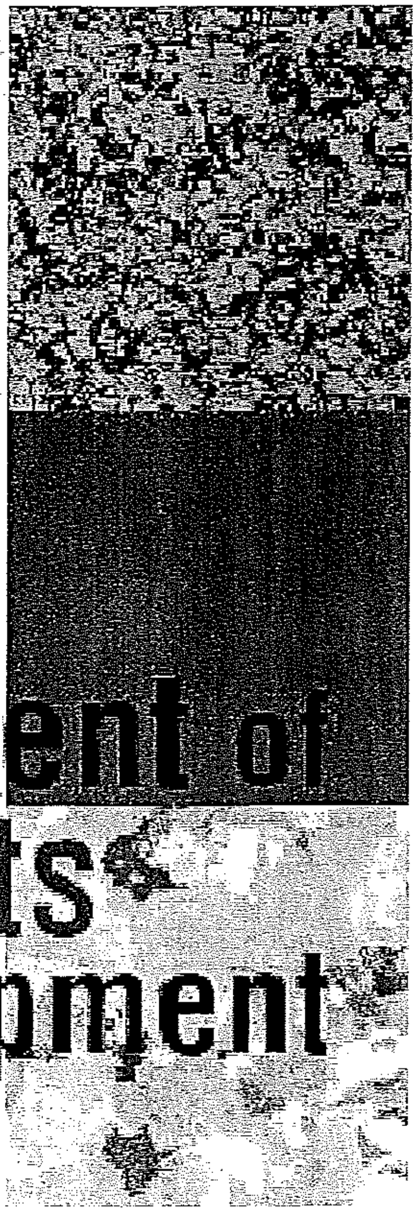
Guidelines for Assessment of Road Impacts of Development Proposals

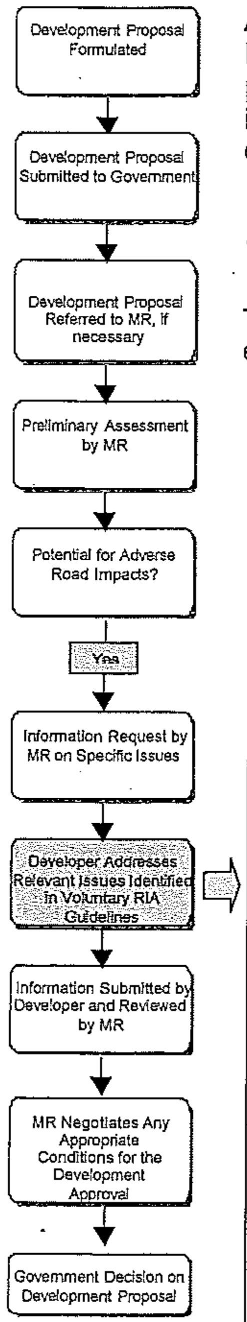


Queensland Government
Department of
Main Roads

3.0 ROAD IMPACT ASSESSMENT

The principles that guide RIAs derive from the legislative basis discussed in Section 2.0 as well as the body of practice that has built up over time. This section provides an overview of the RIA process and information requirements. Relevant definitions are contained in Appendix A.

3.1 RIA Process Overview



Sequence of Events

A RIA report is prepared by the proponent of a development proposal, or by an appropriately qualified person commissioned by the development proponent, to identify and address (to the satisfaction of Main Roads) the implications of the proposed development for State-controlled roads. The detail required in a RIA 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.

The process of conducting a RIA is shown in Figure 3.1. This is an expansion of part of the sequence of events shown in Figure 1.1.

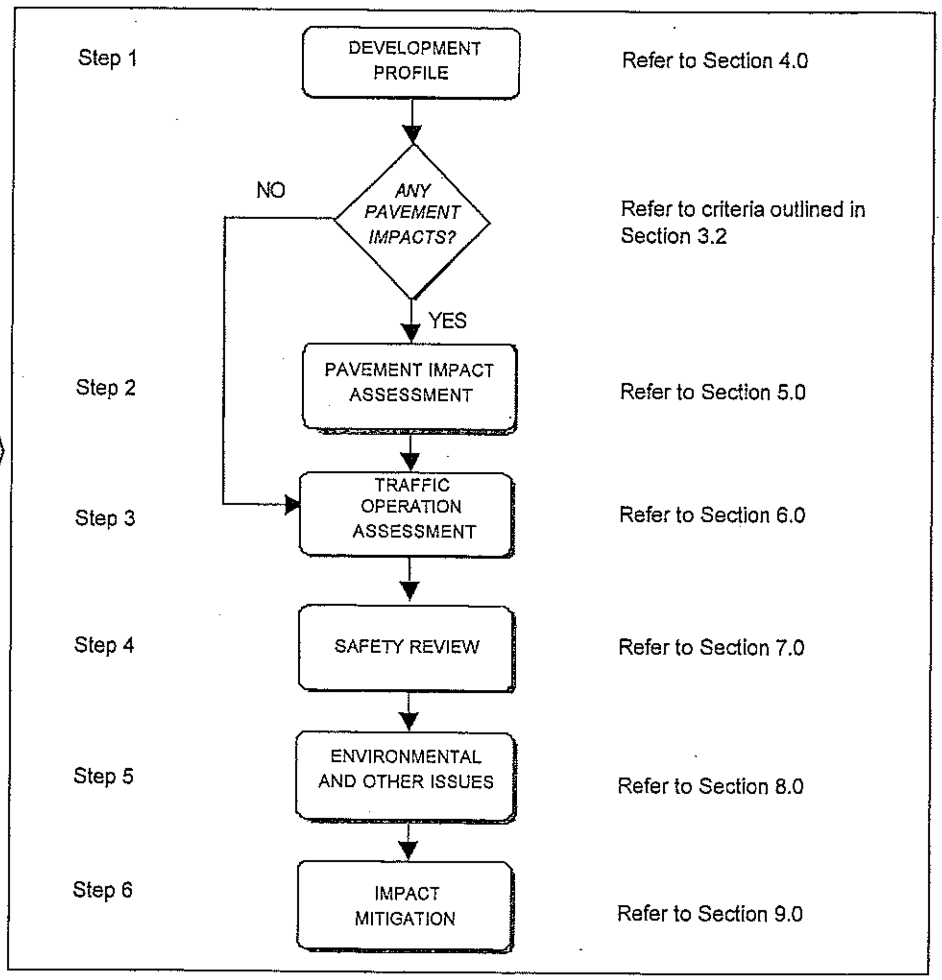


Figure 3.1 *RIA Process Flowchart*

DEVELOPMENT PROFILE

Refer to Section 4.0

Step 1 – Preparation of Development Profile

Details of the proposed development should be collated and presented. These include a description of the characteristics of the proposed development, traffic generation, traffic distribution and surrounding road network. This provides a general profile of the surrounding road network and basic traffic information necessary to assess road impacts.

PAVEMENT IMPACT ASSESSMENT

Refer to Section 5.0

Step 2 – Determination of Road Pavement Impacts

An assessment is undertaken to determine whether the project, because of its size, location and/or vehicle generation characteristics, is likely to have an impact on the road pavement. In many instances there will be no requirement to assess pavement impacts where developments access highly trafficked roads and do not generate a significant heavy commercial vehicle component.

Where pavement impact assessment is required, with and without development scenarios will need to be compared to identify any pavement impacts directly attributable to the development.

TRAFFIC OPERATION ASSESSMENT

Refer to Section 6.0

Step 3 – Determination of Traffic Operation Impacts

Impacts of the development upon the traffic operation of the surrounding road network are assessed for each stage of development covered by the application for development approval.

Where traffic operation impact assessment is required, with and without development scenarios will need to be compared to identify any traffic operation impacts directly attributable to the development.

SAFETY REVIEW

Refer to Section 7.0

Step 4 – Safety Review

Consideration of road safety issues is usually required for all stages of development (including construction).

ENVIRONMENTAL AND OTHER ISSUES

Refer to Section 8.0

Step 5 – Review of Environmental and Other Issues

It may be necessary to assess environmental and other issues including noise, visual impacts, parking, transport corridor planning and access control.

IMPACT MITIGATION

Refer to Section 9.0

Step 6 – Assessment of Impact Mitigation Measures

Steps 2 to 5 will have identified any ameliorative measures required as a consequence of the development including roadworks, changes to the public transport system and possible modifications to the development. The identified ameliorative measures are then analysed to determine the extent to which impacts from the development can be accommodated within existing capacities and planned improvements to the roads infrastructure. Any ameliorative measures that cannot be accommodated should be costed using unit rates applicable to the locality.

This will enable the development proponent to identify their contribution towards the cost of any ameliorative roadworks, either by monetary contribution or by undertaking necessary works.

3.2 Spatial Extent of Assessment

This section defines the study area for assessing the potential impacts of a development on the SCR network.

The safety implications of using the SCR network should always be assessed. Appropriate levels of safety at the point of connection to the SCR network and elsewhere on the network must be achieved.

All relevant planning and hydraulic issues associated with a proposal should also be assessed. Main Roads District Offices can advise whether such issues are relevant.

Refer to Appendix A for definition of AADT and ESA

The spatial extent to which other issues need to be assessed should be determined having regard to the following criteria. The criteria are based on a comparison of construction and operational traffic generated by the development project and existing traffic volumes as measured by Annual Average Daily Traffic (AADT) or Equivalent Standard Axles (ESAs).

Refer to Appendices C and D for Sample Projects

1 – ACCESS TO SCRs
All points of access between the development and the SCR network need to be considered for both the construction and operational stages. This includes direct access to an adjacent SCR or indirect access via an intersection of a local government access road with a SCR.

Refer to Section 5.0

2 – PAVEMENT IMPACT ASSESSMENT
Pavement impacts need to be considered for any section of a SCR where the construction or operational traffic generated by the development equals or exceeds 5% of the existing ESAs on the road section.

Refer to Section 6.0

3 – TRAFFIC OPERATION ASSESSMENT
Traffic operation impacts need to be considered for any section of a SCR where the construction or operational traffic generated by the development equals or exceeds 5% of the existing AADT on the road section, intersection movements or turning movements.

Refer to Appendix A for definition of haul route

4 – HEAVY COMMERCIAL VEHICLE TRAFFIC

Because of the impacts of heavy commercial vehicle movements on traffic operations, any haul route must be identified. Along the haul route, traffic operation impacts will need to be addressed for all sections where the development traffic equals or exceeds 5% of the existing ESAs.

