TIA Guidelines

May 2024

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1 Introduction

1.1 What is a TIA?

In simple terms a TIA is an acronym for 'Traffic Impact Assessment', which is the process of compiling and analysing information on the impacts of specific development proposals on the operation of the transport system.

1.2 Why do we do TIA's?

Council's development application process requires a developer to lodge an application for assessment in accordance with the provisions of the Planning Act and the Townsville City Plan. The City Plan identifies the level of assessment and assessment criteria for development in accordance with the Act for the Townsville area. Depending on the proposed location and the type and scale of the development a requirement for Transport impact, Access and Parking code assessment may be triggered. The City Plan Schedule SC6.4.5.2 details the TIA process that may be triggered and describes the purpose of a TIA is to:

- Assess the adequacy of the existing or future transportation system to accommodate additional traffic generated by a proposed development, redevelopment or land use change; and

- To assist in determining what improvements may be required to transport infrastructure (e.g. roadways, cycleways, pathways, public transport and parking, etc.) to maintain a satisfactory level of service for the Townsville community.

1.3 Purpose of the guideline

This document provides in-depth guidance on the requirements of Schedule SC6.4.5.2 Traffic Impact Assessments of the City Plan and has been prepared to assist development applicants to identify the traffic information which is typically needed to support a development application.

The guideline provides information about the steps involved in preparing a traffic report to support a development application that involves access or connection to a Council controlled road. The guideline may also be used to help identify measures to mitigate any impacts the development proposal may have on the operation of the road.

It is common for the Council planning officer who is assessing a development proposal to request additional information from the Applicant to support their application using the Request for Information (RFI) process. It is often at this stage that the Applicant is faced with a requirement to engage a traffic engineer to prepare a TIA that responds to the RFI.

Upon receipt of the TIA from the Applicant, the Council development assessment team will undertake a review of the TIA report. It is essential that this review is carried out and the Council Assessment Officer **does not** rely solely on the signoff by the Applicant's engineer. Council has a responsibility to ensure that public infrastructure is safe for all users and it is designed to be 'fit for purpose' and compatible with Council's future planning.

A list of technical abbreviations and definitions is included in **Appendix A**.

1.4 When is a TIA required?

Generally, a TIA is only required where a development proposal is referred to Council as part of the development application process and road impacts are likely to be significant and assessment is required in accordance with Schedule SC6.4.5.2 of the City Plan.

Apart from the Department of Transport and Main Roads (TMR) in relation to State Controlled Roads, there is no set standard or common policy for TIA's in Queensland and each Council tends to have their own special criteria as to when a TIA is required. Notwithstanding this Townsville City Council will require a TIA in the following circumstances:

a) The development triggers assessment in accordance with the Part 5 Tables of assessment of the City Plan and Figure SC6.4.5.4 of the City Plan.

b) The land affected by the activity adjoins a State Controlled Road.

c) Council have specifically requested that a TIA be prepared either at a pre-application meeting or as part of a RFI request for further information.

d) Council has determined that the application will be 'Notified' and the Applicant prepared TIA will be made available to the notified parties.

If the Applicant is unsure if their proposal will require a TIA to support their application, they should seek advice from the Council. Often with larger development proposals it is a good idea for prospective Applicants to have a preliminary or pre-application meeting with the Council's planners. At these meetings prospective Applicants will be advised if a TIA will be required and what should be addressed within the TIA

As an initial guide, a list of development types by activity status and what effects should be assessed within the TIA is provided in **Appendix B – Checklist B1**. To make a quick assessment of the traffic generation of the proposal **Appendix D** can also be reviewed.

When it has been determined that a TIA is required, Council and the developer need to consider a range of issues to ensure that the safety and efficiency of the road is not adversely affected by development impacts, these issues include:

a) impact on the local community.

b) road safety considerations.

c) extent of potential impacts.

d) Councils' strategic documents including:

    - Townsville Integrated Transport Plan – Strategic Directions (TITP)
    - Local Government Infrastructure Plan (LGIP); and
    - Priority Infrastructure Area (PIA).

e) The operative City Plan and notified plan changes, as well as the land use implications flowing from the City Plan and these plan changes.

1.5 Principles underlying the guideline.

This section outlines the underlying principles that guide the assessment of road impacts on Council's road network and the circumstances where a developer will be required to meet conditions and/or contribute to measures to mitigate the road impacts of their development.

1.5.1 Principle 1

Council will only approve development if the impacts created by the development can be managed to maintain a safe and efficient road system for all road users not just the development traffic. This approach is supported by the legislative powers of the Planning Act and the Local Government Act that enable Council to impose conditions to mitigate the road impacts of proposed developments.

1.5.2 Principle 2

Council uses its best endeavours to accommodate development by planning and investing in the road network trunk infrastructure for expected growth through the LGIP and CAPEX process. If Council works are required to support the development and these works are not currently programmed, then the developer will need to propose mitigation measures (usually roadworks) that enable Council to continue to operate its road network effectively whilst allowing the development to proceed. The cost of these works will usually be at full cost to the developer, irrespective of who else benefits from the infrastructure upgrades.

1.5.3 Principle 3

When determining road impact mitigation measures Council will not expect developers to do more than what Council would do itself if it were causing the need to upgrade the road.

1.6 TIA Scope

When it has been determined that a TIA is required the scope of the TIA will be relative to the scale of the impact of the development on the road system as follows:

- <u>Low impact (SC6.4.5.2(2)(c) Low TIA report):</u>
  The development is likely to have a very minor impact as the land use is consistent with the Townsville City Plan, but a review is still required to ensure potential traffic issues are assessed in terms of traffic safety and amenity issues. A low-level TIA report will generally involve assessment of the proposed property access of the development and comprise of a statement of impact, and a corresponding statement of proposed mitigation measures to ensure the access is safe.

- <u>Moderate impact (SC6.4.5.2(2)(c) Moderate TIA Report):</u>
  The development is likely to have a moderate traffic impact on the surrounding existing and future land uses, traffic network and operations. A moderate-level TIA Report will be performed using traffic forecasting processes or computerised methods (e.g., Sidra) to estimate and analyse traffic flows on the surrounding road network at predefined time horizons.

- <u>High impact (SC6.4.5.2(2)(c) High TIA Report):</u>
  The development is likely to have a high impact on the surrounding existing and future land uses, traffic network and operations. A high-level TIA report will require a comprehensive assessment approach using appropriate traffic modelling software (e.g., Sidra, Aimsun or Emme) which allows the model outputs to be directly comparable against Council's traffic model outputs at predefined time horizons, e.g. 2026, 2031, 2036 & 2041.

1.7 Types of impacts

The types of impacts that development projects may have on the Council road network include:

a) access to public roads.

b) road safety.

c) traffic operation including intersection priority.

d) operation of other transport modes that use the road network.

e) on-street parking.

f) traffic capacity.

g) limiting access to the network for other road users.

h) environmental (e.g., noise, vibration, visual, dust).

i) pavement rehabilitation and maintenance.

j) stormwater drainage.

k) public utilities and services; and

l) Council plans for road infrastructure.

Once the type of impacts of the development have been determined and agreed, these road impacts can be characterised as either:

a) Site-specific; or

b) affecting the wider road system.

1.7.1 Site-specific impacts

The site-specific impacts are those that solely or predominantly benefit a development, such as site access to a public road or roadworks which Council have not planned to undertake. These aspects must be discussed with the Development Engineer and resolved to Council's satisfaction.

1.7.2 Wider road system impacts.

Impacts that effect the wider road system are those that require nearby intersections to be modified to accommodate the development or cause the bringing forward in time of planned works or result in increased network operating costs (like accelerated pavement renewal works).

In addition to direct road network impacts, there may be issues relating to sound transport planning practice and corridor preservation that may lead to other conditions being framed for complex developments.

1.8 Financial Contributions

A financial contribution is a monetary contribution paid by the developer to the Council or other agency in accordance with a condition of approval or as part of an Infrastructure Agreement (IA).

Financial contributions are generally defined as an Infrastructure Charge (IC) in accordance with the council's current Infrastructure Charge Resolution (ICR).

An IC is required to be paid by the developer to cover trunk infrastructure costs that arise because of their development. Trunk infrastructure is the key network infrastructure that provides essential services to the Townsville area, including sewer, water supply, transport, and parks. An IC is for the cost of capital provision, and not used for maintenance or operational purposes.

In some cases, an Extra Charge (EC) in addition to the charges determined by the ICR may be imposed as a development condition which is calculated to the extent that there is a difference between the nature and/or timing of roadworks necessitated by the development and roadworks scheduled and committed by Council.

The value of an EC can be determined by carrying out a comparison of "with" and "without" development scenarios.

If a TIA identifies that additional roadworks are required as part of a development's impact mitigation measures, it is then necessary to determine whether the works can be accommodated within Councils' LGIP or whether an EC is appropriate.

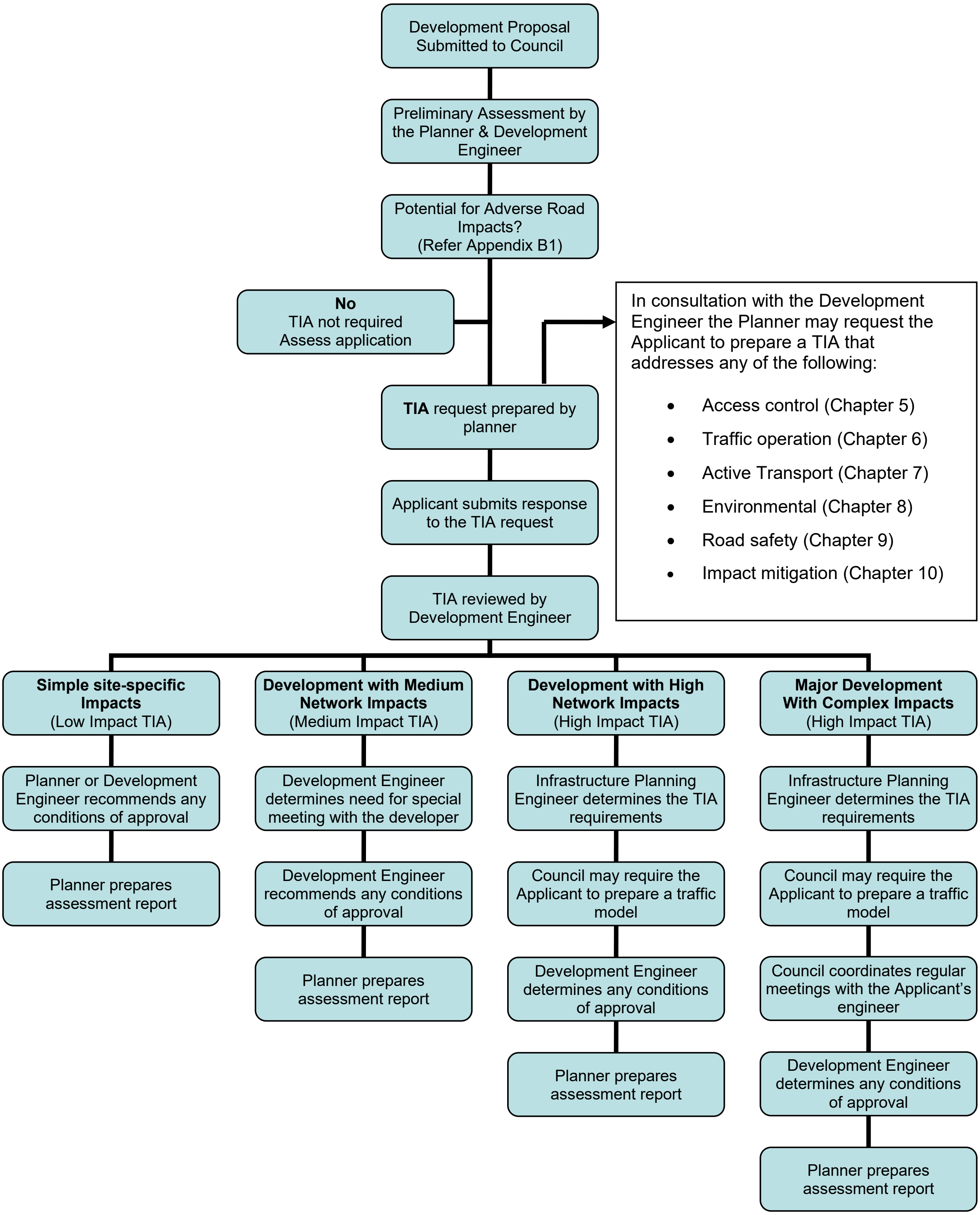
In cases where development-specific roadworks are required (e.g., access from a development site to a Council Road) or if the roadworks are unlikely to have ever been provided in the absence of the development activity, the developer will also be required to meet the full cost of these works. For these works it is usual for the Applicant to design and construct the works as a condition of consent. However, in some instances Council may want to lead the design and manage the construction directly, in this circumstance Council and the developer may decide to develop the site in accordance with an IA.

Further discussion regarding the methods for determining financial contributions is detailed in **Chapter 10**.

1.9 Development Approval Process

Figure 1 below outlines how the TIA process fits into the Council Planning processes for assessment of development applications.

Figure 1 - Council Development Approval Process



2 Traffic Impact Assessment

This chapter provides an overview of the Traffic Impact Assessment (TIA) process and information requirements to enable Council to assess and condition development applications. Relevant definitions are contained in **Appendix A**.

The principles (as outlined in **Section 1.5**) that guide TIAs derive from the legislative basis of the Planning Act as well as the body of practice that has built up over time in the traffic-engineering field.

The scope of a TIA depends significantly on the location, type, staging and size of the development and the ability of the road network to handle traffic generated by the development. However, irrespective of the complexity and scope that the TIA may require the person engaged to perform the TIA must be an 'Appropriately qualified person', this is to ensure that should the application go to an appeal, the person who prepared the TIA is able to represent their client at a Court hearing as an expert.

2.1 Appropriately qualified person

An 'Appropriately qualified person' engaged to perform a TIA for Townsville City Council is a Registered Professional Engineer of Queensland (RPEQ) who holds a current Annual Practising Certificate.

2.2 With and without development scenarios

Where the road impacts are unclear, it is usually necessary for a TIA to develop scenarios about what would occur 'with' and 'without' the development. This requires predictions under each scenario of future traffic flows and consequent road needs, as well as an assessment of the nature and timing of mitigation measures to meet those needs.

In predicting future traffic flows it is correct to assume that background traffic growth will continue, and a component of the background traffic growth is associated with development growth or intensification of existing land-use activity. When determining the future traffic flows in the 'with' development scenario, it is common practice to simply add the traffic generation of the development to the 'without' development traffic flow projection. However, because a component of this future traffic flow is often associated with intensification of existing land-use activity it reasonable in some situations to partially discount the development traffic generation to account for this background traffic growth.

