Department of Transport

Transport Modelling Guidelines
for developments in Activity Centres

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Contents

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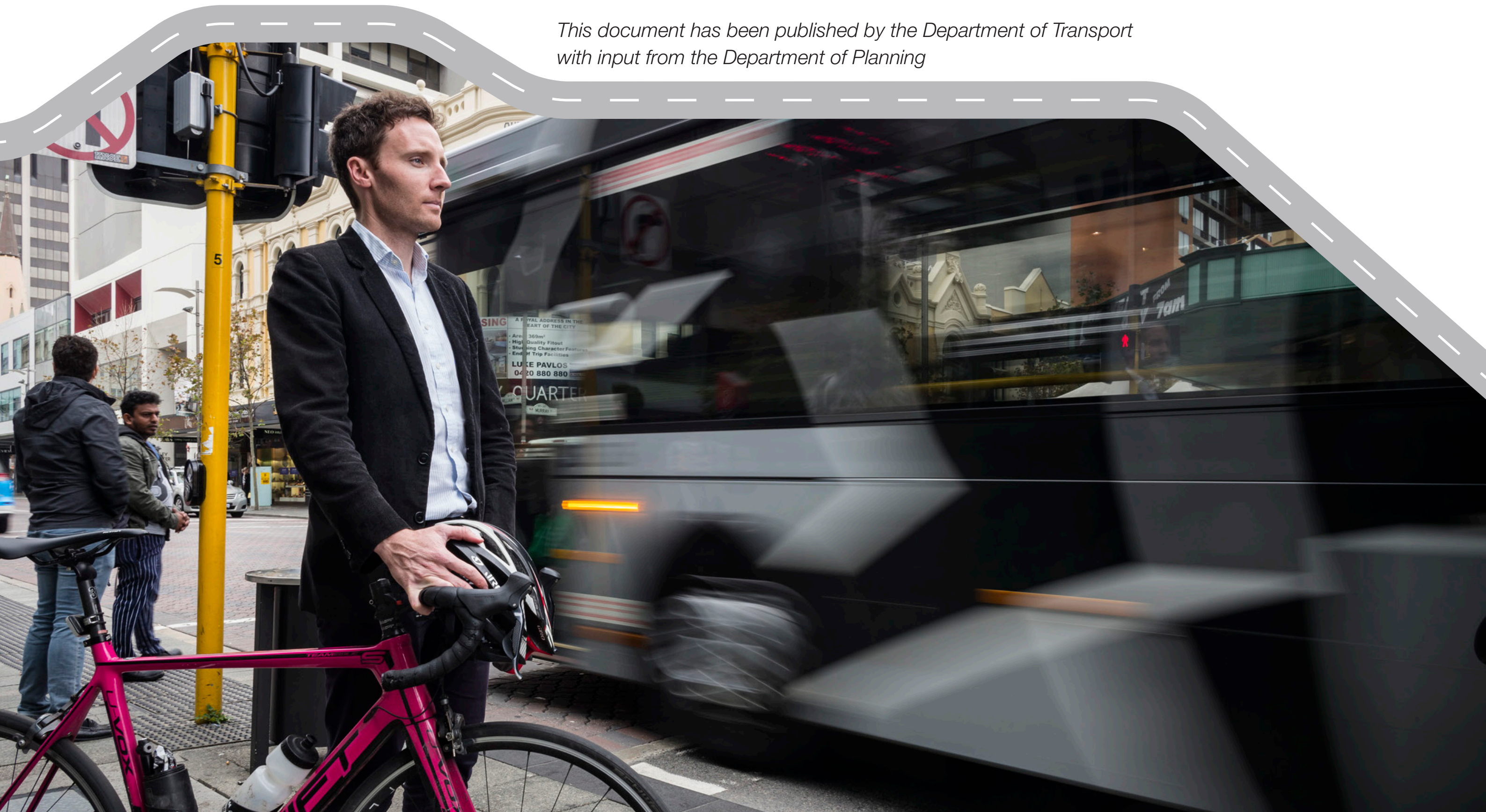


Transport modelling guidelines for developments in Activity Centres

Activity centres are a key element in planning land use for a liveable and prosperous Perth and Peel region.

