

New South Wales Government



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Paramics Microsimulation Modelling RTA Manual





Roads and Traffic Authority www.nsw.rta.gov.au

VERSION: 1.0 ISSUED: May 2009

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ISBN 978-1-921598-52-4 (Electronic only) RTA/Pub. 09.166



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Amendment record					
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Executive summary

The Roads and Traffic Authority of NSW (RTA) is the State Government authority with responsibilities for major road projects, maintenance of the major road network, traffic management and planning. In order to effectively plan and manage the road network, the RTA utilises a set of software tools and guidelines to accurately assess network conditions and plan future operations.

One such tool is the Quadstone Paramics microsimulation software which has been used by the RTA for several years.

The purpose of the this manual is to provide guidance in Paramics to both RTA staff and those submitting work to the RTA in order to maintain a high quality of modelling and accurate decision support models.

Microsimulation modelling is a software based approach for the analysis of detailed and complex intersections, corridors and networks. Microsimulation theory is based on individual vehicle behaviour and the simulation of their interaction with the network and other road users. Microsimulation has developed independently from existing demand modelling and junction design paradigms, and requires specific guidance as to its application so that 'fit for purpose' models are developed.

The RTA requires its own staff and others developing Paramics models to have a level of knowledge sufficient to effectively manage the process of delivering a representative 'fit for purpose' model. The aim is therefore to provide a document that enables staff to manage the process of requesting, completing, reviewing and reporting on projects and proposals that contain a microsimulation component.

This manual aims to function as a practical day to day working guide for those involved in the development and application of Paramics models. It covers the preparation of briefs, scoping projects, the building, calibrating and validation of models, the preparation of outputs, reporting and review of models.

This document provides a review of the available documentation and consolidates the information into one manual suitable for use as an aid in the microsimulation field. It replaces various existing documents and serves as an up to date source of information for Paramics microsimulation modelling in NSW.

This manual should only be considered relevant in NSW and for no other purpose than as a guide for modellers and managers. RTA recognises that the manual may be used as reference outside the RTA's jurisdiction, but the RTA stresses that this is not the intended purpose of the document.



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I. Introduction

I.I. Background

As the State Government authority responsible for the strategic road network, the RTA requires a set of analytical tools to accurately assess network operations and plan future operations. For microsimulation projects the RTA requires the Paramics software to be applied and has developed this manual to provide guidance on the overall development of microsimulation models including:

- Their suitability to the task in hand.
- The appropriate type of model to be used.
- Microsimulation model building.
- Calibration of microsimulation models.
- Validation of microsimulation models.
- Report framework.
- Auditing.

The philosophy adopted in the preparation of this document is to develop a guide to assist modellers and managers achieve 'fit-for-purpose' simulation models using Paramics. By improving the quality of models in the microsimulation field the RTA intends that the pertinent issues associated with the models can be addressed with greater confidence by all those involved.

There are several globally recognised published documents that detail the technical aspects of model calibration and appraisal. These documents are acknowledged as valid documents; it is not intended that this manual supersedes or emulates them. Some issues arising from these documents have been incorporated into this manual in the context of the RTA applications required.

There are a number of existing documents and notes released by various organisations that outline the steps in developing a Paramics microsimulation model. As experience grows, it has become clear that there are issues with the usefulness and practicality of many of the existing documents. These issues include:

- 1. The lack of an over arching document that describes and documents the practice of microsimulation modelling from a practical perspective (using Paramics).
- 2. The existence of inconsistencies, inaccuracies and overlap between various existing documents.
- 3. The limitations that existing documents place on the practice of microsimulation modelling.

The RTA commissioned a review of the available documents to consolidate and organise previous documents and notes into a single manual suitable as an aid to industry. This manual therefore replaces various existing documents and serves as an up to date single source of information for Paramics microsimulation modelling within the RTA's jurisdiction.



Specifically, this manual provides information on the five stages which have been identified as being typically required in the delivery of a project using the Paramics software. These are:

- **Stage I** Project scope
- Stage 2 Model scoping
- **Stage 3** Model development
- Stage 4 Outputs and reporting
- **Stage 5** Auditing a Paramics model.

In addition, this manual contains a range of supporting documentation in the appendices to guide modellers on the application of Paramics in developing robust models.

As microsimulation is a globally recognised field of transportation planning and traffic engineering, guidelines for the development and application of models are already in existence, developed in different countries for different purposes. Due to the flexibility of microsimulation tools, these documents generally retain their validity outside their country of origin. It is the RTA's intention that this guide is only specifically relevant for application of the Paramics microsimulation models in New South Wales, although it is appreciated that the document may be used as a reference document throughout Australia and the world by individuals and organisations.

I.2. Purpose of this manual

This manual is specifically designed to provide guidance without being prescriptive or limiting the modeller building the model. It is not intended to be a rigorous technical appraisal or critique of simulation modelling since other recent work has attempted to deal with these issues. Rather, it aims to function as a practical day to day working document for those involved in the industry.

The RTA has developed this manual for public distribution to help improve the relevance and quality of models submitted by consultants to the RTA. A proportion of the content of the manual is designed to make the model scope, building, submission, review and approval as transparent as possible for all parties without inhibiting the practitioner in the technical construction of the model.

To summarise, this manual aims to:

- Determine the appropriate level of analysis required for a project and in particular whether Paramics is the right tool to use.
- Set out a broad methodology for the RTA and consultants to follow in relation to the five stages detailed above.
- Classify projects and their purpose and provide a guideline to ensure that the model is 'fit for purpose.'
- Incorporate previously developed relevant material and correct any limitations and/or inconsistencies in the range of existing reports and reconfigure them to align with the five stage process.
- Provide a manual that draws together all the issues and is a reference resource for the wider microsimulation community.



I.3. Scope of the manual

The RTA Manual is intended to be used with relevance to the following categories:

- All traffic microsimulation model types (refer to project classification in section 2.2).
- All projects under the RTA's jurisdiction in NSW.
- All clients (internal and external) across public and private sectors.
- Users of the Paramics platform.

It is intended that the manual be periodically reviewed and updated as required so that it is current, useful and relevant for practitioners and incorporates the latest thinking and advancements in the microsimulation field.



2. Stage I – Project scope

2.1. Introduction

Managing traffic congestion has increasingly become a key issue in NSW and around the world. In order to assess the current network conditions, predict future conditions and plan remedial options the appropriate approach should be used. This is defined by developing a project scope in which the existing problem is considered alongside goals and objectives.

Every problem is unique in nature and scale, but some examples of project scope considerations are given below:

- The nature and scale of the problem.
- The stakeholders in the problem.
- The geographic extent of the problem area.
- The resources required to assess the problem.
- The resources available to address the problem.
- The level of detail required to assess the problem and possible solutions.
- The data required and available.
- The possible solutions to the problem.
- The objectives of the study.
- The presentation of the findings.
- The possible future purposes of the study.

As a result of the project scoping process the correct approach to the problem should be identified. This will include the correct software tool to meet the goals and objectives of the project using the least resources.

The project scope should then be incorporated into the project brief so that the correct approach is selected and the methodology successfully meets the objectives of the study.

2.2. Project classification and the use of microsimulation modelling

Microsimulation modelling is not suitable for all analytical tasks requiring some form of modelling. Network wide equilibrium assignment models are often sufficient to address major project justification and strategic requirements, where the detailed representation of traffic operation is not a critical consideration. At the other end of the scale there are many tasks requiring the detailed assessment of minor network changes at individual sites or simple linked systems where a range of packages such as aaSIDRA, SCATES and INTANAL are more suitable.

There are a significant number of projects that lie between the analytical paradigms where network models cannot provide enough detail, and site specific models cannot account for network effects. In this 'middle ground' the detail, flexibility and assignment features of microsimulation modelling are both practical and useful.

2.3. Transport modelling

It is important for the project brief to identify the correct software tools required to address the problem and capable of achieving the project goals within available resources.

This manual covers only those projects that have been identified as requiring microsimulation as the core tool. It is therefore important to understand the context of microsimulation models and where they fit into the hierarchy of transport models available to the practitioner.

There is a wide range of modelling tools available to assist the practitioner assess various transport related policies, strategies and projects. Principally there are two types of transport models: demand models and supply models. These are briefly described in the following sections.

2.3.1 Demand models

Demand models' primary focus is the representation and forecasting of travel demand levels and characteristics over a region. Demand models commonly employ the traditional four step modelling approach: trip generation, trip distribution, mode split and assignment. Important inputs to these models include demographic, car ownership and land use information. Road and public transport network and service details are input through supply models (discussed in the following section) to enable zone to zone travel costs to be estimated. Demand models can have varying levels of network and demand detail, depending on the purpose of the model.

Demand models are generally applied to assist in the development of city wide transport and growth policy and strategies, and for the purposes of assessing the wider impact of major transport projects. Software available for such projects includes EMME/3, Cube Voyager, TransCAD and VISUM.

Microsimulation models are not used as demand models, but may require such models to provide forecasts to enable future year scenarios to be simulated.

2.3.2 Supply models

Supply models refer to the transport network and its characteristics that have demand assigned to them. Microsimulation models fit into the category of a supply model. Such models can vary greatly in detail and scope. Four major categories of supply models are detailed below:

1. Network wide equilibrium assignment models (EMME/3, Cube Voyager, TransCAD, VISUM, SATURN and NETANAL) all have the capability to assess traffic operations over a wide network. They are limited mathematically in their ability to represent traffic operations accurately. The models represent vehicle demands and interactions at an aggregate level. Such models provide value where a large area requires assessment and strategic, policy and funding issues are being investigated. A particular strength of these models is their ability to achieve a stable assignment which provides a strong basis to compare scenarios at a strategic level. SATURN provides capacity to simulate traffic flow by time slicing demand during the assignment. This should not be confused with microsimulation modelling which simulates vehicle by vehicle.



- 2. Mesoscopic simulation models have recently come onto the market including Citilabs Cube Avenue and INRO's Dynamec. Such models attempt to bridge the gap between demand models and microscopic simulation models using a dynamic equilibrium traffic assignment technique. This allows congestion effects and bottlenecks to be modelled at a higher level of accuracy than network wide equilibrium models but not with as much detail as microsimulation models.
- 3. Microsimulation models are the most detailed of all supply models. As such these models are much more data intensive than other supply models. Microsimulation models represent the behaviour of individual vehicles and interactions between vehicles. Inherent in all microsimulation models is the element of randomness. Microsimulation models can be applied at a local level for a single intersection or a length of road or over a wide road network. Their strength is the ability to demonstrate traffic operations visually to decision makers.
- 4. Intersection analytical models such as TRANSYT, SCATES, aaSIDRA and INTANAL have been the traditional methods for assessing local traffic operations in detail. TRANSYT and SCATES are capable of assessing traffic operations of small networks with a concentration of signalised intersections, but are generally applied to the assessment of linear road networks. INTANAL and aaSIDRA are used to assess isolated intersection operation. Such models generally require less data and effort to construct than microsimulation models and provide a quick turnaround of results.

2.4. Microsimulation modelling

Microsimulation softwares represent the state-of-the art tools in the transport modelling field, as they combine more parameters than any other software and are based around individual vehicle/driver behaviour. They are flexible and sophisticated tools that can be adapted to replicate most traffic conditions to a fine level of detail and be used to develop testing options which cannot be represented in other software approaches. Because of this sophistication and flexibility they also require a greater level of understanding from users and managers in order to maximise their potential and achieve accurate models that are fit for their purpose and the parameters remain within acceptable bounds.

The term microsimulation is derived from the ability of the models to simulate wide area models on a microscopic level; vehicle by vehicle. The microsimulation process differs from existing theory which looks at links and nodes within a network as the component elements - simulating mathematically the effects of volume/speed relationships. Microsimulation determines the outputs of the network elements in a probabilistic way rather than a deterministic way preferred by demand modelling. In an attempt to simulate *actual* human driver behaviour rather than the *effects* of human driver behaviour, each microsimulation tool uses a random series of numbers in a discrete manner to replicate the variance created in human driving behaviour on a second by second basis.

Microsimulation theory models have been in existence for over 25 years, but have really come into industry-wide use since 2000 as research and computing technology have progressed to allow microsimulation tools to become commercially practical. As a result, microsimulation modelling has become a standard tool for both road authorities and private sector organisations throughout the world to simulate complex and congested traffic situations.

One particularly notable feature of microsimulation modelling is that it allows detailed testing of options across various modes, and produces results in a format able to be presented to, and understood by, both technical and non-technical audiences.



There are several different microsimulation software tools in use in Australia including, but not limited to, the following:

- Q-Paramics
- S-Paramics
- AIMSUN
- VISSIM

While recognising there are various software packages available this manual principally concerns itself with the application of the software most commonly used by the RTA - Quadstone Paramics (Q-Paramics).

2.4.1 Quadstone Paramics

The Quadstone Paramics suite of software is established and well tested, and continues to be enhanced. Projects range from individual intersection models and linear linked intersection models to through road corridors and large sub-regional urban areas. Models have been developed with train, tram and bus services, freeways, grade-separated interchanges and complex intersection systems with rail level crossings. Typical applications include individual intersection analysis, development planning, detailed road network analysis, corridor studies, sub-CBD and activity centres, and broad level urban and regional transport strategies.



3. Stage 2 – Model scope

3.1. Overview

Once the project brief has been established, the next stage is to transfer the key project issues into a scope for the development of a microsimulation model or the microsimulation component of an integrated project.

Project scope should consider the existing situation, the desired goals and objectives.

Each microsimulation model is created to address a specific situation, purpose or series of issues. Therefore the model must address the intended purpose with a suitable breadth and level of detail and data, so that it can be deemed 'fit for purpose.'

Creating a microsimulation model for a specific purpose is not always a simple task. The information required and outputs worth reporting are some of the issues that need to be carefully considered. This section of the manual is intended to provide assistance to the project manager and the Paramics modeller for scoping the level of detail that should go into Paramics models to achieve a specific purpose.

An example of a model brief can be found in Appendix A.

3.2. The model purpose

Prior to commencing a Paramics model the key objectives of the model should be agreed upon by the modeller, the client and the approving road authority. Some of the questions asked include:

- What is the project objective?
- Why is the analysis required?
- What are the characteristics of the project being analysed?
- What questions should the analysis answer?
- What are the scenarios to be studied/tested?
- What are the design years?
- Who are the recipients of the results who will approve the model?
- Extent of each model required?
- What data and information are required for the model; are these data available, affordable and practical?
- What is the peak period to be modelled?
- What are the potential benefits/uses of the model beyond the project?

The questions outlined above should be addressed prior to the commencement of any Paramics project.

3.3. Model development scope

Microsimulation models can be very data intensive and complex to build. The greater the level of detail in the model, the more time and cost involved in data collection, data processing, model building and reporting. The project's purpose, timeframe and budget are fundamental factors in determining the level of detail required in the model. The extent of the model development task will be reflected in components such as geographic and temporal coverage, the type of model, traffic signal coding, plug-ins used, traffic demand, validation criteria, outputs to be reported and scenario testing. These topics are discussed in the following sections.

3.4. Model coverage

The area to be modelled should be clearly defined in the project brief by way of street map reference and/or an aerial photograph. The consultant should review the modelled area during the scoping stage to ensure that the model will be fit for purpose. The model network boundaries should generally extend to points where there are no 'unreleased' vehicles during the simulation for the base case.