2.3 Information Requests

During the process of assessing a development application the Council may issue the Applicant with a Request for Information (RFI). When the RFI request calls for the Applicant to provide a TIA, often it is necessary for Council to arrange a meeting with the Applicant to properly scope and agree the requirements of the TIA.

2.4 Quick Rules of Thumb (Traffic)

To assist making a quick assessment of the project before commencing a detailed TIA, it is useful to become familiar with a few quick rules of thumb regarding traffic and road design. **Appendix C** lists a few rules of thumb that may prove useful.

2.5 TIA process overview

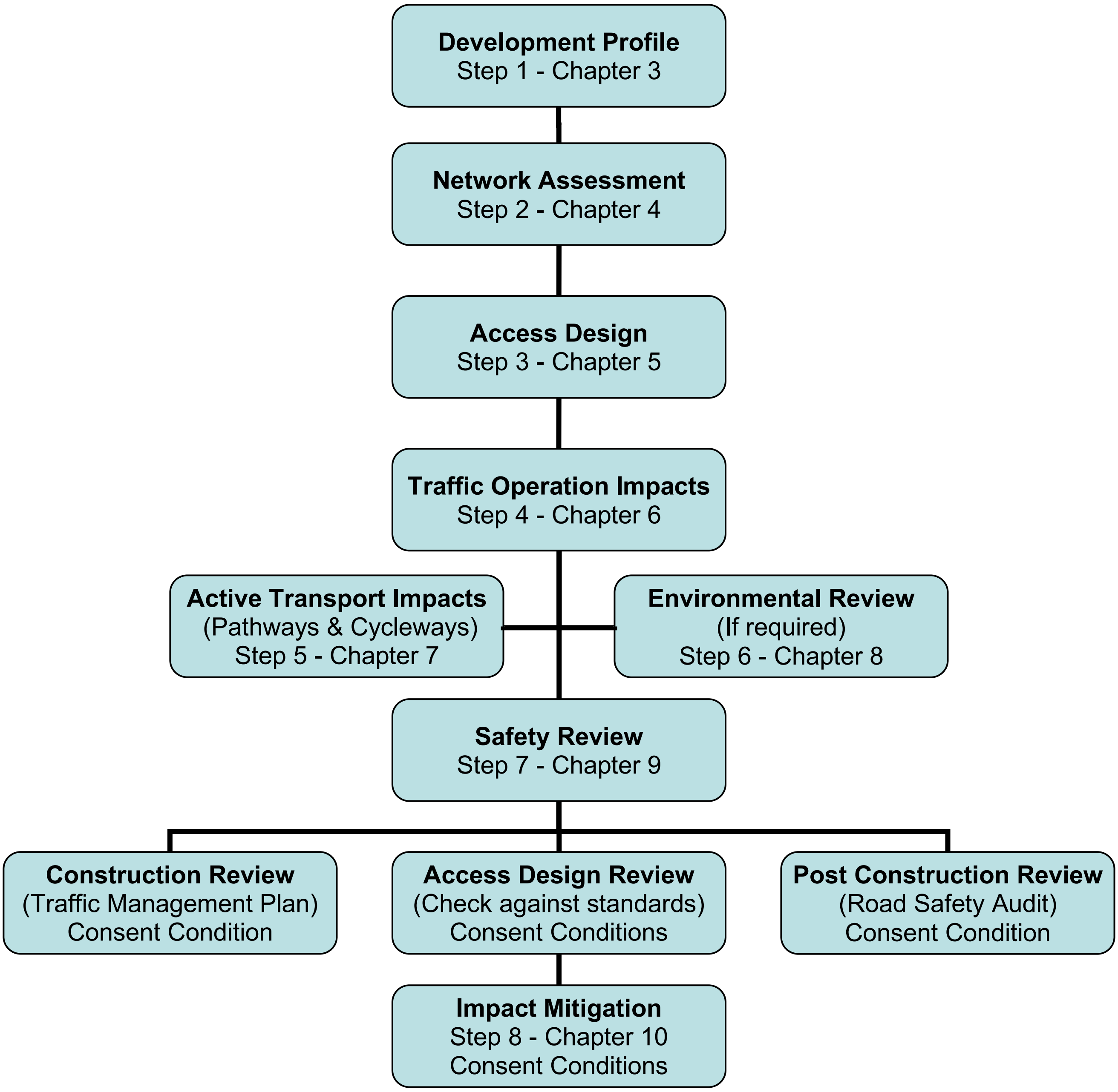
A TIA report in its most basic form identifies and addresses (to the satisfaction of Council) the implications of the proposed development for Council's roads. The steps in the TIA process are detailed in **Figure 2** below.

The detail required in a TIA will depend significantly on:

- the location, type, and size of the development; and

the condition of the road network to handle traffic generated by the development.

Figure 2 - TIA Process Flowchart



2.5.1 Step 1 – Development profile (Chapter 3)

Details of the proposed development should be collated and presented. These comprise a description of the characteristics of the proposed development including staging, traffic generation, traffic distribution and parking. This provides a general profile of the basic traffic information necessary to assess transport impacts.

2.5.2 Step 2 – Surrounding Network (Chapter 4)

The extent of the surrounding road network that is likely to be impacted by the development must be identified. The existing traffic flow conditions operating on the surrounding network which is likely to be impacted also needs to be assessed; this provides a general profile of the surrounding road network.

2.5.3 Step 3 – Access Design (Chapter 5)

The access arrangements of the development to the surrounding road network need to be designed. This process draws on the information collected in steps 1 & 2 and can become an iterative process of option analysis involving step 4 below.

2.5.4 Step 4 – Traffic operation Impacts (Chapter 6)

Impacts of the development on the traffic operation of the surrounding road network require assessment for each stage of development or predefined time horizon. The 'with' and 'without' development scenarios need to be compared to identify any traffic operation impacts directly attributable to the development.

2.5.5 Step 5 – Active Transport Impacts (Chapter 7)

An assessment is undertaken to determine whether the project, because of its size, location and/or active transport generation characteristics, is likely to have an impact on existing active transport infrastructure or require new active transport infrastructure to be developed.

2.5.6 Step 6 – Environmental review (Chapter 8)

It may be a requirement to assess environmental and other issues including noise, vibration, dust, drainage, and visual impacts.

2.5.7 Step 7 – Safety review (Chapter 9)

For the purposes of the Council assessment process, a check of compliance with design standards and an inspection of the site will generally be performed by Council. If Council perceive that there is a possible safety issue it might require the development to undergo a formal Road Safety Audit (RSA).

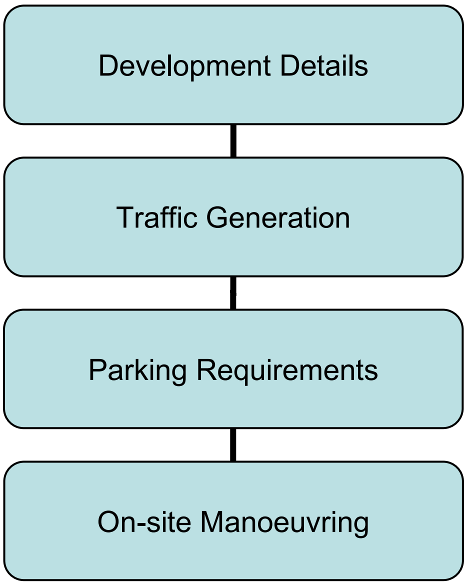
2.5.8 Step 8 – Impact mitigation (Chapter 10)

Mitigation measures are measures (usually changes to infrastructure or new works) that are required to mitigate the impacts of the development on the Council transport system. Steps 1 to 7 will have identified any measures required to mitigate adverse impacts caused by the development on the road network. The identified mitigation measures should then be analysed to determine the extent to which these can be accommodated within existing capacities and planned improvements to Council's infrastructure. Any mitigation measures that cannot be accommodated within Council's planned works could become subject to a condition to design and implement the mitigation works at the developers cost.

3 Development profile

As indicated on the TIA process flowchart in **Figure 2**, the first step is to establish the development profile. The development profile describes the development proposal and determines the traffic generated by the proposal. This provides the traffic information necessary to assess the various road impacts of the proposal. **Figure 3** illustrates the development profile process.

Figure 3 - Development Profile Process



3.1 Development details

The following details should be collated and documented:

a) site location, use an aerial view from Councils' mapping system if available.

b) current and intended use of the site in accordance with the City Plan.

c) current and intended use of adjacent land parcels and relationship with the proposed development, if any.

d) size of development (e.g. floor area, number of dwellings).

e) timing of the development, including staging; and

f) proposed access location(s) to the road network, superimposed on aerial view if possible.

For non-residential uses, details of the proposed hours of operation, peak times and, where appropriate, numbers of employees and visitors, should be included.

Information on the origins, destinations and travel routes that will be used during construction and when the development is operating may be required where haulage of material or heavy equipment is involved.

3.2 Traffic generation

The trips likely to be generated by the development need to be forecast at each stage of the development or at predefined time horizons. This should include vehicle trips by type, public transport trips and pedestrian / cyclist activity.

Peak period traffic volume generation may need to be forecast for the assessment of mid-block and intersection capacity or both. Traffic generation is normally to be provided for the peak periods of the surrounding road system.

For developments in rural areas or where a high proportion of the generated traffic is heavy vehicle traffic, daily traffic generation may be sufficient.

To assess requirements for turning circles, bridge strengths, road widths, and pavement life, traffic generation is to be classified by vehicle type. Expected movement of any heavy loads (e.g. construction plant, generators, quarrying equipment) need to be identified because such loads can exceed the capacity of pavements and bridges.

Traffic generation can be forecast using trip generation rates established for particular land uses. These are available from several sources, including the City Plan. In the absence of trip generation rates for the relevant activity type being detailed in the City Plan, locally derived trip generation rates prepared by the Australian and New Zealand Trips Database Bureau (TDB) is the preferred method. Refer to **Appendix D** for average trip generation rates for various activity classes surveyed by the TDB.

If the development is a new subdivision and the final individual activities that will operate on each newly created lot are unknown, **Tables 1A & IB** below may be used to give an initial gross traffic generation estimate for the subdivision.

Table 1A – Gross Daily Traffic Generation of Subdivisions

Residential Subdivision	Traffic (vpd) = 10 trips / lot / day
Commercial Subdivision	Traffic (vpd) = 50% of gross floor area in m^2 (GFA) / day
Industrial Subdivision	Traffic (vpd) = 200 trips / hectare / day

Table 1B – Typical Hourly Traffic Generation by land use types

Land Use	Unit	AM peak hour trip rate			PM peak hour trip rate		
		In	Out	Total	In	Out	Total
Residential	Dwellings	0.2	0.6	0.8	0.5	0.3	0.8
School	Pupils	0.5	0.5	1.0	0.5	0.5	1.0
Commercial	100m² GFA	1.6	0.4	2.0	0.4	1.6	2.0
Retail (Food) [a b]	100m² GFA	2.0	0.5	2.5	5.0	5.0	10.0
Retail (Non-food) [b]	100m² GFA	1.0	0.25	1.25	2.0	2.0	4.0
Industrial	100m² GFA	0.8	0.2	1.0	0.2	0.8	1.0

a – These rates should be applied to retail development / shopping centres that have a significant food retail component.

b – The trip rates for both food and non-food retail stores can vary significantly depending upon several issues including type of goods sold, location and size. Caution should be used in applying these rates arbitrarily.

For new large residential estates, traffic generation may be estimated using the Townsville Road & Pathway Demand Rates. These rates are derived from the Townsville Growth Model and are available as a downloadable document on the Corporate Information page.

3.3 Parking Requirements

The TIA needs to address parking demand and servicing requirements to ensure that the on-site layout of the development does not cause queuing onto Council's roads or create other adverse road operational effects to occur, such as reverse manoeuvring onto heavily trafficked roads.

Developments which do not allocate sufficient space for on-site parking and are reliant on nearby on-street parking may cause adverse safety, traffic operation or planning impacts to the road network surrounding the development (e.g., the on-street parking may compromise future road or transport options). While Council can overcome these impacts by redesigning, reducing, or prohibiting on-street parking, these mitigation treatments can be difficult to implement if adjacent businesses or land uses have come to rely upon the on-street parking.

Provision for development parking is detailed in the City Plan, Section SC6.10 Parking rates planning scheme policy. In general if the Council in their assessment of a development application determines that the development's long term viability is reliant on exclusive utilisation of existing on-street parking and that existing on-street parking is already operating within the prescribed utilisation parameters defined within the Parking Policy or Council has strategic plans for the effected road that may involve removal of the on-street parking, the Applicant should ensure sufficient off-street parking is provided within the development site.

The design of on-site parking facilities is discussed in *AS 2890.1 – Parking facilities Part 1: Off-street car parking* and *AS 2890.2 – Parking facilities Part 2: Off-street commercial vehicle facilities.*

3.4 On-site Manoeuvring

Like on-site parking requirements, Council may require vehicle manoeuvring on-site to be assessed. This requirement is primarily used as a method of ensuring that standard cars and trucks have sufficient room available on site to manoeuvre.

Council in an RFI may describe the dimensions and turning paths of vehicles that must be assessed. If the RFI requirements cannot be achieved or the RFI does not describe the type of vehicle that requires assessment, the following base dimensions and design standards are sometimes suggested as alternatives providing the use of these alternative standards are discussed and justified within the TIA.

3.4.1 Alternative standard for cars:

AS 2890.1:2004 – Parking facilities Part 1: Off-street car parking, describes the standard car as a 5.2m B99 vehicle, this standard vehicle represents the 99.8th percentile vehicle operating on Australian roads.

3.4.2 Alternative standard for trucks:

The standard truck is described in the *Austroads Design Vehicle and Turning Path Templates* document as the 8.8m Service Vehicle.

3.4.3 Standard for Buses, Large Trucks & Semi-trailers:

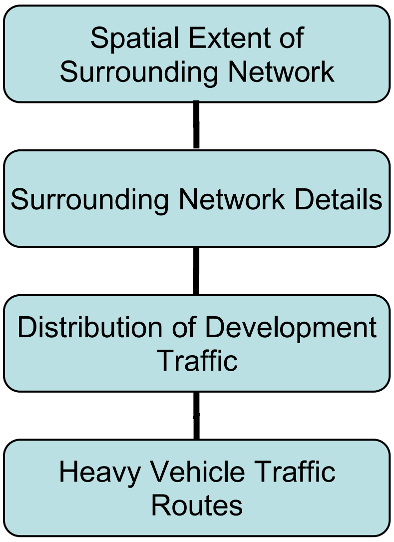
If the development is serviced by buses, large trucks, or semi-trailers these vehicles are described in the *Austroads Design Vehicle and Turning Path Templates* document as the 12.5m single unit truck, 19m Semi-trailer and 12.6m Tour Coach.