A traffic operation assessment focusing on overtaking lanes, road width and provision for heavy commercial vehicle movements at intersections will be required even if an assessment of traffic operations along an identified haul route is not triggered by criterion 3.

(Appropriate permits are required to use vehicles that exceed the legal load or dimension limits. These permits may be issued subject to conditions.)

The spatial extent of assessment identified may be modified with the agreement of the relevant Main Roads District Office, and early discussions in this regard are encouraged.

3.3 Design Horizons

Refer to Appendix A for definition of traffic operation

Refer to Appendices C and D for Sample Projects

For **traffic operation assessment** and any **safety review** that might be necessary, the design horizon should be 10 years after the opening of the development. For a staged development this would be 10 years after opening of the final stage. Where assessment of individual stages is undertaken, base flows for successive stages should include the previous stages' traffic generation.

In circumstances where staging is over a period exceeding five years, it would be preferable to have separate development applications for the later stages, which can then be assessed with greater certainty at the appropriate time. It is preferable to avoid extending time horizons beyond 15 years where reliable area-wide future year analysis has not been completed.

Refer to Appendices C and D for Sample Projects

For **pavement life assessment**, a horizon longer than 10 years is appropriate. Normally a 20 year design horizon is adopted for projects having pavement and maintenance impacts. Mining or other projects with a finite life should be assessed over the expected life of the project.

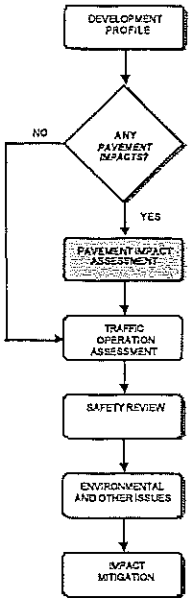
Refer to Appendix A for definition of RIP

In terms of roadworks planning, the Roads Implementation Program (RIP) sets out Main Roads' committed funds for two years and indicative funding for a further three years. Although Main Roads carries out strategic road planning up to 20 years in advance, specific roads projects are usually only identified for up to five years in advance through the annual RIP process.

Refer to Section 9.1

IPA requires Main Roads to develop plans for infrastructure that will be referenced in the planning schemes for local government areas. These

5.0 PAVEMENT IMPACT ASSESSMENT



RIA Process

If the development profile indicates that the proposal will increase ESAs by 5% or more, assessment of pavement impacts may be required. The general process for undertaking a pavement assessment is outlined below. The relevant Main Roads District Office can provide advice on the extent to which this issue needs to be addressed. It may be possible, for example, to limit the scope of pavement impact assessment depending on the level of information already available to the District Office on road conditions and planned future roadworks.

Section 5.1 provides an introduction to pavement management concepts. Principles and issues associated with assessing the pavement impacts of a development are discussed in Section 5.2, while Section 5.3 outlines the process for assessing pavement impacts.

5.1 Impact on Pavement Management

Refer to Appendix A for definition of ESAs

Within the constraints of available funding, Main Roads seeks to maintain SCRs so that their 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 maintenance is carried out during the design life primarily to prevent or repair damage caused by heavy commercial vehicle traffic and environmental effects.

Refer to Appendix A for definitions of maintenance, programmed maintenance, rehabilitation and routine maintenance

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

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 maintenance such as resealing. These activities, whilst preserving the pavement, do not improve it structurally or extend its design life.

Structural condition can be assessed by an estimation of the remaining life of the pavement. This is discussed further in Section 5.3. A pavement's life can only be extended by pavement rehabilitation, such as an overlay, or by replacement of the pavement.

New developments can generate increases in heavy commercial vehicle traffic which 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 need for extra pavement width;

- a change in surfacing type or pavement thickness;
- an increase in maintenance; and
- the need to bring forward pavement rehabilitation or works involving new pavement.

5.2 Assessing Pavement Impacts

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

Where a development will generate significant increases in heavy commercial 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 need to be assessed. A comparison of the nature and timing of roadworks required with and without the development will be needed. This comparison will require predictions of pavement maintenance and/or rehabilitation 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.

Refer to Pavement Design Manual and Pavement Rehabilitation Manual

Guidance on the nature and timing of pavement works, and the design and construction standards to be achieved, can be obtained from relevant manuals, such as the Pavement Design Manual and the Pavement Rehabilitation Manual. An outline of the assessment procedure is provided in Section 5.3. It is important to appreciate that forecasting any required pavement works requires a thorough knowledge of the issues involved and a degree of professional judgement.

The development proponent may be required to meet the costs of any pavement rehabilitation or maintenance works beyond those that Main Roads would normally expect to provide. For example, a developer may be responsible for meeting the cost of bringing forward the need to rehabilitate a pavement earlier than would have been required without the development. The proponent may also be responsible for meeting the cost of any increase in maintenance required as a result of the development.

5.3 Outline of Assessment Procedure

The following procedure expands on Main Roads' general approach to road impact assessment as outlined in Section 1.3 of these guidelines.

Stage 1: Development Profile and Future Traffic Volumes

Refer to Appendices C and D for Sample Projects

The traffic volumes and ESAs with and without the development that were determined as part of the development profile in Section 4.0 will usually provide sufficient information to carry out the pavement assessment. The relevant Main Roads District Office should be consulted about existing traffic growth rates and predicted traffic growth without the development.

Stage 2: Scope of Assessment and Criteria to be Adopted

The relevant Main Roads District Office will be able to confirm the appropriate scope of the pavement assessment. The District Office can also advise if any variation from normal pavement assessment methodologies or criteria is appropriate. Remaining pavement life is normally determined by comparing the traffic on which the pavement design was based with actual traffic that the pavement has carried. Approval should be sought from the District Office before using any alternative method for calculating remaining pavement life (such as roughness trends).

Main Roads holds substantial information on existing pavement condition, expected pavement life and planned maintenance expenditure. This is available for use by development proponents. The following information about current maintenance practice and pavement improvements should usually be sought from Main Roads:

- current pavement design and design life;
- current pavement age;
- date of last programmed maintenance;
- current cost of routine maintenance (including on-costs) in $/km or $/lane km;
- current cost of likely programmed maintenance (including on-costs) in $/m^2;
- current traffic including AADT, percentage of commercial vehicles, growth rate and distribution of vehicles by class (if known) and likely number of ESAs per commercial vehicle;
- any pavement maintenance or rehabilitation planned for the road and its timing; and
- design details of any proposed rehabilitation schemes.

Stage 3: Impact Assessment and Determination of Additional Road Requirements

The pavement assessment should include consideration of the with and without development cases leading to an estimate of the extent, timing and costs of:

- pavement improvements such as road widening;
- maintenance (including increased maintenance where development-related improvements will change pavement area or type); and
- rehabilitation.

Calculation of the remaining life of the pavement can be conducted as a desktop analysis from records of pavement design, current pavement age and past traffic. The task will generally require a consultant with the necessary skills to interpret information obtained from Main Roads. The remaining life (in ESAs) is the difference between the pavement design life (in ESAs) and cumulative past traffic.

The following steps outline the process for assessing the pavement impacts of a development:

- determine the current traffic (number/type/ESAs);
- list the number and types of vehicles that will be generated by the development;
- calculate the total ESAs of commercial vehicles generated by the development;
- calculate the annual ESAs with and without the development based upon the likely growth rates in both cases to the design horizon;

Refer to Pavement Design Manual, Section 7

- determine the remaining life of the existing pavement in ESAs based on information obtained from the District Office;
- predict when the pavement will require rehabilitation with and without the development based on its remaining life and the forecast traffic (having regard to Main Roads' recent and planned pavement works);

Refer to Pavement Rehabilitation Manual

- predict the cost of pavement rehabilitation required at the end of the remaining life of the pavement with the current traffic, and with the current traffic plus the additional traffic generated by the development;
- establish if there is a change in the vehicle mix using the road that may require widening of the pavement or surfacing. This can be done by discussing the vehicle types associated with the development with the relevant Main Roads District Office. Where widening is required, estimate the cost of improvement works and the associated increase in maintenance (such as reseals) to the design horizon; and
- predict the total cost of routine and programmed maintenance in each year to the design horizon with the current traffic, and with the current traffic plus the additional traffic generated by the development.

In some cases a pavement may have reached the end of its design life but it may continue to operate satisfactorily with the current traffic volume. However, an increase in heavy commercial vehicle traffic generated by a development might not be able to be sustained by the pavement. In such a case, a complete pavement evaluation in accordance with the Pavement Rehabilitation Manual may be necessary in order to assess what rehabilitation is required with and without the development.

The above analysis should determine the extent to which any additional pavement works are required to accommodate traffic generated by the development.

Stage 4: Determination of Any Developer Contribution Required

The results of the pavement impact assessment are tabulations of rehabilitation and maintenance requirements over the analysis period with and without the development. These tabulations should be accompanied by documentation of the calculation methodology including all inputs and their source, and any assumptions made during the analysis.

If the pavement works with the development do not align with the works likely to be provided by Main Roads, it may be necessary for Main Roads to seek a developer contribution. Details of the processes involved are contained in Section 9.0. Such a contribution would be based on the bring forward cost methodology shown in Appendix G. In most cases, relevant pavement works would need to be completed prior to the commencement of operations of the development project.

5.4 Impacts on Structures

See also Section 8.11

Impacts on bridges and other structures within the road reserve will need to be considered in some 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, mining equipment) will require early consultation with Main Roads 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 relevant Main Roads District Office should be consulted to determine whether this issue requires assessment.

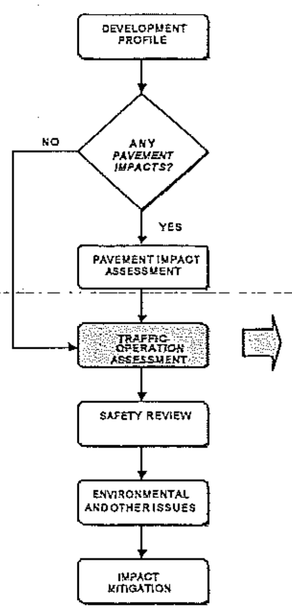
6.0 TRAFFIC OPERATION ASSESSMENT

Refer to Appendix A for definitions of AADT, ESAs and traffic operation

If the development profile indicates that the proposal will increase AADT by 5% or more, assessment of traffic operation impacts may be required. Traffic operation impacts may also need to be assessed along those sections of a haul route where ESAs increase by 5% or more. The general process for undertaking a traffic operation assessment is outlined below. The relevant Main Roads District Office can provide advice on the extent to which this issue needs to be addressed. For example, the District Office may be able to provide advice on traffic volumes to assist the proponent. Also, recent or planned road capacity improvements may be sufficient to accommodate the increase in traffic volume generated by the development without any additional roadworks being required.

