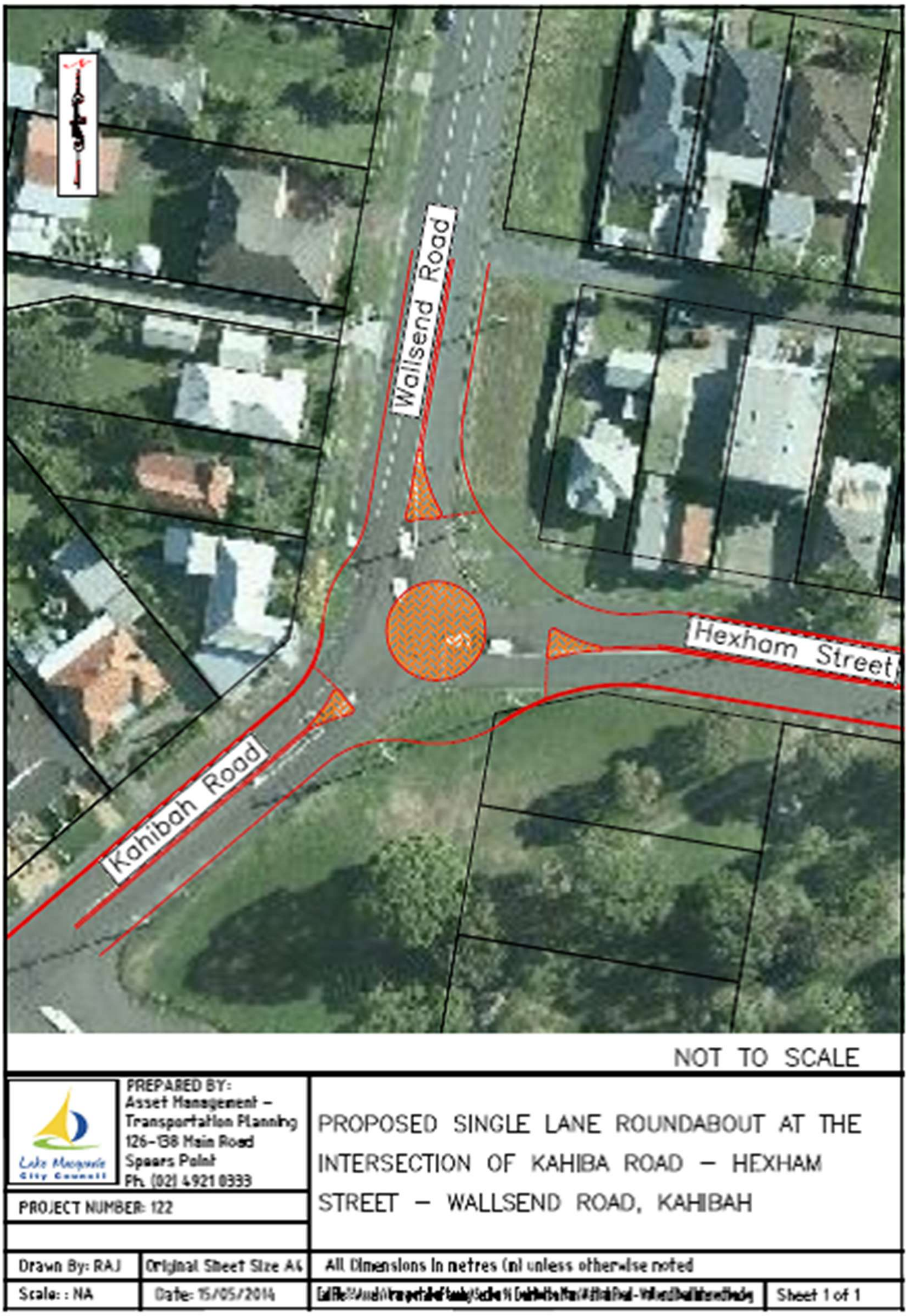
Plan	Charlestown Contribution Catchment
Sub - Catchment	Charlestown
Project	I22
Description	Kahibah Road – Hexham Street - Wallsend Road – Single Lane roundabout
Site Layout	

Table 11.1.1 – Concept Estimate of Works Kahibah Road – Hexham Street – Wallsend Road – Roundabout

Concept Estimate of Proposed Works Kahibah Road – Hexham Street – Wallsend Road – single lane roundabout		
Sub-Task No.	Description	$ Amount
01	Administration	44648
02	Traffic Control	200784
03	Site Establishment	181849
04	Utility Services	59420
05	Erosion and Sediment	19200
06	Clearing and Stripping	15677
07	Earthworks	131245
08	Pipe Drainage	34206
09	Drainage Structures	32238
10	Open Drains/ Stabilisation	5249
11	Sub-Surface Drainage	4087
12	Kerb and Gutter	41219
13	Flexible Pavements	254756
14	Sprayed Bitumen	54202
15	Asphaltic Concrete	197965
16	Concrete pavements	395674
17	Minor Concrete Works	113333
18	Pavement Markings	7304
19	Road Furnishings	4387
20	Barrier Fencing	28546
21	Landscaping	26759
22	Miscellaneous	147253
	Total	**$2,000,000**