4 Network Assessment

This chapter defines the process for assessing the potential impacts of the development on the Council transport network. This step of the TIA process defines the development relationship with the surrounding road network.

The safety implications on the network should always be assessed. Appropriate levels of safety at the point of connection of the development access to the network and elsewhere on the network must be achieved. Figure 4 illustrates the network assessment process.

Figure 4 - Network Assessment Process



4.1 Spatial Extent of Surrounding Network

The network effects of development are categorised into four (4) different effect types based on their spatial extent. Assessment of these effects involves a comparison of 'with' and 'without' development scenarios by measuring the quantum of the change in Annual Average Daily Traffic (AADT) and Peak Hourly Traffic (vph) or Equivalent Standard Axles (ESAs) between each scenario, refer **Appendix A** for definitions.

4.1.1 Network Effect 1: Access to Council's roads

All points of access between the development and the Council network need to be considered for both the construction and operational stages. This includes direct access to an adjacent Council road or indirect access via an intersection of a local private road.

4.1.2 Network Effect 2: Effect on other property

The effect on the operation of property accesses immediately adjacent and opposite the development site should be considered, particularly the potential conflict of turn movements between the development site and other nearby property accesses.

4.1.3 Network Effect 3: Traffic operation assessment

The extent of the road network that should be considered as part of the traffic operation assessment is determined by the 5% rule; where assessment is required on road links and intersections that have an increase in AADT traffic volume of more than 5% over and above the existing AADT as a direct consequence of the development. i.e. The development adds more than 5% traffic to a portion of the road network.

4.1.4 Network Effect 4: Heavy vehicle traffic impacts

High volumes of heavy vehicles will often have an effect on road pavements, accelerating the rate of deterioration of the road surface and underlying pavement layers. When high volumes of heavy vehicles / trucks are anticipated pavement impacts need to be assessed for any section of road where the construction or operational traffic generated by the development exceeds 5% of the existing ESAs on the road section.

4.2 Surrounding road network details

The operating condition of the sections of the network surrounding the development that are likely to be affected by the development will need to be documented. The matters to be addressed will depend on the specifics of the development proposal, but could include some (or all) of the following (with plans, maps, and diagrams as appropriate):

a) road condition, width, alignment, and cross-section detail.

b) intersection configurations, including median breaks and traffic control devices.

c) existing daily traffic (AADT) volumes by vehicle type.

d) existing peak periods (AM peak hour, PM peak hour or both peak hours) and associated traffic volumes by vehicle type. Generally, in the urbanised parts of the network the morning peak period is 8.00am – 9.00am and the afternoon peak is 4.00pm – 5.00pm.

e) traffic growth trends and assumptions relied upon to produce the ‘without development’ traffic volume forecasts for each stage of the development and if requested, predefined time horizons that are directly comparable against Council’s traffic model outputs. i.e. 2026, 2031, 2036 & 2041 future year projection periods.

f) details of transport corridors or significant road improvements planned by the Council.

g) pedestrian, bicycle and public transport routes and facilities.

h) vehicle operating speeds and / or environmental speed; and

i) road crash history

4.2.1 Data collection and surveys.

In most cases, some or all of the above information may be readily available from the Council and extracted from the Townsville Aimsun Integrated Model (TAIM), refer **Appendix H**; otherwise, it may be necessary to carry out traffic, pedestrian, parking, speed or other types of survey.

It is important to note that any information collected should be relevant to the surrounding network and the likely development impacts. Further, Section SC6.4.5.2(4)(a)(i) of the City Plan states:

> *Traffic data must reflect existing normal conditions and should not be used if more than two years old at the time of the TIA submission or if significant changes have occurred at or near the count location or as otherwise requested by council. The traffic consultant or the applicant is responsible for providing traffic counts that are not available through DTMR or council.*

4.3 Distribution of development traffic

The methodology used to determine the distribution of the generated traffic on the surrounding road network should be discussed in the TIA. The report should be accompanied by clear diagrams showing the paths of the generated traffic movements through the network.

Origins of major incoming traffic and destinations of outgoing traffic are needed where a haulage component is likely to cause significant road impacts.

Distribution should take account of the surrounding land use and travel patterns on the road network. Methods to estimate distribution of traffic range from assessment of existing turning volumes in small catchments to number plate surveys and outcomes from strategic modelling studies for large catchments. Reasonable assumptions about the expected traffic distribution are required. Some guidance on this subject can be found in the *Institute of Transportation Engineers, Trip Generation manual*.

Assumptions used to determine the proportion of trips assigned to bus and to walk/cycle modes should also be presented; these assumptions should be supported by statistical or census information where available.

In preparing the distribution of traffic, the traffic may need to be divided into separate components to allow for linked trips. These are often referred to as "drop-in" trips and are mostly associated with business development. "Drop-in" trips are not a deduction from the site generation but are already passing the site or are rerouted existing trips from elsewhere on the network. (See **Appendix E** for discussion on linked trips).

As a rough guide, the following Directional Splits are applicable to arterial roads.

4.3.1 Arterial Road – Directional Splits

a) On outer suburban arterials (e.g. Ring Road, Dalrymple Road, Ross River Road, Thuringowa Drive, Riverway Drive), directional splits are 75/25 to 80/20 on the AM peak and 65/35 to 70/30 in the PM peak.

b) On inner suburban arterials (e.g. Flinders Street, Eyre Street, Dean Street, Sturt Street, Hugh Street, Nathan Street, Bowen Road), directional splits are 55/45 to 60/40 in either peak period.

4.4 Heavy Vehicle Traffic Routes

Heavy vehicle routes that travel through residential areas or areas that have a high level of amenity to a local community can cause environmental impacts on that community. Detailed assessment of these environmental impacts will be required and could involve an assessment of noise, and vibration effects on the impacted community.

Proposals which generate significant heavy vehicle movements may also have an impact on turning at intersections, operating speed on road sections between intersections and may also cause road pavements to deteriorate at a faster rate leading to increased road maintenance costs. In some circumstances, it may be necessary to model the operation of the road section to quantify impacts and assist in determining the need for and location of pavement widening and or strengthening. Computer simulation models used in pavement design that model pavement performance may be needed.

5 Access Design

The safety or efficiency of Council's roads can be impacted by the design of the accesses between the Council road and adjacent land parcels. The planning of a public road can also be impacted upon by the type of access permitted because this can influence:

a) crash rates; and
b) the form, cost and effectiveness (and hence the safety or efficiency) of existing and future road infrastructure.

5.1 Access Control by Council

As part of Council's assessment of a development some form of access control may be imposed via a condition to mitigate the potential for development impacts. These access controls usually include the minimisation of direct access between Council roads and adjacent land parcels or by:

a) limiting or prohibiting direct access where this is necessary to allow an arterial road or TMR road to perform satisfactorily the function allocated to it within the road hierarchy.
b) prohibiting particular turning movements through the use of raised medians.
c) amalgamating existing accesses or redirecting them via the provision of service roads or alternative road links; and
d) restricting use of access to particular types of vehicles or times of day.

5.2 Design of Accesses

Generally, accesses to property should be designed in accordance with the Council's Standard Drawings and the *AUSTROADS Guide to Road Design Part 4: Intersections and Crossings*.

Driveways in the vicinity of intersections on major roads, (Arterial & Sub-arterial) should be located in accordance with *AUSTROADS Guide to Road Design Part 4: Intersections and Crossings* – General, Figure E 5: Corner clearance – channelised intersection.

In addition, accesses should be assessed against the *DTMR Guideline – Treatment options to improve safety of pedestrians, bicycle riders and other path users at driveways.*

A checklist of the design elements Council will likely check to ensure that the proposed access complies with council's standards is included in **Appendix B – Checklist B3.**

Developments that involve access to a TMR controlled road (e.g. Ross River Road) must be designed in accordance with TMR design criteria which may differ from Council's criteria. TMR will be the decision maker on these applications and it will be the Applicant's responsibility to negotiate an access approval with TMR directly as part of the development assessment process.

In addition to the above if the development involves construction of a multi storey parking facility the design of the access and the vehicle movements within the building will need to comply with *AS 2890.1 Parking facilities - Off-street car parking*.

5.3 Warrants for auxiliary turn lanes

Guidance on the warrants for providing turn lanes into accesses is discussed in **Section 6.4.3** and **Appendix F**.

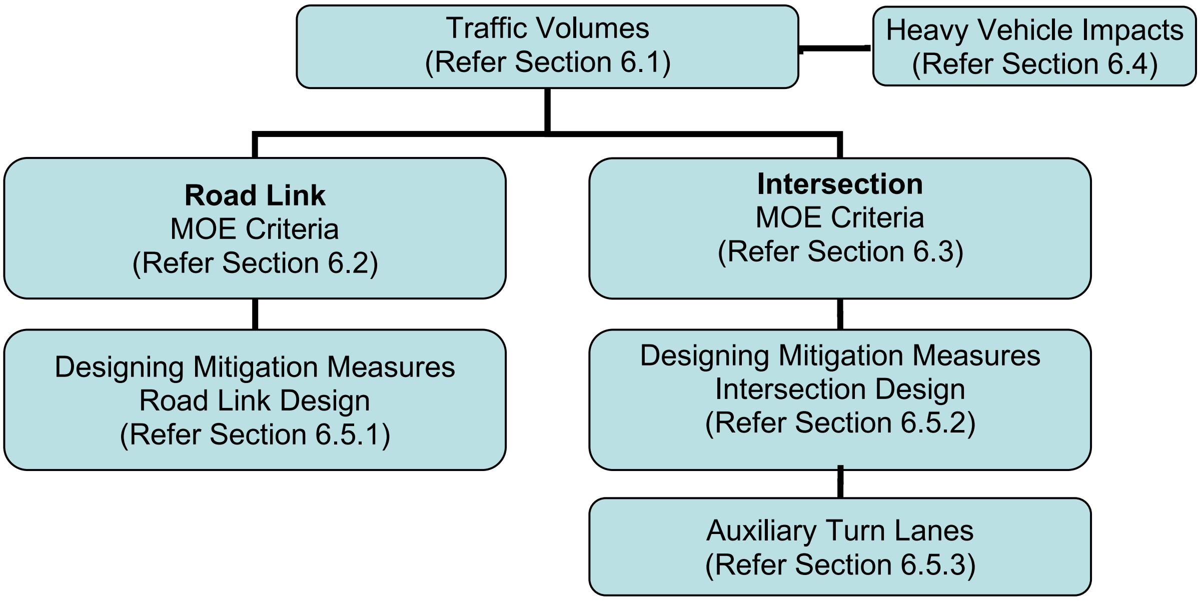
6 Traffic operation impacts

The methodology for assessing the Desired Standards of Service (DSS) of roads and intersections is generally consistent between urban and rural locations, only the Measure of Effectiveness (MOE) changes. Generally, road users expect a higher DSS in rural conditions as speeds are higher, trip lengths are longer, and volumes are lower.

Sections 6.2 and 6.3 describe in detail the DSS and MOE performance criteria for road links and intersections respectively.

Figure 5 outlines the traffic operation assessment process. As shown, operating characteristics need to be compared with MOE criteria. If the MOE criteria cannot be achieved, mitigation measures may need to be implemented and remedial works constructed to ensure the DSS is maintained on the network effected by the development.

Figure 5 - Traffic Operation Assessment Process



6.1 Traffic Volumes – Present & Future

The traffic volumes 'with' and 'without' the development that were determined as part of the development profile in **Chapter 3** and surrounding network in **Chapter 4**, will usually provide sufficient information to carry out the present case traffic operation assessment. Once the present case scenario has been assessed, it is good practice to also assess a future case scenario, which assesses the traffic operational effects for both the 'with' and 'without' development situations using traffic volumes projected out to a time horizon.

6.1.1 Time horizons

Generally, TIA's shall consider the following predefined time horizons:

a) Year of commencement of the development. (Commencement Year)

b) Year of completion of ultimate build-out of the development. (Completion Year)

c) All TAIM future traffic projection periods between the Commencement Year and the Completion Year. The TAIM projection periods are 2026, 2031, 2036 & 2041.

d) Period 10 years after the Completion Year

6.1.2 Traffic volume projections

As discussed in **Section 4.2.1** and **Appendix H** Council can provide future traffic volumes projections on the Network at various locations for the 2026, 2031, 2036 and 2041 time horizons. These projections take account of the proposed timing of LGIP works but do not include traffic volumes attributed to the development (i.e. Without Development Scenario).

If traffic modelling data is not available, it may be necessary to calculate future traffic volumes using an historical growth rate.

6.1.3 Example future traffic volume calculation using growth rates

In 2028, a new greenfield residential subdivision is proposed that will link to an existing road with the following traffic flow characteristics.

2024 AADT = 16,500 (Present Case)
2019 AADT = 14,250 (5-year-old historical count)

With the above information, the link road future traffic volumes in 2028 using both linear and compound rates can be calculated as follows:

Historical linear growth rate = (16,500 – 14,250) / (2024 – 2019) / 14,250= 3.16%
Linear rate projected traffic volume in 2028 = ((0.0316 x 4) +1)) x 16,500 = 18,584

Historical compound growth rate = $e^{(\,(Ln(16,500) - Ln(14,250)\,) / (2024 - 2019)\,)} - 1$ = 2.98%
Compound rate projected traffic volume in 2028 = $(1 + 0.0298)^4$ x 16,500 = 18,553

6.2 Road link – Measure of Effectiveness Criteria

The Measure of Effectiveness (MOE) criteria for road links is Level of Service (LoS).

LoS is defined in the *AUSTROADS Guide to Traffic Management Part 3* and is classified in accordance with a volume / capacity ratio as per the table below:

Table 2 – Level of Service (LoS) verse volume / capacity ratios.

Metric	Level of service - classification					
	A	B	C	D	E	F
Volume / Capacity	< 0.32	0.32 - 0.50	0.50 - 0.72	0.72 - 0.92	0.92 to 1.0	>1.0

6.2.1 Level of Service - Qualitative Descriptions

LoS A This is a condition of free flow in which individual drivers are virtually unaffected by the presence of others in the traffic stream.

LoS B This level is stable flow and drivers still have reasonable freedom to select their desired speed and to manoeuvre within the traffic stream.

LoS C Most drivers are restricted to some extent in their freedom to select their desired speed and to manoeuvre within the traffic stream.

LoS D This level is close to the limit of stable flow. All drivers are severely restricted in their freedom to select their desired speed and to manoeuvre within the traffic stream.