Main Roads is responsible for the safety and transport efficiency of the SCR network. Aspects of both safety and efficiency are embodied in the various traffic operation assessment procedures.

Figure 6.1 outlines the traffic operation assessment process. As shown, operating characteristics need to be compared with performance criteria. If performance criteria are compromised as a result of a development, remedial works may be required.



RIA Process

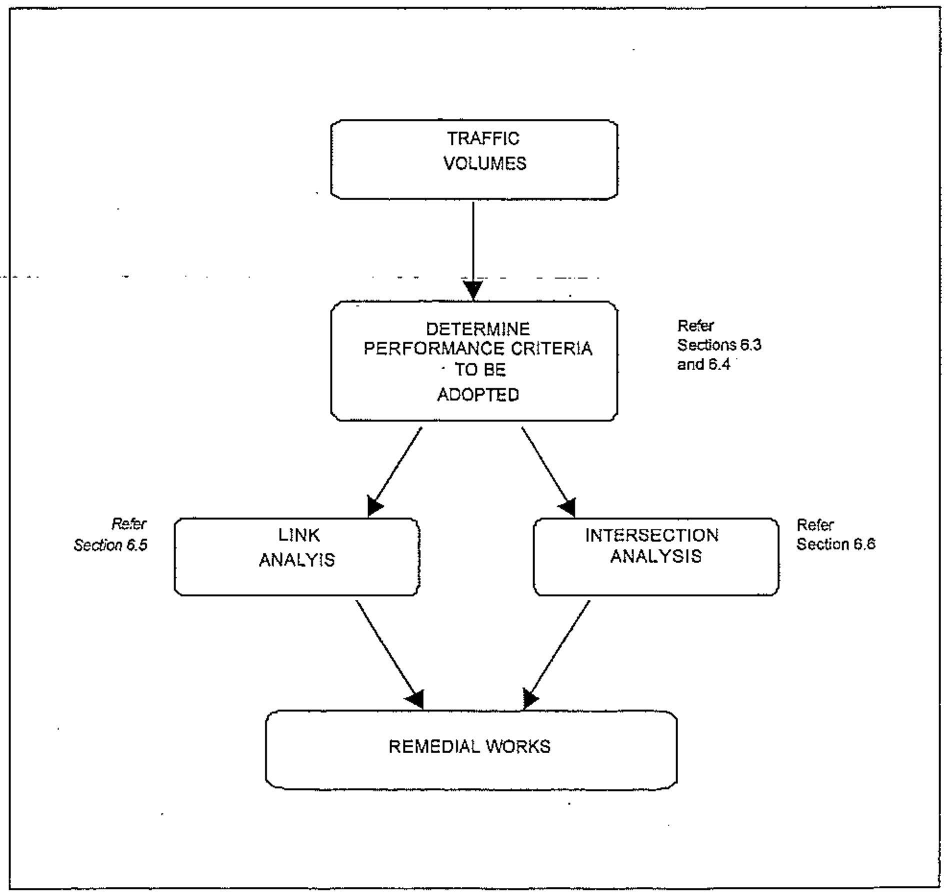


Figure 6.1 *Traffic Operation Assessment Process*

Section 6.1 briefly discusses principles and issues associated with assessing the traffic impacts of a development, while Section 6.2 outlines the assessment procedure. More detailed information on the performance criteria and analysis procedure for road links and intersections is provided in Sections 6.3 to 6.6.

6.1 Assessing Traffic Operation Impacts

Where a development will generate significant increases in vehicle traffic, the impact of that additional traffic on traffic operations needs to be quantified. A comparison of the nature and timing of road construction and maintenance works required with and without the development will be needed, based on forecast traffic volumes for each case. The design horizon for a traffic operation assessment should be 10 years after opening of the final stage of the development.

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

Guidance on the nature and timing of roadworks for different traffic situations can be obtained from relevant technical manuals such as AUSTROADS Guide to Traffic Engineering Practice (GTEP). An outline of the assessment procedure is provided in Section 6.2. In some cases, Main Roads may agree to the use of criteria different to those that would normally apply. For example, having regard to the vehicle mix, terrain and limited road access, it might be appropriate to deviate from standard criteria and accept a higher than normal traffic volume as the threshold for an additional traffic lane on a road link.

Early contact should be made with the relevant District Office to determine if any variation to Main Roads' normal criteria should be adopted in undertaking the analysis. It is important to appreciate that forecasting any required roadworks requires a thorough knowledge of the issues involved and a degree of professional judgement.

The development proponent may be required to meet the costs of any roadworks beyond those that Main Roads would normally expect to provide. For example, a developer would be responsible for meeting the cost of bringing forward the need to provide additional traffic lanes earlier than would have been required without the development.

Once the need for additional roadworks has been triggered by a development activity, there may be instances where the optimum solution from the perspective of 'whole of life' management of the road asset exceeds the quantum of roadworks necessitated by the development proposal. For example, a development project may necessitate partial road widening and yet Main Roads may decide that the most cost effective solution would be to take the opportunity for a major lane duplication having regard to future demands on the road from all sources. In such cases, any developer contribution would be based only on the share of the roadworks directly attributable to the development activity.

6.2 Outline of Assessment Procedure

The following procedure expands on Main Roads' general approach to road impact assessment as outlined in Section 1.3 of these guidelines.

Stage 1: Development Profile and Future Traffic Volumes

Refer to Appendices C and D for Sample Projects

The traffic volumes with and without the development that were determined as part of the development profile in Section 4.0 will usually provide sufficient information to carry out the traffic operation assessment. The relevant Main Roads District Office should be consulted about existing traffic growth rates and predicted traffic growth without the development.

Stage 2: Scope of Assessment and Criteria to be Adopted

The relevant Main Roads District Office will be able to confirm the scope of the traffic operation assessment. The District Office can also advise if any variation from normal traffic assessment methodologies or criteria is appropriate.

The methodology for assessing the performance of roads and intersections is generally consistent between urban and rural locations, only the performance to be achieved changes. Generally, road users expect a better level of performance in rural conditions as speeds are higher, trip lengths are longer, and volumes are lower. However, for rural roads the maximum capacity of a road will also depend upon the roughness of the pavement surface.

Sections 6.3 and 6.4 provide more detail about the performance criteria that apply to road links and intersections.

Stage 3: Impact Assessment and Determination of Additional Road Requirements

The traffic operation assessment will need to consider the nature and timing of roadworks required under both with and without development scenarios. This will require identification of the roadworks necessary to achieve relevant road link and intersection performance criteria (determined in Stage 2) for the traffic volumes forecast under each scenario.

Sections 6.5 and 6.6 outline the processes for analysing the impacts of traffic on link and intersection performance.

Having identified the roadworks required to accommodate traffic generated by the development, the analysis should then consider the extent to which any roadworks required as a result of the development align with roadworks that would be required in the absence of the development.

Stage 4: Determination of Any Developer Contribution Required

If the roadworks with the development do not align with the works likely to be provided by Main Roads, it may be necessary for Main Roads to seek a developer contribution. Details of the processes involved are contained in Section 9.0. Such a contribution would be based on the bring forward cost methodology shown in Appendix G. In most cases, relevant roadworks would need to be completed prior to the commencement of development operations.

If roadworks necessitated by a development are unlikely to have ever been provided by Main Roads, the developer would be required to meet the full cost of the roadworks. Roadworks associated with access to the development site are an example of this.

6.3 Road Link Performance Criteria

DETERMINE PERFORMANCE CRITERIA TO BE ADOPTED

The performance measure for road links is the level of service (LOS), as defined in the GTEP Part 2 – Roadway Capacity. LOS as defined by the GTEP is a qualitative measure describing operational conditions within a traffic stream and the perception of these by motorists and/or passengers.

Level of Service

The GTEP identifies six categories of LOS, summarised as follows:

LOS A This, the highest level, 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 in the zone of 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.

State-controlled Road Standards

LOS criteria apply to road sections away from intersections. LOS E should be considered the limit of acceptable urban area operation and remedial works would be needed if LOS F would otherwise result.

In rural areas, change between LOS rankings is also critical. Generally, remedial measures to maintain existing LOS would be sought on rural

SCRs and LOS C can be considered the minimum standard, although Main Roads may accept LOS D where weekend peaks are the defining event and occur on recreational routes.

For parts of the rural network where the carriageway is unsealed or narrow, acceptable volume limits are reached at relatively low volumes. The volume of heavy commercial vehicles is often an issue when determining pavement life, traffic operations and appropriate road width. Road planning for low volume roads is a lengthy process which takes into account a variety of factors including the composition of traffic (commercial vehicles, tourist vehicles etc.), road alignment, soil type, climatic conditions and available funding.

National Highway Standards

Higher LOS standards are sought on National Highways, on which LOS B should not be exceeded for more than 100 hours per year for a design life of 20 years. However, funding levels mean that a deficiency LOS C may apply subject to agreement with the relevant Main Roads District Office.

6.4 Intersection Performance Criteria

DETERMINE PERFORMANCE CRITERIA TO BE ADOPTED

For intersections, a similar basic approach to link performance is adopted. Volumes on particular movements are compared with a calculated capacity for that movement taking account of competing movements, layout, assigned priorities or signal settings as appropriate. For signalised intersections, the volume/capacity ratio is expressed as degree of saturation (DOS) which is the key indicator of operational performance. For unsignalised intersections, the utilisation ratio calculated as the volume/capacity ratio for entering movements is the key indicator, and is also a measure of DOS.

Refer to SIDRA User Guide

For signalised intersections, the analysis technique described in ARR123 is appropriate. The computer application SIDRA is basically a computer implementation of this analysis with some additional degree of sophistication and enhanced algorithms. For unsignalised intersections (sign controlled intersections and roundabouts) analysis techniques outlined in GTEP Part 5 – Intersections at Grade and Part 6 Roundabouts are appropriate. Again, these algorithms and similar techniques have been implemented and enhanced in the SIDRA application.