Prior to any medium or major development within activity centres, it is important that existing and potential transport patterns are considered.

This document is a reference tool for both transport modellers and planners for the development and use of transport models that accompany Transport Assessments for such development within activity centres.

This document seeks to define and clarify key terms and guide transport modelling approaches for the intended area. It is not intended to be a comprehensive textbook on modelling and is to complement the guidance provided by the Western Australian Planning Commission. These guidelines are to be read in conjunction with Modelling Guidelines for Transport Activity Centre structure plans (Department of Transport 2016).

01 What is an activity centre?

The type and spatial location for activity centres in Directions 2031 and Beyond (Western Australian Planning Commission [WAPC], 2010) is broadly categorised by good existing (or future planned) public transport access (i.e. close to a train station or major bus routes) and they are often centered around existing employment, education or retail hubs.

Business and retail also prefer good road networks access by car, and activity centres should where possible be easily accessed from the major road network. Where possible, it is preferable that this major road system go around rather than through the centre.

It should be recognised that successful activity centres, by their very nature, attract activity, which can lead to increased travel and congestion. As such, it is reasonable to expect movement and vibrancy within these centres and a reasonable level of congestion on some streets during the peak periods.

State Planning Policy 4.2 (WAPC, 2010) defines activity centres as *community focal points. They include activities such as "commercial, retail, higher-density housing, entertainment, tourism, civic/ community, higher education, and medical services. Activity centres vary in size and diversity and are designed to be well-serviced by public transport and provide good safe access by walking and cycling."*

02 What is the role of transport modelling in relation to activity centre structure plans?

When assessing Development Applications, approving authorities need to be able to make a decision on whether to accept or reject a development in the form it is presented based upon the likely impact on the transport system. In particular, the WA Transport Portfolio (comprised of the Department of Transport [DoT], Main Roads WA [MRWA], and the Public Transport Authority [PTA]) needs to be satisfied that its intended outcomes are being met.

Transport models provide an objective basis for projecting and measuring potential impacts on the transport system due to new development or redevelopment.

Such objective criteria can make the evaluation process significantly easier, particularly when qualitative factors are considered.

Whilst Transport Assessments (TA's) are designed specifically to address transport issues, the overall reason society cares about transport is because it affects their quality of life. People are attracted to activity centres because they are easy to access by a choice of transport modes, but also because they are attractive, vibrant places that add to the enjoyment and quality of life of residents and visitors.

Proposed transport solutions should not significantly detract from the overall quality of life experienced in the centre.

03 What are the intended outcomes?

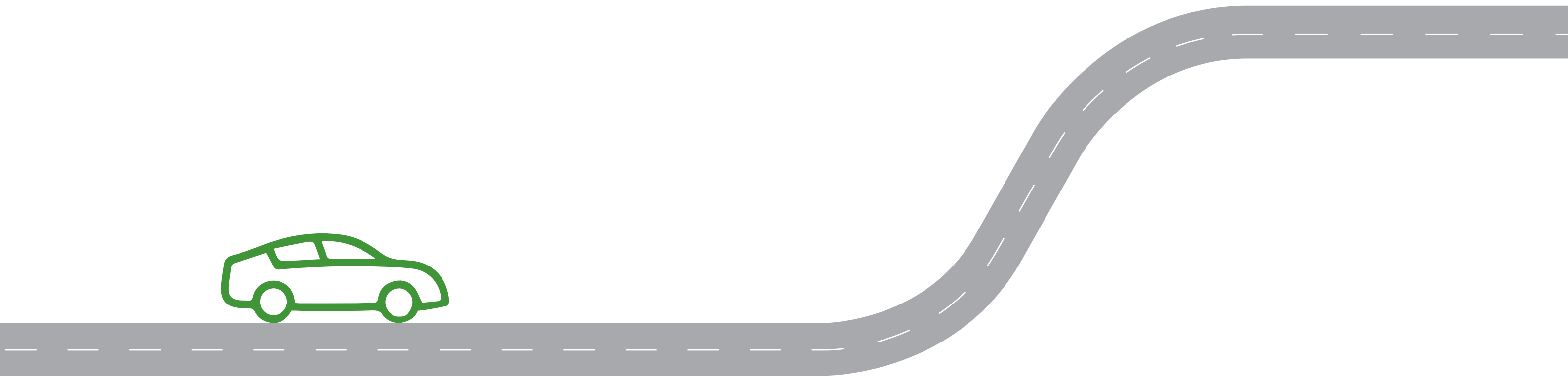
The role of the Transport Portfolio is to ensure that the impacts associated with new developments meet the intended transport outcomes of each of the organisations.