LoS E This occurs when traffic volumes are at or close to capacity and there is virtually no freedom to select desired speeds or to manoeuvre within the traffic stream. Flow is unstable and minor disturbances within the traffic stream may lead to a traffic jam.

LoS F This service level is in the zone of forced flow. Flow breakdowns occur and queuing and delays result.

6.2.2 Road Link – Desired Standards of Service

The Desired Standards of Service (DSS) for road links is expressed in terms of Level of Service (LoS). Generally, if the development causes the operation of a road to change such that it does not achieve the following LoS criteria, the developer should mitigate this effect.

Table 3 - Maximum volume to capacity ratios and LoS for the road network links

Infrastructure item	Maximum volume to capacity ratio by land use	
	Residential (Urban)	Non-residential (Rural)
Arterial	0.9 (Upper limit LoS D)	0.7 (Upper Limit LoS C)
Sub-arterial	0.9 (Upper limit LoS D)	0.7 (Upper Limit LoS C)
Major collector	0.9 (Upper limit LoS D)	0.7 (Upper Limit LoS C)
Arterial (state-controlled)	0.95 (Mid LoS E)	0.95 (Mid LoS E)

6.2.3 Relationship - LoS, Volume and Road Width

A table that describes the LoS ranking for various road widths and traffic volumes is provided in **Appendix G**, this table should only be used as a guide and more detailed assessment of volume capacity verse LoS should be performed if a change in LoS is likely.

6.2.4 Relationship – LoS and On-street parking

To assess the effect of on-street parking on the operating performance of urban roads, the frictional effect of parking should be considered. To conduct this assessment each manoeuvre (either in or out) of a parking space is assumed to block traffic in the lane next to the parking space for an average of 18 seconds. This 18 second delay per parking manoeuvre contributes to a reduction of the LoS operating on the road. In this context, short term parking is likely to be more problematic to vehicle flow than long term parking.

6.2.5 Relationship – LoS, Road Frontage and Access

To assess the effect of a property access on the operating performance of the road, an assessment of gaps in the traffic flow is usually necessary. As a guide, if the flow of traffic on the road is interrupted due to traffic movement entering or exiting a property access, this impact on the flow characteristics of the road is considered a LoS change because of the access. To assist assessment of this impact the following table can be used as a guide, the table details the maximum flow combinations for uninterrupted flow.

Table 4 - Maximum Flow Combinations for Uninterrupted Flow

Road Configuration	Road Fronting Development		Property Access Flow	
	Peak hour flow	AADT	Peak hour flow	AADT
Two - Lane	400	3,350	250	2,100
	500	4,150	200	1,650
	650	5,400	100	850
Four - Lane	1,000	9,100	100	900
	1,500	13,650	50	450
	2,000	18,200	25	225

If the traffic flows generated by the development are greater than the property access flows indicated in the table, then the MOE of the road fronting the development is likely to exhibit a LoS worse than the DSS. In this situation, the access onto the road should be assessed as a new intersection, and the corresponding MOE for intersections assessed as part of the TIA.

6.3 Intersection – Measure of Effectiveness Criteria

The Measure of Effectiveness (MOE) criteria for intersections is Degree of Saturation (DoS), as defined in the *AUSTROADS Guide to Road Design Part 4A:*

DoS is a measure of the volume/capacity ratio on particular traffic movements within an intersection, taking account of competing movements, layout, assigned priorities or signal settings as appropriate. The DoS of the intersection is generally equivalent to the worst performing traffic movement within the intersection.

Calculating DoS is complex, and the computer application *SIDRA Intersection* (version 7 or later) is often used for this analysis. As an alternative, MOE for intersections may be measured using average delay (seconds per vehicle). It is possible to calculate the average delay of each traffic flow stream at an intersection using the following equations:

Equation 1: Used to calculate congestion (absorption capacity) for turning movements.
Ref. Austroads Guide to Traffic Engineering Practice – Part 2 Roadway Capacity.

$$C = \frac{q_p e^{-q_p t_a} \times 3{,}600}{1 - e^{-q_p t_f}}$$

$$Cp = 0.8\,C$$

C = absorption capacity (vph)
C_p = practical absorption capacity (vph)
q_p = major (priority) stream flow rate (vps)
t_a = critical acceptance gap (sec)
t_f = follow up headway (sec)
e = constant (2.7183)

This equation calculates the average gap occurrence (absorption capacity) in the through lane traffic flow between vehicles (follow up headway) such that a turning vehicle can enter the traffic flow without causing the through traffic to slow.

Equation 2: Used to calculate average delay.
Ref. Austroads Guide to Traffic Engineering Practice – Part 2 Roadway Capacity.

***Formulae*:**

$$W_m = \frac{q_p e^{q_p t_f}\left[e^{q_p t_a} - q_p t_a - 1\right] + q_m e^{q_p t_a}\left[e^{q_p t_f} - q_p t_f - 1\right]}{q_p\left[q_p e^{q_p t_f} - q_m e^{q_p t_a}\left(e^{q_p t_f} - 1\right)\right]}$$

q_p = major (priority) stream flow rate (veh/s)
q_m = minor stream flow rate per lane (veh/s)
W_m = average delay to minor stream vehicles per vehicle (sec)
t_a = critical acceptance gap (sec)
t_f = follow-up headway (sec)
e = constant (2.7183)

This equation calculates the delay in seconds caused to turning vehicles (minor stream) trying to enter or cross a through lane traffic flow (major stream).

DoS can also be equated to an equivalent Level of Service using the following table:

Table 5 - LoS verse V/C ratios, delay & DoS for road intersections and approaches

Level of Service (LoS)	Road Approach	Average Vehicle Delay (seconds) and DOS (%)					
	V/C Ratio	Signals		Priority Junction		Roundabout	
A	< 0.32	< 10s	< 60%	< 10s	< 60%	< 10s	< 60%
B	0.32 – 0.50	10 - 20	60 - 70	10 - 15	60 - 70	10 - 20	60 - 70
C	0.50 – 0.72	20 - 35	70 - 90	15 - 25	70 - 80	20 - 35	70 - 85
D	0.72 – 0.92	35 - 55	90 - 95	25 - 35	80 - 90	35 - 50	85 - 95
E	0.92 – 1.00	55 - 80	95 - 100	35 - 50	90 - 100	50 - 70	95 - 100
F	> 1.00	> 80s	> 100%	> 50s	> 100%	> 70s	> 100%

6.3.1 Intersection – Desired Standards of Service

The Desired Standards of Service (DSS) for intersections is expressed in terms of Degree of Saturation (DoS) or Average Delay. If the development causes the operation of an intersection to change such that it does not achieve the following DoS criteria, the developer may be required to mitigate this effect.

6.3.2 Intersection DoS

The DoS parameters below are the maximum theoretical 'practical capacities' for the various intersection types. DoS levels above these parameters indicate the intersection will be subject to substantial increases in delay for modest increases in volume.

Table 6 - Maximum degree of saturation for road intersections

Road network item	Maximum degree of saturation
Traffic signals	0.9 (55 second average delay)
Roundabout	0.85 (35 seconds average delay)
Priority controlled	0.8 (35 seconds average delay)
Traffic signals (state-controlled)	0.9 (55 seconds average delay)

6.3.3 Relationship – DoS Capacity & Intersection Type

The following table describes the relationship between the maximum capacity of the intersection, number of approach lanes on each leg, and the type of intersection. Generally, if the combined traffic volume of both roads intersecting (AADT Road 1 + AADT Road 2) exceeds the intersection capacities shown in the table, the MOE of the intersection is likely to exhibit a DoS worse than the DSS discussed above.

Table 7 – Maximum Intersection Capacities

Number of Approach Lanes	Priority Junction		Roundabout		Signals	
	Peak hour flow	AADT (R1 + R2)	Peak hour flow	AADT (R1 + R2)	Peak hour flow	AADT (R1 + R2)
1 Lane	1,500	15,000	2,500	25,000	1,500	15,000
2 Lanes	1,500	15,000	4,500	45,000	3,000	30,000
3 Lanes	NA	NA	6,000	60,000	4,500	45,000
4 Lanes	NA	NA	NA	NA	6,000	60,000

Note: Approach Lanes include through lanes and turn lanes on each leg of the intersection

6.3.4 Queuing and queue lengths – SIDRA Output

When performing a TIA it is good practice to check that the available length in a short lane such as a right turn lane is long enough to accommodate the expected queue for that lane. For Council roads, 95% confidence limit should generally be used for assessing queue lengths. This is referred to as the 95th percentile queue length.

In *SIDRA*, this parameter is referred to as the 95% back of queue figure, which is expressed as queue length in meters. When assessing the performance of a lane in *SIDRA* it is good practice to check that the 95% back of queue figure indicated in the output table is shorter than the length actually available on the ground. If the *SIDRA* queue length is longer than what is physically possible on-site traffic will be forced to queue within the through lane, which is an unacceptable situation in terms of road safety.

Queue lengths can also be calculated using gap acceptance theory using "Practical Absorption Capacity" (Cp) taken from Equation 1 as input into Equation 3 ($C_{m,x}$) below to determine the 95th percentile queue length measured in vehicles.

Equation 3: Used to calculate the 95th percentile queue length.
Ref. Method adopted by SIDRA based on Highway Capacity Manual 2000.

Equation 17-37 is used to calculate the 95th-percentile queue.

$$Q_{95} \approx 900T\left[\frac{v_x}{c_{m,x}} - 1 + \sqrt{\left(\frac{v_x}{c_{m,x}} - 1\right)^2 + \frac{\left(\frac{3600}{c_{m,x}}\right)\left(\frac{v_x}{c_{m,x}}\right)}{150T}}\right]\left(\frac{c_{m,x}}{3600}\right)$$

where

Q_{95} = 95th-percentile queue (veh),
v_x = flow rate for movement x (veh/h),
$c_{m,x}$ = capacity of movement x (veh/h), and
T = analysis time period (h) (T = 0.25 for a 15-min period).

The queue length in metres is determined by assuming that one (1) queued vehicle occupies 6m of lane length.

Long queues can also cause blocking of driveways and side streets particularly where new signals are proposed.

6.4 Heavy Vehicle Impacts

Generally, an assessment of heavy vehicle impacts is only required if the development involves many heavy vehicles. Heavy vehicle impacts typically involve an assessment of pavement impacts, environmental and amenity impacts on a community. The processes for assessing environmental and amenity impacts are covered in **Chapter 8**; the general pavement assessment process is outlined below.

6.4.1 Impact on pavement management

Within the constraints of available funding, Council seeks to renew its road network so that the network's whole-of-life performance is maximised, having regard to safety, road user costs, community benefits and financial outlays. Pavements are designed to carry a pre-determined level of traffic (measured in ESAs) over the life of the pavement, after which the pavement will need to be rehabilitated. Pavement design life is usually 20 years. Pavement renewal is carried out during the design life, primarily to prevent or repair damage caused by heavy vehicle traffic and environmental effects.

Pavement renewal addresses two broad areas of deficiency: surface condition and structural condition. An assessment of impacts should cover both.

a) Surface condition of the road can be assessed visually and should be recorded by video or photograph. Surface defects are usually repaired by routine maintenance such as patching or by programmed rehabilitation such as resealing. These activities, while preserving the pavement, do not improve it structurally or extend its design life.

b) Structural condition can be assessed by estimating the remaining life of the pavement. This is discussed further in **Section 6.4.3**. A pavement's life can be extended only by pavement renewal, such as an overlay, or by replacement of the pavement.

New developments can generate increases in heavy vehicle traffic that may have adverse impacts on pavements. Typical impacts resulting from an increase in the number and/or size of vehicles using a road include:

a) a need for extra pavement width.

b) a change in surfacing type or pavement thickness.

c) an increase in maintenance; and

d) the need to bring forward pavement renewal or works involving new pavement.

6.4.2 New roads constructed on soft ground

Where a development requires a new road to be constructed on soft ground, the pavement design of this road must be designed specifically for the intended traffic over a 20 year service life, having regard to the subgrade conditions and capacity of the soft ground to take the traffic loads. Soft ground in the context of pavement design has a subgrade CBR less than 3.

Due to the high maintenance associated with these roads, the TIA report should also assess various pavement design options for the roads proposed for construction in soft ground conditions. These pavement options should be designed in accordance with the requirements detailed in the *Section SC6.4.6.2 Pavement design & seal design of the City Plan*.

6.4.3 Assessing pavement impacts

Developers are required to address only pavement impacts directly attributable to their development proposals.

Where a development generates significant increases in heavy vehicle traffic, the additional pavement impacts need to be quantified for each stage of the development. Construction activities often involve intensive, short-term haulage and the road impacts of this haulage over the construction period sometimes need to be assessed also. A comparison of the nature and timing of roadworks required with and without the development is needed. This comparison requires predictions of pavement rehabilitation and/or renewal required under each case, based on forecast traffic (measured in ESAs). Similar analysis is required for potential pavement impacts during the operational stage(s) of the development project.

Guidance on the nature and timing of pavement works, and the design and construction standards to be achieved, can be obtained from Council's Asset Management Team. An outline of the assessment procedure is provided in **Section 6.4.4**.

Developers may be required to meet the costs of any pavement rehabilitation or renewal works beyond those that a Council would normally expect to provide. For example, a developer may be responsible for meeting the cost of bringing forward the need to renew a pavement earlier than would have been required without the development. The Applicant may also be responsible for meeting the cost of any increase in maintenance required because of the development.

6.4.4 Pavement impact assessment procedure

The assessment procedure for determining pavement impacts is complex and requires an understanding of pavement deterioration rates.

The process involves calculating the current ESA loading of the pavement and from this, estimate the current pavement design life attributed to this ESA loading based on the road's intended function. This will determine the Pavement Life Expectancy without the development.

The next step is to calculate the Pavement Life Expectancy with the development.

With the Pavement Life Expectancy 'without' and 'with' the development information known, the change in pavement life expectancy can be determined. This change in pavement life expectancy is the measure of the development impact.

Using the bring forward cost calculation methodology (refer **Section 10.3**) and the annual Council pavement rehabilitation cost amount, a lump sum contribution can be calculated to offset the cost to Council for diminished pavement life expectancy caused by the development's heavy vehicle traffic generation.

Following is an example development scenario that would require impact mitigations measures.