Computer aided analysis of signalised intersections is recommended to facilitate consideration of influencing factors such as:

- pedestrian crossing times;
- effect of shared lanes;
- effect of short lanes; and
- constraints imposed on cycle time, phase sequence and green splits where an intersection operation is coordinated with other intersections.

Limits of Acceptable Operation

The limits of operation for the different types of intersection are generally accepted as being:

signalised intersections – the intersection DOS, which represents the proportion of available green time capacity taken up for the critical movement(s), should generally be less than 0.90. This represents 90% of theoretical capacity and is considered a 'practical capacity' beyond which delays increase substantially for modest increases in volume;

Refer to GTEP Part 6, Section 3

roundabouts – the DOS for any movement calculated using the GTEP procedures should not exceed 0.85; and

Refer to GTEP Part 5, Section 4

priority junctions – the DOS for any movement calculated using the GTEP procedures should not exceed 0.80.

The SIDRA default value for saturation flow is 1950 through car units/hour. The performance results obtained from using this value may be conservative.

A check of queuing is also needed. For SCRs, a 95% confidence limit should generally be used for queue lengths. This is referred to as the 95th percentile queue length. A greater confidence limit may be appropriate where excessive queue length is likely to cause significant problems.

For priority junctions (including accesses), the intersection layout should conform to the GTEP Part 5, Section 5, where layouts for Types A, B and C junctions are provided.

Sight distance at intersections should conform to the GTEP Part 5, Section 5. Desirably, Intersection Sight Distance shall be provided with Approach Sight Distance being the minimum requirement.

6.5 Road Link Analysis

LINK ANALYSIS

The development profile establishes flows on each relevant road link (divided into homogenous sections).

Refer to Appendices C and D for Sample Projects

LOS may be determined for different terrain types, vehicle mix, and grades using the service flow rate derivations of the GTEP Part 2, Section 3, Roadway Capacity

Refer to GTEP Part 2, Section 3

The longer travel distances involved in rural areas make extended operation at LOS D and E intolerable. At these LOS, travel is usually achieved in platoons of vehicles and overtaking opportunities are severely limited which in turn introduces unacceptable delays and safety issues. The GTEP processes take this into consideration.

Overtaking opportunities are critical to achieving acceptable operation on two lane rural roads. The effects of unsealed roads or unsealed shoulders on dust and visibility should be considered. Increases in volume can trigger the need for overtaking lanes. A RIA may therefore need to identify the way in which a proposal could influence overtaking opportunities on a road section.

Proposals which would generate significant heavy commercial vehicle movements (e.g. mine haulage, extractive industry sites or sugar cartage) may have an impact on the LOS of road sections where overtaking is limited by alignment or long adverse grades. In some circumstances, it may be necessary to model the operation of the road section to quantify impacts and so assist in determining the need and location for overtaking lanes. Computer simulation models which represent overtaking manoeuvres may be needed.

Consideration should be given to the safety impacts on the road network, and any necessary changes to the road network as a consequence of the development. The impact on public transport services, changes to bus routes, the need for, and location of, bus stops and the like should be addressed if relevant. The analysis should also examine the impact on amenity, including traffic noise, dust and speed issues. Traffic penetration of adjacent areas (particularly residential areas) should be specifically addressed although its impact may be more related to local government interests.

6.6 Intersection Analysis

INTERSECTION ANALYSIS

Refer to SIDRA User Guide

A variety of computer analysis packages are available for intersections. The package most widely used in Queensland is SIDRA, which provides analysis of isolated signalised intersections and roundabouts. The current version of SIDRA is aaSIDRA 1.02. Where the intersection being considered is adjacent to (within 1 km of) other signalised intersections, it may be necessary to consider the operation of the intersections as part of a linked traffic signal network. The computer application TRANSYT should normally be used for this analysis. The current version of TRANSYT is TRANSYT-7F Release 8. Where reassignment of traffic within a network must be considered, the use of transport modelling packages such as SATURN may be appropriate.

Refer to Appendices C and D for Sample Projects

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

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

- the blocking of driveways and side streets;
- overflows of dedicated turn slots;
- additional energy use; and
- interrupted flow conditions.

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

For rural intersections, the warrants for intersection treatments are embodied in the GTEP Part 5, Section 5.

Accesses to SCRs are to be treated as intersections to a SCR. Requirements could include channelisation, auxiliary lanes, medians, lighting, or development of controlled intersections (signals or roundabouts). As SCRs tend to serve an arterial function, 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, after due consideration is given to relevant Main Roads planning guidelines.

For example, a RIA may indicate that a pavement is expected to require rehabilitation in seven years without a development. With the development, however, rehabilitation is required in four years. Discussions with Main Roads confirmed that Main Roads would expect to schedule the rehabilitation in seven years. However, because of the capital costs involved, Main Roads is unable to fund the rehabilitation in year four and cannot, therefore, accept a bring forward contribution. Consequently, Main Roads and the development proponent will need to discuss alternative arrangements for dealing with the impact of the development.

9.3 Determining a Development Proponent's Contribution

The basis for determining developer contributions for roadworks is largely contained in IPA.

As a general principle, if Main Roads intended to provide the roadworks at some future date then the developer contribution would normally be based on a 'bring forward cost' methodology. For example, a bring forward contribution may be sought for road impacts from the construction phase of a new resource development project. Construction activity usually involves intensive use of heavy commercial vehicles resulting in accelerated deterioration of road pavements and earlier rescheduling of roadworks to address adverse road impacts.

Under the provisions of IPA, the maximum bring forward costs will not exceed the full capital cost of the roadworks and, in the case of additional operating and maintenance costs, the additional costs over a maximum period of 15 years.

If the roadworks are unlikely to have ever been provided in the absence of the development activity, or the estimation of the timing of the roadworks is regarded as too speculative, then the developer would be required to meet the full cost of the roadworks. Such a situation would normally arise where roadworks are development-specific and the developer is expected to be the sole beneficiary or cause of the works. An example is where a development may require special acceleration/deceleration lanes or turning lanes at an existing intersection so that heavy commercial vehicles do not reduce the efficiency of the road system. In such instances, the full capital cost and any ongoing maintenance of the works would normally be sought from the proponent as a contribution prior to commencement of the development activity. The proponent will need to calculate the capital cost and maintenance cost of the works (see Sections 9.4 and 9.5).

A development proponent and Main Roads may enter into an infrastructure agreement about the provision of roadworks. Such agreements may cover the standards required, timing of delivery, funding and the obligations of both parties in regard to such matter as cost variations due to unforeseen circumstances.

It is recognised that there may be instances where other road users (current and future) may benefit from roadworks provided on the basis of a contribution from a development proponent. However, it does not necessarily mean that other road users receiving benefits should contribute to the financing of the roadworks, especially if they did not precipitate the timing of provision of those roadworks. There will also usually be practical difficulties in assessing and securing any appropriate contribution from other road users when they have 'as of right' access to the affected roads and no effective regime exists for obtaining road user charges on the basis of actual, verifiable road use by specific vehicles.

When determining a development proponent's contribution, consideration needs to be given to any protocols between Main Roads and local governments which outline funding responsibilities in respect of roads and road reserves.

9.4 Construction Costs

In its own operations, Main Roads refines cost estimates for projects as they progress from design to construction. The accuracy of cost estimates improves as the process progresses.

Main Roads will principally be interested in having the appropriate works completed. Where works are funded in part, or brought forward in time, it will be necessary for the proponent to prepare cost estimates for the works involved.

Cost estimates should be based on reasonable unit rates for works on SCRs in the area of the development. The Main Roads District Office may be able to supply this information as well as details of the contract conditions applicable to works carried out on SCRs.

9.5 Maintenance Costs

The maintenance of a roadway is an ongoing cost rather than an up-front capital item. Maintenance is incurred for pavements, bridges and the other fixtures in the road reserve such as signs, pavement markings, lighting, guardrails, drainage systems, noise barriers and landscaping.

To some extent there is a fixed cost component of maintenance (e.g. for signs, lighting etc) and a variable component, which depends on the level of usage (e.g. pavement wear). The fixed cost portion of maintenance will not be included in considering contributions by developers to road maintenance.

Main Roads maintains records of maintenance expenditure by road section. This data can be obtained from the relevant District Office. An average cost over several years is needed for reliable cost estimation.

9.6 Present Values of Costs

Refer to Appendix G

For the calculation of developer contributions based on providing roadworks earlier than they would have normally been provided by Main Roads, it is important that the valuation of costs takes into account the time at which the roadworks would occur. This is achieved by discounting costs to a present value. The term 'present value' indicates that costs have been discounted to present value terms (i.e. to an equivalent amount of today's dollars).

Discounting for time preference is an entirely different concept to that of price inflation. In Queensland, discount rates for public capital investments are periodically reviewed and set by the State Treasury. These rates are obtainable from Main Roads' Cost Benefit Analysis Manual for Road Projects.

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.

9.7 Other Fees and Charges

The amount of any developer contribution will not take into account road user taxes or charges that are not directly relevant to the roadworks. For example, fuel excise and national heavy vehicle charges are paid into general government revenue, are not hypothecated for specific roadworks and are not relevant to roadworks which are unplanned or unfunded by government.

9.8 Presentation of Cost Calculations

The tables presented in Appendix G may be reproduced and used to present the bring forward costs associated with the project. These tables can be used in conjunction with the discount factors also presented in Appendix G.

9.9 Goods and Services Tax

The effect of the Goods and Services Tax (GST) on developer contributions is complex especially in relation to the provision of works 'in kind'. Specialist advice should be sought to determine if, and when, GST needs to be paid.

However, in accordance with a determination by the Commonwealth Treasurer gazetted on 1 March 2000, it appears that a developer contribution (in the form of a monetary payment) obtained under the provisions contained in one or more of the following Acts may not be subject to the GST:

- *Transport Infrastructure Act 1994*

A DEFINITIONS

Annual Average Daily Traffic (AADT) 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.

Commercial Vehicle A motor vehicle (excluding any car or motorbike) built to carry goods or tow a trailer. This includes **heavy commercial vehicles** (see below).

Equivalent Standard Axles (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 design horizon.