The model network should include, but not be limited to, the following:

- All relevant public roads.
- All traffic signals, including coordination and pedestrian movements.
- All significant traffic control devices such as roundabouts, Stop and Give Way signs.
- All new access traffic lanes, turning lanes, turning bays and other changes to the road network for option testing.
- Bus and transit lane facilities, configured to carry the appropriate vehicle types including illegal users.
- Road networks that are spatially accurate, and preferably built using the RTA Lamberts 94 projection.
- Parking, clearways, transit lane and bus lane restrictions by time of day.

The modeller must check the model road network against the actual network using on-site inspections to ensure that any variance between the supplied aerial photo overlays and the actual network are acceptable and if deficient, are rectified.

3.5. Model type

The model area will generally determine the type of model to be developed. The model purpose, timeframe and budget must also be carefully considered when choosing the type of model to build. Network models are typically far more complex than linear models because of the inherent route choice available to vehicles in the network. Route choice in a model significantly increases the number of calibration parameters and requires a much more involved demand matrix development process.

Microsimulation models can be broadly categorised into the following types:

- Intersection models
- Linear models
- Network models



3.5.1 Intersection models

Often the operational analysis of isolated intersections can be more efficiently undertaken manually or by using analytical models such as aaSIDRA and INTANAL. Key reasons for undertaking microsimulation modelling for isolated intersections include the following:

- Use as consultation material using the strong visual capability of Paramics.
- Assess public transport priority impacts (including bus lanes, B phases, rail level crossings) where events such as bus arrivals do not occur on a regular cycle by cycle basis.
- Assess complex signal phasing arrangements.
- Assess grade-separated interchanges.
- Assess closely spaced intersections with unusual lane geometry and/or phasing arrangements, where issues such as queue interactions impact on system performance.

3.5.2 Linear models

A key issue for the assessment of traffic operations on linear road networks has been that analytical models are generally weak at representing queuing effects of vehicles across adjacent intersections. Microsimulation models can provide particular value in this area. Often, interfaces with strategic demand or supply models are an important consideration. These interfaces cab supply demand accurately to the microsimulation model and accurately represent capacity in the strategic model In addition to the benefits described above for isolated intersections, key reasons for developing linear microsimulation models are as follows:

- Assessment of road geometry changes or traffic growth due to development on the subject road corridor.
- A more detailed assessment of network wide capacity than provided by other tools such as TRANSYT and SCATES.
- Assessment of public transport priority.
- Consideration of travel demand management measures such as T2 lanes, which allow lane by lane effects to be represented.
- Assessment of operation and capacity at bus interchanges.
- Assessment of freeway corridors.
- Assessment of signal linking strategy, potentially incorporating a dynamic linkage to SCATS.

3.5.3 Network models

Microsimulation models can be developed to represent a small local road network or a wider road network such as a town centre. Network models incorporate an element of route choice between various origin and destination zones in the modelled area, resulting in a higher degree of complexity than linear or intersection models. Uses for which a network model may be developed include:

- Town centre traffic management strategies.
- Signal coordination strategies.
- Parking strategies.
- Temporary construction management plans.
- Emergency access plans.
- Incident management plans.
- Freight access plans.
- Major public transport priority impacts.

Clearly there is some overlap between the use of microsimulation models and analytical models such as SATURN for network wide supply models. The development of a large network wide microsimulation model generally requires much more time, effort and data than a network wide analytical model. The project manager should balance the cost and time implications with the objectives of the modelling exercise. Microsimulation modelling of large networks requires detailed origin-destination demand information and turning movement counts to develop a trip matrix. Large town centre models include vehicle route choice and are typically designed to test the long term effects of changes to land uses within a town centre, mitigating works and changes to the road and transport network.

A summary of the key characteristics of each of the model types is offered in Table I and Table 2, including the reasons to consider using microsimulation, the level of complexity, data requirements and other software options. Professional judgement and discretion should be applied to suit the prevailing circumstances.

Model	Description	Reasons to consider	Complexity	Data	Other Software
Туре	-	microsimulation		Requirements	Options
I	Intersection	Consultation material	Low	Intersection	aaSIDRA
	Model	Public transport priority		geometry	INTANAL
		Complex phasing		Turning	
		Closely spaced intersections		movement	
				counts	
				PT schedules	
				Signal phasing	
				and timings	
2	Linear Model	Corridor management plans	Medium	As above +	TRANSYT
		Signal operation		Intersection	SCATES
		Road network changes		spacing and mid-	
		Mitigating works		block lane	
		Development impacts		arrangements	
		Public Transport variation		Origin and	
				destination	
				surveys	
				desirable	
3	Network	Town centre access plan	High	As above +	SATURN
	Model	Road network changes		Origin and	EMME/2
		Mitigating works		destination	
		Development and growth		surveys highly	
		impacts		desirable	
		Freight access plans		Parking	
		Emergency access plans		occupancy	
		Parking strategies		surveys	
		Major public transport			
		improvements			
		Signal coordination strategy			

Table I Broad Model Classification Summary

A further detailed breakdown of these types of models is offered in Table 2.



Model Type	Description	No. of Signalised Intersections	Typical Length (km)	Route Choice Required	Origin Destination Information	Complexity	Analytical Method	SCATS Paramics Interface requirement
Ι	Intersections							
1.1	Unsignalised	0	0.5	No	No	L	Manual/ aaSIDRA	No
	Intersection					М	aaSIDRA	No
						н	Paramics	No
1.2	Signal Controlled	1 I	0.5	No	No	L	Manual/ aaSIDRA	No
	Intersection					М	aaSIDRA	No
						Н	Paramics	Consider
2	Linear Models							
2.1	Small Linear Model	<6	1-2	No	Useful	L	SCATES	No
						М	SCATES / Paramics	Consider
						н	SCATES / Paramics	Required
2.2	Medium Linear	<12	2-3	No	Useful	L	SCATES	Consider
	Model					М	SCATES / Paramics	
						н	Paramics	
2.3	Large Linear Model	>12	>3	No	Useful	L	Paramics	Consider
						М		
						н		
3	Network Models			-				
3.1	Small Town Centre	<10	As	Yes	Desirable	L	Paramics	No
	(Grid Network)		requir			М		Consider
	Model		ed			н		Required
3.2	Large Town Centre	>10	As	Yes	Required	L	Paramics	Consider
	(Grid Network)		requir			М		Required
	Model		ed			н		Required

Table 2 Detailed Model Classification Summary

[1] L = Low level traffic congestion or complexity, M = Medium level traffic congestion or complexity, H = High level traffic congestion or complexity

[2] The use of SCATS Paramics is subject to relevant delegated authority as set out in the RTA Delegation Manual.

[3] aaSIDRA is one of a number of possible models that can analyse intersections and its inclusion in the table is intended to be representative of all commonly used models

3.5.4 Signal Coding

There are three different ways of coding signals in Paramics, each with varying levels of complexity:

- I. Fixed time phase times are constant for every cycle in a given period.
- 2. Vehicle Actuation (VA) signal control plan files can be written to alter the default signal timings and operation under defined traffic conditions.
- 3. SCATSIM SCATS interface plug-in for Paramics.

Signal coding in models can consist of one or a combination of the above methods. Fixed time coding is by far the simplest approach and is generally adequate for most models and purposes.

VA signal coding is more complex and, depending on the level of detail in the coding, can be very time consuming. Useful applications of VA plans include modelling on-demand public

transport phases, ramp metering and adaptive signal control. Some VA coding may be necessary for modelling public transport or phases that only run under certain conditions.

SCATSIM should only be used for highly complex models where the SCATS operation is considered absolutely critical to the conclusions made from the analysis. If SCATSIM is a requirement it should be clearly stated in the brief.

3.5.5 Pedestrian activity

Paramics is primarily a tool to assess traffic movement and is generally not well equipped to handle traffic-pedestrian conflict in detail. Areas where pedestrian activity has a significant effect on traffic operation should be identified and represented in some form. Some methods of representing pedestrian effects on traffic are:

- Provision of dummy signal phases to block vehicle movements opposed by pedestrians.
- Reduced link or link end speeds.
- Link end stop times.
- Incidents.

3.5.6 Plug-ins

The Paramics software provides an Application Programming Interface (API), which allows users to develop customised modules to augment the core simulation. These developed modules are known as plug-ins.

A number of plug-ins have been developed for the RTA to improve control over traffic behaviour and to generate useful and consistent output statistics. Currently the plug-ins will work in Paramics version 5.2. Further development to allow their use in Paramics version 6 is under investigation. The use of plug-ins can be considered in certain circumstances to enhance Paramics core capability. If the use of any plug-ins is considered particularly important for the project, the specific plug-ins and reasons for their importance should be stated in the brief.

A full list and description of available plug-ins can be found in Appendix F.

3.5.7 Time period coverage

The time period to be modelled should be project specific, based upon the project purpose and the local traffic conditions. The number of time periods modelled should be minimised to those that are required to meet the project objectives. The addition of time periods in large models can significantly increase the modelling task and cost.

A pre-loading 'warm up' period is required to load traffic onto the network to provide a realistic starting point for the main peak period to be analysed. A post peak 'cool down' period is also required to allow any vehicles loaded in the main period to complete their trips. A rough guide to assist in determining the length of these warm up and cool down periods is the time taken for vehicles to pass through the model.

The length of the peak period for the model must be determined according to the model purpose and site specific conditions. Generally as a minimum, the peak AM hour and peak PM hour should be modelled, excluding warm up and cool down periods.



In Sydney, for relatively large linear or network models, it may be desirable to model a longer time period in the AM and PM peaks using the following ranges:

- AM peak 6am to 10am.
- PM peak 3pm to 7pm.

There is scope to reduce the time period coverage and this should be determined on an individual project basis.

The model should be constructed in a periodic manner. The following files are able to be periodic:

- Links
- Demands
- Vehicles
- Priorities

Demand profiles for the model must be for 15 minutes or less although generally 15 minute profiles are acceptable. Traffic must load onto the network based on the available SCATS count data or similar.

Individual demand profiles should be developed for the major entry points into the network. Flat or generic profiles should be justified if used. Zones with similar loading profiles may be appropriately amalgamated.

3.6. Data

It is true of most analytical tools that the quality of the input data reflects in the quality of the output data. This is equally true in microsimulation models.

In order to deliver the project objectives the project manager and the modeller should have an understanding of the appropriate level of data required to deliver those objectives. Data requirements should be laid out in the model scope to ensure that the expected level of detail output of the model is obtainable from the input data.

3.6.1 Data requirements

It is essential that a reliable and comprehensive dataset is collated in order to develop a robust Paramics model. Generally, the more information that is entered into a model the more detailed and accurate the outputs and reporting can be.

The type of inputs can include the following, although not all of these will be required for every simulation task:

- Aerial photograph (or ECW).
- Design drawing (dxf) file for option testing.
- Signal plans.
- SCATS Intersection Diagnostic Monitor (IDM) data and diagrams.
- Public transport information (stops, timetables etc.).
- Traffic counts/SCATS detector counts.
- Queue length surveys.
- Travel time information.



- GIS information.
- Road classification and speed limits.
- On street parking and clearway times.
- Zone system.
- Origin-destination demand data.
- Off street parking supply and demand.
- On street parking activity.
- Details of proposed land use or road network changes to be tested.
- Forecast travel demands for future conditions assessments.

Sometimes there is a balance between the extent of the data collection exercise and the time and cost of collecting the data based on the project and model objectives. Table 3 provides guidelines on the key information required for various types of models.

Model Type/ Input	Isolated Intersection	Linear	Network				
Information	isolated intersection	Lillear	Network				
Base Year Medel Requirements							
A suist Dises such	Denvined	D	De quine d				
Aerial Photograph	Required		Required				
Drawing File (DVVG)	Desirable	Desirable	Required for complex intersections				
RTA Signal Plans	Required	Required	Required				
SCATS Counts	Useful to assess day to day ti	raffic variations and an independen	t source from surveyed traffic counts				
SCATS IDM Data	Recommended	Recommended	Recommended				
Road Speed &	Required to construct the	Required to construct the	Required to construct the network				
Classification	network	network					
Public Transport	Required as a vehicle type	Required if present	Required if present				
Information	only. Route and timetable						
	may be required if priority						
	options are evaluated.						
Traffic Count	Required to develop	Required to estimate demand	Required to estimate demand in				
Information	demand matrices	in combination with origin and	combination with origin and destination				
		destination information and	matrices and to validate the model				
		validate model					
Queue Length	Desirable to calibrate	Required to calibrate model	Required to calibrate model operations				
Surveys	model operations	operations					
Travel Time	Desirable to validate the	Required to validate the	Required to validate the model				
Information	model	model.					
Origin – Destination	Not required	Desirable particularly where	Required				
Information	·	the corridor exhibits non-					
		linear traffic flow as lane					
		changing between					
		intersections can result in key					
		capacity constraints					
GIS Information	Not required	Desirable	Desirable				
Parking and	Desirable so that approach	Required	Required				
Clearways	capacity is accurately	•					
,	represented						
SCATS - Simulation	Not required	Determined in the brief	Determined in the brief				
Option Testing Require	ements						
Land Use Changes	Required	Required	Required				

Table 3 Information Required for Each Model Type



Model Type/ Input	Isolated Intersection	Linear	Network			
Information						
Road Network	Required	Required	Required			
Changes						
Future Year Development Requirements						
Strategic model		Possible input to forecast base	Possible input to forecast base model			
inputs		model growth	growth			

3.6.2 Data collection

The project manager should identify the data available for the project, its source and any charges payable. Additional data collection is often required to improve the reliability and accuracy of the model. Any additional data collection by the consultant should have the prior written approval of the project manager.

Data from several sources will most likely be available for use in the model development and calibration. The principal sources of data are:

- Consultants' databases.
- NSW Ministry of Transport's Transport Data Centre, which holds the Sydney and Wollongong Strategic Travel Model, plus travel data from home interview surveys, commercial travel surveys and the ABS Census journey to work survey.
- RTA which regularly publishes traffic volume data and holds other unpublished traffic volume data such as turning movement counts at key intersections, vehicle occupancy counts, travel times survey data, SCATS loop counts, traffic signal operation data (including phase plans and offsets) from the SCATS traffic signal control system and bus lane and transit lane surveys.

It is the consultant's responsibility to identify and provide any additional counting, inventory or survey data required for the successful validation of the model.

Data collection should be managed such that (where possible) the time periods of the datasets are consistent. For example, travel time and queue length data should be collected at the same time as traffic count data. This is not always possible or practical. In large models it is often impractical to even collect all traffic count data on the same day. The modeller should exercise judgement in such situations.

In the case of SCATS IDM data, this is not collected or stored by the RTA unless specifically requested. Therefore any requests for SCATS IDM data should be made prior to the time period for which it is required.

3.6.3 Signal information

Detector map diagrams should be provided along with SCATS phasing and timing data. It is essential that the provision of turning movement information and SCATS volume data at each intersection be provided where available. The base model signal time coding should be based on SCATS and IDM data whether the coding is fixed time, VA or SCATS plug-in. Signal information is discussed in further detail in Appendix B.

3.7. The study area transport network

Based on the inventory, the transport network models should accurately represent the operational characteristics of the road system. This includes bus and light rail services where such operations exist. The models should be capable of:

- Assigning generated loads to the network and outputting link, corridor and network performance.
- Demonstrating the sensitivity of queuing and waiting times to various options testing.
- Generating performance measures such as travel times, vehicle queues, turn and link flows etc.
- Modelling the impact of transport system incidents and assisting in the development of incident response strategies.
- Being used by experienced Paramics modellers within the RTA or its agents.
- Summarising information in a format suitable for incorporation/importation into strategic models where relevant.