11.1.2 Project I25 – Smith Street – Smart Street – Traffic Signals

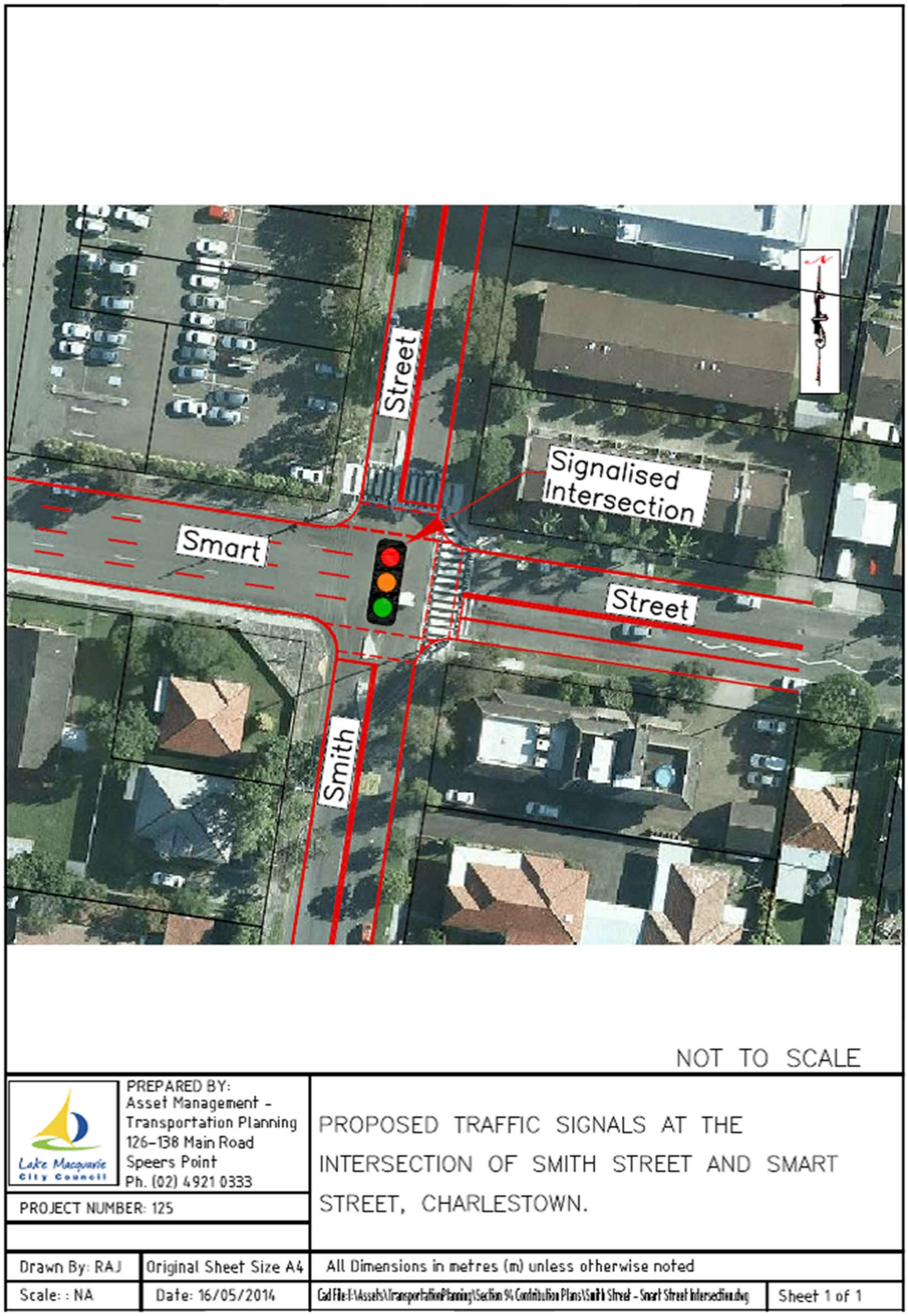
Plan	Charlestown Contribution Catchment
Sub - Catchment	Charlestown
Project	I25
Description	Smith Street – Smart Street – Traffic Signals – Single Lane approach
Site Layout	

Table 11.1.2 – Concept Estimate of Works – Smith Street and Smart Street – Traffic Signals

Concept Estimate of Proposed Works Smith Street - Smart Street – Traffic Signals – Single Lane approach		
Sub-Task No.	Description	$ Amount
01	Administration	10046
02	Traffic Control	45176
03	Site Establishment	40916
04	Utility Services	13370
05	Erosion and Sediment	4320
06	Clearing and Stripping	3527
07	Earthworks	19530
08	Pipe Drainage	7696
09	Drainage Structures	17253
10	Open Drains/ Stabilisation	1181
11	Sub-Surface Drainage	1920
12	Kerb and Gutter	9274
13	Flexible Pavements	127320
14	Sprayed Bitumen	12195
15	Asphaltic Concrete	84542
16	Concrete pavements	129027
17	Minor Concrete Works	25500
18	Pavement Markings	1643
19	Road Furnishings	987
20	Barrier Fencing	6423
21	Landscaping	5021
22	Miscellaneous	33103
	Total	**$600,000**

11.1.3 Project I26 – Smith Street – Frederick Street – Traffic Signals

Plan	Charlestown Contribution Catchment
Sub - Catchment	Charlestown
Project	I26
Description	Smith Street – Frederick Street – Traffic Signals - Single Lane approach
Site Layout	

Table 11.1.3 – Concept Estimate of Works – Smith Street – Frederick Street – Traffic Signals

Concept Estimate of Proposed Works Smith Street - Frederick Street - Traffic Signals – Single Lane approach		
Sub-Task No.	Description	$ Amount
01	Administration	10046
02	Traffic Control	45176
03	Site Establishment	40916
04	Utility Services	13370
05	Erosion and Sediment	4320
06	Clearing and Stripping	3527
07	Earthworks	29530
08	Pipe Drainage	7696
09	Drainage Structures	17253
10	Open Drains/ Stabilisation	1181
11	Sub-Surface Drainage	1920
12	Kerb and Gutter	9274
13	Flexible Pavements	117320
14	Sprayed Bitumen	12195
15	Asphaltic Concrete	84542
16	Concrete pavements	119027
17	Minor Concrete Works	35500
18	Pavement Markings	1643
19	Road Furnishings	987
20	Barrier Fencing	6423
21	Landscaping	6021
22	Miscellaneous	32103
	Total	**$600,000**