Haul Route The sections of State-controlled road that are used during the construction and/or operational phase of a development for the transport of materials or stock by heavy commercial vehicles and concentrated on one or a small number of origins and/or destinations.

Heavy Commercial Vehicle A commercial vehicle (including trailers) with a gross vehicle mass greater than 4.5 tonnes.

Local Government Road A road controlled by a local government. It includes all roads that are not State-controlled or privately owned (e.g. by mining companies or tollways).

Maintenance Management of ongoing performance and condition of the road asset. This can be separated into rehabilitation, programmed maintenance and routine maintenance.

Programmed Maintenance Those activities that restore the integrity of the road surface and can be predicted and planned by engineering and pavement techniques.

Where roadworks increase the pavement or surfaced area, there will be a corresponding increase in programmed maintenance to resurface this increase. It is only necessary to calculate programmed maintenance impacts where the surfaced area is increased or the type of surfacing is changed as a result of the development, and an increase in the programmed maintenance costs are expected to result.

Rehabilitation That group of activities that restores the structural capacity and condition of the carriageway, without altering the geometric standards, and can normally be predicted and planned by engineering and pavement techniques. This also includes the restoration of a bridge to the level of service and load capacity it had when constructed.

Pavements are designed to withstand a number of repeated standard axle loads. Increases in heavy commercial vehicle traffic raise the rate at which the number of these repetitions are applied to the pavement and the design life of the pavement in years is reduced. Once the design life is reached, rehabilitation should occur to extend the operating life of the pavement. Thus, an increase in heavy commercial vehicle traffic causes rehabilitation to be needed earlier and the resultant rehabilitation bring forward cost has an impact on the RIP. The quantification of the bring forward costs should be based on estimating the remaining life of the pavement with and without development. In some instances it may be more cost effective to completely rebuild a pavement.

Road Impacts Road impacts of a development project are defined as the effects on the SCR network (including planning impacts on existing and future SCRs), which result from the presence of the development and/or traffic movements by vehicles, public transport, pedestrians and bicycles to and from the development during the construction and operational phases, and which cause:

- works to be required on a road or within a road reserve;
- shifts in the nature or timing of works from what was planned or might reasonably have been expected in the absence of the development;
- effects upon the safety or efficiency of the road system; and/or
- effects on the planning of the road system.

Impacts are identified by comparing at key milestones during a suitable design horizon, the situations with and without the proposal.

Roads Implementation Program (RIP) A five year program of projects approved by the Minister for Main Roads which includes project description, estimated cost and funding profile by financial year (two years firm, three years indicative).

Routine Maintenance Those activities that maintain the shape or profile of the pavement and amenity of the road corridor.

Increases in routine maintenance result from increased pavement wear and damage caused by additional heavy vehicle traffic. The additional cost can be calculated by estimating the current pavement-related routine maintenance average cost for a kilometre per ESA. This rate is then applied to the ESAs associated with development over the length of pavement affected.

Pavement-related routine maintenance items include maintenance of the sealed or unsealed roadway including edges, surface, pavement, shoulders and overheads. The non-pavement routine maintenance items that are not assessed as attributable to additional traffic include drainage and roadside structures. When estimating pavement impacts of a development, the non-pavement related routine maintenance items are not included in the calculation of average annual cost for a kilometre per ESA.

The routine maintenance cost data is stored by Main Roads in the Road Maintenance Performance Contract database and summarised for the current and previous year. This data is available from the relevant Main Roads District Office.

State-controlled Road (SCR) A road declared to be controlled by Main Roads, including all National Highways in Queensland. A tollway is not declared as a SCR whilst it is controlled by a franchisee. Main Roads District Offices can provide advice about SCRs in their area.

Traffic Traffic includes vehicle, pedestrian and bicycle movements.

Traffic Operation Traffic operation is defined by way of intersection and road section performance measures. Intersection performance is normally measured in terms of degree of saturation. The performance of road sections between intersections is measured in terms of a volume/capacity ratio or level of service based upon particular deficiency criteria.

Works Works include construction, upgrading, maintenance, pavement reconstruction, surfacing and environmental mitigation works.

C SAMPLE PROJECT (RURAL)

The following sample project is intended to provide an understanding of those issues requiring consideration for rural developments. It is not intended to provide an exhaustive example of traffic analysis, although some analysis is provided for illustrative purposes.

Example 1 – Quarry

STEP 1: DEVELOPMENT PROFILE (Refer Section 4.0)

Development Details (Refer Section 4.1)

- The proposal is a new quarry to be located outside a large rural town as shown in Figure C.1. An existing processing plant, which will receive the extracted material, is located 2.5 km to the east on the same SCR (Desert Crossing Road).
- The quarry has an estimated output of 200 000 t/year.
- The development application was referred to Main Roads by the local government as the quarry would have direct access to a SCR. Further, the planned size of the quarry exceeds identified referral thresholds. (Referral triggers are documented in Main Roads' *Development Application Referral Guide*.)
- Currently the site is vacant and there are agricultural land uses adjacent.
- The development is proposed to have a single (all movements) access onto Desert Crossing Road. The processing plant has an existing access direct to Desert Crossing Road.

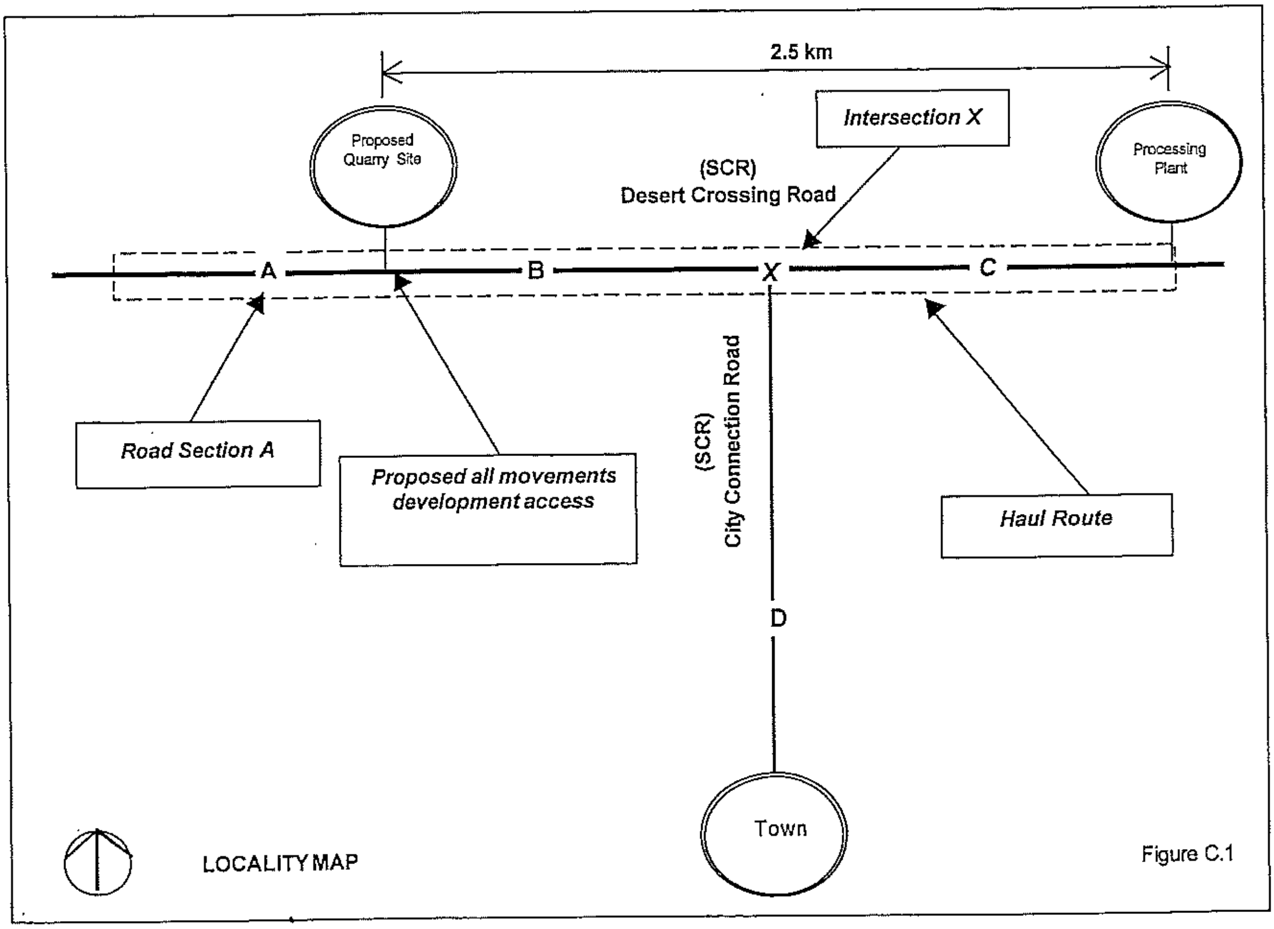


Figure C.1

- The quarry is proposed to operate in a single 6am to 5pm shift, six days per week, throughout the year (i.e. 312 days/year). Up to 25 staff will be present during a shift.
- Haulage vehicles will be 42.5 t GVM triaxle semi-tippers with a tare (vehicle) mass of 16 t and net (payload) weight of 26.5 t.
- The proposed development will employ a local workforce, residing primarily in the town.
- The quarry is expected to become fully operational in the year 2001 and has an estimated extraction life of 20 years.