The Transport Portfolio also has a role to ensure the needs of other stakeholders (local government agencies (LGA's), businesses and the broader community) are adequately considered.

There are a range of intended transport outcomes that are outlined in the visions of each of the Transport Portfolio organisations. These can broadly be categorised as:

- **Accessibility** – the ability for people to reach goods, services and activities;
- **Efficiency** – the ability to minimise the cost, time and space of travel;
- **Sustainability** – the method of reaching the destination is environmentally friendly, now and in the future;
- **Safety** – the destination can be reached as safely as possible by all modes of transport; and
- **Reliability** – the destination can be reached within a consistent time.

It should be noted that as some of these measures improve, others are typically impacted adversely. For example, reducing the number of interchanges on a highway can improve efficiency on the highway but, as a result, it can become less accessible and there can be reduced efficiency and congestion at the reduced number of access points. A balanced solution is required and road purposes need to be identified.



04 What actions can influence the outcomes?

There are a number of actions that can be implemented to improve intended outcomes, including:

1. Implement policy and/or pricing mechanisms;
2. Undertake education, marketing and information programs; and
3. Provide improved infrastructure and services.

It is noted that the first two actions may be described as demand management measures, whilst the third measure is generally implemented to increase the people moving capacity of the system through physical means.

In general, it should be recognised that proponents can, as part of the development, more easily fulfill policy and pricing mechanisms first (particularly with respect to parking and information), followed by capital expenditure on infrastructure and lastly by operational expenditure on services.

This order of option generation is also more preferable to the Transport Portfolio.

05 What are the Performance Criteria?

Performance criteria related to such issues as accessibility and efficiency are important considerations in determining whether or not a development should be approved.

As noted above, transport modelling provides an objective assessment in terms of accepting or rejecting transport related outcomes based on particular numerical outputs. However, ideally the outcomes of transport models should not solely influence whether a development should be allowed to proceed or not because each activity centre has unique transport, land use, and access requirements.

As such, the modelling outputs should be evaluated by the relevant agencies on a case by case basis to ensure that the specific land use and transport context of the activity centre are also considered.

Accessibility and efficiency criteria and metrics will be discussed in more detail, below.

5.1 Accessibility metrics and criteria

A range of metrics defined for measuring accessibility have been developed over a number of years for different modes of transport.

The focus in traffic modelling exercises tends to be on accessibility of road functionality, however transport planning should consider accessibility over all modes.

If accessibility is defined as being whether someone can access their needs and opportunities within their destination or not, then an oversaturated network is an inaccessible one.

Based upon this, a pass / fail criteria is recommended to ensure that a development does not oversaturate the network over peak hour periods.

With respect to traffic models, saturation can be measured either by:

- **Analytical models** - Volume over Capacity (V/C) ratios. In this case, the pass / fail criteria for a scenario would be that V/C ratios of critical parts of the network (including intersections) fall below / exceed practical capacity (i.e. 90 per cent); or
- **Simulation and hybrid models** - the number of unreleased vehicles, as vehicles cannot be released once the network has reached a point of saturation. In this case, the pass / fail criteria for a scenario would be that the number of unreleased vehicles falls below 10 per cent.

It is noted that not all of these intended outcomes can be fully described within the context of traffic modelling. To this end, only the most common considered measures are outlined in the Performance Criteria section. It may be that in future years other metrics are added to provide guidance on other intended outcomes.