Scenario: A minor rural road has a quarry development proposal:

Development Profile:

Existing AADT:	720
Current Heavy Vehicle Component:	3.2%
Network spatial extent:	1.9km road length effected
Traffic Generation of development:	120 trucks / day

Council Annual Road Rehabilitation Cost $80,000 / km for this road

Situation without development:
215,842 ESA's, Deterioration Rate 3.6% / year
28 year Pavement Life Expectancy

Situation with development:
1,462,456 ESA's, Deterioration Rate 24.37% / year
4 year Pavement Life Expectancy

Impact of development:
Change in % Heavy Vehicles = 16.67%
Change in Pavement Life Expectancy = - 24 years
Change in road asset value = - $92,617 (Cost of accelerated pavement damage)

In the above example Council would need to bring forward pavement rehabilitation works on the road to mitigate the pavement damage effect of the additional truck traffic. The cost of those works is estimated at $92,617. The mitigation measure in this scenario would be for the developer to provide a financial contribution to Council of $92,617 to offset the cost of bringing forward the pavement rehabilitation works.

6.4.5 Impacts on structures

Impacts on bridges and other structures within the road reserve need to be considered in cases where the addition of development traffic (especially during construction) exceeds the capacity of existing infrastructure. In particular, expected movement of heavy loads (e.g. construction plant, generators, quarrying equipment) requires early consultation with Council to determine if movement of the load is possible and, if so, under what conditions.

While structural impacts are unlikely to be an issue in the majority of instances, the Council should be consulted to determine whether this issue requires assessment.

6.5 Mitigation Measures

The traffic operation assessment considers the nature and timing of mitigation measures required under both 'without' and 'with' development scenarios. This requires identification of the mitigation measures necessary to achieve relevant road link and intersection DSS criteria for the traffic volumes forecast under each scenario (see **Sections 6.2 and 6.3** for analysis on the impacts of traffic on link and intersection MOE).

Having identified the mitigation measures required to accommodate traffic generated by the development, the analysis should then consider the extent to which these mitigation measures align with roadworks that would be required in the absence of the development.

Generally, if the proposed mitigation measures do not align with any work proposed by Council the developer will be responsible for designing and constructing the mitigation measures as a condition of approval.

6.5.1 Designing Mitigation Measures – Road Links

Generally, if the minimum DSS of a road link cannot be achieved because of a development proposal, suitable mitigation measures need to be designed in order for the development proposal to be approved by the Council.

The design of these mitigation measures usually involves modifying the existing road in some way to accommodate the development. Generally, the design will be performed in accordance with *AUSTROADS* standards.

The design process starts at the development profile stage which establishes flows on each relevant road link. The impact on public transport services and the active transport network should be addressed if relevant. The analysis should also examine the impact on amenity, including traffic noise, and speed issues.

6.5.2 Designing Mitigation Measures - Intersections

Generally, if the minimum DSS of an intersection cannot be achieved because of a development proposal, suitable mitigation measures need to be designed in order for the development proposal to be approved by the Council.

The design of these mitigation measures usually involves modifying the existing intersection in some way to accommodate the development. Generally, the design will be performed in accordance with *AUSTROADS standards and the Guide to Road Design Part 4A: Unsignalised and Signalised Intersections*.

A variety of computer analysis packages are available to assist in intersection design. The package most widely used in Australia is *SIDRA Intersection* (SIDRA Intersection version 9 or later should be used), which provides analysis of isolated signalised intersections, roundabouts, and unsignalised intersections.

Where the intersection being considered is adjacent to or reasonably close to other intersections, it may be necessary to consider the operation of the intersections as part of a linked network. The latest version of *SIDRA Intersection* allows for small scale intersection networks to be analysed.

Where reassignment of traffic within a network must be considered or the development is large scale effecting multiple intersections across the network, the use of transport modelling packages such as *Aimsun* may be appropriate.

The intersection analysis should consider operation during the road peaks and, for larger developments, during peak generation of the development, or during the combined peaks where relevant.

With signalised intersections, consideration of other operating characteristics aside from DoS is also needed, including queuing and long delay. If excessive, these may generate other problems such as:

a) blocking of driveways and side streets.

b) overflows of dedicated turn slots.

c) interrupted flow conditions and platooning effects on downstream intersections.

All assumptions made in the assessment of intersections or network impacts should be clearly stated.

Accesses to Council roads are to be treated as intersections if the LoS of the Council road is impacted by the development, refer **Section 6.2.7**. Requirements could include channelization, auxiliary lanes, medians, lighting, or development of controlled intersections (signals or roundabouts). Where an arterial road is affected, it is preferable to avoid additional turning movements, median breaks, and intersections. Only where the overall efficiency of the system is enhanced would such additional facilities be considered for approval.

6.5.3 Warrants for Auxiliary Turn Lanes

At an intersection, an auxiliary turn lane is an additional lane added beside the through lane to cater specifically for turning movements, the effect of this additional turn lane is to improve safety and/or intersection capacity, for this reason an auxiliary turn lane is considered a possible impact mitigation measure.

Warrants for the use of auxiliary turn lanes cannot be stated definitively because of the many factors to be considered, such as speeds, traffic volumes, capacity, type of road, service provided, traffic control and accident history. The need for an auxiliary turn lane should be established using the basic design data and the methodology described in **Appendix F**.

7 Active Transport Impacts

In accordance with State Planning Policy (SPP) and Planning Regulation 2017 Council is required to assess new residential Reconfiguration of a Lot (ROL) development applications against specific benchmarks that support the development of walkable neighbourhoods and by extension Active Transport (AT) networks that support our communities.

The Planning Regulation specifies the following minimum requirements in new residential ROL developments.

a) connectivity for pedestrians is provided through a grid-like street layout responding to the local landscape

b) block lengths are a maximum of 250 metres

c) footpaths are provided on at least one side of local neighbourhood roads and on both sides of main streets

d) at least one street tree is provided per 15 metres on each side of all streets

e) blocks are within 400 metres of a park or open space to the extent topography and other physical constraints reasonably permit. A park may refer to any of the types of park defined for this assessment benchmark.

In accordance with the SPP footpaths / pathways and cycleways are collectively referred to as Active Transport Infrastructure.

For the conduct of a TIA to be consistent with the SPP terminology the definitions of pathways and cycleways within the City Plan SC6.4.4.7 have been modified as follows:

Pathway Active Transport Infrastructure that is primarily for use by pedestrians, however can be a shared facility also used by cyclists and other permitted users providing the pathway is of sufficient width in accordance with the Desired Standard of Service (DSS) and Measure of Effectiveness (MOE) for pathways.

Cycleway Active Transport Infrastructure that is intended for exclusive use by cyclists, this includes both on-road facilities (e.g. Bicycle Lanes) and off-road facilities designed for exclusive use by cyclists.

Sections 7.1 and 7.2 describe in detail the DSS and MOE performance criteria for pathway and cycleway active transport infrastructure.

7.1 Pathway Network

The pathway network is defined as an Active Transport network comprising highly inter-connected walking & shared use pathways linked with a network of streets with bike lanes, pedestrian links at intersections and from ends of streets including park reserves, laneways, and cul-de-sacs.

Active Transport on pathways is described as a transport mode that is efficient, cost effective, healthy and active, sustainable and accessible which has many benefits for both the individual and the community. It refers to trips which rely primarily on human power to get from place to place. The most common forms of active transport on pathways are walking and cycling, it can also include such modes as wheelchairs, skateboards, roller blades, mobility devices and scooters.

7.1.1 Pathway – Measure of Effectiveness Criteria

The Measure of Effectiveness criteria for pathways is Level of Service (LoS) as described below:

Table 8 – Pathway Level of Service (LoS) definitions

LOS	Pathway Facilities - Description
A	Shared use off-road pathway minimum 2.5m wide with no driveway or road crossings.
B	Shared use pathway on nature strip / footpath minimum 2.5m wide on both sides of road with few driveway crossings.
C	Shared use pathway on nature strip / footpath minimum 2.5m wide on one side of the road and pedestrian pathway minimum1.5m wide on other side of the road.
D	Shared use pathway on nature strip / footpath min. 2.5m wide on only one side of road OR Pedestrian use pathway on nature strip 1.5m wide on both sides of the road.
E	Pedestrian use pathway on nature strip / footpath 1.5m wide on only one side of road
F	Demand exists for a pathway, but no facility has been provided.

7.1.2 Pathway – Desired Standards of Service

The Desired Standards of Service (DSS) for Pathway Facilities are as follow:

a) New Trunk Roads – LOS C

b) New Non-Trunk Roads – LOS D

c) All Existing Roads – LOS E

7.1.3 Shared use pedestrian and cyclist pathways

Austroads Part 6a requires that any pathway which is intended for shared use with cyclists must be a minimum of 2.5m wide. This is the absolute minimum standard that should be applied to any pathway which is intended for use by both pedestrians and other users that are not classed as pedestrians such as cyclists and people using motorised riding vehicles that travel faster than 10 km/h, i.e. eScooter.

7.1.4 Pathway – Width requirement based on demand and function

The following table details the preferred width of pathways based on daily pathway Active Transport (AT) volumes assuming a 50/50 split of directional flows.

Table 9 – Pathway width verse volume requirements

Daily Pathway AT Volume	Recommended Path Width (m)	Comments
0 - 50	1.5m pedestrian pathway	Not suitable for shared use with bicycles or eScooters
50 - 250	2.5m shared path	Assume up to 25% cyclist component
250 - 500	3.0m shared path	Assume up to 50% cyclist component
500 - 1000	4.0m shared path	Optional 1.5m ped. path & separate 2.5 cycle path
1000 - 1750	1.5m ped. path + 3.0m cycleway	Ped. Only Path & Cyclist Path must be separated
< 1750	1.5m ped. path + 4.0m cycleway	Ped. Only Path & Cyclist Path must be separated

7.1.5 Pathway – Daily Volumes

The volume of users of the Active Transport network is difficult to predict, however it is reasonable to assume that the AT network will provide an attractive travel option for many people as follows:

a) Exercise i.e. walking to the park or riding a bicycle for personal fitness.

b) Short walking trips to nearby destinations / shops close to home or place of work.

c) Commuter cycling for people that ride on the road or cycleways to travel to work

d) Recreation short walking trips or safe cycling on shared pathways

e) Education trips both walking and cycling to and from schools, TAFE, and university

In the absence of reliable survey data pathway AT volumes can be estimated based on 4% of directional AADT data.

e.g. If the road has 2000 AADT on the northern side of the road and 2250 AADT on the southern side of the road the pathway volumes are estimated as follows:

Northern side of road footpath = 2000 x 4% = 80 people per day

Southern side of road footpath = 2250 x 4% = 90 people per day

7.1.6 Table 10 - Traffic volumes affecting pathway road crossing amenity.

Road cross-section	Traffic volume affecting ability of pedestrians to cross * (vehicles per hour – two-way)
2 lane undivided	1,100 vph
2 lane divided (or with pedestrian refuge islands)	2,800 vph
4 lane undivided (without pedestrian refuge islands)	700 vph
4 lane divided (or with pedestrian refuge islands)	1,600 vph

7.2 Cycleway – Measure of Effectiveness Criteria

The Measure of Effectiveness criteria for cycleways is Level of Service (LoS) as described below:

Table 11 – Cycleway Level of Service (LoS) definitions

LOS	Cyclist Facility - Description
A	Off-road two-way cyclist facility minimum 3.0m wide separated from pedestrian pathway and raised threshold cyclist priority road crossings. OR On-road bicycle lanes 2.5m wide with 600mm wide separator against marked traffic lanes.
B	On-road bicycle lanes 1.8m to 2.2m wide with 600mm wide separator against traffic lanes.
C	On road bicycle lanes 1.2m to 1.5m wide located adjacent to marked traffic lanes.
D	Very narrow bicycle lane < 1.2m wide.
E	Wide traffic lanes without marked bicycle lanes on local road.
F	Demand exists for a cycleway, but no facility has been provided.

7.2.1 Cycleway – Desired Standards of Service

The Desired Standards of Service (DSS) for Cycleway Facilities are as follow:

a) Cycleway on Existing or Future Principal Cycle Network (PCN) – LOS A & B

b) All Cycleways not on PCN alignment – LOS C

8 Environmental Review

Environmental issues associated with transport may result in adverse impacts on residential communities and people that interact with the transport network. The extent to which these environmental issues will need to be addressed depends on the nature of the impact on the road system.

This chapter identifies most of the environmental issues that could possibly require further assessment as part of a TIA.

8.1 Heavy Vehicle Environmental impacts

Developments that generate significant volumes of heavy vehicles or concentrate heavy vehicle movement onto local or residential roads may impact of residential amenity. Impacts that may require further assessment as part of the TIA include:

a) Immediate amenity affects causing community complaints to Council, typical complaints include increased noise, vibration, and effects on parking.

b) The interaction of heavy vehicles (associated with development construction activities or operations) with general traffic and other road users in residential areas at intersections (chiefly development access entry and exit points).

c) Insufficient passing space on Council roads for semi-trailers.

8.2 Road traffic noise

A road noise assessment may be required if noise sensitive receptors are identified. Refer to City Plan Schedule SC6.4.19 Noise and vibration assessment guidelines for more information.

The significance of the noise problem is measured by the increase in noise over the prevailing background noise level.

8.2.1 When road noise is considered excessive?

Generally, an increase in road noise is considered significant in terms of impact if the noise level increases 10 dB (A) or more over the background noise level. This change is considered about double in terms of subjective loudness. To generate an increase in noise of 10 dB (A) by additional traffic the existing traffic volume needs to increase by about a multiplier of 8, refer **Table 12** below:

Based on Table 12 it is very unlikely that a development will generate sufficient traffic volumes to cause the existing traffic volumes on the road to increase by a multiplier of 8. Therefore, the subjective loudness of traffic is unlikely to double, and road noise will generally not be deemed an impact that requires mitigation.

Table 12 - CoRTN88 Model noise level prediction

Traffic Volume AADT	Speed Limit	Predicted Noise Level 20m from road edge L_{10} (18 Hour) dB(A)
2000	60	59
	80	61
	100	63
4000	60	62
	80	64
	100	66
8000	60	65
	80	67
	100	69
12000	60	67
	80	69
	100	71
18000	60	68
	80	71
	100	73
22000	60	69
	80	72
	100	73
32000	60	71
	80	73
	100	75

8.2.2 Road Noise Reverse sensitivity

In some circumstances, Council may seek to condition residential subdivision development to ensure the Council does not receive complaints from future residents of the development regarding road noise. Conditioning the development to have a buffer facing busy roads is often a better solution than dealing with complaints from residents at some time in the future if a Council approves a development without any buffer and road noise is likely to be amenity impact for people that buy into the development.

8.2.3 Road Noise Mitigation Measures

Noise mitigation treatments can be incorporated into development proposals by including barriers, setbacks, building orientation, building insulation and/or development layout (e.g. locate the more sensitive components of the development away from the road).

The effectiveness of barriers is dependent upon issues such as topography, building height, barrier type and location. Treatments other than barriers become very important in instances where barriers are less effective (e.g. hilly terrain or multi-storey buildings).