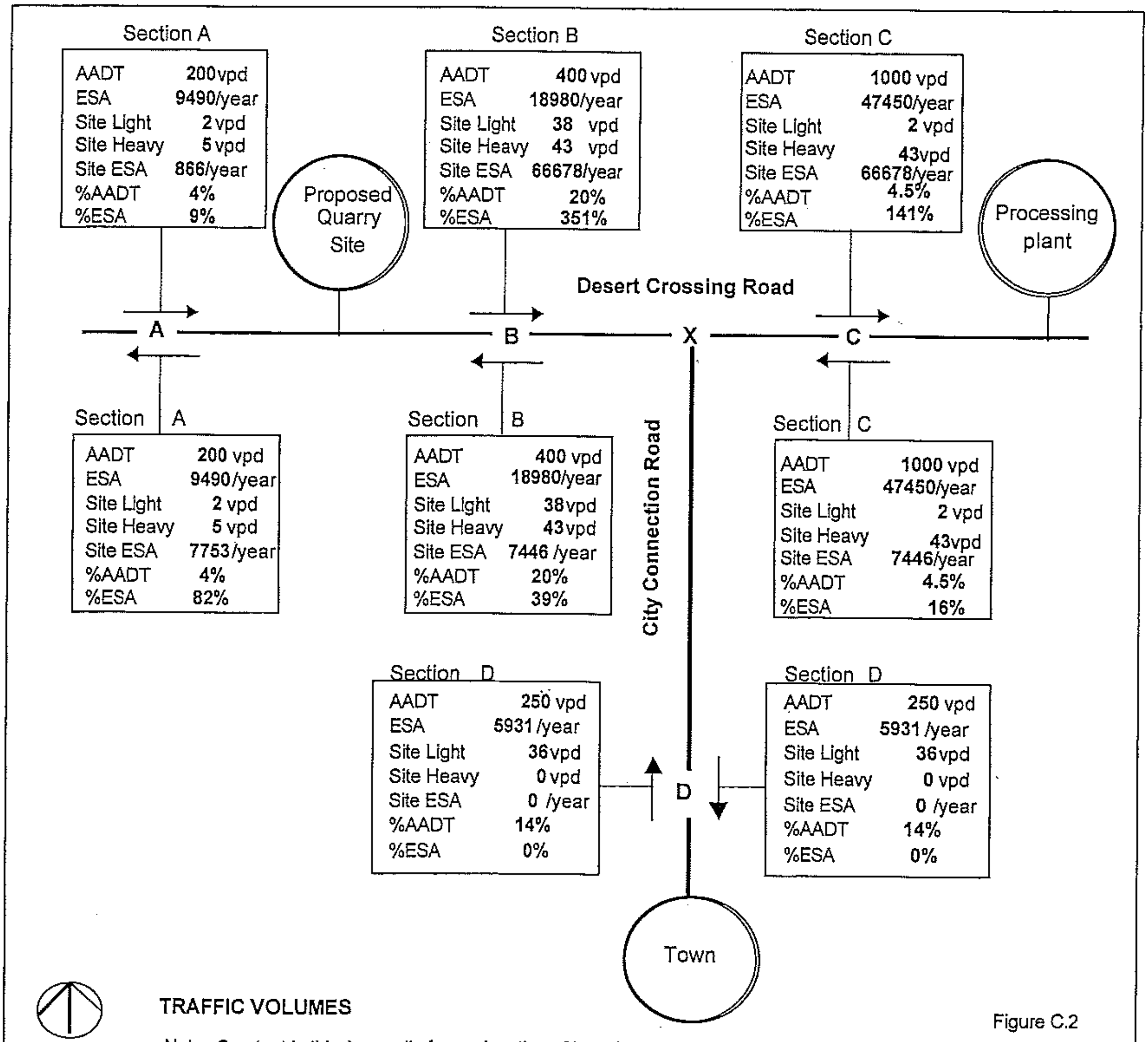


Figure C.2

Note: See text in this Appendix for explanation of how the site traffic is determined.

Surrounding Road Network Details (Refer Section 4.2)

- Desert Crossing Road is a SCR as is City Connection Road to the town. Both are low volume rural roads.
- Both roads have a 10 m pavement, comprising two 3.5 m lanes and 1.5 m sealed shoulders (the road forms were confirmed by site inspection).

- Existing AADTs provided by the Main Roads District Office are shown in Figure C.2. Road sections A, B and C have 10% commercial vehicles whilst road section D has 5% commercial vehicles.
- The Main Roads District Office has advised that the traffic growth rate in the area is of the order of 2% linear per annum.

Development Traffic Generation (Refer Section 4.3)

The likely traffic profile generated by the proposal was based upon consideration of the operation and its traffic generation characteristics.

Traffic Generation – Light Vehicles

- In this particular example, peak employee traffic has been estimated for a period of one hour. However, this may not be sufficient in some situations and estimates for periods of 15 minutes might be necessary where arrival or departure rates are more pronounced. Visitor movements have also been estimated.
- No reduction in trip making due to potential ride sharing has been made. Options for operating a shuttle bus have been examined but found to be unviable. Some ride sharing may occur and would be encouraged by the plant operator.
- A survey of a similar development was conducted by means of an automatic traffic counter to identify the traffic profile. Previous surveys of similar developments also support the assumptions adopted.

Traffic Generation – Light Vehicles

Employees		*25 staff per day x 2 trips/staff/day (1 in/1 out)*
	=	*50 light vehicle trips/day .... (A)*
	or	*25 light vehicle trips/hour (peak)*
		(trips during shifts are unlikely)
Visitors		*average of 15 visitors per day x 2 trips/visitor/day (1 in/1 out)*
	=	*30 light vehicle trips/day.. (B)*
		(it is unlikely that any of these trips would occur during the peak period)

Traffic Generation – Heavy Commercial Vehicles

- The anticipated annual profile of quarry extraction was examined and the design case identified. For the purposes of traffic operation, the peak operation ('worst case scenario') should be considered whereas for pavement impacts, the average case should be used. For the purposes of this example, it has been assumed that the peak demand is the same as the average demand.
- The quarry operator has forecast that March will be the peak month. Extraction is expected to be in the order of twice the average.

Traffic Generation – Heavy commercial vehicles
Average Demand

200 000 t/year ÷ (26.5 t/truck x 312 days/year)
= 24 loaded truck trips/day;
(24 unloaded trips/day to the site/24 loaded trips/day from the site)
= 48 heavy commercial vehicle trips/day

Peak Demand (twice the average extraction)

= 48 loaded truck trips/day;
(48 unloaded trips/day to the site/48 loaded trips/day from the site)
= 96 heavy commercial vehicle trips/day.................................(C)

Traffic Generation – All Vehicles

= 80 light vehicle trips/day + 96 heavy commercial vehicle trips/day (A+B+C)
= 176 total vehicle trips/day.

Development Traffic Distribution (Refer Section 4.4)

- The anticipated distribution of development traffic has been estimated based upon the locations of potential product destinations and staff accommodation. This is shown below in Table C.1.

Component	*Percentage*	*Road Section*	*Volume*
Light Vehicles	90%	D	72
	5%	C	4
	5%	A	4
	100%		*80*
Heavy Commercial Vehicles	90%	B and C	86
	10%	A	10
	100%		*96*

Table C.1 Traffic Distribution

- In accordance with this distribution, the daily site traffic volume is as shown in Figure C.2.

Study Network Definition (Refer Sections 3.2, 3.3 and 4.5)

- All haul routes associated with the development will need to be assessed in accordance with Criterion 4 in Section 3.2.

- To identify the spatial extent of investigation, information on existing traffic volumes and ESAs was obtained. In most cases, AADT and percentage commercial traffic will be available from the relevant Main Roads District Office. Supplementary traffic counts may be required.

Traffic Operation

- For traffic operation, assessment is required where the development traffic exceeds the thresholds set by Criteria 3 and 4 in Section 3.2.
- This is the case for road section A (Criterion 4), road section B (Criterion 3), road section C (Criterion 4) and road section D (Criterion 4).
- Intersection X also requires assessment (Criteria 3 and 4).

Pavement Impacts

- Assessment of pavement impacts is required where development traffic generates an increase in ESAs equal to or greater than 5% (Criterion 2).
- As shown in Figure C.2, the development will generate an increase in ESAs equal to or greater than 5% on road sections A, B and C. Road section A extends for the full distance of the haul route to the west.
- Existing ESAs for each road section should be calculated, as shown below, by weighting the AADT in accordance with the proportion of existing commercial traffic.

ESA Calculation (Road Section B)		
AADT	=	400 vpd eastbound
Commercial Vehicle (CV) %	=	10%
ESA:CV ratio	=	1.3 *(derived from MR's Pavement Design Manual)*
Existing ESA (Section B)	=	400 vpd x 10% CV x 365 days/year x 1.3 ESA/CV
	=	18 980 ESA/year

<u>Design Horizon</u>

- The design horizon for this project was identified as 2021, as the quarry has an estimated operating life based upon identified yield of 20 years beyond initial opening in 2001.
- For the purposes of traffic operation, it is appropriate to limit the impact assessment to 10 years and therefore 2011 has been adopted for traffic operation assessment.

<u>On-Site Aspects (Refer Section 4.6)</u>

- All servicing and parking will take place on-site as there is ample space.

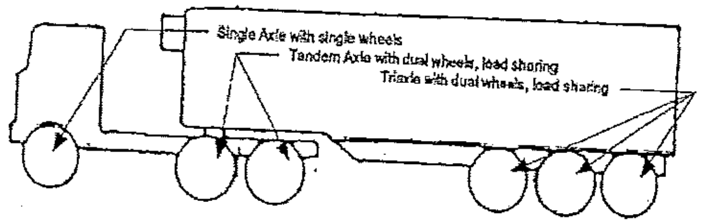
STEP 2: PAVEMENT IMPACT ASSESSMENT (Refer Section 5.0)

Pavement Loading

- To calculate development pavement loading, the ESA loading for the quarry triaxle semi-tipper was calculated as shown.

Equivalent Standard Axle Example

Triaxle Semi-tipper



Loaded or Unloaded		Single Axle Single Wheels	Tandem Axle Dual Wheels Load Sharing	Triaxle Dual Wheels Load Sharing	Totals
Unloaded	Weight (tonnes)	4.5	5.0	6.5	16.0
	ESAs	0.5200	0.0200	0.0150	0.5550
Loaded	Weight (tonnes)	6.0	16.5	20.0	42.5
	ESAs	1.5200	2.0700	1.3800	4.9700
Average	ESAs	1.0200	1.0450	0.6975	2.7625

Source: Department of Main Roads' Pavement Design Manual

Figure C.3

The resultant ESA loadings for this vehicle are:

Unloaded - 0.555
Loaded - 4.970

Development ESA (section B - Eastbound)

= 43 loaded trucks x 4.97 ESA x 312 days
= 66 678 ESA/year

Development ESA (section B - Westbound)

= 43 unloaded trucks x 0.555 ESA x 312 days
= 7 446 ESA/year

Section B - Eastbound

AADT	400 vpd
ESA	18980 /year
Site Light	38 vpd
Site Heavy	43 vpd
Site ESA	66678 /year
%AADT	20%
%ESA	351%

Section B - Westbound

AADT	400 vpd
ESA	18980 /year
Site Light	38 vpd
Site Heavy	43 vpd
Site ESA	7446 /year
%AADT	20%
%ESA	39%

- AADT and ESA calculations for the remaining sections were then completed as is shown in Figure C.2. Section B summaries are replicated below Figure C.3.