5.2 Efficiency metrics and criteria

In terms of efficiency, traffic assessments typically consider the impact of travel time and the efficiencies associated with these. These are often described in terms of travel time, average delay or Level of Service.

Efficiency of space is not as well considered as time and cost in TA's, but can provide a significant effect on the outcome. For example, in moving people, public transport provides a more efficient use of space than single occupancy cars. On the other hand, most freight movements in cities are more cost effective when they are moved by road.

Where public transport exists, efficiency should be maintained. Likewise, where heavy freight movements exist these should also be maintained.

Based upon this, two pass / fail criteria are recommended for the intended outcome of efficiency.

These are:

- → Public transport vehicles are able to travel along their designated routes with minimal delay, or without any travel time addition through the network as a result of the development; and
- → The travel times for freight vehicles along primary freight roads are no longer than those experienced without the development.

With respect to traffic models, the travel time criteria can be measured with either:

- → **Analytical and hybrid models** - travel time is estimated using congestion functions. These functions may be link based and / or turn based. Key travel times along a route should be considered.
- → **Simulation models** - vehicle travel times are simulated for the extent of a route. Key travel times along routes should be considered.

06 Setting up a transport model for assessment of developments at activity centres

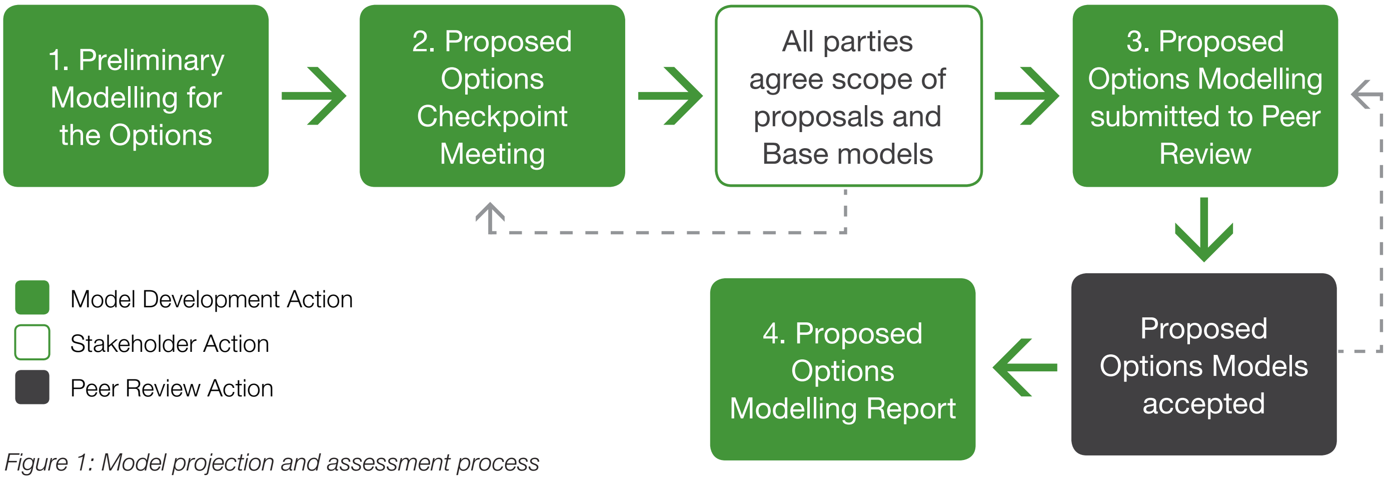


Figure 1: Model projection and assessment process

6.1 Preliminary planning and stakeholder liaison for transport modelling

Modelling is, by definition, intended to simulate a situation related to a task, ensuring that the risks associated with the inputs are minimised.

It is a waste of effort to build a detailed or precise traffic model for a scenario where the inputs are so uncertain, whilst similarly it is a waste to build and use a model which is singularly unsuited for assessing a particular task.

The scope of the model and the scope of the data that is required to be collected should be established by a representative of the developer's consulting team at a scoping meeting with representation from the Transport Portfolio, the Department of Planning and a representative from the relevant LGA.