Models should be capable of simulating movement and operation by all road based transport modes as dictated by the project objectives. Specific features of the road network relevant to a study may include some or all of the following:

- Road capacity and delay.
- Road intersection operation, including special provision for pedestrians such as scramble crossing phases.
- Signal coordination.
- Parking.
- Effect of road congestion on public transport travel times.
- Public transport schedules.
- Road closures and incidents.
- Tolling facilities.

3.8. Demand

Scoping the traffic demand requirements of a project should be carried out in the context of the desired output. Depending on the purpose of the project some elements of the traffic demand data may not be required such as journey purpose, vehicle occupancy, vehicle generation profiles and public transport volumes. In such examples the level of detail required to add these to the model may not provide any incremental benefits with regard to the objectives of the project and yet consume large amount of resources to gather the data and to incorporate into the model.

The project manager and modeller should outline what demand data are relevant to delivering the project objectives and match any benefits against the resources required to gather and incorporate the data into the model.



3.8.1 Vehicle types

The model should use vehicle types based on the standard RTA Paramics vehicles file. This includes the following:

- Private car.
- Freight vehicles.
- Taxis.
- Fixed route on-road public transport (eg buses).

Consideration can be given to separately identifying development traffic through the use of a different vehicle colour to assist in the interpretation of the model outputs.

In order to model bus priority treatments or high occupancy vehicle lanes, private cars could be subdivided into the following groups:

- Single occupant.
- Two or more occupants.
- Vehicles with one occupant that illegally use the bus or transit lane.

3.8.2 Traffic demand

Origin-destination demand matrices must be constructed to release traffic onto the network. The complexity of an origin-destination matrix development process increases with the number of zones and the availability of route choice in a model. The use of the dynamic feedback assignment technique also significantly increases the complexity of the task.

Data that can be useful for developing origin-destination matrices include:

- Origin-destination surveys.
- Link counts.
- Intersection turning movement counts.
- SCATS intersection and RTA count station counts.
- Volumes from other validated RTA Paramics models where available.

In congested networks, careful distinction should be made between traffic demand (the number of vehicles seeking to pass through the network) and traffic counts (the number of vehicles succeeding in passing through the network). A model that treats observed throughput as if it were demand will underestimate delays and queues in a congested network.

Origin-destination matrices may be constructed using the Paramics Estimator or by other estimation techniques. The matrix development methodology must be clearly documented in the report.

3.8.3 Public transport

Buses and trams run on fixed routes with variable headways and variable stop (dwell) times as per State Transit Authority (STA) and Ministry of Transport (MoT) requirements. The requirement for public transport representation in the model should be identified based on the model purpose. In situations where public transport operations are being assessed or have a significant impact on general traffic operations all public transport routes and timetables should be coded during network development. Paramics requires the mean dwell times and standard deviations to be specified for buses at bus stops. Passenger models may also be coded. Such



parameters can have a significant impact on traffic operations and where this is deemed to be the case, surveys should be undertaken to derive the relevant parameters.

3.9. Calibration

Model calibration is the process that develops and adjusts model parameters to adequately reflect the observed traffic behaviour. In microsimulation models the calibration task involves a review of global and local model parameters that relate to network and demand matrix definition and assignment.

Different models will require different levels of calibration. In scoping the level of calibration required, the model purpose must be considered. For example, with a small intersection model built for the purpose of testing various intersection designs, a high level of calibration is typically necessary. Calibration can be a highly intensive process requiring a significant amount of time, particularly in Paramics models. Large network models are generally not expected to be as well calibrated as small intersection models. Consideration must be given to the level of calibration required to provide confidence in possible conclusions drawn from analysis of the model.

3.10. Validation

The model validation provides an independent check of the calibrated model to assess its accuracy and confirm it is 'fit for purpose'. The check may involve comparisons of modelled outputs versus independent observed data such as:

- Turning movement counts.
- Link counts.
- Screen line flows.
- Travel times.
- Queue lengths.
- SCATS.

Because validation is used to assess a model's fit for purpose, the validation criteria can vary widely between models. Some thought should be given to the validation criteria for a model at the beginning of the project. The criteria may be revised as the project evolves and the level of validation necessary to provide certainty in conclusions and decision-making becomes more apparent. What is important at the beginning of the project is that the type of independent data used for validation be identified so that it may be collected, preferably at the same time as traffic count data is collected.

Paramics uses random number generators to influence the release and behaviour of vehicles during a simulation, meaning that every run will vary slightly. To ensure that a model is stable, the validation runs must use a minimum of 5 seed value runs, although for more complex models more than 5 seed runs may be required. The seed runs should be analysed, documented and reported and the log directories and files provided to the client. Upon analysing the results it is acceptable to identify and remove an 'outlier', but this should be documented. The documentation should demonstrate that the results are statistically acceptable (eg fall within the 95% confidence limit). The auditor should undertake additional runs using different seeds to confirm the acceptability of the validation and option results.



3.11. Fit for purpose

A thorough analysis of model inputs and outputs, visual simulation observations and validation statistics must be carried out in order to determine whether a model is fit for purpose. Deciding whether a model is fit for purpose requires the discretion of the modeller and the project manager. The fundamental question that must be addressed is whether the model is capable of providing the platform for analysis from which relevant conclusions can be made with confidence.

It is possible for favourable outputs to be achieved with inappropriate inputs. Therefore, model inputs are just as important as model outputs in determining whether the model is fit for purpose.

3.12. Scenario testing

The future year or post development options testing scenarios to be modelled should be defined. As for the validated model a minimum of 5 seed runs should be undertaken for each option tested. The changes made to the validated model should be fully documented including:

- Network changes.
- Signal timings including the source of the assumptions (ie it may be necessary to undertake supplementary analysis to determine optimal signal timings)
- Public transport routes and timetables.
- Demand changes.

As well as the evaluation/comparison of the test options against the base model, the model outputs should be determined and agreed as per the requirements set out in the Paramics network build methodology stage.



4. Stage 3 – Model development

4.1. Overview

After the project scope has been defined and the model scope derived from that, the next stage is to build the Paramics model.

As a result of the flexibility of microsimulation software, there is often a lack of guidance on the application of model elements. This section presents some guidance for modellers of limited experience on the coding elements within Paramics and presents the RTA's comments on the validity of varying particular elements and parameters in the coding process. By doing this the modeller is aware of issues that must be addressed in order for the RTA to approve a model.

However, this manual is not intended to be a detailed user guide about building a Paramics model; details on the application of Paramics are held in the Paramics manuals that accompany the software.

A guide for building and calibrating a Paramics model is located in Appendix B.

4.2. Model building process

In order to develop accurate future models, a model must be built which accurately represents the existing situation.

This is known as the base model. The base model is constructed by representing the network area that was defined in the model scope and using actual, historical traffic flow data. The validated base model is used to develop a 'future year base model' against which scenarios and design options can be compared.

Developing the future year base model requires input from the project manager or through project scoping stage to establish a methodology for traffic growth conditions and identify any committed network schemes which may affect the operation of the network.

Future year base models can be used as a reference to compare options or as a starting point for the development of a 'Do-Nothing' or 'Do-Minimum' option, which is then used as the base model for comparison of selected tests and design options.

4.2.1 Building the base model

Building a validated base model can be summarised in the following steps:

- I. Define model parameters.
- 2. Develop base demand.
- 3. Develop base network.
- 4. Calibrate network.
- 5. Validate model.
- 6. Document results.

More detail and guidance on the building, calibration and validation of base models is contained in Appendix B of this manual.

Appendix C outlines the process for recording and documenting the base model validation in the section entitled 'Model Validation Note' (C.3).



4.2.2 Building the future year base model

The process of building a series of future year models starts with the validated base model. The future year base model may include committed network upgrades or changes and predicted traffic growth assumptions.

The process is similar to the building of the base model. It is assumed that the parameters for the future year base model are the same as the base model. However, validation of the model cannot be made as traffic data cannot be gathered for the future. Therefore building a future year base model can be summarised in the following steps:

- I. Define and develop future year demand.
- 2. Develop future year network.
- 3. Calibrate network.
- 4. Document results.

Appendix B outlines in more detail the tasks associated with building models.

4.2.3 Building the test options

The process for building a series of test options is similar to that of building the future year base model in that the base model parameters are generally adopted and the model cannot be validated since observed traffic data are not available.

Building the test options can be summarised in the following steps:

- I. Define and develop test network and test demand.
- 2. Calibrate network.
- 3. Document results and conclusions.

The comparison of the test options to the future year base model will provide insight into the operational benefits of each option when compared to the 'Do-Minimum' scenario. This analysis is documented and conclusions are derived for each comparison.

Appendix B outlines the tasks associated with building models in more detail.

Appendix C outlines a recommended reporting structure for the submission of a model to the RTA.

4.3. Demand

The development of an accurate demand matrix is an important element of the modelling process.

The periods to be covered by the Paramics model will normally be prescribed in the RTA brief. However, the modeller may be required to derive the appropriate peak hour or hours from the observed data.

Given that developing a demand matrix will depend on the data available and the purpose of the model, the list below is intended to act as a guide. The key stages are:

- I. Define a methodology to build the demand matrix.
- 2. Identify the number of periods and define the required profiles.
- 3. Identify available data, models and information.



- 4. Identify data requirements.
- 5. Establish and document an interface with the strategic model (if a strategic model is being used to provide input to base and/or forecast year demands).
- 6. Define vehicle types to be represented (eg cars, light commercial vehicles).
- 7. Define demand categories (or segments) to be represented (eg journey to work, freight vehicles, taxis).
- 8. Establish a zone system, noting that microsimulation models require a much finer zone system than strategic models.
- 9. Process data.
- 10. Estimate the demand matrices from the available data.

As part of the Paramics suite of programs, the Estimator tool allows the modeller to develop OD matrices from traffic count data.

Using the Paramics Estimator requires a calibrated network. Further, the Paramics Estimator outputs should be thoroughly analysed to ensure they are realistic.

4.4. Network

The development of a network that accurately determines the constraints of a road network is an important stage in the modelling process. The model building process remains relatively constant across all models but the level of detail and scale of the network may change.

The key network building tasks apply to all model builds. They are described in detail in Appendix B and summarised below:

- Define configuration parameters.
- Define categories.
- Code nodes.
- Code links.
- Code zones.
- Code junctions including signalised intersections.
- Edit kerbs and stop lines.
- Code public transport stops and routes.
- Apply appropriate plug-ins.
- Define assignment and operational parameters.
- Define periodic network/demand changes.

4.5. Calibration, validation and fit for purpose

While some validation guidelines have been developed for microsimulation models, most notably by the *FHWA* (2004), *Austroads* (2006) and *Transport for London* there are generally no universally accepted guidelines. The guidelines that do exist tend to relate to those specified by the *Design Manual for Roads and Bridges* in the UK for network assignment highway project models, rather than have specific relevance to microsimulation models. The reason for the lack of accepted criteria is the degree of variability in requirements for different types and purposes of models, and to some extent the accuracy limitations of the collected data. For example, a small linear model might be expected to have a higher level of validation than a large network model. The validation guidelines should be developed during the model scoping. It should be noted that if a model does not achieve all validation guidelines this does not necessarily indicate the model is not fit for purpose. Validation guidelines should be viewed



as guidelines only. Validation guidelines help in the assessment and provide context in terms of where the model sits in relation to the guidelines. Professional judgement must be exercised by the modeller, project manager and auditor with regard to the model being fit for purpose.

Microsimulation models can be validated against the following datasets:

- Turning movement counts.
- Link counts.
- Travel times.
- Screen line flows.
- Queue lengths.
- SCATS.

Appendix B outlines sample validation targets. These conditions could vary depending on the type and use of the model, its complexity, purpose and various other criteria. The ability to meet certain conditions is also related to the quantity and quality of data and the requirements for it to be 'fit for purpose'.

For strategic modelling, model validation is an important task to provide confidence to stakeholders that the model parameters applied to trip generation, distribution, mode split and assignment can reproduce results that reflect observed conditions. As a rule, microsimulation models should utilise the best available traffic count data to develop a demand matrix rather than hold back the data for independent validation. Therefore, particularly for smaller models, an independent set of count data is not always available or required for microsimulation models. In such cases the lack of independence should be recognised; for simplicity a comparison between modelled and observed flows should be documented under the validation section, even though it is not validation in the strictest sense.

4.6. Base forecasting

Once the base model is calibrated it may be necessary to develop a base case future year model. The adopted approach should consider the following:

- The availability of historic traffic growth.
- Demographic, land use and development changes.
- The availability of a strategic demand model.

Where a strategic demand or supply model is available it should generally be used to forecast background traffic growth on the base model rather than apply absolute traffic numbers. The zone system for a microsimulation model in most cases will be much coarser than a strategic model. Therefore, the interface between the strategic model and the microsimulation model should be defined.

4.7. Option testing

Once the base model has been completed, scenarios are then developed to test the impact of demand and/or supply changes and the acceptability of proposed mitigating works. Scenarios may include alterations to any one or more of the following, although this is not an exhaustive list:

- Changes to land use within a model.
- Testing of the effect of significant developments on the surrounding road network.
- Changes to road network geometry such as:


- o Lane or road closures or additional traffic lanes.
- New intersection controls such as roundabouts or traffic signals.
- Altered public transport services (service patterns, frequencies, routes, patronage, etc).
- Altered signal timings/phasing/linking/offsets/etc.
- Testing of future year traffic growth on a network.

The type of changes required for the test options should be determined in the scope of work and should be related to the model's purpose.

The outputs of a model and the information to report when comparing different options are discussed in the next section.





5. Stage 4 – outputs and reporting

5.1. Overview

After completion of the base model and option testing, the information extracted from the model needs to be reported in a suitable format, which may include both graphical and tabular outputs depending on the ultimate audience and model purpose. This section discusses the type of information to report, how to present the information and how to compare results of options testing.

A guide for reporting the details of a Paramics model is located in Appendix C.

5.2. Report requirements

When a Paramics model has been completed, the presentation of relevant information is a key step. If there are specific outputs the project manager considers necessary for a specific project, this should be stated in the brief. Report templates and pro forma have been developed for specific RTA projects which are aimed at easily exchanging information and satisfying RTA requirements. Some of these reports include:

- Calibration and Validation Report.
- Road/Transport Network Data Report.
- Model Operational Analysis Report.

Key statistics and information specific and relevant to the project are required to demonstrate both the model validation and the impact of any proposal which may relate to some of the following:

- Travel time.
- Intersection delay.
- Intersection level of service.
- Network changes such as altered traffic throughput.
- Queue lengths.
- Unreleased vehicles.
- Overall network performance.

Plug-ins have been developed for use in Q-Paramics modelling in order to extract some of the information described above. Alternatively, this information can be extracted from the model using data manipulation from the standard outputs.

In addition to reporting model output statistics, observations from the visual simulation of the network are important to report. Observations may include operational issues such as excessive queuing, overflowing turn bays, unreleased vehicles etc. Observations may be reinforced by including snapshots of the model.

5.2.1 Model limitations

The RTA acknowledges that the resources required to build a microsimulation model are limited and so each model is built and calibrated/validated with the project purpose and scope in mind. The RTA therefore recommends that the modeller include comment on the limitations of the model, to ensure that subsequent uses of the model are not outside the capabilities of the model to deliver.