As a general rule of thumb every time the distance between the noise source and the receiver is doubled, the noise level will drop by 3 dB(A), therefore it takes a very wide buffer distance to mitigate noise effects through distance alone. Other rules of thumb useful in designing developments which are subject to traffic noise are as follows:

a) Doubling the road traffic AADT increases noise by 3dB(A);

b) Doubling the distance between the road and building reduces noise by 3dB(A);

c) Resurfacing a chip seal road with dense graded asphalt reduces noise by 3dB(A);

d) Resurfacing the road with open graded asphalt reduces noise by 5dB(A)

8.3 Vibration effects of traffic

The significance of vibration effects can be considered in terms of their effects on building occupants and structures near the existing road. The most critical factors to be considered are the road surface roughness and longitudinal profile, with complaints generally related to vibration generated by tyre / road impacts arising from surface or shape defects (potholes, patches, trench repairs, manholes etc). The type of sub-soil, separation distance between the road and (residential) buildings and vehicle speed are also important.

Relevant methods to avoid, minimise or mitigate the disturbance on adjacent residential property from road traffic generated vibration include:

a) Maintenance of road surfaces to minimise wheel bounce and body pitch of vehicles;

b) Managing the adjacent road operation through optimizing the vehicle speed and road surface type to minimise vibration.

8.4 Dust control

Developments such as crushing or screening plants and some crop farming activities can generate dust that could affect the safety of Council roads; however, contemporary industry regulations have reduced the incidence of this.

Mitigation treatments could include setbacks and dust control devices.

8.4.1 Locating developments near unsealed roads

If a dust-sensitive development (e.g. residential dwelling) is located near an unsealed Council road, this can adversely affect the development. The presence of the development can then affect the efficiency or planning of the Council road network if Council is forced to reroute or close the road to control the dust nuisance.

Mitigation treatments in these circumstances may range from architectural measures in the dust-sensitive development such as placing windows away from the dust source, to sealing appropriate sections of the Council road.

8.5 Hydraulic and drainage impacts

Existing and future Council roads can be affected by upstream and downstream developments that change the location, level, flow rate and quality of water runoff. These impacts can be in terms of:

a) safety (e.g. accidents caused by water flowing over the road)

b) efficiency (slowing down of traffic or blocking of roads via flooding)

c) planning (e.g. changing the effectiveness of future road infrastructure).

Mitigation treatments can include:

a) incorporating hydraulic designs into the development such that the location, level, flow rates and quality of water run-off along or across Council's roads are not changed (e.g. retention basins); and

b) incorporating additional hydraulic infrastructure in Council's roads to accommodate the changes to the location, level, flow rates and water quality.

8.6 Headlight glare

If residential development is placed near a busy Council road, headlight glare from the traffic stream can affect amenity, therefore mitigation measures such as landscaping or fencing may be necessary.

A common treatment is the incorporation of landscaped buffers between the Council road and the residential development. Landscaping vegetation can grow to quite high levels and effectively shield buildings.

8.7 Distractive lighting

Some developments may have significant on-site activities or lighting that can distract motorists on Council's roads and thereby affect safety or efficiency.

Mitigation treatments can include landscaped buffers between the development and the Council road and/or the placement of shields on the lighting to prevent direct light being emitted onto the traffic stream.

8.8 Aesthetic appearance of roads

The community expects that Council's roads (at least new roads in a residential neighbourhood) present an aesthetically pleasing vista wherever possible, especially if it is a new road. This includes the minimisation of 'hard' surfaces such as concrete and asphalt and the maximisation of 'soft' surfaces such as landscaping including street trees and shade.

Some specific areas of a city and other communities should probably receive more visual amenity emphasis such as suburb entrances and parks, these areas may have special requirements or plans that relate specifically to the area's visual amenity.

Development located within these specific areas of interest should be assessed in terms of its impact on the visual amenity that Council expects to have for the road environment associated with the area. If an impact is perceived because of the development, Council may seek to impose conditions to restore the visual amenity character of the area in terms of the aesthetic appearance of the affected road.

8.9 Roadworks in the road reserve

If roadworks are proposed outside of the existing road formation that will require earthworks, vegetation removal or infrastructure extension (e.g. lane widening or bridgeworks), then detailed assessment of the impact of those roadworks may be required by way of an Assessment of Environment Effects (AEE).

Typical issues that may need to be addressed within an AEE include:

a) Impact on Active Transport facilities, footpaths and existing driveways.
b) Impact on service utilities both above and below ground.
c) impact on flora and fauna from any proposed clearing in the road reserve.
d) impact of any changes to surface and subsurface drainage.
e) impact of any land disturbance in the road reserve, including weed infestations, erosion, and sedimentation.
f) impact on any structures (natural or constructed) in the road reserve; and
g) impact on any items of cultural heritage.

9 Safety review

Council as the Transport Authority must ensure road projects proposed in its area of jurisdiction are built as safely as is practical. This chapter outlines the safety checks to be undertaken as Step 7 of the TIA process shown in **Figure 2**. All TIAs should satisfy the safety checklist included in **Appendix B**.

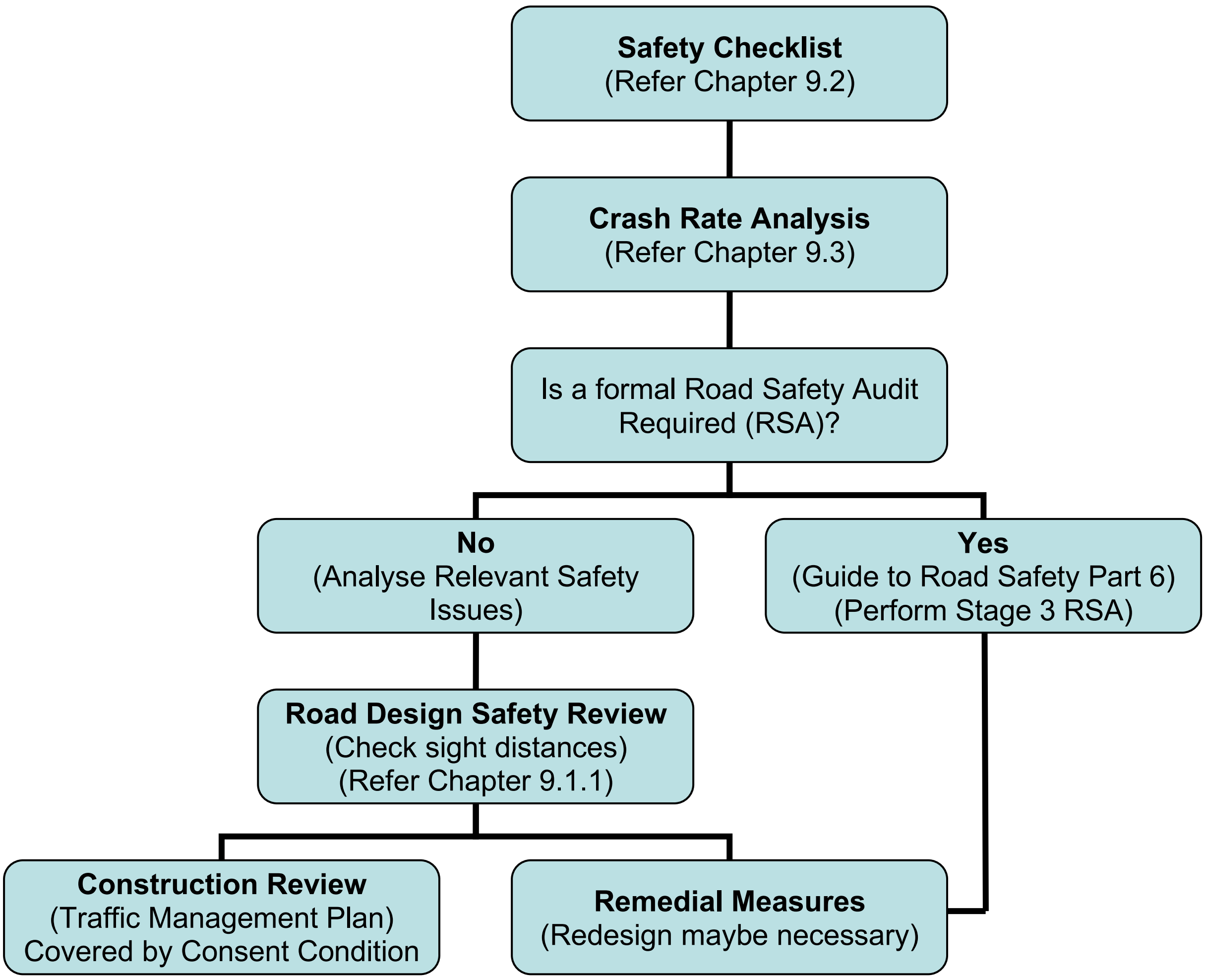
There may be some circumstances involving major works at critical locations where the Council may require a Road Safety Audit (RSA) to be done as part of the TIA. However, generally this level of effort is not expected in a TIA unless specifically requested by the Council.

If an RSA has been requested, the developer must engage an accreditated road safety auditor to undertake an independent Road Safety Audit, in line with the Guide to Road Safety Part 6, Austroads.

When performing a TIA where a formal RSA has not been requested by Council, consideration of the road safety impacts for each stage of a development (including construction) will usually be required. Ameliorative measures are likely to be required if a development is expected to create a road safety hazard.

Figure 6 expands the TIA process flowchart in dealing with safety issues.

Figure 6 – Safety Review Process



9.1 Relationship – Road Operation & Safety

Road safety considerations are embodied in many road design and traffic performance criteria. In many cases, therefore, additional analysis of road safety issues will not be required as part of a TIA.

Many safety aspects are implicit within operational performance measures such as intersection capacity. For example, at a give-way controlled intersection, the relevant performance measures are visibility, clear priority measures are in place, capacity and delay controls are on the minor approach. Critical values of these performance measures are set to avoid drivers being forced to accept inadequate gaps in the traffic flow.

9.1.1 Sight distances at property accesses

Generally, all site accesses that connect to the road network must be checked to ensure that safe sight distances are achieved on all approaches to the access connection point. In accordance with the *Guide to Road Design Part 4A: Unsignalised and Signalised Intersections*, the following minimum sight distances should be achieved for all accesses based on a 2.0 second reaction time.

- Access / Minor Road – Approach Sight Distance (ASD).
- Council Road / Major Road – Safe Intersection Sight Distance (SISD).

At driveways visibility splays should also be reviewed against the *DTMR Guideline – Treatment options to improve safety of pedestrians, bicycle riders and other path users at driveways.*

9.2 Safety checklist

To ensure relevant safety issues are not overlooked, a checklist of matters that may need to be reviewed is provided in **Appendix B – Checklist B2**. It also provides references to relevant guidelines. The safety issues are grouped under the headings of:

a) intersections and access.

b) road links.

c) pedestrians.

d) cyclists; and

e) motorcyclists.

As already noted, many safety issues will have been addressed through other parts of the TIA and will not need to be dealt with separately, for example, through the traffic operation assessment. The safety checklist identifies those issues most likely to have been addressed through other parts of the TIA.

Some of the road safety issues will not necessarily apply to every development. For example, safety considerations relating to large pedestrian movements on a Council road are unlikely to be relevant to a development in a residential street or rural location. The Council will be able to provide advice on what safety issues need to be considered for a specific development.

9.3 Crash rate analysis

If the nature and location of a development is likely to contribute to an increased crash risk, the Council may require an analysis of crash rates as they can indicate a potential road safety problem. Where a development is expected to result in an unacceptable crash risk, the TIA will need to assess what can be done to overcome or reduce the risk of crashes occurring.

To understand any accident trend or safety issue that is inherent in the current road system without the development, the traffic accident histories of the intersections and road links affected by the development proposal need to be analysed. Each crash at an intersection needs to be classified in terms of the seriousness of the crash, the type of crash and the main causative crash factor as determined by the police. With this information a frequency of crash type or trend may be identified that could influence the possible design options associated with the development proposal. (e.g. If poor observation is identified as a common / frequent causative crash factor, visibility could be a contributing factor or poor signage)

TMR has an accident database system known as the Crash Analytics Reporting System (CARS) which can be accessed to obtain crash records on road links surrounding a development site. This crash data should be examined over a five- or ten-year period to obtain a reasonable trend.

Crash data (by crash type and severity) is generally identified separately for mid-block sections of the road and for intersections.

Because crashes are generally related to exposure to potential conflict, crash rates need to be normalised by:

a) vehicle–kilometres travelled for mid-block sections

b) vehicle throughput for intersections.

The existing crash rates are then compared with a level of crash expectation attributable to the development to determine whether the development will increase the existing crash rate.

The expected crash rate with the development is then compared with relevant critical crash rates to determine whether a significant road safety problem exists. Critical crash rates consider the average crash rate for intersections and links across the network with similar traffic and land use characteristics. Where it is deemed there is a significant safety problem, further investigation can determine any road safety treatments that would be required. These treatments can include barrier medians, turn lanes, turning prohibitions or a reduction in traffic speed.

Further guidance on crash assessment is beyond the scope of these guidelines however, the *AUSTROADS Guide to Road Safety Part 8: Treatment of Crash Locations* provides a full breakdown of the assessment process.

10 Impact mitigation

Previous chapters have identified development impacts in terms of traffic operations (Chapter 6), pavements (Chapter 7) and other matters such as drainage and noise (Chapter 8). In determining these impacts, the developer needs to have considered the safety and efficiency implications of their development on the Council road network.

This chapter deals with Step 8 of the TIA process, covering the consolidation of identified impacts and determining the types of treatments and/or measures required to address these impacts, including costing of mitigation treatments and funding arrangements.