In particular, consultation should be undertaken with the Major Urban Centres Branch of the DoT, and the MRWA Planning Branch.

It is recognised that getting representation from all of these agencies may be difficult. Therefore, the applicant should liaise with each and identify and agree a point/s of co-ordination and leadership across all agencies (referred to herein as the agency leader). It is important that these agencies work together.

The following components of the modeling should be established and agreed upon:

- the spatial scope of the model;
- the time periods that the model represents;
- the approach to modelling traffic signals in the base case and with development cases; and
- an appropriate auditor for the model.

Further to this, the modelling approach chosen should allow (in some form) the testing the effect of:

- of parking pricing on mode choice for the centre;
- of parking time restriction on departure time choice and mode choice for the centre;
- of parking restraint on mode choice for the centre;
- of improvement of bus frequency and travel times on mode choice for the centre; and
- of the provision of bicycle facilities on mode choice for the centre.

The modelling approach chosen needs to be able to adequately provide data that responds to the criteria set out in Section 5.

Additionally, a transport model auditor should be selected to undertake the tasks detailed in below. This auditor should report to the agency leader, but be commissioned by the proponent. Both the agency leader and the applicant need to select the auditor together.

The approach identified should be documented and distributed to all the relevant agencies through the agency leader.

Refer to Transport Modelling Guidelines for Activity Centre structure plans (DoT 2016) for additional information.

6.2 Data collation and collection

There are a number of broad survey types that can be collected to assist in transport model development, including:

- Data on the transport network, including physical layout, number of lanes, capacities (either road network or public transport), signal timings, and public transport routes and frequencies, parking provision and prices;
- Counts of persons at entry points or accessing / egressing public transport or vehicle movements at centre access points, midblock or at intersections;
- Parking occupancy and length of stay data;
- Journey times (either public transport, pedestrian or general vehicle);
- Origin / destination surveys; and
- Interview surveys, in which transport users describe their travel behavior (either that they have made or would make) through household travel diaries, intercept surveys or web-based surveys.

The first four data types can be collected in relatively large quantities from a range of sources at relatively little cost. However, the data is limited because it does not provide the relevant information that informs the weakest inputs into the model, such as trip purpose, destination choice, mode choice, and time of departure choice. As such, more comprehensive and expensive data collection is often required to develop more robust transport models, such as targeted electronic surveys and in person interviews. These are discussed in more detail below:

- **Electronic surveys** - In some activity centres, travel to mandatory computer based activities (ie. white collar work, education purposes) can often be surveyed most cost effectively and timely through email based surveys where employee lists are available. For example most universities have access to all emails of employees and students.

  Previous studies have suggested that these surveys can achieve above 10% sample rate within three days of issue of emails.

  The negative side of this survey approach is that it may have significant sample bias.

- **In person interviews** - In retail focused activity centres, door intercept or car parking surveys can be used to capture (and disaggregate) the travel patterns of both mandatory and discretionary travel. These surveys are best undertaken as interview surveys as experienced and persuasive interviewers can often achieve reasonable sample rates and are not so exposed to sample bias.

  A potentially cheaper alternative is to use a survey hand out with a link to a mail and / or web-based return mechanism. This approach requires some incentive to obtain a high sample rate, and again may suffer sample bias depending on the return mechanism and the incentive.

The significant benefits of both survey types described are that they can expose both revealed preference and stated preference data about trip purpose, destination choice, mode choice and time of departure choice. Stated preference data should be collected in instances where mitigation options not currently available may be implemented.

For example, a shopping centre that does not currently have a car parking pricing policy may use a series of stated preference questions to test the willingness to pay for particular schemes.

6.3 Model development and calibration

It is assumed that the model development would be undertaken with guidance from an experienced transport modeller.

This guidance recognises that methods change, and so flexibility is required. A series of standard references are contained within Section 9 of this document to support a variety of approaches.

In general, the calibration process should result in the model being able to reflect adequately observed values that form either wholly or part of the metrics that are being used to assess the development.