Commenting on the model limitations provides the modeller the opportunity to provide reasons as to why a particular approach was adopted and what impact this may have on future applications of the model.

5.3. Report content and presentation of results

An example of a modelling report's 'Table of Contents' as well as examples of how to present some of the statistics described above, both for base model validation and scenario/option analysis, are presented in Appendix C.

The type of information required in a typical report on options testing should include the following:

- The data sources.
- The land use assumptions, distribution and quantum.
- Nature of generated vehicle trips.
- Changes to the default Paramics settings and RTA standard files.
- Traffic and road network analysis consistent with the purpose of the project.

Austroads has developed a pro forma for simulation modelling that allows the user to detail the relevant information for a calibrated report. This report format is relevant for road authorities.

Evaluation plug-ins such as network evaluator, validator and economic evaluator report relevant data in a manner that is easily accessible for reporting purposes, reducing the time required for data manipulation.

5.4. Comparison of options

Key information for comparison of the options/scenarios must be reported since this provides the basis for any recommendations and/or commentary on the adequacy of the resulting network operating conditions. The following list sets out some of the key information useful for comparing options/scenarios:

- Travel time changes the travel time between specific locations is a useful tool when comparing scenarios. This can be for all vehicle types or vehicle-specific such as on-road public transport vehicles.
- Intersection level of service (LOS) changes LOS is based on intersection approach delay and can be extracted from the model and used as a comparison between scenarios.
- Network performance the network performance for all vehicles can be compared between models and reported for all vehicles within the model period in terms of average speed, distance travelled and delay.
- Queue length changes similar to travel time, a comparison of the average queues on approaches demonstrates the differences between scenarios.
- Economic module utilisation of the Azalient Economic Evaluator plug-in to compare the performance of each simulation run in terms of economic variables.
- Visual observations model operation is often most easily and effectively assessed by observing the visual simulation and documenting apparent issues in the network.





6. Stage 5 – Model auditing

6.1. Overview

Model auditing is a process used to confirm that the submitted model is satisfactory for the needs of the study ie 'fit for purpose'. The audit procedure should be carried out by a suitably qualified and independent party.

The audit process checks that the modeller has constructed the model in accordance with the three stages of model building described previously in this manual and is consistent with the model purpose.

6.2. Audit purpose

As more and more Paramics projects are developed by consultants and others, it is important that the auditing of models is normal practice so that the standard of modelling within the industry is consistent and at a level suitable for its intended purpose.

Given the flexibility inherent within microsimulation models, the auditing procedure is a check for ensuring that the base microsimulation model conforms to industry standards and model parameters are within acceptable bounds.

The audit procedure is an objective process with the secondary aim of providing the auditor with an opportunity to suggest improvements to the model and to comment on possible limitations of the model.

6.3. Audit procedure

The audit procedure should be adapted to reflect the model size and classification, the model purpose and any other relevant criteria.

A detailed procedure for auditing a Paramics model is set out in Appendix D.

6.4. Validation

Some of the information in Appendix D may not be relevant for certain types of models for them to be deemed "fit for purpose." It is therefore important that the information used in the Paramics model to calibrate and validate against, is documented clearly.

The calibration and validation parameters described in Stage 2 should be checked to ensure that the comparison between observed and modelled counts is satisfactory.

6.5. Model approval

Generally, for a model to test land use scenarios, the approving authority (local government or road authority) will approve the model. The criteria for model approval should be stated in the brief.

The RTA now conducts audits of Paramics models in an effort to improve the standardisation and quality of modelling work undertaken, as well as to ensure that the work is 'fit for purpose'.

Unless coding inconsistencies and errors are discovered as part of the audit process (that then makes the model unsuitable as a decision support tool), the audit process should not require any further changes to the model.



Recommendations made by the auditor as part of the audit process should be acknowledged by the modeller.

6.6. Process improvement

Upon submission of a report, the RTA welcomes any objective comment from the modeller that would help to improve the model building and reporting process. Topics of interest are:

- Efficiency of building a model.
- Improvements in the project and model scoping.
- Improvements to the reporting process.

Software based improvements can be submitted to the RTA (regarding use of plug-ins) or to Portrait Software PLC, the developers of the Paramics software.

Provision for modeller comment on process improvement is included in the audit forms.

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Appendix A - Sample brief outline



A.I Scope of works

Objective

- An outline of the study objectives.
- Any software requirements, typically:

This brief requires that Q-Paramics be used for this project.

Background

Background to the project.

Contract process

Details of the contract process.

Study scope

- The scope of the project.
- The deliverables.
- Allowance for additional work.

Proposed model structure

The suggested model structure including SCATS elements.

Road network

The time periods to be modelled, typically:

- The AM peak period.
- The PM peak period.

The network coverage and junction detail, for example:

- All traffic signals within the modelled area, including coordination and pedestrian movements.
- All SCATS loops in the Paramics models will be set-out as per Appendix X, Paramics Coding for SCATSIM: Detectors.

Traffic control

Microsimulation requirements of the traffic control, typically:

The recently developed interface between Paramics and the SCATS signal system ('SCATSIM') will be used in this model. Achieving effective operation of this element of the model is key to the overall usefulness of the project to the RTA. To this end the RTA will provide support to the consultant in relation to SCATS requirements. This support will include SCATS data (free of charge), relevant software licences and software, and the advice of appropriately qualified and experienced staff.

Geographic coverage

Expected geographic coverage.

Major deliverables

The deliverable of the project, typically;

The RTA requires a detailed project timeline outlining each stage and estimated timeframe for the development of the Paramics base models.

Paramics SCATS models

Details of any SCATS modelling requirement, typically;

Calibrated and validated Q-Paramics SCATS models covering the AM and PM peak period with the required warm up and cool down periods as outlined in Section X.X of the brief shall be delivered to the RTA.

Model documentation

Details on the required level of documentation and validation, typically;

A detailed report is to be prepared, recording the development of the models, validation and operation, including comprehensive user documentation for RTA staff or agents who may be required to use the model.

The section covering the model validation must address all aspects of the validation process listed in Section X.X, and provide detailed comments on any cases in which traffic signal settings (phase plans, splits and offsets) in the validated models are significantly different from those currently used by SCATS.

Paramics model calibration report

The minimum requirements of the calibration report, typically;

The Paramics model calibration report shall include at a minimum:

• A title page including the date completed.



- A declaration stating that the model meets the requirements of Design Manual for Roads and Bridges Vol 12 – Traffic Appraisal of Road Schemes (DMRB12) and any other calibration requirements as set out in the brief.
- A table of contents.
- A table of maps and figures.
- Summary and explanation of the traffic data used in the construction and calibration of the models.
- Maps showing the Paramics networks at a scale of 1:10000 maximum.
- Maps showing the location of any information used in the calibration of the models; its temporal and volume information. One map shall be provided for each information type.
- A report outlining where the road/traffic network operations were varied from the provided/inventory data set and a justification for each and every modification.
- A list of plug-ins used and the reasons for their use.
- A completed model variation statement.
- An explanation of any variations between the DMRB12/ RTA calibration requirements and the models.
- A summary of model stability including current NV and current mean speed graphs.
- Tables showing the comparison of link flows, turning movement flows, cordon flows, screen line flows, travel time comparison using the DMRB12 Requirements.

Paramics model operational analysis report

The minimum requirements of the model operational analysis report, typically;

The Paramics model calibration report shall include at a minimum:

- A title page including the date completed.
- A declaration that both the Road/Transport Network Data Report and the Paramics Model Calibration Report have been accepted by the Project Manager.
- A table of contents.
- A table of maps and figures.
- Maps showing the Paramics networks at a scale of 1:10000 maximum.
- Maps showing the performance (through the capturing of hotspots) for all signalised intersections and any intersection where there is spillback queuing.
- Summary tables showing the results from the TripStats and/or Network Evaluation plugin. These tables shall include the following information:
 - Total trip time; Mean speed; No. of unreleased vehicles; Mean PT speed; No. of Stop; Network operational cost.
 - Average delay per period for all signalised intersections and any intersection or link nominated by the project manager.
 - Any sites within the model, where additional network changes (including those nominated by the project manager) may be included to improve the road/transport network operations.

Outputs

The required model outputs, typically;

Key outputs will be measures of system performance, in terms of congestion, queuing and travel times. In particular, the models must identify 'hot spots' for AM and PM peaks where serious congestion, queuing or delay occurs.

Available data

The RTA shall provide the following data on a confidential basis. No charge shall be made for any data that replicates the RTA data:

- Road Centrelines from the RTA ArcGIS dataset for conversion into Paramics.
- Aerial Photography at a Scale 0.15m resolution ECW format.
- Traffic counts from RTA traffic survey stations.
- Traffic Counts from SCATS sites.
- Any applicable RTA PARAMICS model.
- SCATS Graphics.
- SCATS Signal timing data, in mutually agreed format (IDMs).

Data from several sources will also be available for use, free of charge, in model development and calibration. The principal sources are:

- The Transport Data Centre of the NSW Ministry of Transport, which holds the Sydney Strategic Travel Model, plus travel data from home interview surveys, commercial travel surveys and ABS Census journey to work questions.
- RTA, which regularly publishes traffic volume data, holds other unpublished traffic volume and travel time data, the SCATS traffic signal control system and local traffic surveys. Traffic information provided by the RTA is to include data relating to traffic volumes, speeds and vehicle classifications.
- Traffic signal control system data provided by the RTA for the relevant real world SCATS regions. The consultant will submit a detailed written data request to the RTA that specifies the information and the required format.
- Public transport operators' schedules taken from published timetable information. It is the responsibility of the consultant to ensure that the information provided is accurate and up-to-date.

Where information is required for the project from organisations other than the RTA, the RTA will transmit the request to the relevant agency on behalf of the consultant.



A.2 Modelling requirements

Basic purpose

The basic purpose of the model within the context of the project, typically;

The purpose of the work is to represent the current operation of the traffic system in the network area during the two peak periods. The RTA will use the models to develop options to improve traffic network operations within the study areas to meet their statutory objectives. Development of alternative SCATS operating strategies will be a prime focus of the RTA's subsequent work. Therefore, the requirement to include SCATSIM functionality in this project's models is critical to meeting the project's objectives.

The consultant may be asked to model, test and evaluate the options developed by the RTA. Work to develop future traffic demands and road networks is not included in this scope of works or in this project.

Data exchange

Any data exchange requirement allowing data to be transferred to and from the model, typically;

The Paramics models will form one component of RTA's overall modelling strategy. They must be capable of exchanging network and travel demand data in a generic and industry-recognised delimited text file format using an industry-standard coding system, such as ASCII.

A.3 Models

Data collation

Data collection requirements on the part of the consultant, typically;

It is the responsibility of the consultant to collate all network timing, count and movement data and to document and report on that data.

Determination of additional survey data

Data collection requirements on the part of the consultant, typically;

It is the responsibility of the consultant to identify any additional counting, inventory or survey data required for the successful validation of this model.

Scenarios (if required)

Responsibilities for providing and reporting on the scenarios for testing, typically;

It is the responsibility of the consultant to model, test and evaluate scenarios and to document and report those scenarios in terms of source and method of testing.

It is the RTA's responsibility to provide the scenarios to be modelled and data required to the consultant in a timely fashion in data formats and on media specified by the consultant to facilitate data handling and processing in an efficient manner. Such media and data formats specified by the consultant should be reasonable and compatible, as far as is practical, with the RTA's internal data systems.

Paramics reporting standard

Details of the reporting standards to be used, typically;

This report should deal with all the standards used, covering vehicle lengths, configuration and movement tables. It should explain why, if any, variations have been made from RTA's Paramics standards used for validation and they should be justified by referral to information in the calibration report. In particular, justification of changes to standard headways, aggressiveness factors etc should be supported by documentary and/or empirical evidence.

Intersection validation

Details of the intersection validation standards to be used, typically;

For every important intersection, this means at least every sub-system master intersection and any other intersection deemed to be of critical importance (list to be provided and agreed). The following information should be provided.

- A comparison of hourly flows for each turning movement against counts.
- A comparison of queuing lengths, by movement if applicable.
- Comparison of intersection delays.
- A comparison of cycle throughput for each cycle throughout the period.
- A discursive comment about intersection operation.

Cordon and screenline flows

Details of the Cordon and Screenline standards to be used, typically;

Cordon and screenline flows should be compared in each direction separately, preferably by half-hour period. The total cordon and screenline, with more than 5 counts, flows should be within 3% and 5% of hourly counts, respectively.

For each hour the following tabulation should be made for each road in the cordon and in each screenline.

- Percentage within 20% or 200 vehicles per hour equivalent (target 95%).
- Percentage within 10% or 100 vehicles per hour equivalent (target 90%).
- Percentage within 5% or 50 vehicles per hour equivalent (target 80%).

In particular, comparisons of flows should be by quarter hour and prepared as a separate screen line.



Cycle utilisation

Details of the signal cycle utilisation standards to be used, typically;

Comparisons should be made of key signals for each of the SCATS regions to compare the Paramics predicted saturation percentage. Where anomalies occur in this evaluation, discursive comments should be provided to explain the discrepancy.

Signal optimisation

Details of the signal optimisation to be used, typically;

Due to the nature of deriving signal timings and offsets, it is desirable that an overall comparison be made of offsets. Thus an offset program should be run on the data (eg something similar to the SCATES program) and then a comparison of offsets for each set of signals should be made.

Again, discursive comments should be made about any discrepancies etc.

Platoon dispersion

Details of platoon dispersion considerations, typically;

Examination of platoon dispersion should be undertaken to ensure correct factors have been used.

Travel times

Details of travel time validation, typically;

For each corridor validation, a comparison of simulated to measured times will be undertaken. 90% should be within the RMS of at least 5 runs or 10% of median travel time.

SCATS optimisation

Details of SCATS optimisation if part of the study, typically;

Signal timings will be optimised by SCATS. This will require the support of appropriately qualified and experienced RTA staff to be made available by the RTA, at no charge to the consultant. RTA staff will indicate the acceptance of the SCATS data.

Distribution of errors

Identification and documentation of model weaknesses, typically;

In any model of this complexity it is likely that certain areas or functions will be better validated and calibrated than others. It is essential that confidence intervals be determined spatially, temporally and functionally within the model. These should be presented, preferably graphically. For example, if certain areas of the model are less accurate than others or certain



time periods or certain vehicle groups exhibit less than desirable levels of calibration or validation, this should be documented in the validation report.

A.4 Development of future am and pm peak period models

SCATS operation

Detailed requirement for operation of SCATS in future scenarios, typically;

- The interface between the Paramics simulator and SCATS signal system is to be used in the Paramics models.
- The RTA will provide all background data from the real world SCATS regions, as well as provision of the SCATS software required for this project. These data and materials will be provided by the RTA at no charge to the consultant.
- Appropriately qualified and experienced RTA SCATS users will configure the SCATS (in simulation) system to be used in these models. The RTA will provide these resources at no charge to the consultant.
- The consultant will code, link and test the communication (messages) between the Paramics simulator and SCATS.

Report network performance

Details of requirement of the network performance reporting, typically;

- A model validation report will be produced that will summarise the goodness of fit of modelled and observed conditions.
- A base model report will be produced that describes baseline traffic conditions and economics.