11.1.4 Project I27 – Smith Street – Ridley Street – Traffic Signals

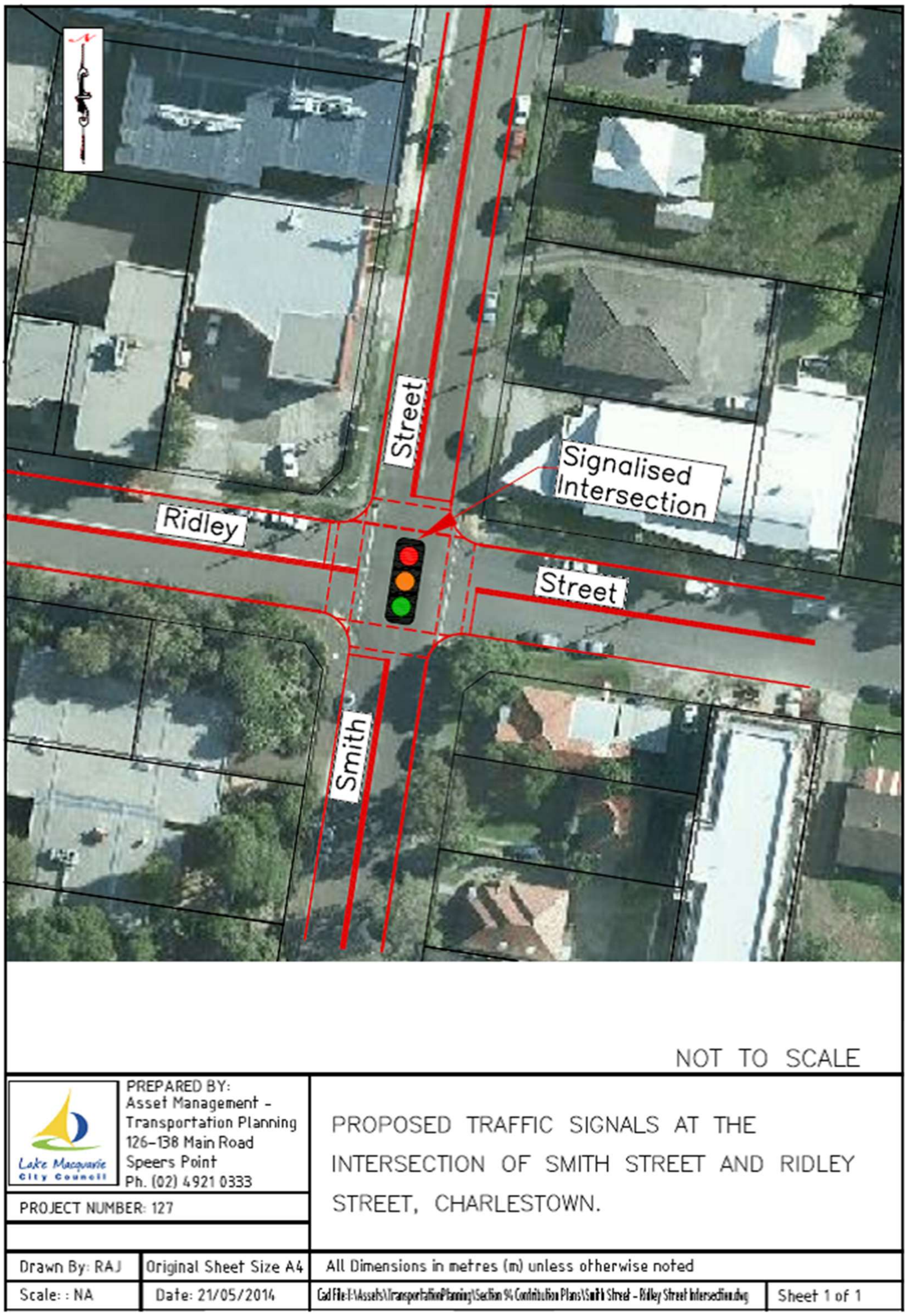
Plan	Charlestown Contribution Catchment
Sub - Catchment	Charlestown
Project	I27
Description	Smith Street – Ridley Street – Traffic Signals - Single Lane approach
Site Layout	

Table 11.1.4 Concept Estimate of Works – Smith Street – Ridley Street – Traffic Signals

Concept Estimate of Proposed Works Smith Street - Ridley Street Traffic Signals – Single Lane approach		
Sub-Task No.	Description	$ Amount
01	Administration	10046
02	Traffic Control	45176
03	Site Establishment	40916
04	Utility Services	13370
05	Erosion and Sediment	4320
06	Clearing and Stripping	3527
07	Earthworks	39530
08	Pipe Drainage	17696
09	Drainage Structures	17253
10	Open Drains/ Stabilisation	1181
11	Sub-Surface Drainage	1920
12	Kerb and Gutter	9274
13	Flexible Pavements	98320
14	Sprayed Bitumen	12195
15	Asphaltic Concrete	84542
16	Concrete pavements	119027
17	Minor Concrete Works	35500
18	Pavement Markings	1643
19	Road Furnishings	987
20	Barrier Fencing	6423
21	Landscaping	6021
22	Miscellaneous	31133
	Total	**$600,000**

11.2 Charlestown Sub- Catchment – Shared Pathways

11.2.1 Project C1 – Warners Bay Road from Bypass to Dudley Road – Off Road Shared Pathway – 1.8km

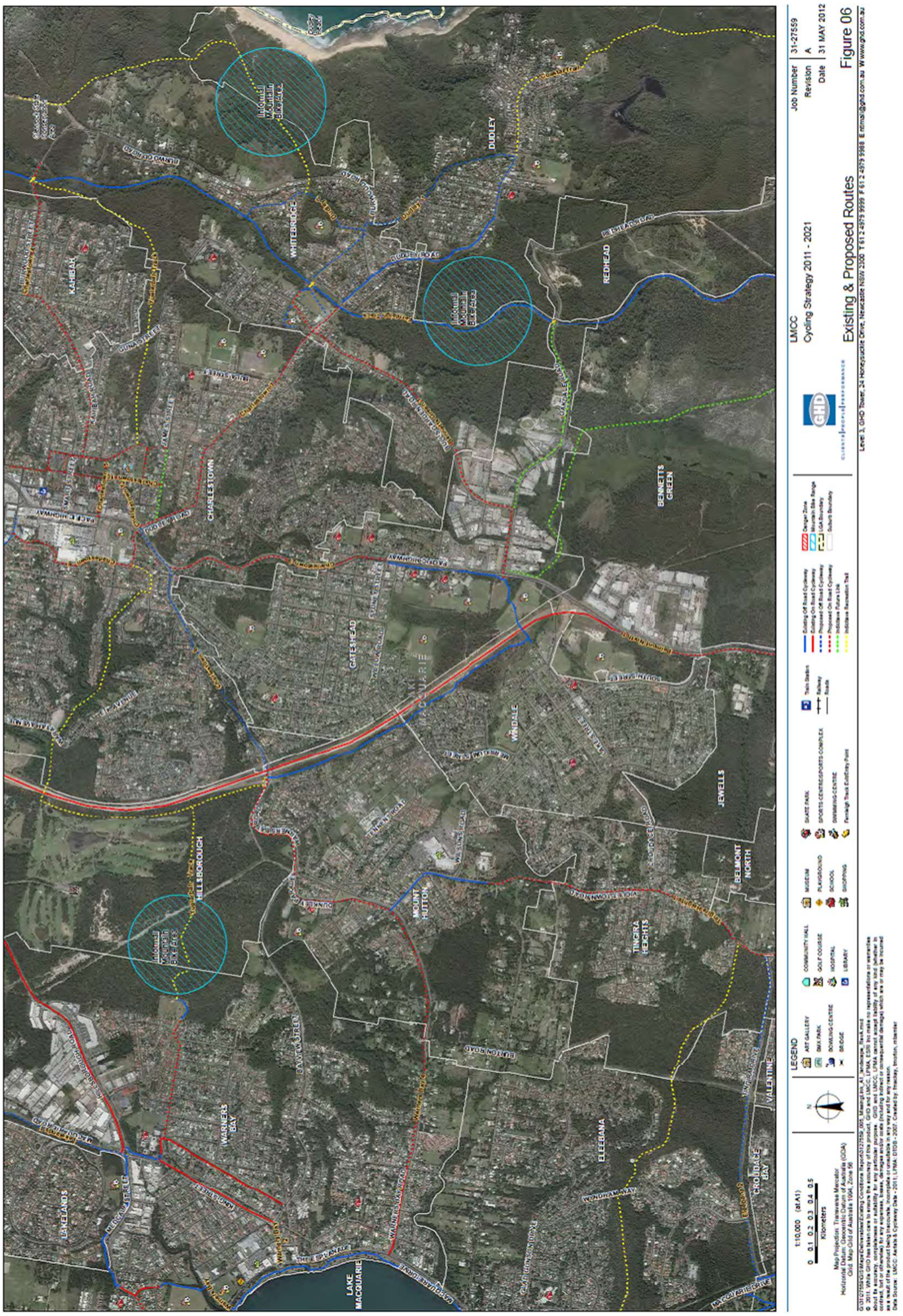
Plan	Charlestown Contribution Catchment
Sub - Catchment	Charlestown
Project	C1
Description	Warners Bay Road from Bypass to Dudley Road – Off Road Shared Pathway – 1.8km
Site Layout	