To this end, if the goals are to model accessibility and efficiency as described in the related metrics above (Section 5) then the calibration should be able to demonstrate that the model is able to replicate:

- Traffic volumes along key corridors;
- Capacities along the key corridors;
- Travel times along key bus routes; and
- Travel times along key freight routes.

Statistical and engineering approaches for measuring the goodness of fit include statistical methods such as linear regression methods, and other specifically designed traffic engineering criteria like the GEH criterion. Detailed discussion of these and other methods can be found in a range of other international documents; for more information please refer to Section 9.

In undertaking the calibration, the transport modeller should consider whether the calibration has potentially warped the efficacy of a model, and provide comment on this within the modelling report.

6.4 Model auditing and validation

Once a model has been developed and calibrated, it is recommended that a model auditor be engaged to check a sample of input, composition, parameters and outputs of a model to both check for errors and to ensure that the model meets the agreed scope.

The auditor should also undertake validation of these model outputs using data independent from that used in the calibration. The object of this is not to flag a re-calibration, but to point out the potential margin for error associated with the model.

07 Projection and assessment of outcomes

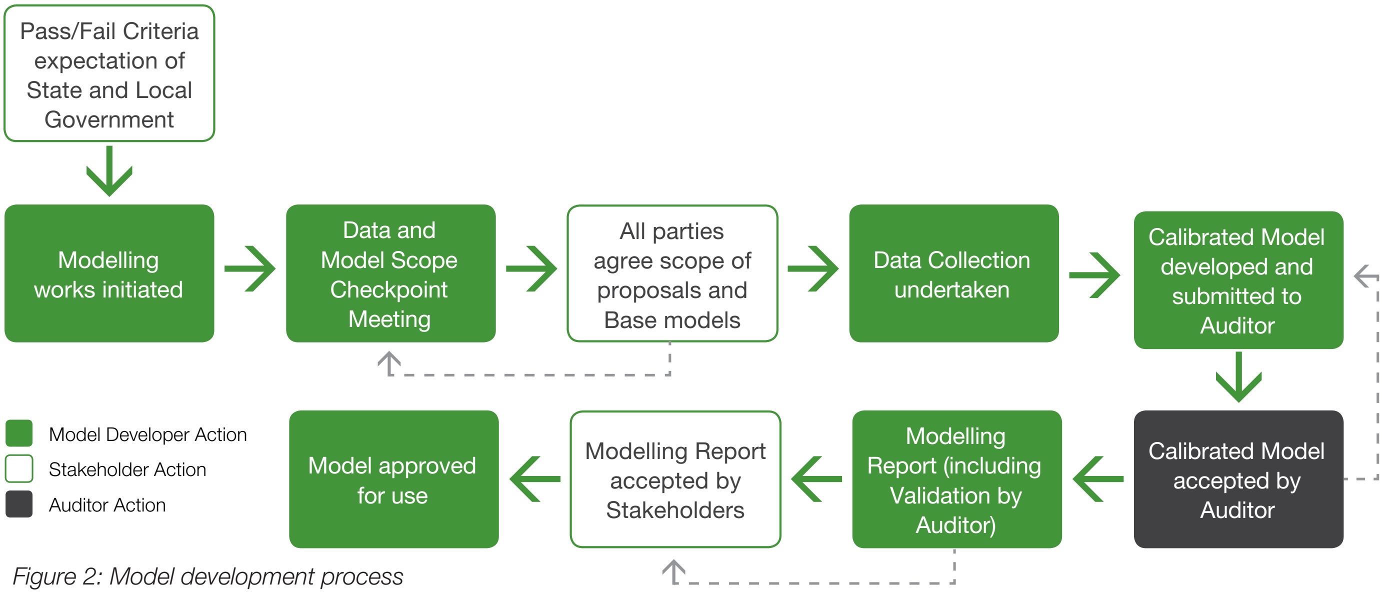


Figure 2: Model development process

The Transport Assessment Guidelines for developments (WAPC, 2006) refer to three scenarios that should be considered when assessing outcomes, including:

- **Base Case -** the year of full opening of Development, without the development – in most cases this can refer to the calibrated base case already prepared;
- **With Development Case -** the year of full opening of development, with the development; and
- **With Development Expected Sensitivity Case -** this looks at 10 years after full opening with the development and expected changes in background traffic.