Audit process for paramics models

Responsibilities of the model audit, typically;

An external audit of the paramics models may be undertaken. The RTA will be responsible for engaging an appropriately qualified and experienced firm to undertake the audit. Prior to engagement of the auditor by the RTA, the consultant will have the option to object to a particular auditor. The cost of the audit will be the responsibility of the RTA, and does not form part of the cost estimate for this project.



A.5 Software

Software required to set up and run SCATSIM

RTA's responsibilities to provide the relevant SCATSIM version, typically;

It is the RTA's responsibility to provide and license software required to set up and run SCATSIM to the consultant, so as to enable the SCATSIM signal control system to function. This software provision and licence shall be at no charge to the consultant.

Software control

Details of any version control for the software required, typically;

Software release and version levels will be agreed at the commencement of the project and shall not change during the project period without written agreement of the RTA and the consultant.

Where software release and version changes are anticipated to result in re-work, or delay to project schedule or both, then this shall be scoped and agreed by the RTA and the consultant prior to any commitment to change software versions. Such changes to scope shall be treated as a project variation and would be subject to clause XXX of this agreement.

Use of Paramics plug-ins

The Paramics plug-ins that are expected to be used.

A.6 Implementation program

Completion date

The date that the project is to be submitted to the RTA.



Appendix B – Model development



B.I Network build

The purpose of this section is to provide guidance to model developers on key issues to be considered when constructing a Paramics model. The guide is not intended to be prescriptive. Further, adhering to the guidance in this appendix and conforming to the RTA's policy does not automatically qualify a Paramics model as fit for purpose.

In this section the RTA has specified coding policies that are aimed at providing a level of uniformity, without limiting the scope available to model developers. By having a consistent coding policy, localised models can be expanded or amalgamated in the future with greater ease and models can be assessed more easily and with greater assurance.

The coding and development of Paramics models should incorporate, but not be limited to, items described in the following sections.

Paramics network name

It is recommended that models supplied to the RTA have the following naming convention. "wwwww_xxxxx_yy_zz"

Where:

- I. "wwww" is the model location or corridor number.
- 2. "xxxxx" is "base" or "opt" (depending on the scenario being built).
- 3. "yy" is the 2 digit year (e.g. "06" or "11").
- 4. "zz" is the time of day ("am" or "pm").

Overlay

One of the initial steps in the Paramics model development is to define the physical area of the model so that it is consistent with RTA mapping data. An aerial photograph or dxf format file should be imported to provide a scale template of the road network geometry. This enables the model to include all of the road network geometry features such as lane configuration, storage bay lengths, stop line locations, intersection priority and other similar network details.

Aerial photography of the study area should be provided in ECW format and a cadastral overlay in GIS format supplied by the RTA.

If specified in the brief, networks should be built as RTA Lamberts 94 projection (with the first digit of the 7 digit number missing – so for example the Sydney GPO is 688878, 423704 in Paramics and 9688878, 4423704 in RTA Lamberts).

Configuration file

The configuration file specifies the global parameters to be applied in the simulation model. These will include base parameters (such as the start time, duration, driver behaviour factors, assignment definition and parameters) and model options, all of which are discussed further below. The standard RTA configuration file (configuration.doc) should be used as a base for all RTA projects. The parameter values set out in the configuration file should only be edited in accordance with the instructions held within the commented section of the file. It is not mandatory to use the file unmodified, but any changes to the file should be highlighted in the calibration report and reasons should be given for the changes.

The configuration file includes the following information:

- I. New and additional parameters.
- 2. 'Amber time' set to 4 seconds.
- 3. 'Loop length' set to 4.5 m.
- 4. 'Options' included as default.

Parameters such as 'Split Random Seeds' and 'Maximum Diversion' have been introduced since the Paramics Version 3 release. These, together with the 'Date' parameter are included as input. While changing the date parameter has no effect on simulation results, the date is used by the reporting plug-ins (Economic Evaluation, Validator and Auditor) and in message communication to SCATS where the SCATS plug-in is used.

The 'amber time' parameter is set to 4 seconds (common time for many SCATS intersections). Note that Paramics V5.2.2 allows the user to code individual amber times for each intersection. The amber time should be thought of as a means to change the effective green time for each intersection and should be adjusted accordingly.

The 'loop length' parameter is set to 4.5m to match default induction detector loops as used in SCATS.

Additional 'options' are included as default, namely, use of TWOPAS gradient model, gap reduction for stopped buses, stacking stopline loops and roundabout visibility. Previous modelling has shown that using these parameters will provide more accurate and realistic models.

Any changes made to parameters in the standard RTA configuration file must be documented and justification provided as appropriate.

Seed numbers

Microsimulation models use computer generated pseudo-random numbers in order to produce variance in the model, making it a probabilistic rather than deterministic tool (such as demand models and intersection analysis tools).

The seed number is a place marker that enables the software to replicate the same result if the same model is simulated with the same seed number. If there is any change to either the network or the seed value the results will be different.

No seed number statistically produces any better or worse results than any other. In order that model runs are not chosen with selective seed numbers, the RTA, as part of a project brief, will provide a standard set of seed numbers to be used in all simulation runs. The specification of seed numbers is to ensure that seeds are kept consistent between base and option models and to minimise the number of seed runs undertaken for option tests.

In such cases, the five standard seed runs provided by the RTA are: 560, 28, 7771, 86524 and 2849.



An additional 5 seed numbers are suggested by the RTA if it is desirable to carry out more model runs. These are: 5321, 137, 98812, 601027 and 559.

For comparison purposes, some level of consistency can be achieved when comparing models that contain no modification to demand, zoning or release links. This is achieved by the selection of the Split Random Seeds option in the configuration.

Categories file

The categories file contains a library of road link types available for use in the model. The standard RTA 'categories' file (categories.doc) has been developed by the RTA over time and is the file that should be used for all RTA projects.

It is not required that every link is selected from the categories provided by the RTA and remains unedited. It is required that each link in the Paramics model is derived from a base category provided in the RTA categories file. This coding policy is instituted in order to retain a level of consistency across RTA projects.

The categories are organised into category groups, with individual categories varying by the number of lanes and speed limit. The current list of category groups by colour is:

Freeway	Colour green
Arterial	Colour yellow
Sub-arterial	Colour blue
Collector	Colour orange
Local	Colour white

Careful consideration should be given to the road hierarchy and how it should be represented within the coding of the network. From a modelling perspective, some models do not require a road hierarchy to be successfully delivered. However, it is the RTA's view that all networks should have a realistic hierarchy coded so that they can be expanded or amalgamated easily in the future.

The hierarchical structure is essential for developing and controlling route choice within networks.

The visual recognition of the categories, by colour, aids in the auditing of networks, which is an important part of the modelling process.

In addition to the colour coding of category groups, the RTA categories provide recommended parameters for each category that is relevant to NSW. This includes the following parameters that vary between categories:

- I. Highway and urban link types.
- 2. Major and minor link types.
- 3. Category cost factors
- 4. Speed limits.
- 5. Carriageway width.



6. Signposting distances.

It is recommended that the categories are not modified, but rather individual links are modified to reflect localised conditions.

Additional categories can be created in order to define more category cost factors when creating the hierarchies, in order to control route choice. Note that the default setting in the RTA configuration file specifies that category cost factors are only visible to familiar drivers.

The RTA categories file may be updated periodically. The modeller is responsible for checking the validity of the file prior to the commencement of the model building process.

Nodes

Nodes represent points in the network where conditions change - either physically or behaviourally. Typically nodes should be placed at junctions and at locations where link types change - forming the start and end points of road links.

If the gradient of the road network is considered important, the height above sea level should be specified for each node, thus creating a three dimensional model. Three dimensional models will use the TWOPAS gradient model as specified in the RTA configuration file.

Nodes representing points of entry to the network should be coded as "zone connector" types, designating them as route zones.

Nodes that have connection to only two other nodes (either uni-directional or bi-directional) are termed 'dummy' nodes and are generally used to represent geometric changes, speed limit changes or behavioural change points. Dummy nodes do not have any effect on routing within the Paramics core simulation.

Links

Links should be coded initially using the standard RTA categories. Link specific details are also included such as lane closures, vehicle type restrictions, speed controls, signposting and link flags, and link-specific behavioural and assignment parameters.

Link speeds should be coded as the posted speed limit unless evidence is provided to the contrary.

In unrestricted conditions vehicles will tend to drive at approximately 110% of the posted speed limit. This is seen as representative of driving behaviour in NSW, but the RTA views it as reasonable to modify link speeds to reflect speed influences that will affect driver behaviour. Such influences could include: narrow lanes, temporary road works and the effects of side friction such as parking manoeuvres in larger linear and network models. The RTA notes that link speeds should not be varied in order to calibrate the model without sufficient evidence or methodology to support the change.

The RTA recognises that in order to avoid turning vehicles manoeuvring from incorrect lanes at intersections, the through lanes are sometimes split from the turning lanes into separate links. The Lanechoices feature in Paramics is capable of improving lane discipline on links and at approaches to intersections where signposting distances cannot reach far enough to reflect the



correct vehicle behaviour. The RTA advises that the Paramics based Lanechoices feature should be used with caution.

The Azalient "Lanechoice" plug-in can also help solve this problem and thus eliminate the need for links to be split in most cases. It is recommended that link splitting should only be considered when there is a physical median or solid white line separating the lanes.

Signposting distances and signposting ranges which are associated with links should be checked to consider any upstream widening hazards and propagated as appropriate.

Zones

Trip origin and destination zones should be coded with consideration to geographical boundaries, access road locations and parking, if considered important.

Within Paramics there are two different types:

- Area zones these represent areas in the network where vehicles load and exit informally and without specific location. Examples of these would include residential streets or large areas where traffic loads in an informal manner.
- Route zones these represent specific points in the network where vehicles are generated in traffic flow conditions such as network entry points for freeways, highways, arterials, car parks etc.

To differentiate between the two zone types the 'zone connector' designation is used to change a node that has no upstream link into a route zone. By default, all zones are applied as area zones unless the 'zone connector' designation is used.

Restrictions

Restrictions by vehicle type and by time of day should be coded as per observed conditions or as per information provided by the RTA. This may include heavy vehicle restrictions, public transport lanes, transit lanes etc.

Restrictions are coded generically and then applied to individual links or turns. It is possible to create a restrictions file that can be used for common restriction types and used on multiple projects. The RTA recommends that this approach is not used since, although it can provide consistency, it can also increase the time that route cost tables take to build as part of the dynamic assignment. If this approach is adopted, it is advised that restrictions that are not used are removed from the restrictions file.

Junctions

A junction represents any point where more than two links meet in the network and traffic interacts or makes route choice decisions.

Each junction is represented by a basic configuration detailing: turning movements, their lane allocation and their associated priority. Priority at junctions is coded in hierarchical terms:

major, medium, minor and barred movements. Turning movements are allocated by specifying the range of lanes that are available to make each prescribed turn.

The lane indexing within Paramics starts at the kerbside (lane I) and continues to the median side lane.

Priority junctions

Priority junctions contain the basic junction parameters associated with all junction types and represent the least controlled type of urban junction.

Traffic interaction at priority intersections is determined by a series of parameters primarily:

- Priority (Node)
- Node type (Node)
- Non blocking compliance (Node)
- All-way stop (Node)
- Stop line positioning (Control Points)
- Visibility (Link)
- End Speed (Link)
- End stop time (Link)
- Gap acceptance (file)

In addition to the above list of parameters, all vehicles have an inbuilt 'Patience' parameter that decreases each second the vehicle is delayed in finding a gap in traffic streams. Once the Patience parameter reaches zero the vehicle will accept reduced gap criteria in order to make its desired movement.

During the model audit and calibration stages, vehicle behaviour at unsignalised junctions should be monitored and if necessary non-default gap acceptance parameters can be defined. Paramics also offers the ability to force vehicles at a junction to enter a traffic stream if they have exceeded a patience threshold. This replicates the way in which driver courtesy allows vehicles in a give-way position to enter a priority traffic stream which is stationary.



Roundabouts

Roundabouts represent junctions in the network where additional behaviour is used to represent the merging effects of roundabout behaviour.

Roundabout behaviour is in effect at every node marked with 'Rb' lettering when the editor is active. Roundabout nodes are created automatically when a roundabout is created from a single node. Alternatively, a series of linked one-way links can be edited to create a roundabout. The node type is attributed as a roundabout node to each node in the circle, prior to a save operation.

Default priorities are applied when a roundabout is created from a single point; assigning a minor priority to entry movements and major priority to circulating movements.

The RTA recognises that the default entry priorities (minor) may be changed to medium priority in order to represent observed site conditions. In addition, the application of the link based 'visibility' parameter is recommended in order to calibrate driver behaviour at roundabouts.

The default option in the RTA configuration file specifies that the default visibility for links approaching a roundabout is 10 metres, which may then be changed as appropriate.

Signalised Junctions

Signalised junctions represent road intersections controlled by traffic signals. Within NSW signalised junctions are operated on fixed time cycles, vehicle actuated or by Sydney Co-ordinated Adaptive Traffic System (SCATS).

SCATS is a computer based urban traffic control system that controls and coordinates signalised junctions by intersection, group and region. SCATS was developed by the RTA and is currently in use in over 80 cities around the world. Under SCATS operation, cycle times, phase times and offsets can vary cycle by cycle in response to changes in the traffic flows across each stop line.

Within Paramics, fixed time signal operation provides an approximation of SCATS operated junctions. In order to determine the timings for SCATS operations, Intersection Diagnostic Monitor (IDM) data must be analysed to determine the appropriate fixed time signal coding. For a fixed time Paramics model to adequately approximate SCATS signal operation, the period for which coded phase times remain at one fixed representative value in the model should not be more than 2 hours.

The RTA recognises that an appropriate level of detail in the SCATS phasing is required to match the level of detail in the scope of a project.

In NSW, the RTA is the only source of SCATS data. The RTA is able to provide this data for use with Paramics models. Historic data are available on request, and data for future dates can be requested provided adequate advanced notice is given to the RTA. In requesting SCATS data from the RTA, the modeller should specify:

- The intersection location.
- The date of the data.
- The time periods for collection.



Data from SCATS controlled intersections can be requested from the RTA by contacting:

The Manager Traffic and Transport Modelling Roads & Traffic Authority Tel. 02 8588 5675

In some cases it may be appropriate to collect the data for multiple SCATS periods in order to analyse phase and cycle time variation over the simulation peak.

The data are provided by the SCATS system via the IntView software and is in IDM format which is a graphical display, in tabulated form of the phasing, phase lengths, cycle times, offsets, green, amber and red times. An example of the IDM data supplied is shown in Figure B.I below.

tatistics for	I=															
Phase	Freq	Min	Max	Av"	Av%	Total"	мх	FG	RT	w	w	Plan	#SP	#LP	Ped	Occ.
А	1529	10	79	32	57	49316	1150		570			1	1267	727	1	560
В	964	11	37	21	24	20686	964					2	168	298	2	442
с	937	15	34	17	19	16384	937					3	67	270	3	583
D												4	27	234	4	478
E												5			5	
F												6			6	
G												7			7	
Act. Cycle	1529	10	131	56								8			8	
Nom. Cycle	1529	36	110	56	1											

Figure B.I Example of SCATS IDM data

The following statistics are tabulated for each phase:

- I. Freq the number of times the phase ran.
- 2. Min the minimum duration of the phase in seconds.
- 3. Max the maximum duration of the phase in seconds.
- 4. Av the average duration of the phase in seconds for those cycles in which the phase was not skipped. It is calculated as the total phase time divided by the frequency.
- 5. Av% the average percentage of the cycle time for which the phase ran. This is calculated as the total phase time divided by the total cycle time. The values in this column should add up to 100%.
- 6. Total the total phase time in seconds for the selected time range.