Table 11.2.1 Concept Estimate of Works – Warners Bay Road from Bypass to Dudley Road – Off Road Shared Pathway – 1.8km

Concept Estimate of Proposed Works Warners Bay Road from Bypass to Dudley Road - Off Road Shared Pathway – 1.8km		
Sub-Task No.	Description	$ Amount
01	Administration	27905
02	Traffic Control	45176
03	Site Establishment	113655
04	Utility Services	45254
05	Erosion and Sediment	12000
06	Clearing and Stripping	9798
07	Earthworks	162342
08	Pipe Drainage	47141
09	Drainage Structures	20147
10	Open Drains/ Stabilisation	3281
11	Sub-Surface Drainage	2554
12	Kerb and Gutter	25762
13	Flexible Pavements	159223
14	Sprayed Bitumen	0
15	Asphaltic Concrete	0
16	Concrete pavements	371024
17	Minor Concrete Works	70833
18	Pavement Markings	4565
19	Road Furnishings	2742
20	Barrier Fencing	17841
21	Landscaping	16724
22	Miscellaneous	92033
	Total	**$1,250,000**

11.3 Windale Sub-Catchment – Roads and Intersections

11.3.1 Project I30 – South Street and Merrigum Street – Traffic Signals

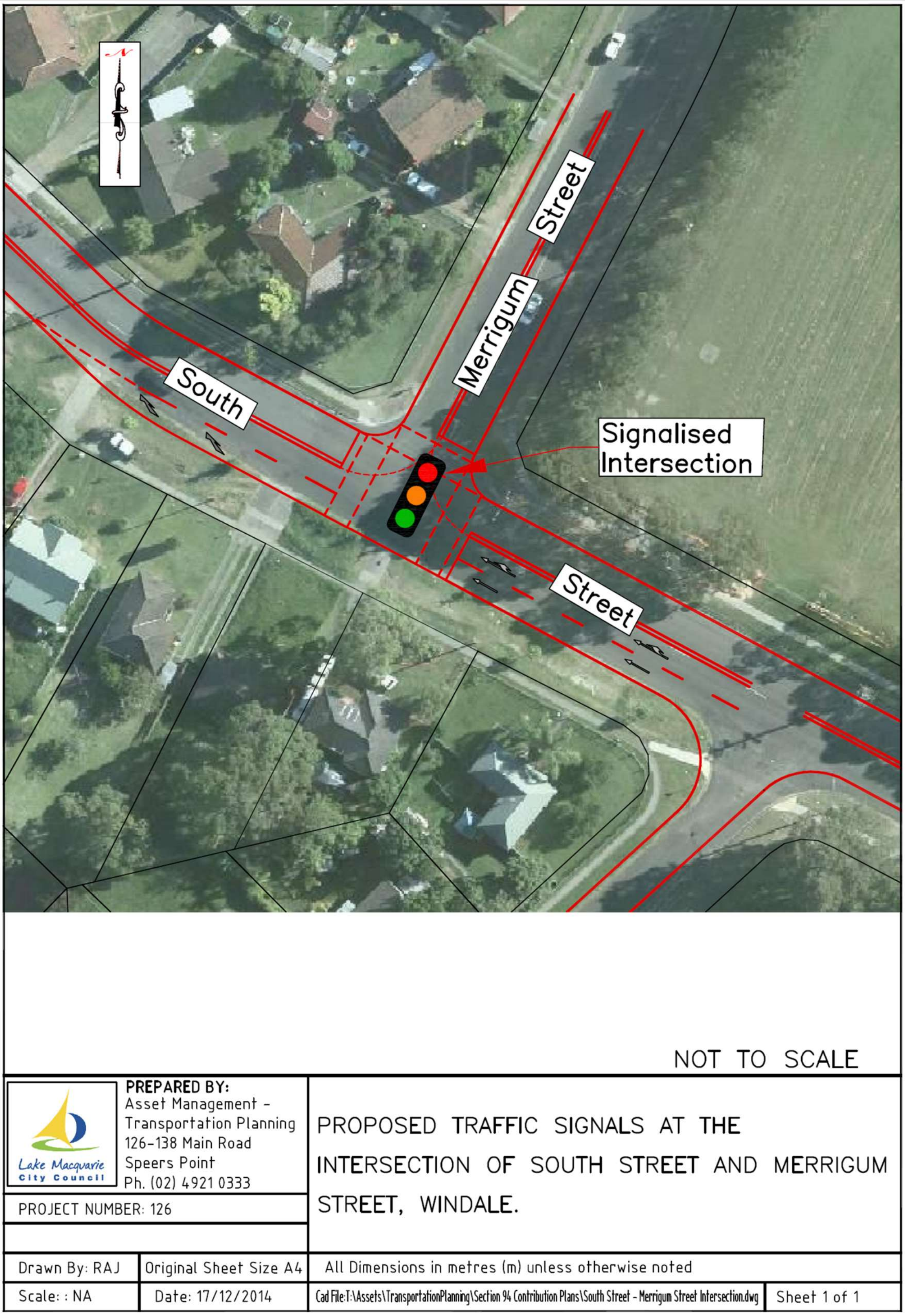
Plan	Charlestown Contribution Catchment
Sub - Catchment	Windale
Project	I30
Description	South Street – Merrigum Street – Traffic Signals - Single Lane approach
Site Layout	

Table 11.3.1 Concept Estimate of Works – South Street and Merrigum Street – Traffic Signals

Concept Estimate of Proposed Works South Street and Merrigum Street – Traffic Signals		
Sub-Task No.	Description	Amount
01	Administration	34,491
02	Traffic Control	155,104
03	Site Establishment	140,478
04	Utility Services	45,904
05	Erosion and Sediment	14,832
06	Clearing and Stripping	12,109
07	Earthworks	$135,720
08	Pipe Drainage	60,756
09	Drainage Structures	59,235
10	Open Drains/ Stabilisation	4,055
11	Sub-Surface Drainage	6,592
12	Kerb and Gutter	31,841
13	Flexible Pavements	337,565
14	Sprayed Bitumen	41,870
15	Asphaltic Concrete	290,261
16	Concrete pavements	408,659
17	Minor Concrete Works	121,883
18	Pavement Markings	5,641
19	Road Furnishings	3,389
20	Barrier Fencing	22,052
21	Landscaping	20,672
22	Miscellaneous	106,890
	Total	**$2,060,000**