The purpose of the Base and With Development cases is to establish whether the development meets the assessment criteria as detailed in Section 5.

Whilst the data from the scenarios would ultimately result in a large amount of numerical information being developed, there is a requirement for the modelling to be communicated in a manner that is accessible to the wider transport planning community.

As such, it is expected that the modeller would provide a written description (along with diagrams where possible) of the expected changes that would occur with respect to the impact of the new development.

7.1 Projecting the change in traffic for the centre

In developing the final With Development case, it is likely that the developer will revise aspects of the development and associated policies to change either travel demand or infrastructure in order to meet the criteria.

In doing so, options 1 and 2 (changes to policy/ pricing and providing education/information) listed in Section 4 should be considered first, before option 3 (investment in infrastructure and services), and agreement with the stakeholders of the preferred order should be derived prior to modelling.

The purpose of the With Development Sensitivity Case is to identify the timing of review and / or action for the government organisation. The With Development Sensitivity Case should identify the change in demand at the worst location/s identified in the With Development Case, and identify the timing at which accessibility is breached.

Given the typical uncertainty associated with the assumptions in a 10 year horizon, the modelling outputs of this scenario should not imply a high level of accuracy.

Furthermore, in significant Activity Centres, High and Low sensitivity growth scenarios should also be prepared so that an Action Range can be determined.

Projections of changes in background traffic for the sensitivity test are likely to be controversial. There is often significant error associated with projections of broad changes in land use, which either seem illogical (because of the land use forecasting approach used) or ambitious (because they are aspirational targets set by competing entities).

They also often favour outcomes of infrastructure provision over demand management measures. It is recommended that change in background traffic be a considered combination of objective data with subjective views from the following sources:

→ **Future plans for arterial corridors (TransPriority)** – for example, it may be a goal to limit traffic growth along a street or network to a certain level of which a certain realistic amount may be agreed to by the stakeholders;

→ **Strategic model forecasts** – depending on the circumstances, strategic model forecasts for corridors may be obtained from the Strategic Transport Evaluation Model (STEM) or the Regional Operations Model 24 (ROM24). For further information about STEM and ROM24, refer to Transport Modelling Guidelines for Activity Centre Structure Plans. Ideally these values should not be applied without consideration to the error that occurs with them, and adjustments where necessary; and

→ **Trend analysis** – this involves the plotting of temporal traffic data along a corridor to establish a growth rate if there is a growth (or a rate of decline if there is a rate of decline). The trend should also include the lowering of car mode share to date and projected rates are often applied linearly.

7.2 Peer review

Resulting from the With Development and Development Expected Sensitivity scenarios, a number of assumptions will need to be made by the modeller and/or other parties, regardless of the level of detail and autonomy of the model.

A peer review is recommended to provide a sense check on the validity of the key assumptions that have been made and the reasonableness of the model outcomes. In particular, the following should be considered:

→ the reasonableness of the travel generation;

→ the reasonableness of the distribution to/from accesses to centre development;

→ any assumptions or modelling with respect to changes associated with demand management measures;

→ reasonableness of the derivation/ methodology of arriving at the future background traffic change; and

→ any other innovative ideas that should be considered.

08 Reporting checklist

8.1 Model development reporting

The Transport Assessment Report should include, as a minimum, the following features from the modelling exercise that would be of interest to both transport planning and modelling assessors – these include:

- a summary of the existing surveyed traffic generation;
- the surveyed or assumed travel distribution of the centre – this may be preferably displayed as a desire line plot or in a summarised tabular format;
- the agreed model scope including spatial information and how the model accounts for each of the features listed in Section 6;
- a summary in map form of the calibration results;
- a summary of the key limitations of the traffic model; and
- a summary of the findings of the auditor's report and the validation exercise.

The Transport Assessment Report should include as an Appendix the auditor's report and a detailed transport modelling development report.