- 7. MX the number of cycles in which the phase ran to the maximum allocated time.
- 8. FG the number of cycles in which the phase entered 'false green' ie extended into the time allocated for the next phase.
- 9. RT the number of cycles in which the 'request for termination' message was received. This indicates that the phase approaches had stopped extending (by gap or waste) but the phase was unable to terminate due to a 'no gap' flag or a pedestrian movement in 'clearance'.
- 10. W' the number of occasions where the 'walk termination pulse' (P-) was sent.
- 11. W" the number of occasions where the 'walk termination pulse' (P+) was sent.

The table includes the frequency, minimum, maximum and average seconds for the 'actual' and 'nominal' cycle lengths. The 'actual' cycle length is the addition of the actual phase times ending with the 'stretch' phase. The 'nominal' cycle time is the SCATS sub-system CL value printed in the header of the intersection monitor data. This later value is only available when the site is operating in Masterlink mode.

The table also includes the number of cycles during which each split plan (SP) and link plan (LP) were in operation.

For signalised junctions operating in SCATS version 5.x (or later) with a VC4 controller, the number of 'walk termination pulses' (WI to W8) are also tabulated.

Ramps

Ramps are specialised junctions that contain specific behaviour and parameters. Ramps are used to merge links to freeway sections; ramps should not be used for any other purpose.

Ramps are not considered normal lanes within the Paramics structure since they do not have a lane index and cannot be edited directly once created.

The parameters associated with a ramp node include:

- Ramp length the physical length of the ramp.
- Minimum ramp time the time a vehicle spends on the ramp before considering a merge.
- Headway factor a localised headway factor since merging vehicles may accept smaller gaps when merging.
- Ramp aware distance the distance upstream from start of the ramp that mainline vehicles will consider a lane change to accommodate vehicles on the ramp.

When considering ramp merging behaviour the ramp parameters are critical to the operation of the ramp.

The RTA recognises that the parameter values are critical to the ramp operation, but no guidance is given to the values used because individual ramps can exhibit differing behavioural characteristics.

Slips

Slips are considered off ramps in Paramics and are used to provide an auxiliary lane for traffic exiting a motorway. Slip lanes should not be used for any other purpose.

Slip lanes are not considered normal lanes within the Paramics structure since they do not have a lane index and once created cannot be edited directly.

The purpose of slip lanes is to provide an auxiliary lane for traffic exiting a motorway. Additional behavioural characteristics will apply to vehicles using slip lanes.

Off ramps that have two exit lanes are termed a 'diverge' within Paramics and would be coded as a motorway junction where two lanes exit.

The RTA considers it acceptable practice that a slip is replaced with a motorway exit junction that dedicates the kerbside lane to exit the motorway.

Bus stops

Bus stops represent any point on the network where fixed route vehicles stop for a period of time or where fixed route vehicles enter or exit the model. The main purpose of fixed route vehicles is to represent public transport, but they can be used for many other purposes.

In order to represent the impact of public transport vehicles on the network, bus stops must be located and coded appropriately. Bus stops that have a bay dedicated for loading/unloading passengers should be coded appropriately.

The impact of PT dwell times at bus stops can be significant and should be suitably modelled. Surveys may be required to confirm the appropriate dwell time parameters where loading/unloading PT vehicles are considered to have a significant impact on the traffic flow.

Kerb and stop line editing

Kerb points define the extent of the carriageway for visualisation purposes. In addition, they define the default position of the stoplines associated with the link.

Stoplines control the trajectory of vehicles as they enter and exit links. Each vehicle must pass over the entry stopline at the indicated angle and exit over the exit stopline at the indicated angle. In this way the positioning of stoplines influences the speed and behaviour of vehicles moving between links.

Checks should be made to ensure that the stoplines within a network allow realistic dynamics of vehicles as they pass from one link to another.

Stop lines in straight sections of a road network need to be aligned carefully to provide smooth flow of vehicles between these links. At junctions, the entry and exit points for each link need to be defined accurately since they define the radius and therefore vehicle speeds for these manoeuvres.



The RTA recognises that the positioning of stoplines is part of the calibration process and is used to influence vehicle behaviour, gap acceptance and throughput. In order for a model to be fully calibrated, editing or checking of stoplines is considered fundamental.

Detectors/SCATS detectors

Detectors are representative of inductive loop detectors used in data gathering and traffic signal operation. In Paramics, detectors have both upstream and downstream edges allowing simulated data to reflect the output data a real detector would give.

Detectors used in data gathering are used to generate 'point data' - data that are reported for each vehicle passing over the detector. Detectors also produce visual data during the simulation.

Detectors in Paramics are used to emulate the input from SCATS detectors for simulation with the SCATSIM and associated softwares. In order to do this, loop detectors in Paramics require a specific naming convention, as detailed below:

{loop "[SCATSIM Intersection no]_[SCATSIM detector No]" at [Loop start point (x m from the stop line – usually 6)] m on link [paramics link id (node 1:node 2)] lane [paramics lane No - 1] length [loop length (usually 4.5 or 11 m)] m }.

An example of detector loop file is shown below and an explanation of the formatting is set out in Table B1:

- loop 1590_5 at 6.0 m on link 872:1590 lane 0 length 4.5 m
- loop 1590_4 at 6.0 m on link 872:1590 lane 1 length 4.5 m
- loop 1590_3 at 6.0 m on link 872:1590 lane 1 length 11.0 m

Care should be exercised for detectors place on curved links. These will not function as intended and should be modified accordingly.

ltem	Description
SCATSIM Intersection no	The SCATSIM TCS number.
SCATSIM detector No:	The number assigned to the approach detectors within the SCATSIM system.
Loop Start Point	Loop start point is measured from the approach edge of the loop to the stop line. This point can vary from site to site, but is generally 6.0 m from the stopline for all detectors.
Paramics link id:	The Paramics link that the detector is to be placed on. The formatting is start node: end node.
Paramics lane No-I	A lane number must be input into the detectors file. This value is the lane number less I (e.g. the kerbside lane is lane "0").
Loop Length	Loop length is one of two distances:
	4.5 m for all approach and queue detectors;
	I I m for all departure detector loops.

Table	B .I:	SCATS	detector	coding

An example of the coding required for this set up is shown in Figure B.2.







Periodic network changes

Changes to the network by time of day should be included if appropriate. Examples of periodic network changes would include school zone speed limits, clearway restrictions, vehicle restrictions PT lanes and signal phase time changes.

The RTA specifies that periodic network changes should be coded where appropriate and where key to the main scope of the study.

B.2 Demand

Vehicles (types, characteristics, proportions)

The standard RTA 'Vehicles' file (vehicles.doc) is to be used as a base for all models submitted to the RTA. Any edits made to the file, with the exception of the matrix and proportion, should be documented by the modeller.

The RTA's vehicle registration database (DRIVES) has been interrogated to provide vehicle length and vehicle proportion information for light vehicles. The results of the data extraction and analysis are contained in the report '*Traffic Model Standardisation – Light Vehicle Lengths*'.



Commercial vehicle proportions, sizes and power to weight ratios reflect those used by the RTA for the strategic bus corridor models. Vehicle type proportions may be altered to suit each model.

By default, only familiar drivers react to category cost factors and dynamic feedback. It is accepted that the proportion of familiar drivers is a valid calibration parameter and may be changed in the vehicles file to calibrate routing in the model.

The 'acceleration-profiles' file (acceleration-profiles.doc) is a new standard file for Paramics V5.2. This has been introduced because the standard 'vehicles' file references acceleration and deceleration profiles. The values used for this standard file match those of the Paramics default profiles.

Within Paramics two methods of defining vehicle acceleration and deceleration profiles exist:

- Specified acceleration/deceleration.
- Speed/acceleration profiles.

Vehicle speed/acceleration profiles provide an alternative to the vehicle specific maximum acceleration and deceleration values.

During testing it was shown that using acceleration profiles increases the number of recorded stops per model run. However, the average speed and overall model performance is not significantly different from similar non gradient models.

The 'aggression' and 'awareness' parameters contained in the 'behaviour' file (behaviour.doc), are pseudo controllers for car following, lane changing and gap acceptance. These parameters are used in Paramics as a means of characterising the individual behaviour of a driver within a driver-vehicle unit. The values of aggression and awareness assigned to each vehicle are abstract values, each one based on an independent normal distribution. That is, there are no measurable or recorded values for aggression and awareness.

As the Paramics software was being developed, the core models of car following and lane changing were calibrated against observed flow and headway data using a default normal distribution of these abstract parameters.

It remains a concern that if users change these distributions then there is no guarantee that the core models will provide a good representation of driver behaviour. It is therefore recommended that the default normal distribution for aggression and awareness are retained in all Paramics models built for the RTA.

The RTA recommends that all changes to core values are specified and that all changes be recorded where appropriate and key to the main scope of the study.

Origin-destination matrices

Origin-destination demand matrices should be constructed making full use of available observed data, which may include:

- I. Origin-destination surveys.
- 2. Link counts.
- 3. Intersection turning movement counts.
- 4. SCATS intersection and RTA count station counts.
- 5. Volumes from other validated RTA Paramics models where available.

Origin-destination matrices may be developed using the Paramics Estimator or by other estimation techniques. If the Paramics Estimator is used, methodology must be clearly documented, including the pattern matrix specification. Care should be taken when using the Paramics Estimator to ensure realistic results. A good initial pattern matrix is important in achieving good results from Estimator. The specification of the pattern has significant impact on Estimator outputs.

Demand profiles

The profile of vehicle demand over the simulated time period is specified in Paramics. From traffic volume data, vehicle demand versus time profiles should be developed and included in the model simulation. The demand profiles should be developed for 15 minute intervals or less, separately for major entry points to the model. Aggregate profiles can be applied to a model, but must be justified.

Warm up and cool down periods

A warm up period must be coded in order to begin the main period with a loaded traffic network. The length of a warm up period should be at least the length of time it takes for a vehicle to complete the longest route in the modelled network.

A cool down period is also needed after the investigation period in order to allow all vehicles released in the main period to complete their trips. Therefore the length of the cool down period must be long enough to incorporate the longest trip in the network.

Public transport demand

All on-road public transport services which operate within the model should be included in the model. This includes all stops, each individual vehicle service based on timetables and any provided surveyed travel time data. Each individual route is coded into Paramics as a fixed route. A vehicle type (eg bus) and stops are allocated to the route. Fixed or random stop times around a mean can be coded for each service at each stop. Alternatively, passenger boarding and alighting information can be specified for each individual stop.



B.3 Calibration

Calibration is the process of adjusting the model parameters, network and demand to reflect observed data and/or observed site conditions to a sufficient level to satisfy the model objectives.

Calibration parameters

There are currently no standard procedures for the calibration of microsimulation models. It is up to the modeller to determine the appropriate adjustments to be made in order to calibrate the model to observed data and site conditions. Any adjustments to global parameters should be done with considered judgement.

Some degree of standards are set by the RTA in the form of the 'RTA Standard Files' for Paramics along with comments on which parameters should and should not be adjusted in the calibration process.

The parameters in the RTA Standard Files are classified into three groups; parameters that:

- "should be changed for different models."
- "may be altered to suit each model."
- "should NOT be changed."

This classification provides a hierarchical guide for calibration of parameters in these files. It also indicates the level of justification that should be provided by the modeller if changes to the parameters are made as part of the calibration process.

An example is the time step parameter in the configuration file which impacts on the number of calculations per second during a simulation run. Generally a time step parameter of 2 should be used as the default. However, there may be some benefits in increasing the time step value in larger models. In such cases the speed memory parameter should correspondingly be adjusted to allow for smaller time steps. The time step parameter should not be used to control simulation run speeds.

It is important to consider whether parameters adopted in base models would still be applicable under future scenario conditions. Ideally, parameters in scenario models should be consistent with the base model. However, this is not always the case. So if critical parameters are different in base and scenario models, appropriate justification must be provided.

Demand calibration

Demand matrices must be developed to reflect observed cordon, link and turning movement counts.

Generally demand matrix development involves the use of observed count data so adjusting matrices is a calibration exercise. Nevertheless, final comparisons of modelled versus observed counts should be reported in the model validation section of the report.

In addition, for larger models, a separate, independent data set of traffic counts may be required to validate the model demand.

The demand calibration process should include the running of multiple seeds. Particularly in large network models, there is potential for significant variability in modelled counts using different seeds. This kind of sensitivity in a model should not be viewed as a flaw, since the same sensitivity is often observed in reality. However, if there is significant variability between seeds in the model the extent of it should be understood and documented.

Network calibration

Network calibration involves adjusting network characteristics such as:

- stoplines
- kerbs
- node placement
- nextlanes
- signposting
- lane choices
- network entry points
- priority rules
- individual link characteristics

The network calibration process involves a significant amount of visual inspection of simulation runs. This often means it is convenient to control the simulation speed. It is important to understand that the use of +/- buttons on the keyboard to control simulation speed alters the time step parameter, which significantly affects model calculations and results. To control simulation speed for full model runs the "inter time-step pause" function should be used.

In addition, for larger models, a separate, independent data set may be required to validate the model using cordon flows, turning movement counts, travel times and queue lengths. The validation should generally report the average of the assigned volumes of the multiple seed runs undertaken.

An example of the guideline for model validation is set out in the following section.

Future year calibration

It is recognised that as a result of traffic growth and network constraints the driver behaviour for future models may alter driver behaviour in the base model. RTA recognises that the adjustment of future models may be necessary to provide an accurate assessment of network conditions. This adjustment process falls under the calibration procedure and must be treated in the same manner.

The adjustment of a network, traffic demands or parameters to reflect the expected future behaviour in future year models should only be considered if the traffic behaviour is outside the realms of what would be considered 'normally' acceptable. Adjustments made in this process are to be documented and commented by the modeller so that that they are clearly identified and justified to the RTA.



Calibration adjustments that are made in the future year base model and are pertinent to any of the test options should be applied, where appropriate, to the options so that they can be compared on a like-for-like basis.

B.4 Validation

The validation guidelines set out in this section have generally been adapted from those outlined in *UK Highways Design Manual for Roads and Bridges, Volume 12 – Traffic Appraisal of Roads Schemes.* The targets outlined in this section should be used as a guide only since the validation requirements could vary depending on the type and use of the model, its complexity, its purpose and various other criteria. The validation guidelines should be determined on a project by project basis.

Link validation

Cordon and screenline flows should be compared in each direction separately for the modelled period. Half hour flows may be required if specified in the brief. As a guide, the total cordon and screenline flows should generally be within 3% and 5% of hourly counts, respectively. For large network models, screenlines should be within 10%.

The validation of individual link flows not on screenlines should also be reported for large linear and network models. The GEH statistic should be used as an indicator to report the level of validation.

For each hour the following tabulation should be made for each road in the cordon and in each screenline:

- Percentage within 20% or 200 vehicles per hour equivalent (target 95%).
- Percentage within 10% or 100 vehicles per hour equivalent (target 90%).
- Percentage within 5% or 50 vehicles per hour equivalent (target 80%).

Intersection validation

For every important intersection, particularly in linear models, the following information should be provided.

- A comparison of hourly flows for each turning movement against counts.
- A comparison of queuing lengths, by movement (if applicable).
- A comparison of intersection delays.
- Cordon and screenline flows (if applicable).