The main purpose of Chapter 10 is to provide a basis for determining:

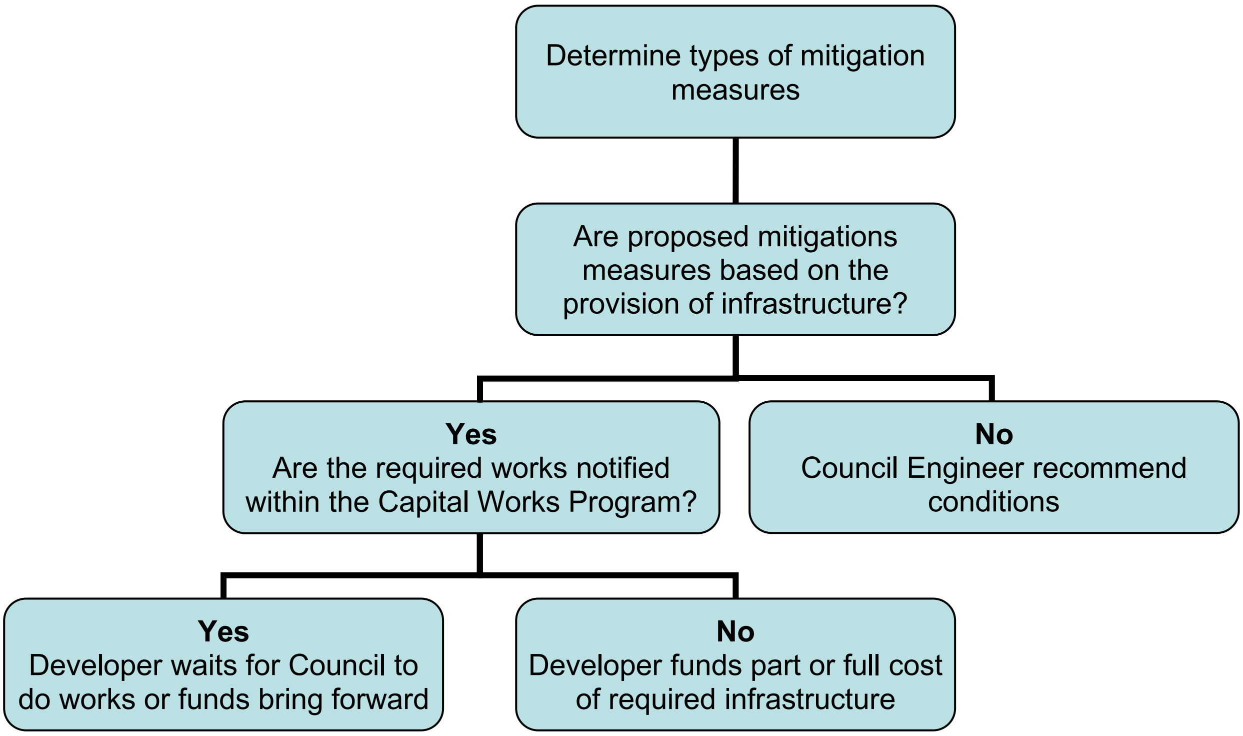
a) what additional roadworks or mitigation measures are required to accommodate the proposed development impacts on the Council network; and

b) if Council will be able to have in place the roadworks and associated infrastructure required by the development?

If Council works are required to support the development and these works are not currently programmed, then the Applicant will need to propose mitigation treatments that enable Council to continue to operate its road network and meet its legislative obligations (refer Principle 2 in **Section 1.4**) whilst allowing the development to proceed. The cost of these works will usually be at full cost to the developer, irrespective of who else benefits from the infrastructure upgrades.

Figure 7 illustrates the impact mitigation process for development proposals.

Figure 7 – Impact Mitigation Process



10.1 Extra Infrastructure Charges and Consistency with Council plans

Where there is a difference between the development's requirements for roadworks (referred to hereon as, 'impact mitigation measures') and Council's likely provision of future roadworks, it will usually be necessary for the developer to resolve with the Council which party will fund the works.

In order to assess the consistency between the development's impact mitigation measures and Council plans, the Council and the developer need to agree which category the development's impact mitigation measures fall under. Four (4) Extra Charges (EC) categories are discussed below, and the development will align with one of these categories. The relative category applying to the development will establish the basis for determining the financial contribution condition applied to the development by the Council.

10.1.1 EC Category 1: Consistent with Council's CAPEX

The impact mitigation measures required for the development to proceed are clearly identifiable in the Capital Works Program (CAPEX) as roadworks to be constructed that will suit the timing of the development.

With this category the developer constructs only the site-specific access works.

If Council does the work in conjunction with constructing programmed capital works, i.e. Builds the development access as part of a scheduled road upgrade project, the access work component will be charged as an EC financial contribution

10.1.2 EC Category 2: Planned Work to be bought forward

There are two possible scenarios:

a) The development's requirements are consistent with the CAPEX, but the required mitigation measures are not proposed by Council within the timeframe that will suit the developer.

b) The development's requirements are not listed in the CAPEX Program but consistent with Council's longer-term planning.

In both scenarios, the developer, in consultation with the Council, needs to determine whether the mitigation measures required by the development will become a priority for Council in the development's timeframe. Mitigation measures that fall outside Council's priorities will not be programmed within the forthcoming works program and have no firm funding allocation.

With this category the developer constructs the site-specific access works and pays the bring-forward-cost for impact mitigation measures as an EC financial contribution.

10.1.3 EC Category 3: Timing is ok but different work needed

For example, Council has planned an intersection upgrade including a 75-metre auxiliary right turn lane, but the traffic operation assessment for a proposed development indicates a requirement for a 125-metre auxiliary right turn lane.

With this category the developer constructs the site-specific access works and pays the difference between the cost of Council's planned infrastructure works (75-metre auxiliary right turn lane) and the cost of works needed for the development as an EC financial contribution (i.e. the cost to construct the impact mitigation measure of the 125-metre auxiliary right turn lane)

10.1.4 EC Category 4: Inconsistent with Council plans

The impact mitigation measure requiring roadworks would never have been anticipated or planned or are so far into the future (beyond 15 years) that they are regarded as highly speculative and uncertain. For example, as a direct result of the proposed development, a low order road link is expected to cater for B-Doubles that were never envisaged and is inconsistent with the road hierarchy.

With this category the developer constructs all of the works required to mitigate the impact of the development on the road system, this work includes both site specific access works and works required to mitigate wider network impacts.

10.2 Construction costs

For private developments, Council is principally interested in having the appropriate works completed. Where works are funded in part by Council, or brought forward in time, the developer should prepare cost estimates for the works involved and seek agreement with Council of those costs if Council is contributing to the funding of the works.

Cost estimates should be based on reasonable unit rates for works on Council roads affected by the development. The Council may also require contract conditions to be used for construction of the work. In complex projects a Memorandum of Understanding (MOU) or Infrastructure Agreement (IA) between a Council and the developer maybe necessary to establish a process to determine the cost apportionment between the parties.

10.3 Present values of costs

For the calculation of financial contributions based on providing roadworks earlier than they would have normally been provided by Council, it is important that the valuation of costs takes into account the time at which the roadworks are likely to be programmed. This is achieved by discounting costs to a "present value". That is, costs have been discounted to an equivalent amount of today's dollars.

Discounting for time preference is a different concept to that of price inflation. In Queensland, discount rates for public capital investments are periodically reviewed and set by the Treasury. These rates are obtainable from the Council Infrastructure Planning Unit and Queensland Treasury and are the basis of the Cost Benefit Analysis (CBA) methodology required by TMR for works involving State Controlled Roads.

The calculation of present value costs assumes that the developer will pay the contribution ‘today’. If payment is deferred until works are undertaken in future years, then the contribution will need to be indexed to reflect the future cost of those works.

Example

Intersection works are programmed by Council for 2036. Development causes the works to be needed in 2031. The TCC time preference discount rate is 8.05%.

Time Preference	Discount Factor (10%)	NPV
Value of the work ($100,000) (Calculated in 2024 dollars)		=$100,000
Value of works when needed by developer (NPV 2031)	$= (1.0805)^{-(2031-2024)}$ = 0.5816	=$58,160
Value of works when programmed by Council (NPV 2036)	$= (1.0805)^{-(2036-2024)}$ = 0.3949	=$39,491
Bring Forward Cost (Developer to pay) (NPV 2031 – NPV 2036)		=$18,669

Appendix A: Technical Abbreviations

AADT	Annual Average Daily Traffic is a common measure of traffic volume equivalent to the total volume of traffic passing a roadside observation point over the period of one year, divided by the number of days in the year.
DoS	Degree of Saturation
DSS	Desired Standards of Service
DHV	Design Hourly Volume also referred to as 30HV, 30^{th} highest hourly volume in 1 year.
ESAs	Equivalent Standard Axles is a measure defining the cumulative damaging effect to the pavement of the design traffic. It is expressed in terms of the equivalent number of 80kN axles passing over the pavement up to the future time horizon.
GFA	Gross Floor Area
GRD	AUSTROADS Guide to Road Design
ITE	Institute of Transportation Engineers
LGIP	Local Government Infrastructure Plan
LoS	Level of Service
MOE	Measure of Effectiveness
RSA	Road Safety Audit
RFI	Request for Information
SIDRA	Signalised and unsignalised Intersection Design and Research Aid
TAIM	Townsville Aimsun Integrated Model
TDB	Trips Database Bureau
TIA	Traffic Impact Assessment
VPD	Vehicles Per Day
VPH	Vehicles Per Hour

Appendix B: Checklists

The checklists on the following pages provide a convenient summary of the issues that need to be addressed in considering the road impacts of a development.

Checklist B1 is guidance on when a TIA is required and the effects to be assessed.

Checklist B2 lists the various road safety issues to be considered in a TIA.

Checklist B3 lists the design elements Council will check when assessing a new access.

Some of the issues in checklists B2 and B3 may not necessarily apply to every development.

Checklist B1: When TIA is required and the effects to be assessed

Development Category	When Required	If a TIA is required these effects will be assessed in the TIA report				
		Access to public roads	Traffic operations	Environmental effects	Heavy vehicle impacts	Mitigation
Accepted Development	May be required if a specific traffic Desired Standard of Service has been nominated as an acceptable outcome.	Yes	Subject to possible RFI request for additional information			
Assessable Development (Code assessment)	Requirement as stated in Part 9.3.5 Transport impact, access and parking code of the City Plan	Yes	Yes	Subject to possible RFI request for additional information		Yes
Assessable Development (Impact assessment)	For Assessable Developments that require impact assessment, a TIA is always required	Yes	Yes	Subject to possible RFI request for additional information		Yes
Prohibited Development	For Prohibited Developments, a TIA is always required	Yes	Yes	Subject to possible RFI request for additional information		Yes
Any activity connecting to a State Controlled Road	For developments on property adjoining a State Controlled Road a TIA is always required	Yes	Yes	Subject to possible RFI request for additional information		Yes

Checklist B2: Safety code checklist

Safety aspect	Reference *
Intersections and accesses	
Sight Distances	GRD Part 4A
Vehicle Crossings	City Plan & AS 2890
Intersection operation	GRD Part 4, 4A & 4B
Auxiliary turn lanes / lengths / weaving	GRD Part 4 & 4C
Vehicle manoeuvring, parking & turning paths	AS 2890 & City Plan
Speed environment	GRD Part 3 & 6B
Signage and pavement markings	MUTCD
Road links	
Road width	City Plan
Vertical / horizontal alignment	GRD Part 3
Clearance to obstructions	GRD Part 6
Overtaking opportunities	GRD Part 3
Pedestrians	
Road crossing facilities	GRD Part 6A & MUTCD
Footpaths	City Plan & GRD Part 6A
Disabled people provision	AS 2890
Cyclists	
Cycle lanes / paths	City Plan & GRD Part 6A
Road crossing facilities	GRD Part 6A & MUTCD
Intersection provision	GRD Part 4
Motorcyclists	
Warning of hazards	MUTCD
Barrier kerbs	GRD Part 6
Visibility at intersections	GRD Part 4
Drainage pits and culverts	GRD Part 5
Safety Barriers	
Guardrails	AS 3845

* Where:

GRD refers to AUSTROADS Guide to Road Design

AS refers to Australian Standard

Checklist B3: Assessment of new road connections

When considering an application for access to a Council road, the Council Development Engineer will check the following:

a) Whether the crossing is sufficiently removed from an intersection having regard to traffic volumes on the roads, and any other factors that will prevent conflict and confusion between vehicles turning at the crossing or at the intersection.

b) The adequacy of available sight distances having regard to the 85th percentile speed of vehicles on the road.

c) Whether there is a need to separate entry and exit to reduce potential traffic confusion and conflict.

d) Whether the physical form of the road will minimise the adverse effects of access (e.g. whether the road offers good visibility; whether a solid median barrier will stop unsafe right hand turns or a flush median will assist right hand turns etc);

e) Whether mitigation measures such as a deceleration or turning lane are required due to speed or volume of vehicles on the road.

f) The design of the crossing to enable traffic exiting the site to safely enter the traffic stream.

g) The location and design of the crossing in relation to pedestrian and cycle safety.

h) Whether there is adequate queuing and parking space on-site so that vehicles do not queue over vehicle crossings or onto the Council road.

i) Any potential cumulative effects of extra access points on the function of the road.

j) Any relevant accident history of the road in the vicinity of the site; and

k) The traffic characteristics of an existing or proposed activity, including expected traffic generation, types of vehicles etc

To avoid potential RFI requests for additional information, the TIA should have enough information to be able to satisfy checking of these issues by the Council.

Appendix C: Rules of Thumb

Traffic Flow Characteristics – Capacity

a) The saturation flow for a major arterial link e.g. Ring Road is 1800 - 2000 veh/h.

b) The typical capacity of a through lane at a signalised intersection, where the intersecting roads have approximately equal flows, is between 800 veh/h and 900 veh/h. (45% of saturation flow).

c) The maximum flow of an urban arterial road is 1200 veh/h/lane, the achievement of which generally requires at least 60% green time. However, maximum flow is a function of green time and intersections with minor side roads may achieve higher flows.

d) In a simple gap acceptance situation with single lane minor flow, capacity is achieved when the sum of the major and minor flows is approx. 1500 veh/h.

Traffic Flow Characteristics – Traffic Growth

e) The doubling of traffic volume over a period of x years is equivalent to a linear growth rate of approximately (72/x) % per annum.

f) Traffic growth on a major arterial road is about 2%. It must be noted that typically around 1-3% per annum but may be more than this depending on the LGIP growth forecast.

g) On most major roads, traffic growth is closer to linear than it is to exponential.

Traffic Flow Characteristics – Directional Splits

h) In outer suburbs directional splits are 75/25 to 80/20 in the AM peak and 65/35 to 70/30 in the PM peak.

i) In inner suburbs directional splits are 50/50 to 60/40 in either peak period.

Traffic Flow Characteristics – Volume Ratios

j) A typical peak hour / 24-hour volume ratio on a rural road is 15%.

k) On urban arterials, peak hour / 24-hour volume ratios are 10-12% for uncongested conditions and 7-10% for congested conditions.

l) 24 hour / 12 hour volume ratios are typically 1.20 to 1.25 for rural roads and 1.25 to 1.30 for urban roads.

m) The 30th highest hourly volume (30HV) of the year is around 15% of AADT for rural roads and 12% of AADT for urban roads. This is also referred to as the Design Hourly Volume (DHV). It can be estimated using the following equation:

$$30HV = 307 + 0.10126\ AADT$$

Reference: ARRB Proceedings (Paper No. A61) Leong & Dominis - 1974

Traffic Flow Characteristics – Commercial Vehicles

n) Peak volumes of commercial vehicles often occur between 10 am and 12 noon on urban roads.

o) Averaged over the day, the proportion of commercial vehicles on urban arterials is approximately 10% of all traffic. During the peak period, the proportion of commercial vehicles is about 5%. It must be noted that these values vary depending on location.

p) On rural highways, commercial vehicles typically comprise 15-25% of all traffic, but this depends on location.