11.4 Mount Hutton Sub-Catchment – Roads and Intersections

11.4.1 Project I23 – Warners Bay Road – Bayview Street – Dunkley Parade

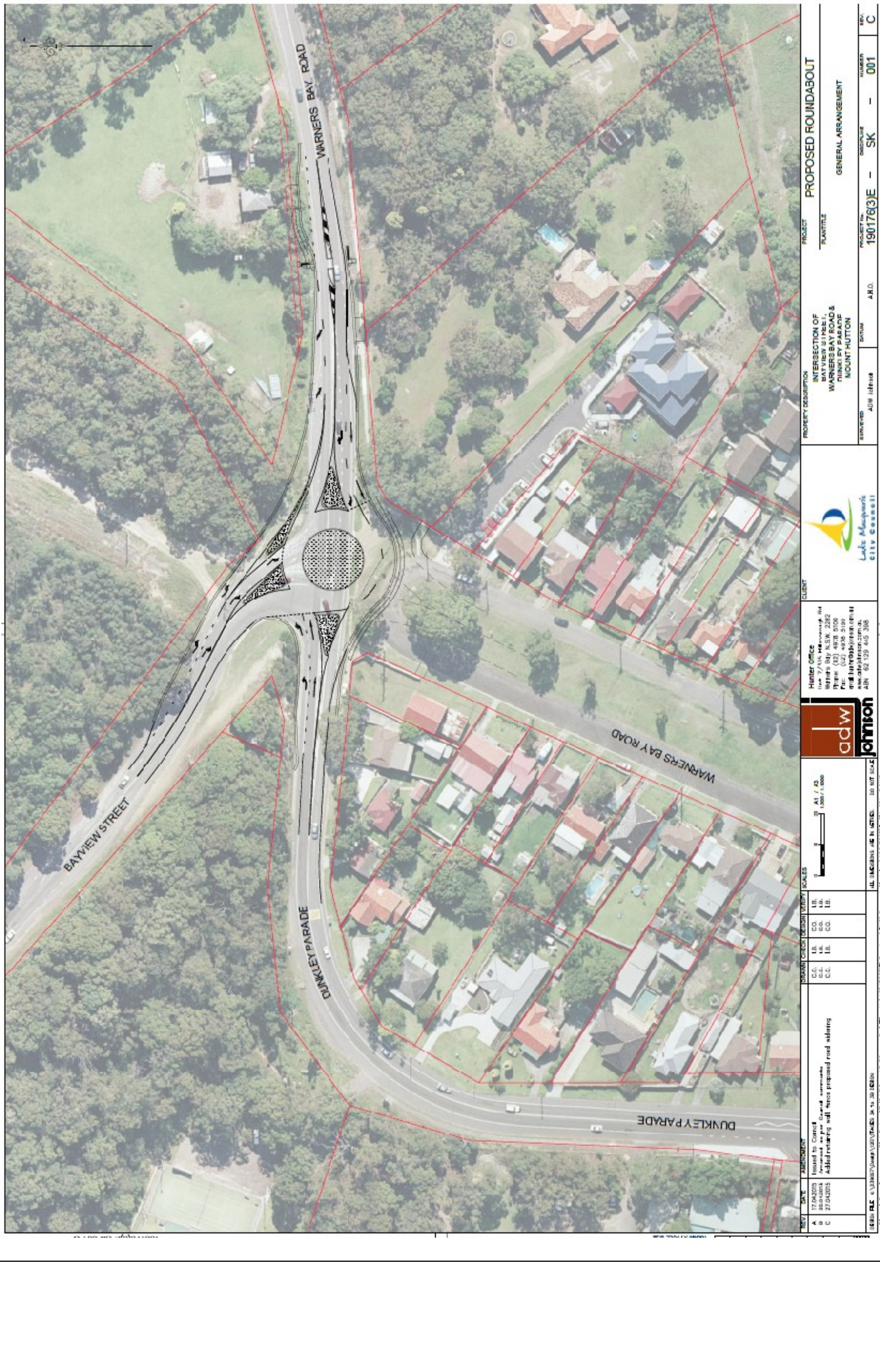
Plan	Charlestown Contribution Catchment
Sub - Catchment	Mount Hutton
Project	I23
Description	Warners Bay Road – Bayview Road – Dunkley Parade –roundabout
Site Layout	

Table 11.4.1 Concept of Estimate of Works – Warners Bay Road – Bayview Street – Dunkley Parade

Concept Estimate of Proposed Works Warners Bay Road – Bayview Street – Dunkley Parade – single lane roundabout		
Sub-Task No.	Description	Amount
01	Administration	$77,250
02	Traffic Control	$400,000
03	Site Establishment	$400,000
04	Utility Services	$325,000
05	Erosion and Sediment	$30,000
06	Clearing and Stripping	$30,400
07	Earthworks	$144,500
08	Pipe Drainage	$32,000
09	Drainage Structures	$13,500
10	Sub-Surface Drainage	$54,000
11	Kerb and Gutter	$42,900
12	Full pavement construction	$542,750
13	Minor Concrete Works	$90,800
14	Pavement Markings	$20,000
15	Road Furnishings including street lighting	$160,000
16	Retaining Wall	$115,500
17	Landscaping	$75,000
18	Miscellaneous	$217,817.50
19	Contingency	$628,583
	Total	**$3,400,000**