Intersection counts

Guidelines for validation to intersection counts are difficult to source from available references. The level of validation that is achievable will vary greatly depending on the data sources and the purpose and scope of the model. It is recommended that the following

guidelines, which are derived from those commonly applied to link flows for network assignment from the DMRB, be adopted:

- For observed flows less than 700 vehicles per hour, at least 85% of all individual flows to be within 100 vehicles per hour of observed flows.
- For observed flows between 700 and 2700 vehicles per hour, at least 85% of all individual modelled flows to be within 15% of observed flows.
- For observed flows of greater than 2700 vehicles per hour, at least 85% of all individual flows are to be within 400 vehicles per hour of observed flows.
- Total screen line modelled flows to be within 5% of observed screen line flows.
- Greater than 85% of all individual modelled flows to have a GEH of less than 5.
- Greater than 85% of all travel time routes to have modelled travel times within 15% of observed travel times (or 1 minute if higher).

While they are considered reasonable guidelines for calibrating and validating turning movements, the conditions can be time consuming to satisfy particularly for large linear or network models. Again, the purpose of the model should be considered when determining the extent to which these and all other parameters are met.

Travel times

Observed travel time data is generally limited to a small number of samples, while modelled travel times are samples of every single vehicle trip which can equate to hundreds and thousands of trips.

The variation between observed and modelled sample sizes increases the difficulty of calibrating a model to travel time data. One method for calibrating and validating model travel times is to compare the average modelled travel time against the range of minimum and maximum observed travel times. This is usefully done on a visual basis where the effects of abnormal (or infrequent) events can be ignored if appropriate.

Methods for comparing observed and modelled travel times include:

- Average modelled travel time compared with observed minimum and maximum travel time.
- Average modelled travel time compared with average observed travel time with 95% confidence interval.
- Comparison of observed and modelled travel time to volume relationships.

The appropriate method depends very much on the size of the observed dataset and the level of variability of travel times on the route. Again, the extent to which modelled travel times correlate with observed data is dependent on the type of network and purpose of the model.



Queue lengths

It is possible to extract the range of queue lengths from the model, which is a useful guide to compare against observed queues. A range should be provided for the modelled queue lengths to be compared against. This also provides a good base from which to test future year scenarios.

Model stability

A standard method for checking model stability is to check the maximum and minimum hourly flows for each cordon and screenline crossing points for at least five seeds. This is a particularly important check for large network models.

The graphs of the network vehicles over the simulation time period can indicate the stability of a model. Should the graphs correlate and indicate consistency between models, the turning movement count results from one of the model runs may be used for calibration.

Demand release

Generally the percentage of unreleased vehicles must be equal to zero for the base model at the end of the simulation period.

Sensitivity tests

Sensitivity tests should be carried out to ensure the model responds logically to network and demand changes.

Option models

Models for scenario and option testing should be developed from the base model. Network and/or demand changes may be introduced. Option models will require some level of calibration to ensure realistic driver behaviour is being simulated. The amount of work required for option models will depend on the extent of network and demand changes.

The base and option models should be kept consistent as much as possible. Network changes in an option model may require adjustment of parameters such as signposting, stoplines, nextlanes and other network characteristics. Increased demand can potentially require significant adjustment to the base model network parameters. Global parameters should remain consistent with the base model in almost all cases.

As for the base model validation, option tests generally require multiple seed runs to account for variability between seed runs. The modeller needs to ensure the outputs represent statistically significant results. On certain projects the RTA will require the same seed to be run for options tests as for the median base model run. This is a method to reduce time and effort undertaking and analysing multiple simulation runs. In projects where there is a low degree of variability and relatively minor changes to the network or demand, this may be considered a reasonable approach. However, the travel time and queue length variability needs to be demonstrated for both base and option models.


Appendix C – Reporting



C.I Overview

This document provides an overview of some of the types of information to report, how to present the information and how to compare results from the test options. The project manager should add or subtract text as appropriate.

Key information relevant to the project is required to demonstrate the outcomes of the modelling. The type of key information relevant to a project may include some or all of the following:

- Travel time changes.
- Intersection delay changes.
- Intersection level of service changes.
- Link level of service changes.
- Network changes.
- Queue length changes.
- Overall network performance.

As discussed previously, plug-ins have been developed for use in Paramics modelling to extract some of the information described above. Alternatively, this information can be extracted from the model using data manipulation from the standard outputs.

C.2 Model operational analysis report

This section is designed to be used for succinctly reporting the details of a model and its outputs.

Model area description

A description of the model provided in the brief should be provided in addition to a map showing the model area in relation to the rest of the nearest capital or major city.

Summary of model analysis

A short description of the model performance, including any operational issues with the existing network not identified prior to the commencement of model development, should be provided. It is also useful to provide a list of any limitations within the model.

Include a table showing the overall performance of all base model and options/scenario tests for any of the following items (to be nominated by the project manager):

- Total travel time.
- Total average trip time.
- Mean average travel speed.
- Total operational cost.



- Unreleased vehicles (this must be equal to 0 for the current year).
- Key intersection performance.
- Average movement delay.
- Average intersection delay.
- Level of service.
- Queue length.

This could be undertaken with the use of the Network Evaluation Plug-in.

Network performance

The modeller is to report and discuss any mid-block sections of the network as required by the project manager or where existing network design hampers traffic flow (eg poorly performing S-lane, downstream short lanes, insufficient queue storage capacity, poor lane utilisation, intersection layouts that could be improved by re-marking the lanes, improved bus stop locations).

Operational issues within the model

The modeller is to report and discuss other operational issues within the model (eg excessive queuing, demand exceeding capacity, unreleased vehicles [zone blocking]).

The results identified above should be undertaken for the following:

- I. The base model.
- 2. Test/scenario options.

Preferred option

The preferred option should be identified and the reasons for this described.

C.3 Model validation note

Presentation of Paramics reporting standard as attached to this document. This report deals with all the standards used covering vehicle lengths, configuration and movement tables. It should explain what variations have been made from Paramics defaults and RTA standards and they should be justified by referring to information in the calibration report. In particular, changes to standard headways, aggressiveness factors etc, should be supported by appropriate justification.



Project Details

Please provide general information about the project.

Client							
Project Title							
Route Name		Scheme	e Location (ind	cluding grid refe	rence)		
Study carried out by:					*		
Previous Reports: Title							Date
Project Description:							
		fi a Mad	.1				
Model Base/Design* (delete a	ne Tra	IIIC MODE	ei	Size of Model (Calibration Pasel)			
Yeen	s appi c	priace)		Number of 7			
Tear					ones		
I raffic flow units				Number of Li	nks		
Time Dependent Model	Ye	s 🗆	No 🗆	Number of N	odes		
Modelled time period(s)				Number of M	odelled Junction	s	
				Number of Si	gnals	FT	VA
Calibration and Validation Sta	tistics						
Have modelled flows and trav	el time	s been va	alidated to acc	eptable standard	ls?	Yes 🗆	No 🗆
If "yes" please specify the stan	dards	adopted?		NSW 🗆	UK DMRB] Other	
If "other" please specify							
Are results reported in Mode	l Valida	tion Rep	ort?			Yes 🗆	No 🗆
Model Trip Database2							
Туре		No.	Date	Туре		No.	Date
Roadside Interviews				SCATS Coun	ts		
Registration Number Survey				Link Count C	nly		
Manual Classified Counts				Commercial V	/ehicle Survey		
Automatic Traffic Counts				Postcard Que	stionnaires		
Junction Counts				Household In	terviews		
Matrix Estimation Techniques	usea						
Check and Junction Count only							
Synthetic Matrix (give details)							
Partial Matrix (give details)							
Combination of Observed and Synthetic (give details)							
Other (please specify)							
Present Year Validation							
Is the model base year more than three years earlier than t			he current year	2	Yes	No	
If yes, has a Present Year validation been undertaken?				Yes	No		
Details of Sub-models (software) used		Application N	ame		Version		
Traffic assignment model							
Mode Choice Model			1			1	
Other (place specify)							

¹ Please ensure the Local Model Validation Report contains a network diagram showing numbered links and nodes, for both base and design.

² Please list counts used to derive base year matrices as detailed in the Traffic Survey.

Model input

This section lists changes made to default values (either Paramics default values or NSW default values). Please indicate which default values were used and what changes were made to the Paramics files and comment on the reasons for the changes.

Run Initialisation

Configuration File	NSW Paramics 🗆
(tick default used)	Paramics 🛛
	Other 🛛

Description	Paramics	NSW	t	Other non default values		
	Values	Default Values		Values Used	Comment on reason for changes	
Mean Headway	1.0	1.0				
Mean reaction time	1.0	1.0				
Demand weight	100.0	100.0				
Demand matrix tuning level	0	0				
Curve speed factor	1.0	1.0				
Amber time	3.0	4.0				
Timestep detail	2	2				
Cost Coefficients	1,0,0	0.4667, 0.2833, 0.4167				
Feedback	disabled	disabled				
Perturbation	disabled	disabled				
Generator	0	0				

Behaviour file

Have the "aggression" levels been changed from the default normal distribution?

Yes 🗆 No 🗆

Have the "awareness" levels been changed from the default normal distribution?

Yes 🗆 No 🗆

If "yes", please provide comments on reasons for changes.



"Behaviour" File	Change	Comment on reasons for changes
Aggression		
Awareness		

Network

Categories File	(tick default used)	١
Categories rife	(lick delault used)	

NSW Paramics 🗆

Paramics

Were changes made or additional categories used? Yes \Box No \Box

If "yes" or if a new set of categories were defined, please complete the following table.

List Changes or Additional Categories				
Category Number	Change	Reason for changes		

(Please use additional sheet if necessary)

Next Lanes File

Was the default lane mapping changed? Yes \Box No \Box

If "yes", please complete the following table with reference to the "nextlanes" file.

Lane mapping, "nextlanes" file				
Node Number	de Change Reasons for changes from default			

(Please use additional sheet if necessary)

Hazards File

Was the look ahead lane/route choice changed? Yes \Box No \Box

If "yes", please complete the following table with reference to the "hazards" (signposting) file.

Lane/route choice, "hazards" (signposting) file.				
Link	Reasons for changes from default			
Number				



Lanechoices File

If "yes", please complete the following table with reference to the "hazards" (signposting) file.

Lanechoice file.				
Link Number	Location	Reasons for coded Lanechoice		

(Please use additional sheet if necessary)

Restriction file

Have network restrictions been modelled? Yes \Box No \Box

If "yes", specify the location and type of the restriction in the following table.

Network restriction, "restrictions" file				
Link Number	Location	Description of coded restrictions		

Demand

Vehicles File	(tick default used)	NSW Paramics \Box
	(/	

Paramics

Were changes made or were additional vehicle types used? Yes \Box No \Box

If "yes" or if a new set of vehicle types were defined, please list changes and complete the following table.

	List Additional Vehicle Type						
No.	Туре	Speed (kph)	Matrix	Proportion	Perturbation	Familiarity	Colour

(Please use additional sheet if necessary)

Incidents file

Have incidents been coded? Yes \Box No \Box

If "yes", please describe the type of incident, the location, and explain why incident modelling has been included.

Incidents File					
Туре	Location	Comment			



Summary of OD Data input to Paramics

Please complete the following tables for trip matrices and vehicle proportions.

Trip Matrices

Time Period	Year	Profile Number	Profile Interval (mins)	Proportions per Interval	Corresponding OD movements (e.g. all, zones 2 to 4, etc.)

(Please use additional sheet if necessary)

Vehicle Classification Proportions

Time	Year	Matrix	Vehicle Type / Trip purpose	Proportio	Matrix Totals (vehicles)
Period		No.		n	



Assignment

Generalised cost	equation			
Assignment method		All or nothing		
(please tio	(please tick)		√ 1	or %
		Dynamic Feedback	Feedback inter	rval (minutes)
Vehicle Type	Perc	entage Familiar	F	Perturbation
Pouting Table	Eamilian		wistion Critoria	Vehicle Types which
Number	Unfamilia	r (e.g. taxi only,	2T weight limit)	Restrictions apply to

(Please use additional sheet if necessary)

Model Output Checklists

Network

Identify which of the following checks have been undertaken and provide comments/reference to output results.

	Yes	No	Comments/References
Check overlay scale of model grid			
Check network connectivity			
Check appropriate zone connections			
Check warning messages			
Other network checks (please specify)			



Demand

Identify which of the following checks have been undertaken and provide comments/reference to output results.

	Yes	No	Comments/References
Have desire line diagrams been produced?			
Does traffic release match OD demand?			
Have plots of demand profile by time period been produced?			
Other demand checks (please specify)			

(Please use additional sheet if necessary)

Assignment

Identify which of the following checks have been undertaken and provide comments/reference to output results.

	Yes	No	Comments/References
Have individual OD paths been checked?			
Have OD paths been plotted?			
Has a comparison of flows/speeds on alternative routes been completed?			
Other assignment checks (please specify)			



Operation

	Yes	No	Comments/References	
Has the model run record sheet been completed?				QA
Does simulation operate as expected?				Visualisation
check against local knowledge				
check against video tape records				
Do link counts match assigned flows?				Comparison of Counts
Do turn counts match assigned turn flows?				
Do travel times match observed?				Comparison of speeds, TT
Do speeds match modelled speeds?				& queues
Queue lengths checked against video records and/or surveys?				
Have runs with different seed values been completed? (State seed values used)				Model stability
Is the model stable? (document variability statistics e.g. speed travel time, flows etc)				
Has comparison to following lane data been completed?				Lane usage
lane usage (flow)				
lane speeds				
lane headways				
Have the following standard plots been produced?				Model plots
Assignment plots				
Speed plots				
Flow comparison (scatter) plots				
Other model operation criteria (please specify)				



Process improvement

Modeller comment

Please provide objective comment on the project with the aim of improving the process in the future from the viewpoint of the consultant, client or software developer.

Modeller Comment	RTA Comment	Further	Action
		Yes	No
Model Scope Comment			
Model Building Comment			
Output and Reporting Comment			
Software Development Comment			
General Comment			
Other Comment			



C.4 Reporting framework

The report framework for submission to the RTA will depend on the purpose and scope of the model. Any specific requirements for a project report will be detailed in the RTA's project brief.

Accompanying the project report the RTA requests that all reports submitted for approval will contain a structure similar to the one below.

Title:- < Model Title> - Model Operational Analysis Report

Executive summary

A 1-2 page synopsis of the report including all salient points and recommendations

I.0 - Introduction

An overview of the brief and the specific modelling approach.

2.0 - Existing model

This section addresses the existing base mode and its application.

2.1 - Overview

A synopsis of the base model and its application.

2.2 - Location and Description

Description on the model coverage and brief description.

2.3 - Model assumptions

Assumptions made and parameters used in base model.

2.4 - Application of model

How the model is applied and limitations of the output.

2.5 - Framework for evaluation

Note on the framework used for evaluation.

3.0 - Modelling

This section covers the modelling of the options and the results.

3.1 - Proposed options

List of proposed options.

3.2 - Detailed options



Physical and operational detailed description of the options.

3.3 - Modelling results

A summary of the results and salient issues.

3.4 - Modelling comments

Modeller's comments on the operation of the network.

4.0 - Summary and recommendations

This section contains a summary of results (tabulated) and recommendations made.

4.1 - AM Peak

4.2 - PM Peak

4.3 - Weekend Peak

Appendix A - Model results

All model results outlined in the framework.