Pavement Impacts

- When addressing pavement impacts, four elements need to be addressed:
  - asset improvement;
  - programmed maintenance;
  - routine maintenance; and
  - rehabilitation.
- The pavement on road section A was calculated to have some eight years' remaining life with no development. As the development brings forward the need for rehabilitation by less than one year, no contribution was sought from the developer. However, the developer contributed towards the cost of increased routine maintenance brought about by the development.
- The pavement on road section B was calculated to have no remaining pavement life. However, in the absence of the proposed development, it would have most likely continued to operate effectively with minimal maintenance. The developer accepted responsibility for half the cost of rehabilitating road section B to Main Roads' standards, following consultation with Main Roads.
- Road section C was calculated as having a further four years' design life (2004) with no development of the quarry site. With development, the need for rehabilitation is accelerated by two years to the year 2002. The current RIP contains funding for rehabilitation that is likely to occur in 2004. Main Roads will need to ensure that funding is available to enable rehabilitation to occur in 2002, if bring forward costs are accepted from the developer.
- In this case, options for ameliorative roadworks were negotiated and agreed. However, the result of such negotiations will vary depending upon the development type and location as well as the standard of existing infrastructure. Other outcomes could include contributions based on an annual payment to cover increased maintenance costs generated as a result of the development or full payment by the developer for rehabilitation with a refund by Main Roads at a later time.
- The costs associated with the pavement impacts should be presented in a tabulated format similar to that shown in Appendix G for each road section.

STEP 3: TRAFFIC OPERATION ASSESSMENT (Refer Section 6.0)

Following identification of the traffic profile of the development, discussions with the Main Roads District Office were convened to resolve what traffic operation assessment was required along the haul route on road section A. In this instance, the District Office limited the assessment to road sections B, C and D and intersection X. The analysis process for each is outlined below.

Road Link Analysis (Refer Sections 6.3 and 6.5)

- Volumes on all sections of roads are within acceptable limits for the present road forms.
- Existing AADT volumes (2000 base year) were factored by the 2% linear annual growth rate for the 2011 analysis. The forecast link volumes without and with development are shown in Table C.2.
- Volumes on all road sections will continue to be acceptable with the existing road forms at 2011 with the development operational.
- No overtaking lane provision or four lane upgrading will be required within the 2011 design horizon.

Link	Existing AADT (2000)	2001		2011	
		No Dev	With Dev	No Dev	With Dev
Section A	400	408	422	488	502
Section B	800	816	978	976	1038
Section C	2000	2040	2130	2440	2530
Section D	500	510	582	610	682

Table C.2 Forecast Link Volumes

<u>Intersection Analysis (Refer Sections 6.4 and 6.6)</u>

- To determine the adequacy of intersection X, the site access and the processing plant access, the following have been considered:
  - intersection capacity; and
  - criteria for auxiliary turn lanes.
- Peak hour turning movement volumes with and without the development at the opening year (2001) and design year (2011) were forecast.
- SIDRA analysis for operation of unsignalised intersection X is summarised in Table C.3. Degree of saturation and 95 percentile queue lengths are as shown. The critical degree of saturation for an unsignalised intersection of this form is 80% (Refer GTEP Part 5, Section 4).
- Intersection X will continue to operate adequately in its existing unsignalised form to 2011 with the development operational.
- Rural turn lane warrants were checked under projected traffic volumes to determine whether any upgrading to the existing form of intersection X is required. In this instance, the existing AUSTROADS Type B right turn configuration will need to be upgraded to a Type C form on site opening. With no development of the quarry, upgrading would not be required within the 2011 design horizon.
- Traffic operation at the proposed quarry access and the existing processing plant access was also examined using SIDRA. The degrees of saturation at 2011 with the development operational were calculated to be 40% and 50% respectively, which in both cases is acceptable. Rural turn lane warrants were checked for both accesses and AUSTROADS Type A layouts found to be required. The existing processing plant access has already been built to this standard and requires no further work.

Design Case	DOS (%)	95%ile Queue (m)	
		Right Turn In	Right Turn Out
2001 No Development	40	10	5
2001 With Development	42	12	8
2011 No Development	75	15	8
2011 With Development	79	19	12

Table C.3 Intersection Operating Characteristics

STEP 4: SAFETY REVIEW (Refer Section 7.0)

- Actual crash rates for road sections B, C and D and critical crash rates for the district were obtained from the Main Roads District Office. As the actual crash rates were well below the critical crash rates, no amelioration is necessary.
- The safety issues checklist provided in Appendix B was used to check the safety aspects of the intersections and accesses associated with the proposed development. Pedestrian and cycle facilities are not present or needed on the low volume rural roads assessed.
- Discussions with the Main Roads District Office indicated that no safety audit is required.
- No development works are required to ameliorate any existing safety deficiencies.

STEP 5: ENVIRONMENTAL AND OTHER ISSUES (Refer Section 8.0)

- No new transport corridors are planned in the vicinity. The existing reserve for Desert Crossing Road is adequate to accommodate four lanes on the southern side if and when necessary.
- The development will not generate significant night traffic and the adjacent agricultural land uses are not sensitive to the noise and vibration created by heavy commercial vehicle traffic that will be generated by day.
- There is no adjacent development that could be affected by headlight glare. On-site lighting will be oriented so as to avoid illuminating Desert Crossing Road.
- Detailed design of the proposed quarry access will need to include landscaping to present well to passing motorists and to replace existing vegetation removed and avoid erosion on Desert Crossing Road.
- Approval for the quarry access onto Desert Crossing Road is being sought as part of this application. The spacing between the proposed access and the nearest adjacent access is approximately 1.25 km. There are few access points along this section of road and it is not anticipated that the proposed access would interfere with others.
- The detailed design of the proposed quarry access and upgrading of Intersection X to AUSTROADS Type C configuration will need to allow for drainage continuity with the existing swale drains along each side of Desert Crossing Road.
- The quarry access will need to be sealed so as not to generate dust across Desert Crossing Road. The on-site design and operational procedures will need to minimise dust generation so as not to impact Desert Crossing Road.
- There is one structure over a creek along the haul route between the site and the processing plant on road section C. Its design has been verified to accommodate the proposed haulage vehicle fleet.
- An Environmental Impact Statement (EIS) is being prepared as part of the development application. This EIS will examine the overall impact of the development.

STEP 6: IMPACT MITIGATION (Refer Section 9.0)

Impacts

The RIA has identified that the following improvements are required as a result of the development:

- Contribution toward increased routine maintenance on road section A.
- Rehabilitation of the pavement on road section B.

- Rehabilitation of the pavement on road section C is brought forward from 2004 to 2002.
- Upgrading of intersection X to AUSTROADS Type C at opening of the development.
- Construction of an AUSTROADS Type A site access intersection to the development.

Costing/Contributions

- Main Roads identified that road section A has an annual routine maintenance allowance of \$50 000 (2000 \$). With development, ESAs will increase by 9% and 82% eastbound and westbound respectively. The development therefore creates a need for a further \$22 750 per year (9% x \$50 000/2 + 82% x \$50 000/2) for routine maintenance during its operational life. In this case, Main Roads and the developer agreed that the requirement for additional routine maintenance would be limited to the first 10 years of operation of the quarry.
- After discussions with Main Roads, the developer agreed to pay half of the cost of pavement rehabilitation on road section B. This road section had no remaining pavement life but would have continued to operate effectively with minimal maintenance in the absence of the development. Using Main Roads' unit rates, the full cost of rehabilitating the pavement on road section B was estimated at \$1.25M (in 2000 \$). The developer therefore accepted responsibility for paying \$625 000.
- Main Roads advised that \$1.25M (in 2004 \$) was expected to be allocated through the RIP for rehabilitating the pavement on road section C in 2004. Using an out turn factor of 1.00/1.12 extracted from the RIP Guidelines, this is converted to \$1.12M (in 2000 \$). The cost of bringing this improvement forward from 2004 to 2002 is the responsibility of the developer. The Main Roads District Office will need to ensure that the capital cost for the rehabilitation is available in 2002.
- The developer paid for the whole cost of upgrading Intersection X to an Austroads Type C form at year 2001 (\$475 000 in 2000 \$).
- The developer paid for the cost of construction of the Type A access intersection to the quarry (\$150 000 in 2000 \$).

BRING FORWARD COST SUMMARY TABLE

(Refer Appendix G)

The development impacts are summarised below for the with development and the without development cases:

With Development

Year	Discount Period	Road Section Expenditure (X)				Intersection Expenditure (Y)				Total Expenditure (Z=X+Y)	Discount Factor (F)	Present Value (2000 $) (Z x F)
		Construction	Rehabilitation	Programmed Maintenance	Routine Maintenance	Construction	Rehabilitation	Programmed Maintenance	Routine Maintenance			
2000	0				$50,000					$50,000	1.0000	$50,000
2001	1		$1,250,000		$72,750		$625,000			$1, 947,750	0.9434	$1,837,507
2002	2		$1,120,000		$72,750					$1,192,750	0.8900	$1,061,547
2003	3				$72,750					$72,750	0.8396	$61,081
2004	4				$72,750					$72,750	0.7921	$57,625
2005	5				$72,750					$72,750	0.7473	$54,366
2006	6				$72,750					$72,750	0.7050	$51,288
2007	7				$72,750					$72,750	0.6651	$48,386
2008	8				$72,750					$72,750	0.6274	$45,643
2009	9				$72,750					$72,750	0.5919	$43,060
2010	10				$72,750					$72,750	0.5584	$40,624
TOTALS			$2,370,000		$777,500		$625,000			$3,772,500		$3,351,127 (C)

Base Year (2000)

Opening Year (2001)

RIP allocation for rehabilitation of road section C brought forward from 2004 to 2002

Total cost of rehabilitating road section B 50% Developer 50% MR

Increased routine maintenance cost on road section A

Cost of rehabilitating Intersection X ($475,000) and quarry access intersection ($150,000)