11.4.2 Project I24 – Violet Town Road – Wilsons Road

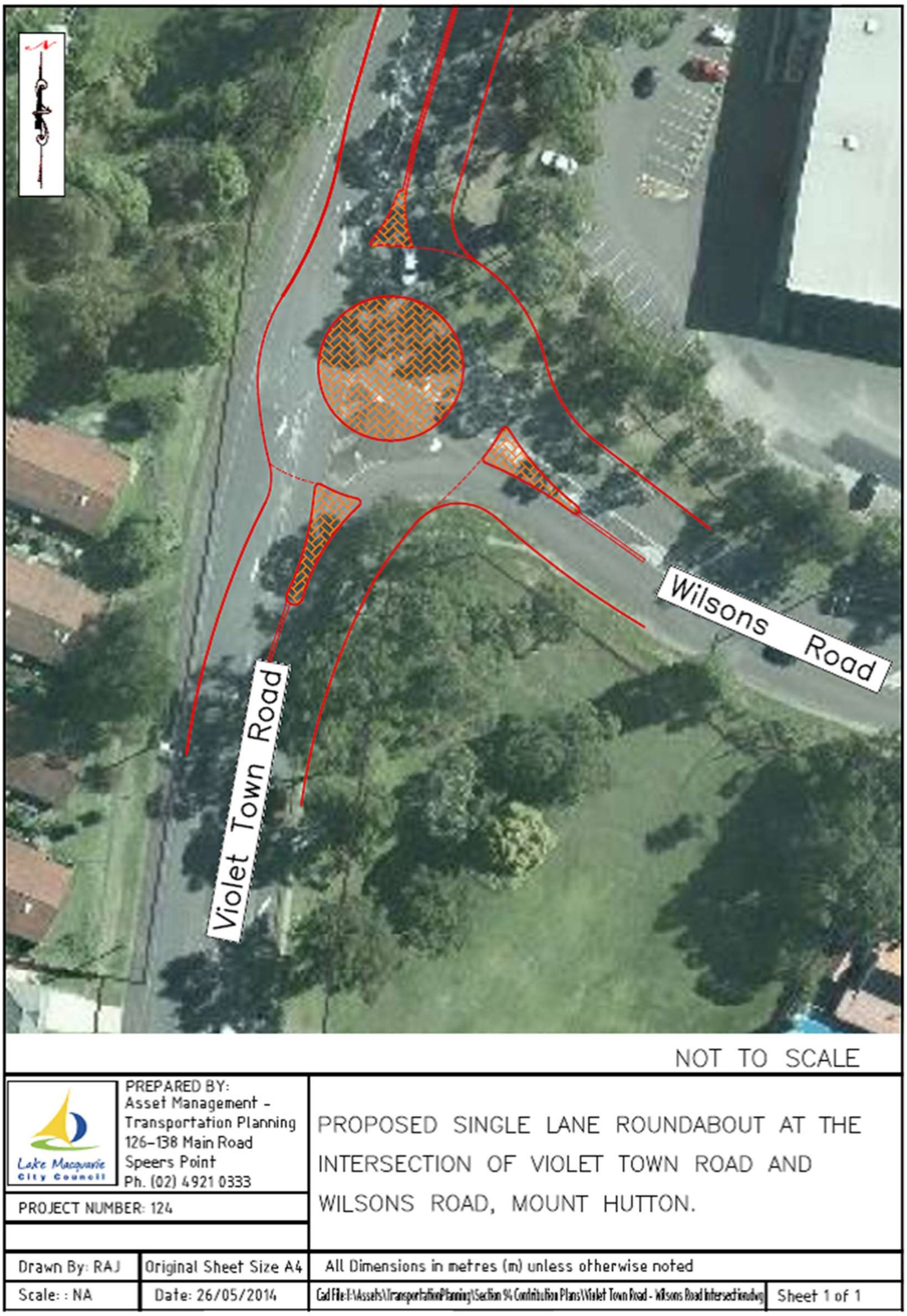
Plan	Charlestown Contribution Catchment
Sub - Catchment	Mount Hutton
Project	I24
Description	Violet Town Road – Wilsons Road – Single Lane roundabout
Site Layout	

Table 11.4.2 Concept Estimate of Works – Violet Town Road – Wilsons Road

Concept Estimate of Proposed Works Violet Town Road – Wilsons Road – single lane roundabout		
Sub-Task No.	Description	Amount
01	Administration	33486
02	Traffic Control	150588
03	Site Establishment	136386
04	Utility Services	44565
05	Erosion and Sediment	14400
06	Clearing and Stripping	11758
07	Earthworks	98436
08	Pipe Drainage	75655
09	Drainage Structures	74177
10	Open Drains/ Stabilisation	3937
11	Sub-Surface Drainage	3065
12	Kerb and Gutter	80914
13	Flexible Pavements	441067
14	Sprayed Bitumen	40651
15	Asphaltic Concrete	148473
16	Concrete pavements	411156
17	Minor Concrete Works	85000
18	Pavement Markings	5478
19	Road Furnishings	3290
20	Barrier Fencing	21409
21	Landscaping	20069
22	Miscellaneous	110440
	Total	**$2,000,000**