Intersections – General Design Principles

q) The fundamental rule for safe intersection design in rural areas is to ensure that effective priority is maintained. This means that priority should be simple and obvious (e.g. vehicles on the minor road slowed down by a physical means) and intersection control should be appropriate to the volumes.

r) At a cross, T or Y intersection, the desirable minimum angle of intersection is 70°. Every attempt should be made to align the intersection at close to 90°.

s) The travel time between two adjacent intersections should not be less than 5 seconds (equivalent to a distance of 1.4V where V is the travel speed in km/h).

t) The legal definition of a cross or T-intersection is the area between prolongations of the property lines abutting the intersecting roads.

Intersections – Safety

u) In rural areas, some 20-30% of accidents occur at intersections. In urban areas, the proportion is around 50-60% and about 50% of these are at minor-major intersections.

v) Because of lower traffic volumes, the accident rates (per veh) at rural intersections are usually higher than at urban intersections, even though the number of accidents is lower.

w) New Intersections in rural areas should be T intersections or possibly, in some cases, roundabouts. Cross and Y intersections have a much poorer accident record.

Appendix D: Trip Generation Rates

Trip generation data for a variety of land uses is available from the following sources:

a) City Plan

b) Trips Database Bureau (TDB); and

c) Guide to Traffic Generating Developments prepared by the Roads and Traffic Authority of NSW

d) Institute of Transportation Engineers (ITE), Trip Generation Manual

Following is a summary of trip generation rates compiled from the above sources.

Category	Trips per 100m^2 GFA
Residential Activities	
Housing: Single Detached	7
Housing: Apartment / unit / Townhouse	6
Motel	4
Retirement Village	2
Community Activities	
Recreation Community Centre	81
Theatre: Cinema	80
Child Day Care Centre	75
Clinic / Medical Centre	49
Commercial / Business Activities	
Service Station (Petrol Pumps) with Convenience Store	531
Fast Food with Drive-Through	315
Neighbourhood Shops	133
Fast Food without Drive-Through	125
Supermarket	105
Retail- Free Standing Discount	100
Major Shopping Centre	84
High Turnover Restaurant	70
Quality Restaurant	59
Tavern / Bar	43
Government Office Building	31
Retail-Specialty Shops	31
Single Tenant Office Building	20
Industrial Activities	
Garden Centre Retail	95
Retail- Hardware	47
Manufacturing	25
Car Service Centre	18
Warehousing	17
Industrial Park	8
General Heavy Industry	2
Storage	2
General Light Industry	1

Appendix E: Linked trips

Historically, traffic impact assessments conservatively assumed that all generated traffic was new. More recently, 'discounts' have been applied to generated traffic to account for the 'drop in' component, which is not new traffic to the network.

Research undertaken on this subject has concluded that it is appropriate to adjust generated traffic due to linked trips.

Trips can be broadly categorised into the following types:

Linked Trip A journey where there is a chain of stops from origin to ultimate destination. A trip from home to work with stops at school and the post office comprises three linked trips:

1. Home to school
2. School to post office; and
3. Post office to work

Unlinked Trip A journey with no intermediate stops (referred to as New Trips in TIA).

For the purposes of a TIA, the following three types of trips are commonly used:

New Trip In traffic impact studies, unlinked trips are generally referred to as new trips. These are trips attracted to the development and without the development would not have been made – hence a new trip.

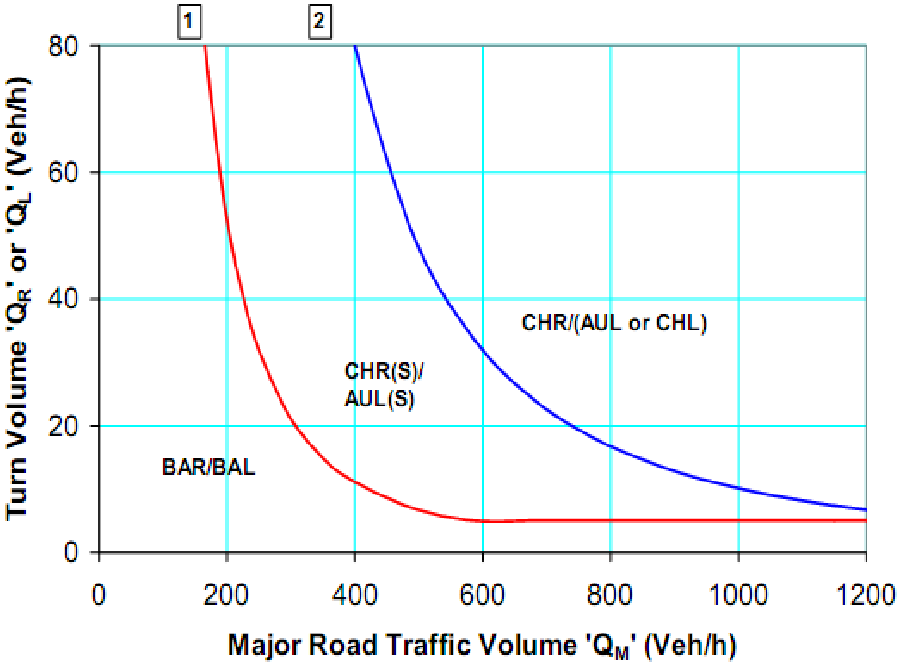
Diverted Trip A linked trip from an origin to a destination that has made a significant network diversion to use the new development.

Undiverted Trip A linked trip from an origin to a destination that previously passed the development site. This is also referred to as a 'pass by' trip and the new development is an intermediate stop on a trip that is made from an origin to a destination.

The diverted and undiverted trips are considered trips that are already part of the existing flows on the road network.

Appendix F: Warrants for Auxiliary turn lanes

The following figure details the warrants for auxiliary turn lanes. The figure can be used as an aid in determining if either a left turn lane or right turn lane is required on the road frontage to enable the access to the development site to operate without causing traffic flow on the Council road to be significantly disrupted.



Where:

BAR = Basic passing right

BAL = Basic passing left

CHR(S) = Channelized right (Short)

AUL(S) = Auxiliary left (Short)

CHR = Channelized right

AUL = Auxiliary left

CHL = Channelized left

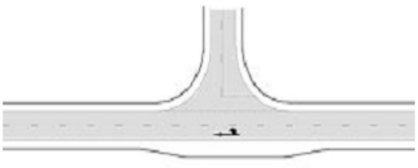
Traffic Volumes (Veh/h)

Q_R = Right turn traffic

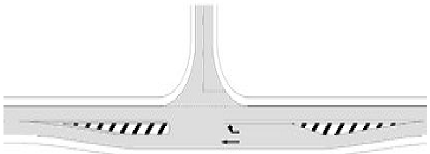
Q_L = Left turn traffic

$Q_M = Q_T + Q_L$ or $Q_T + Q_R$

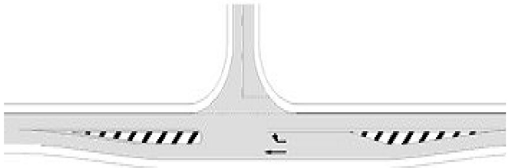
Where Q_T =Through lane traffic



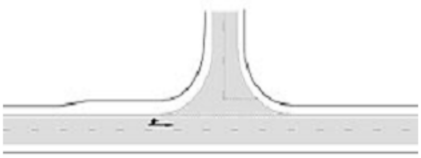
BAR - Basic Passing Right



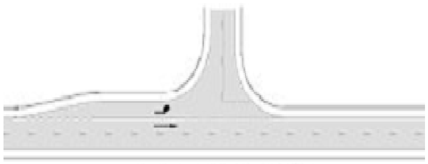
CHR (S) - Channelized Right (Short)



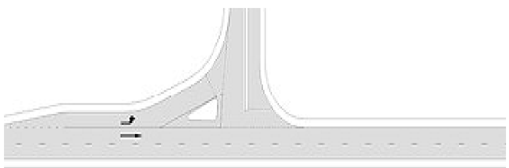
CHR – Channelized right



BAL - Basic Passing Left



AUL (S) - Auxiliary Left (Short)



CHL – Channelized Left

Appendix G: Midblock Traffic Capacities – LoS

LGIP Codes	Typical Minimum Road Reserve Width	TCC Standard Drawing	Road configuration	LOS A AADT Range		LOS B AADT Range		LOS C AADT Range		LOS D AADT Range		LOS E AADT Range	
				0.00	0.32	0.32	0.50	0.50	0.72	0.72	0.92	0.92	1.00
Minor	15m	Gravel Road	Minor formed and unsealed rural road	0	640	640	998	1000	1440	1440	1840	1840	2000
Rural	15m	Minor Sealed Road	Minor Rural Road (Non Trunk)	0	1408	1408	2196	2200	3168	3168	4048	4048	4400
Local	20m	Urban Type A	Access	0	704	704	1098	1100	1584	1584	2024	2024	2200
Urban	20m	Urban Type B	Local Street	0	1120	1120	1747	1750	2520	2520	3220	3220	3500
Streets	20m	Urban Type C	Major Street + Parking	0	1536	1536	2396	2400	3456	3456	4416	4416	4800
R2MTN	30m	Rural Type A	Minor Collector – Rural Res	0	3008	3008	4691	4700	6768	6768	8648	8648	9400
R2STN	30m	Rural Type A	Sub Arterial – Rural Res	0	3008	3008	4691	4700	6768	6768	8648	8648	9400
R2STM	30m		Sub Arterial – Rural Res Divided	0	3008	3008	4691	4700	6768	6768	8648	8648	9400
R2STN	30m	Rural Type A	Sub Arterial – Rural (3.25m lanes)	0	3424	3424	5340	5350	7704	7704	9844	9844	10700
R2ATN	30m	Rural Type B	Minor Arterial – Rural (3.50m lanes)	0	3424	3424	5340	5350	7704	7704	9844	9844	10700
U2MKM	30m	Collector Type A	Minor Collector - Urban Median + Park	0	1536	1536	2396	2400	3456	3456	4416	4416	4800
U2SKM	30m	Collector Type A	Sub Arterial - Urban Median + Parking	0	1536	1536	2396	2400	3456	3456	4416	4416	4800
U2MKN	20m	Collector Type C	Minor Collector - Urban	0	1600	1600	2495	2500	3600	3600	4600	4600	5000
U2SKN	20m	Collector Type C	Sub Arterial - Urban	0	1600	1600	2495	2500	3600	3600	4600	4600	5000
U2MKM	25m	Collector Type B	Minor Collector - Urban Median	0	1600	1600	2495	2500	3600	3600	4600	4600	5000
U2SKM	25m	Collector Type B	Sub Arterial - Urban Medium	0	1600	1600	2495	2500	3600	3600	4600	4600	5000
U2AKN	20m		Arterial - Urban + Parking	0	1600	1600	2495	2500	3600	3600	4600	4600	5000
U2AKM	30m		Arterial - Urban Median + Parking	0	1600	1600	2495	2500	3600	3600	4600	4600	5000
R4STM	40m	Sub Arterial Type B	Sub Arterial - Rural Divided	0	9600	9600	14970	15000	21600	21600	27600	27600	30000
R4MTM	40m	Sub Arterial Type B	Major Collector - Rural Divided	0	9600	9600	14970	15000	21600	21600	27600	27600	30000
R4STN	30m		Sub Arterial - Rural	0	9600	9600	14970	15000	21600	21600	27600	27600	30000
R4ATM	40m		Arterial - Rural Divided	0	9600	9600	14970	15000	21600	21600	27600	27600	30000
R4ATN	30m		Arterial - Rural	0	9600	9600	14970	15000	21600	21600	27600	27600	30000
U4SKM	30m	Sub Arterial Type A	Sub Arterial - Urban Median	0	4160	4160	6487	6500	9360	9360	11960	11960	13000
U4SKN	30m		Sub Arterial - Urban	0	4160	4160	6487	6500	9360	9360	11960	11960	13000
U4MKM	30m	Sub Arterial Type A	Major Collector - Urban Median	0	4160	4160	6487	6500	9360	9360	11960	11960	13000
U4MKN	30m	Sub Arterial Type A	Major Collector - Urban	0	4160	4160	6487	6500	9360	9360	11960	11960	13000
U4AKN	30m		Arterial - Urban	0	4800	4800	7485	7500	10800	10800	13800	13800	15000
U4AKM	30m	Arterial Type A	Arterial - Urban Median	0	4800	4800	7485	7500	10800	10800	13800	13800	15000
U6AKM	40m		Major Arterial - Urban Median	0	7200	7200	11228	11250	16200	16200	20700	20700	22500
R6ATM	50m		Major Arterial - Rural Divided	0	13120	13120	20459	20500	29520	29520	37720	37720	41000

Level of Service (LoS) range is based on the following conditions: Terrain is Level, 60/40 Directional split, 20% no-passing zone, 14% HVs

LGIP Codes
1st = Type of road Rural or Urban
2nd = Number of Lanes
3rd = Heirarchy classification
4th = Kerb or Table Drain
5th = Medain or No Median

Appendix H: Traffic Model Data Fact Sheet

Traffic Model Fact Sheet:

- Townsville City Council Maintains a traffic model for the entire city.
- The model is called the Townsville Aimsun Integrated Model (TAIM).
- The TAIM is a city-wide mesoscopic model and is Council's primary planning tool for the analysis of proposed improvement options, upgrades, and interventions on the road network to support growth identified in the Local Government Infrastructure Plan (LGIP).
- The TAIM is calibrated annually against traffic signal information provided by the Department of Transport and Main Roads and provides detailed traffic flow information across the entire city for the calibration year and future year projections in 2026, 2031, 2036 and 2041.
- The TAIM is also used to assess the impacts of land development proposals on the operation of the Townsville road network.
- Model information comprising traffic flow data can be provided by Council upon request, Council encourages the use of this data when submitting a development application for assessment as the modelled traffic flows represent the planned future network structure in accordance with the LGIP.

The following limitations apply to the TAIM

- The TAIM is an imperfect representation of traffic information on the road network in the calibration year. The traffic model has been developed using Aimsun traffic modelling software and provides an interpretation of the traffic conditions limited by the modelling processes.
- The model has been calibrated against traffic flow data recorded by vehicle detection equipment at 148 signalised intersections comprising 2175 detection counts, and 55 mid-block permanent traffic counter sites located across the city.
- Townsville City Council accepts no responsibility for damages, if any, suffered by any party because of decisions or actions made based on data extracted from the model.