Without Development

Year	Discount Period	Road Section Expenditure (X)				Intersection Expenditure (Y)				Total Expenditure (Z=X+Y)	Discount Factor (F)	Present Value (2000 $) (Z x F)
		Construction	Rehabilitation	Programmed Maintenance	Routine Maintenance	Construction	Rehabilitation	Programmed Maintenance	Routine Maintenance			
2000	0				$50,000					$50,000	1.0000	$50,000
2001	1				$50,000					$50,000	0.9434	$47,170
2002	2				$50,000					$50,000	0.8900	$44,500
2003	3				$50,000					$50,000	0.8396	$41,980
2004	4		$1,120,000		$50,000					$1,170,000	0.7921	$926,757
2005	5				$50,000					$50,000	0.7473	$37,365
2006	6				$50,000					$50,000	0.7050	$35,250
2007	7				$50,000					$50,000	0.6651	$33,255
2008	8				$50,000					$50,000	0.6274	$31,370
2009	9				$50,000					$50,000	0.5919	$29,595
2010	10				$50,000					$50,000	0.5584	$27,920
TOTALS			$1,120,000		$550,000					$1,670,000		$1,305,162 (D)

Base Year

Limit of current RIP

RIP allocation for rehabilitation of road section C

Routine maintenance cost on road section A

Developer Contribution in Year 2000 = *$C-D*

= *$3,351,127 - $1,305,162*

= *$2,045,965*

*Less MR contribution** - *$625,000*

Total Contribution = *$1,420,965*

* *50% of the cost of rehabilitating road section B*

G BRING FORWARD COSTS

Bring forward costs are defined as the difference between the discounted present value of the cost of construction of works as planned by Main Roads and the discounted present value of the cost of construction of the same works at an earlier time dictated by a development.

In order to calculate the bring forward costs it is necessary to determine when the roadworks are required by the development and when those roadworks would normally have been provided by Main Roads. The timing of road projects to be provided by Main Roads is indicated in the RIP.

Where the timeframes extend beyond the 5 year term of the RIP it may not be possible to determine from Main Roads' plans for infrastructure whether the specific roadworks associated with a development activity are planned by Main Roads and the timing of any such roadworks. In such cases, Main Roads District Office will be able to advise on an appropriate methodology to determine when the roadworks would reasonably have been expected to be provided by Main Roads. This date would normally reflect the timing of associated roadworks or the date when traffic volumes would have triggered the roadworks having regard to past trends in traffic growth and realistic assumptions about availability of government roads funding, taking into account other competing priorities. In some instances, the road needs of the development may already have been taken into account in the scheduling of future roadworks.

Main Roads will have regard to the future commitments in the RIP before accepting a bring forward cost option. Funds are committed in the first two years of the RIP. Where the works under consideration are substantial, it may not be feasible for Main Roads to accept bring forward cost arrangements and other funding arrangements may be necessary. Bring forward cost arrangements are only available where Main Roads can accommodate any of the necessary changes required to future budgets and works arrangements. Subject to the provisions of IPA, Main Roads has discretion in whether to accept any bring forward cost arrangements.

Present value is calculated using present day construction costs and the discount rates established by State Treasury. The discount rate is a 'time preference' discount rate, which is net of any allowance for inflation.

The RIP presents construction costs in 'out-turn' prices (i.e. the predicted cost in future dollar terms). An allowance for inflation is made using factors that are released each year in the RIP guidelines. As a result, future year construction costs in the RIP have to be deflated by these factors to obtain present day construction costs.

Example

Intersection works are shown on the RIP for 2004. The construction cost in 2004$ was 'deflated' to give a cost of $870 000 in current dollars (2000$). Development causes the works to be needed in 2002. The Treasury time preference discount rate is 6%.

Refer to Discount Factors Table in this Appendix

Discount Factor (2004 – 2000)	$= (1.06)^{-(2004 - 2000)}$
	= 0.7921
Present value of works in 2004	= $870 000 x 0.7921
	= $689 127
Discount Factor (2002 – 2000)	$= (1.06)^{-(2002 - 2000)}$
	= 0.8900
Present value of works in 2002	= $870 000 x 0.8900
	= $774 300
therefore bring forward cost	= $774 300 - $689 127
	= $85 173

DISCOUNT FACTORS (F)

Treasury Time Preference Discount Rate / Discount Period (years)	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
1	0.9901	0.9804	0.9709	0.9615	0.9524	0.9434	0.9346	0.9259	0.9174	0.9091
2	0.9803	0.9612	0.9426	0.9246	0.9070	0.8900	0.8734	0.8573	0.8417	0.8264
3	0.9706	0.9423	0.9151	0.8890	0.8638	0.8396	0.8163	0.7938	0.7722	0.7513
4	0.9610	0.9238	0.8885	0.8548	0.8227	0.7921	0.7629	0.7350	0.7084	0.6830
5	0.9515	0.9057	0.8626	0.8219	0.7835	0.7473	0.7130	0.6806	0.6499	0.6209
6	0.9420	0.8880	0.8375	0.7903	0.7462	0.7050	0.6663	0.6302	0.5963	0.5645
7	0.9327	0.8706	0.8131	0.7599	0.7107	0.6651	0.6227	0.5835	0.5470	0.5132
8	0.9235	0.8535	0.7894	0.7307	0.6768	0.6274	0.5820	0.5403	0.5019	0.4665
9	0.9143	0.8368	0.7664	0.7026	0.6446	0.5919	0.5439	0.5002	0.4604	0.4241
10	0.9053	0.8203	0.7441	0.6756	0.6139	0.5584	0.5083	0.4632	0.4224	0.3855
11	0.8963	0.8043	0.7224	0.6496	0.5847	0.5268	0.4751	0.4289	0.3875	0.3505
12	0.8874	0.7885	0.7014	0.6246	0.5568	0.4970	0.4440	0.3971	0.3555	0.3186
13	0.8787	0.7730	0.6810	0.6006	0.5303	0.4688	0.4150	0.3677	0.3262	0.2897
14	0.8700	0.7579	0.6611	0.5775	0.5051	0.4423	0.3878	0.3405	0.2992	0.2633
15	0.8613	0.7430	0.6419	0.5553	0.4810	0.4173	0.3624	0.3152	0.2745	0.2394
16	0.8528	0.7284	0.6232	0.5339	0.4581	0.3936	0.3387	0.2919	0.2519	0.2176
17	0.8444	0.7142	0.6050	0.5134	0.4363	0.3714	0.3166	0.2703	0.2311	0.1978
18	0.8360	0.7002	0.5874	0.4936	0.4155	0.3503	0.2959	0.2502	0.2120	0.1799
19	0.8277	0.6864	0.5703	0.4746	0.3957	0.3305	0.2765	0.2317	0.1945	0.1635
20	0.8195	0.6730	0.5537	0.4564	0.3769	0.3118	0.2584	0.2145	0.1784	0.1486
21	0.8114	0.6598	0.5375	0.4388	0.3589	0.2942	0.2415	0.1987	0.1637	0.1351
22	0.8034	0.6468	0.5219	0.4220	0.3418	0.2775	0.2257	0.1839	0.1502	0.1228
23	0.7954	0.6342	0.5067	0.4057	0.3256	0.2618	0.2109	0.1703	0.1378	0.1117
24	0.7876	0.6217	0.4919	0.3901	0.3101	0.2470	0.1971	0.1577	0.1264	0.1015
25	0.7798	0.6095	0.4776	0.3751	0.2953	0.2330	0.1842	0.1460	0.1160	0.0923

BRING FORWARD COST SUMMARY TABLE

With Development

Year	Discount Period	Road Section Expenditure ($X)				Intersection Expenditure ($Y)				Total Expenditure ($Z)	Discount Factor (F)	Present Value (Base year $)
		Construction	Rehabilitation	Programmed Maintenance	Routine Maintenance	Construction	Rehabilitation	Programmed Maintenance	Routine Maintenance			
Base Year	0	*Estimate of construction costs in base year dollars*	*Estimate of rehabilitation costs in base year dollars*	*Estimate of programmed maintenance costs in base year dollars*	*Estimate of routine maintenance costs in base year dollars*	*Estimate of construction costs in base year dollars*	*Estimate of rehabilitation costs in base year dollars*	*Estimate of programmed maintenance costs in base year dollars*	*Estimate of routine maintenance costs in base year dollars*	=X+Y		=ZxF
.	1											
.	2											
.	3											
.	.											
.	.											
.	.											
.	.											
.	.											
.	.											
.	.											
Horizon Year												
TOTALS												$ NPV (C)

Without Development

Year	Discount Period	Road Section Expenditure ($X)				Intersection Expenditure ($Y)				Total Expenditure ($Z)	Discount Factor (F)	Present Value (Base year $)
		Construction	Rehabilitation	Programmed Maintenance	Routine Maintenance	Construction	Rehabilitation	Programmed Maintenance	Routine Maintenance			
Base Year	0	*Estimate of construction costs in base year dollars*	*Estimate of rehabilitation costs in base year dollars*	*Estimate of programmed maintenance costs in base year dollars*	*Estimate of routine maintenance costs in base year dollars*	*Estimate of construction costs in base year dollars*	*Estimate of rehabilitation costs in base year dollars*	*Estimate of programmed maintenance costs in base year dollars*	*Estimate of routine maintenance costs in base year dollars*	=X+Y		=ZxF
.	1											
.	2											
.	3											
.	.											
.	.											
.	.											
.	.											
.	.											
.	.											
.	.											
Horizon Year												
TOTALS												$ NPV (D)

TOTAL DEVELOPMENT CONTRIBUTION = $ (C-D) Base Year Dollars

With Development

Year	Discount Period	Road Section Expenditure				Intersection Expenditure				Total Expenditure	Discount Factor (F)	Present Value (Base year $)
		Construction	Rehabilitation	Programmed Maintenance	Routine Maintenance	Construction	Rehabilitation	Programmed Maintenance	Routine Maintenance			
TOTALS												

Without Development

Year	Discount Period	Road Section Expenditure				Intersection Expenditure				Total Expenditure	Discount Factor (F)	Present Value (Base year $)
		Construction	Rehabilitation	Programmed Maintenance	Routine Maintenance	Construction	Rehabilitation	Programmed Maintenance	Routine Maintenance			
TOTALS												

TOTAL DEVELOPMENT CONTRIBUTION = $