11.5 Eleebana Sub-Catchment – Shared Pathways

11.5.1 Project C7 – Eleebana – Bareki Road – Toonibal Avenue to Eleebana Lions Park – Off Road Shared Pathway – 0.45km

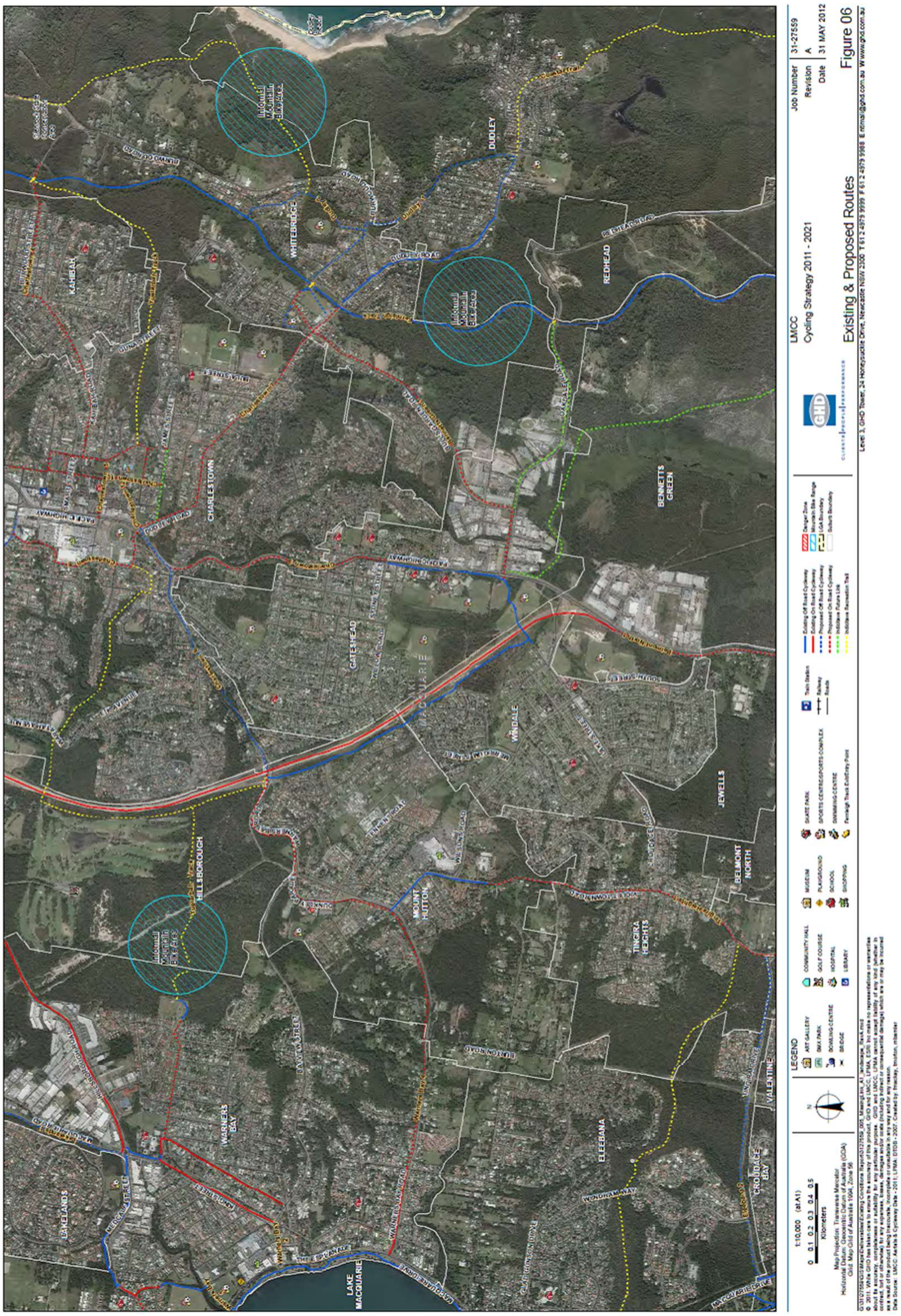
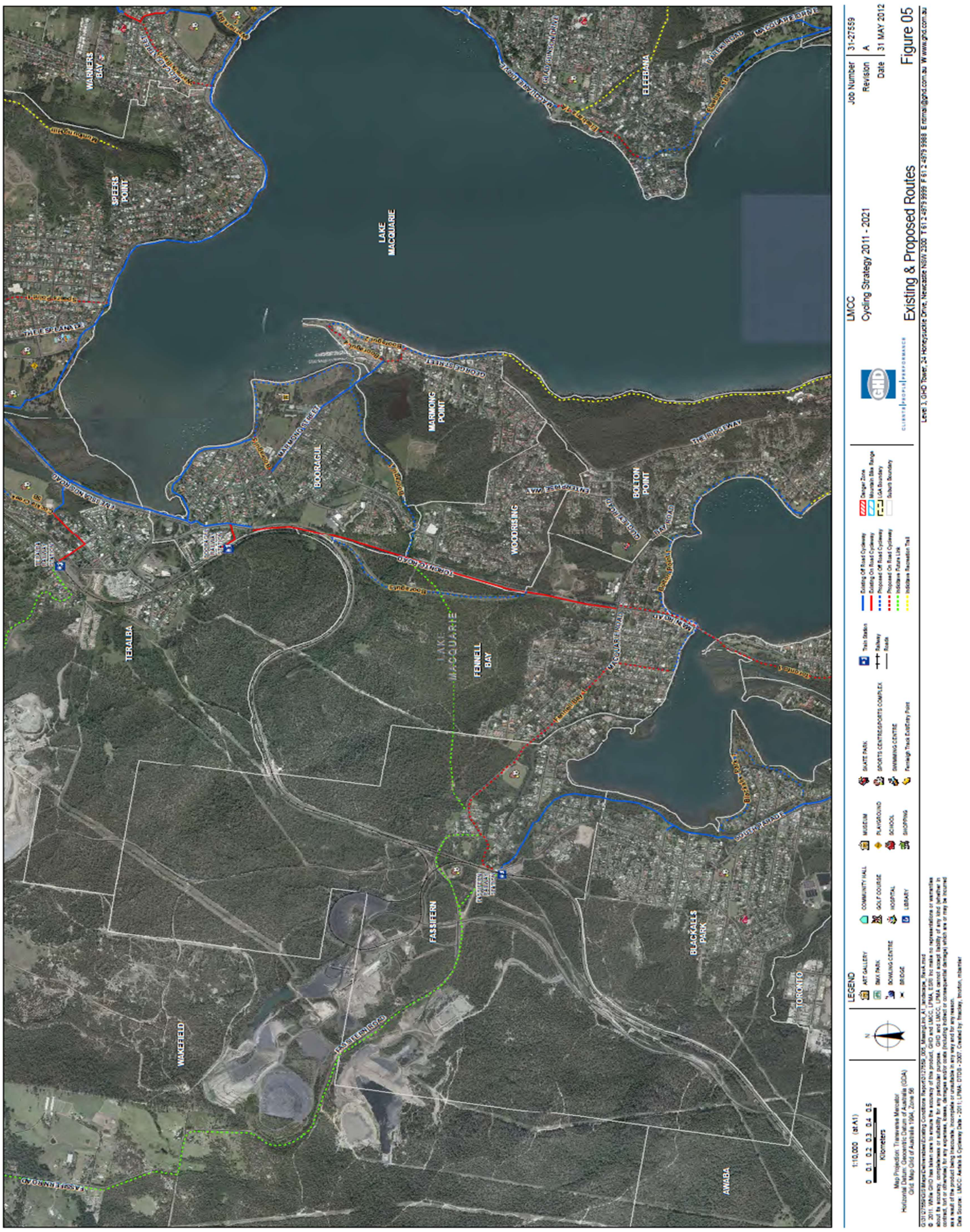
Plan	Charlestown Contribution Catchment
Sub - Catchment	Eleebana
Project	C7
Description	Eleebana – Bareki Road – Toonibal Avenue to Eleebana Lions Park – Off Road Shared Pathway – 0.45km
Site Layout	

Table 11.5.1 Concept Estimate of Works –Eleebana – Bareki Road – Toonibal Avenue to Eleebana Lions Park – Off Road Shared Pathway – 0.45km

Concept Estimate of Proposed Works Eleebana – Bareki Road - Toonibal Avenue to Eleebana Lions Park – Off Road Shared Pathway – 0.45km		
Sub-Task No.	Description	Amount
01	Administration	21208
02	Traffic Control	95373
03	Site Establishment	86378
04	Utility Services	228225
05	Erosion and Sediment	59120
06	Clearing and Stripping	57447
07	Earthworks	262341
08	Pipe Drainage	16248
09	Drainage Structures	15312
10	Open Drains/ Stabilisation	2493
11	Sub-Surface Drainage	1941
12	Kerb and Gutter	19579
13	Flexible Pavements	246755
14	Sprayed Bitumen	0
15	Asphaltic Concrete	0
16	Concrete pavements	482378
17	Minor Concrete Works	53433
18	Pavement Markings	3470
19	Road Furnishings	2084
20	Barrier Fencing	13559
21	Landscaping	12710
22	Miscellaneous (Property acquisition/adjustments)	2569946
	Total	**$4,254,000**