8.2 Model options reporting

The report should:

- summarise the input assumptions associated with the With Development scenarios and where possible provide justifications for those assumptions;
- summarise the preferred mitigation options for testing that were agreed before modelling the assessment scenarios;
- summarise the travel generation under all scenarios – this would ideally be done within a bar graph form;
- compare the accessibility measures (as discussed in Section 5) across each of the three scenarios;
- compare the efficiency measures across each of the three scenarios (as discussed in Section 7); and
- summarise in graphical form the expected timing of reaching saturation (and hence the action time), and in primary activity centres, the range of action time. The broader TA should consider and outline the need and timing for that action.

Whilst the assessment primarily revolves around the ability to meet the intended outcomes as described by the accessibility and efficiency measures, the Transport Assessment Report should also communicate the broader expected outcomes.

This may be through a number of the following ways, such as:

- Videos of animations (if the model is a microsimulation model);
- Written communication of the operations; and
- Intersection tables summarising Degree of Saturation, Level of Service and expected maximum queuing (i.e. 95% back of queue-lengths or maximum simulated queue-lengths).

09 Glossary and web-based reference material

GLOSSARY	DEFINITION
Analytical model	A model that uses direct mathematical computations to determine system states. Examples of commercial network analytical models that use predominantly analytic methods to estimate aspects of traffic operation are EMME, Cube Voyager and VISUM whilst intersection analytic models include SIDRA and HCM. These models are best suited for long term, less detailed projections and can best provide objective information about the state of the road network in the form of average delays and V/C ratios and 95% expected queue information.
Simulation model	A model that uses various rules (mostly in the form of mathematical equations) for movement of vehicles in a system (individually or in platoons). Commercial examples include Paramics, VISSIM, AIMSUN Micro and Commuter. These models are best suited for short term, very detailed projections and can provide simulated delay and travel time, unreleased vehicles and simulated queue information.
Hybrid model	A model that uses both analytic and simulation techniques in some form. Commercial examples include Cube Avenue, AIMSUN Meso, SATURN, VISUM (Dynamic assignment), TRANSYT and LINSIG. These can typically provide both sets of information that can be extracted from both simulation and analytical models.
Mode choice	Users of the transport system decide which mode of transport to take (e.g. car, public transport, walk, cycle, etc.).
Departure time choice	Users of the transport system decide when to start a trip.
Preferred arrival time	Users of the transport system decide when they would like to end a trip.

REFERENCE DOCUMENTS	AVAILABLE AT
WA State Planning Material	
Western Australian Planning Commission 2010, *Directions 2031 and Beyond*, Albert Facey House, Perth	http://www.planning.wa.gov.au/publications/826.asp
Western Australian Planning Commission 2006, *Transport Assessment Guidelines for Developments, Volume 1 – General Guidance,* Perth	http://www.planning.wa.gov.au/publications/1197.asp
Guidance and Material for Transport Modellers These manuals typically provide large amounts of detail appropriate for transport modellers in the guidance of model development, calibration and validation.	
Transport and Infrastructure Council 2015, *2015 National Guidelines for Transport System Management in Australia: Travel Demand Modelling,* Canberra	http://ngtsmguidelines.com/tools- techniques/demand-modelling/
Smith, J & Blewitt, R (eds) 2010, Traffic Modelling Guidelines: *TfL Traffic Manager and Network Performance Best Practice,* London	https://www.tfl.gov.uk/cdn/static/cms/documents/traffic-modelling-guidelines.pdf
Federal Highway Administration 2004, Guidelines for *Applying Traffic Microsimulation Modeling Software, McLean*, Virginia	http://ops.fhwa.dot.gov/trafficanalysistools/tat_vol3/
Roads and Maritime Services 2013, *Traffic Modelling Guidelines*, NSW	http://www.rms.nsw.gov.au/business-industry/partners-suppliers/documents/technical-manuals/modellingguidelines.pdf
Department of Transport (UK), 2014, TAG UNIT M1 – *Principles of Modelling and Forecasting*	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/427118/webtag-tag-unit-m1-1-principles-of-modelling-and-forecasting.pdf

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