11.5.2 Project C6 – Tingira Drive from Violet Town Road to Macquarie Drive, Eleebana – Off Road Shared Pathway – 4.0km

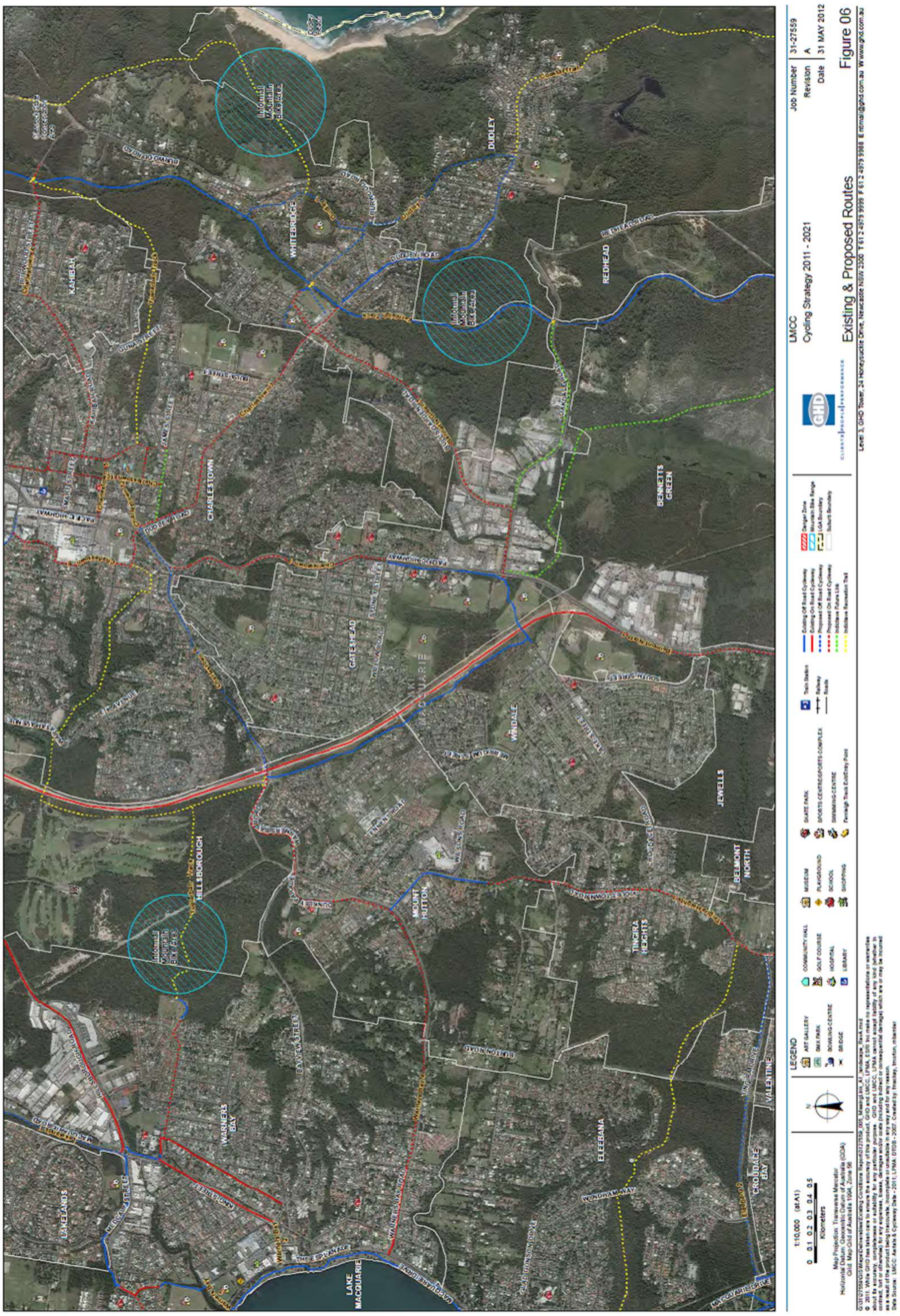
Plan	Charlestown Contribution Catchment
Sub - Catchment	Eleebana
Project	C6
Description	Tingira Drive from Violet Town Road to Macquarie Drive, Eleebana – Off Road Shared Pathway – 4.0km
Site Layout	

11.5.2 Concept Estimate of Works – Tingira Drive from Violet Town Road to Macquarie Drive, Eleebana – Off Road Shared Pathway – 4.0km

Concept Estimate of Proposed Works Tingira Drive from Violet Town Road to Macquarie Drive, Eleebana – Off Road Shared Pathway – 4.0km		
Sub-Task No.	Description	Amount
01	Administration	21208
02	Traffic Control	95373
03	Site Establishment	86378
04	Utility Services	128225
05	Erosion and Sediment	59120
06	Clearing and Stripping	57447
07	Earthworks	162341
08	Pipe Drainage	16248
09	Drainage Structures	15312
10	Open Drains/ Stabilisation	2493
11	Sub-Surface Drainage	1941
12	Kerb and Gutter	19579
13	Flexible Pavements	146755
14	Sprayed Bitumen	0
15	Asphaltic Concrete	0
16	Concrete pavements	281978
17	Minor Concrete Works	53833
18	Pavement Markings	3470
19	Road Furnishings	2084
20	Barrier Fencing	13559
21	Landscaping	12710
22	Miscellaneous (Property acquisition/adjustments)	2269946
	Total	**$950,000**

11.6 Dudley Sub-Catchment – Shared Pathways

11.6.1 Project C2 – Fernleigh Track to Dudley – Off Road Shared Pathway – 2.0km

Plan	Charlestown Contribution Catchment
Sub - Catchment	Dudley
Project	C2
Description	Fernleigh Track to Dudley – Off Road Shared Pathway - 2.0km
Site Layout	

11.5.1 Concept Estimate of Works – Fernleigh Track to Dudley – Off Road Shared Pathway

Concept Estimate of Proposed Works **Fernleigh Track to Dudley – Off Road Shared Pathway – 2.0km**		
Sub-Task No.	Description	Amount
01	Administration	44648
02	Traffic Control/Wages	200784
03	Site Establishment	181849
04	Utility Services	59420
05	Erosion and Sediment	19200
06	Clearing and Stripping	15677
07	Earthworks	131245
08	Pipe Drainage	34206
09	Drainage Structures	32236
10	Open Drains/ Stabilisation	5249
11	Sub-Surface Drainage	4087
12	Kerb and Gutter	41219
13	Flexible Pavements	308934
14	Sprayed Bitumen	0
15	Asphaltic Concrete	0
16	Concrete pavements	593698
17	Minor Concrete Works	113300
18	Pavement Markings	7304
19	Road Furnishings	4387
20	Barrier Fencing	28546
21	Landscaping	26759
22	Miscellaneous (EIS/Property acquisition/adjustments)	147253
Total		**$2,000,000**