Appendix B - Models

The model, including supporting files on CD.

Appendix C – Calibration and validation

Summary of base model calibration and validation.



Appendix D – Auditing



D.I Overview

The audit procedure detailed below is intended to give guidance for the parties involved in the model building process to ensure that the model is fit for purpose.

In order for a microsimulation model to be a valid decision support tool it is sufficient that it is a 'good representation' of the existing road network in the context of the purpose for which it was built. Modelling options derived from the base model must demonstrate consistency with the base model and assumptions.

A base model must conform to standard industry practice and all parameters used should be within accepted bounds or be identified prior to the audit by the modeller.

It is the nature of traffic behaviour that there are random elements and daily variations, which are represented in microsimulation tools. In identifying the appropriate level of detail for the audit, these elements must be considered.

This procedure describes the process for carrying out technical audits of traffic models developed using Paramics Microsimulation software. The aim of the audit process is to determine whether or not a model is 'fit for purpose'.

In order to establish this, the auditor of the model must be assured that:

- The data is of good quality and its use is appropriate within the model.
- The modelling results are sufficiently accurate and robust as a decisions support tool.
- The learning processes of both the modeller and the project manager (in preparing briefs and interpreting model results) have benefited from the audit.

It is not practical for the audit to examine every component of the modelling work, and the audit cannot therefore certify that the modelling is "correct" in every respect. Each audit should be carried out with the purpose and context of the model in mind.

D.2 Scope

This procedure applies to the:

- Project manager.
- Lead auditor and auditor team.
- Contractor/Consultant.

The project manager should add or subtract details to the process below to ensure that the nature and extent of the audit is appropriate for each individual project. This will be influenced by the model purpose and its suitability as a decision support tool.

D.3 Overview

The audit examines the following aspects of the work:

- **The brief**. This is the basis of the modelling work. The audit examines the adequacy of the brief, and conformity of the work to the brief.
- **The network model**. The audit checks the sources of geometric data and carries out spot checks to confirm correct scale and layout of one or more critical elements of the network. It also checks special coding of link categories, speeds, lane functions (turning movements permitted and "stacking" where appropriate), lane restrictions (eg bus lanes or transit lanes) and look-ahead ("signposts") for suitability.
- **Traffic signal control**. Where the network model includes traffic signals, the audit checks the source of traffic signal control data (phases, cycles and offsets) and spot checks critical intersections for accuracy.
- **Travel demand data**. The audit checks the sources of travel demand data and if the estimates of base year and future year modelled demands are acceptable.
- **Configuration data**. The audit checks that all parameters in the configuration file are acceptable and any changes to the standard RTA configuration file are documented and justified.
- Vehicle data. The audit checks whether standard default vehicle data is used, the need for any non-standard vehicle data, and the source and suitability of non-standard data.
- **Driver behavioural data**. The audit checks whether standard default behavioural data is used, the need for any non-standard data, and the source and suitability of non-standard data.
- **Bus routes**. The audit checks the sources and modelling of bus routes, bus stops and frequencies.
- **Road network performance data**. The audit checks the scope, adequacy and documentation of performance data used in calibrating and validating the model.
- **Origin destination matrices**. The audit checks that the methodology behind the matrix development is sound and that the matrices reflect realistic trips.
- **Traffic assignment**. Where the modelled network provides alternative routes for any trips, the audit checks the assignment process used, including the cost function, assignment algorithm, driver familiarity, perturbations, strategic routes (if defined) and any route restrictions for special vehicle types.
- **Model calibration**. The audit checks the process used for calibrating the model, the data against which it is calibrated, the changes made to the model to improve the calibration, and the final accuracy of calibration achieved.
- **Model validation**. The audit examines whether the model has been validated against data independent of that used for calibration, and the results of the validation.



- **Model application**. The audit checks the results obtained from the model for reasonableness and (where suitable sensitivity tests have been carried out) for robustness.
- **Documentation of model development and application**. The audit checks that all the above aspects of the modelling work are adequately documented.

D.4 Model calibration and validation

The project manager is to determine which items to include in the audit depending on the size of the model.

- **Data collation**. It is the responsibility of the modeller to collate all network timing, count and movement data and to document and report on that data.
- **Determination of additional survey data**. It is the responsibility of the contractor to identify any additional counting, inventory or survey data required for the successful validation of the model.
- **Network depiction**. This report should cover the physical representation of the network and in particular the following (noting that this is not a complete list):
 - Are all the intersections there that should be there?
 - Do all intersections have the right number of lanes and do they have correct controls?
 - Are all signal phasing and timings correct?
 - Do all roundabouts have the correct number of entry, exit and circulating lanes?
 - Have all traffic controls (eg No Stopping, Clearways) been identified?
 - Do all roads have the correct number of lanes?
 - Are all merges and diverges correct?
 - Are all bus routes correct and bus stops in the right place?
- **Paramics reporting standard**. The report should deal with all the standards used, covering vehicle lengths, configuration and movement tables. It should explain why variations (if any) have been made from Paramics standards and the relevant justification by referral to information in the calibration report. In particular, changes to standard headways, aggressiveness factors etc, should be supported by appropriate justification.

The following items are to be checked against the procedures set out in Stages 1 to 3 of this manual.

- Intersection performance.
- Cordon and screenline flows (if required).
- Matrix validation.

- A table should be produced comparing zonal trip generation and attraction and comment should be made of any gross discrepancies.
- Comparison should be made on vehicular movement through the cordon points in both directions between total inter-cordon traffic generation and through cordon generation.
- Travel times.

D.5 Procedure

The audit procedure may be required for small intersection models through to large grid network models but is generally not required for small, simple and uncongested models. The audit procedure should be adapted to reflect the model size and classification, the model purpose and other relevant criteria. The following sub-sections should be added or subtracted by the project manager to align with the model purpose, keeping in mind the objective to achieve 'fit for purpose' modelling.

Pre-audit

The project manager shall:

- Determine the starting and finishing dates for the audit.
- Nominate the lead auditor.
- Determine the composition of the audit team, in consultation with the lead auditor.
- Supply the lead auditor with a copy of the brief for the modelling project, and any reports presented by the contractor.
- Contact the contractor at least five working days prior to the commencement of the audit, and inform the contractor of:
 - The date(s) of the audit.
 - The scope of the audit.
 - The time and place of the opening meeting (if required).
 - The person nominated as lead auditor.
 - \circ $\;$ The records and systems access required for the audit.
 - The contractor's personnel required for the audit.

The lead auditor shall:

- Review the brief and reports.
- Examine the audit schedule, and strike out any items which are outside the scope of the work set out in the brief.



- Brief audit team members regarding the details of the audit and their respective roles, and provide them with relevant documentation.
- Confirm details of the opening meeting (if required) with the contractor and ensure that the contractor's project manager and other required personnel will attend.

The opening meeting (if required)

The audit team, the contractor's project manager, and those on the contractor's staff who will be required to participate in the audit should attend the opening meeting. The purpose of the opening meeting is to ensure that the contractor is familiar with:

- The scope and purpose of the audit.
- The audit team.
- The information, access to electronic systems and access to contractor's staff which the audit team will require.
- The audit procedure.
- The opportunities which will be available to the contractor to discuss the audit and its findings.

In certain circumstances it may be impractical or unnecessary to hold an opening meeting.

Conduct of the audit

The audit team shall:

- Examine and assess all of the items listed in the audit schedule.
- Ensure that the lead auditor is kept informed of the progress of the audit, and any matters of concern that are identified.
- Where the audit schedule uses the term calibration, it refers to the process of estimating model parameters by fitting model results to a set of observations. The term validation refers to a subsequent process of checking model outputs against a second set of observations, independent of the set used for calibration. The modeller may subsequently undertake a process of adjustment to improve the fit between model outputs and the second set of observations. No further validation is possible unless a third set of observations can be found, which are independent of the sets used for calibration.
- Where standard "default" values are available for model parameters, and the audit finds that other values have been adopted, care should be taken to determine the reasons for that choice, the source of the non-standard values, and their reasonableness, having regard to values used for other modelling projects, or values obtained from direct observation.
- Where spot checks are called for, the audit team shall select a small number of critical points in the model for detailed checking. In addition, base and future

models should be subjected to a visual check of the operating model, to confirm that traffic movements and queues appear reasonable.

- Where the audit schedule calls for an assessment of the reasonableness of model results, consideration should be given to theoretical and logical expectations, and to any modelled or observed outcomes of similar projects.
- In examining sensitivity tests as an indication of the robustness of the model results, consideration should be given to the risk that the model results might lead to an incorrect decision, in terms of:
 - The risk that a given modelling assumption might be incorrect.
 - The sensitivity of the modelling results to likely error in the assumption.
 - The sensitivity of the final decision to the likely variation in model results.
- Throughout the audit, consideration should be given to the brief for the modelling work in terms of whether the brief adequately specified the work, and whether the work complies with the brief.
- The over-riding consideration in conducting the audit should be 'fitness for purpose'. The audit team must therefore keep clearly in mind the intended use of the model and the decisions which its results will inform. The model results, and even the observed data used to calibrate the model, are not precise values. They represent a range of probable values which can be expressed as a probable error or a confidence interval. What is important is that:
 - The degree of accuracy is adequate for the decisions to be made.
 - Decision makers are aware of the accuracy of the information they are given.

Closing meeting (if required)

At the closing meeting, the lead auditor and other team members shall discuss the outcomes of the audit with the contractor, ensure that any findings are understood, and allow the contractor to comment on recommendations to be made in the audit report. As for the opening meeting, it may be impractical or unnecessary to hold a closing meeting.

Audit Report

Following the closing meeting, the lead auditor shall submit the audit report to the project manager. The report shall consist of a completed audit schedule (see below), and any supporting material.



Roles and Responsibilities

Project Manager	Is the Responsible Officer and is responsible for:				
	Determining the starting and finishing dates for the audit				
	Nominating the Lead Auditor				
	Determining the composition of the Audit Team, in consultation with the Lead Auditor.				
Supplying the Lead Auditor with a copy of the Brief for the modelling project, and					
	reports presented by the Contractor.				
	Contacting the Contractor at least five working days prior to the commencement of the				
	audit, and inform the contractor of essential audit information				
Service Provider	May include RTA, councils and/or external contractors, and is responsible for:				
	Performing all the work and obligations of the contract or agreement.				

The audit report is the most critical component of the auditing procedure and provides a guide as to whether or not a model is 'fit for purpose'.

Audit Schedule

The Project

Location / Route / Area	
Project Description	
Purpose of Modelling	
Model developed by	

The Audit

Auditor(s) -	
Date(s)	

Model Scope

Geographical extent	(describe)
Years modelled	
Time periods modelled	
Periodic variations (profiles) in:	(describe the time profiles used, and list the time dependent aspects of
Traffic demand	the model)
Links	
Junction control	
Number of zones	
Number of links	
Number of nodes	
Number of junctions	
Number of traffic signals:	
Fixed time	
Vehicle Actuated	
SCATS controlled	
Adequately defined in the brief?	
Work complies with the brief?	
Work adequately documented?	



Networks

Base Network	Source
Basic geometry	
Intersection layouts	
Traffic signal controls	
Categories file	
Next lanes file	
Signposts file	
Restriction file	
Time dependent profiles	
Carparks	

Spot Checks	Details
Network scale	
Detailed layouts	
Signal controls	
Visual check of operating model	

Future Networks	Source
Basic geometry	
Intersection layouts	
Traffic signal controls	
Other variations from base network	
(give details)	

Spot Checks	Details
Detailed layouts	
Signal controls	
Visual check of operating model	
Adequately defined in the brief?	
Work complies with the brief?	
Work adequately documented?	

Vehicle and Driver Data

Data Type	Source and Details
Default vehicle data used?	NSW standard ?
	Paramics standard?
Additional or non-standard vehicles	
used?	
Vehicle proportions	
Familiarity	
Aggression distribution	
Awareness distribution	
Headway	
Reaction time	
Adequately defined in the brief?	
Work complies with the brief?	
Work adequately documented?	



Base Travel Demand

Source	Details
Automatic vehicle counts	
Manual vehicle counts	
Classified counts	
Manual turning counts	
SCATS counts	
Number plate survey	
Roadside interviews	
Mail-back questionnaire	
Home interview	
Commercial vehicle survey	
Other	
Adequately defined in the brief?	
Work complies with the brief?	
Work adequately documented?	

Base Trip Table Estimation

Method	Details
Counts only	
Synthesised from counts:	
Observed	
Modelled	
Other	
Are time dependent demand profiles used?	(Give details and sources)
Adequately defined in the brief?	
Work complies with the brief?	
Work adequately documented?	

Future Trip Table Estimation

Method	Details
Growth factors	
Modelled	
Other	
Adequately defined in the brief?	
Work complies with the brief?	
Work adequately documented?	

Assignment

Algorithm	
Cost coefficients	
Incidents	(Give details)
Signposting	(Give details)
Strategic Routes	(Give details)



Calibration

Calibrated To	Calibration Statistics
Trip length distribution	
Observed volumes	
Queue lengths	
Travel times	
Other (specify)	
Adequately defined in the brief?	
Work complies with the brief?	
Work adequately documented?	

Validation

Has the calibrated model been validated against data not used for calibration?	
Validated Against	Validation Statistics
Observed volumes	
Queue lengths	
Travel times	
Other (specify)	
Adequately defined in the brief?	
Work complies with the brief?	
Work adequately documented?	

Model Application

Performance measures reported	(List measures of network performance reported)
Sufficient for proper comparison of	
options?	
As required by brief?	

Options Tested	Reasonableness of Results

Sensitivity Tests	Robustness of Results
Adequately defined in the brief?	
Work complies with the brief?	
Work adequately documented?	



Summary of audit recommendations

The Model

ltem	Recommendations

The Brief

ltem	Recommendations



Appendix E – RTA NSW Standard Files for Paramics



E.I Overview

The RTA has developed a series of standard files that are relevant to the traffic and vehicle characteristics in NSW. These files are to be used as a guide for standard Paramics inputs. changes to the files must le logged and reported in the report submitted to the RTA. The contents of the files can be seen in the following sections of this Appendix.

The use of the standard files is not intended to restrict the modeller's application of the software, but to give guidance to users in relation to inputs and calibration parameters. Standardisation of inputs helps to maintain general consistency between models which is useful for analysis and for the potential amalgamation of separate models. The balance between applying the standardised file inputs and allowing flexibility for the modeller is the responsibility of the modeller as the balance is not currently well defined.

The RTA standard files group input parameters into three categories:

- 1. "Parameters in 'green' should be changed for different models."
- 2. "Parameters in 'blue' may be altered to suit each model."
- 3. "Parameters in 'red' should NOT be changed."

This classification provides some guidance to the modeller in relation to which parameters are appropriate to change, along with the level of justification necessary for changing parameters. Parameters in red are not necessarily strictly fixed; rather it is recommended other parameters are first considered for calibration purposes.

The most recent release of the RTA standard files can be obtained by contacting:

The Manager Traffic and Transport Modelling Roads & Traffic Authority Tel. 02 8588 5675



"Categories" File

RTA NSW Standard "categories" file.

File prepared by the Roads and Traffic Authority of New South Wales

File version 3.00 for Paramics V5.2.2

Date I January 2008

Updated versions of this file will be released periodically

Please contact Mr. R. Tudge (RTA NSW +61 292186929) for information

regarding new file versions.

Replacing previous standard 'categories' file 9/12/2005 ## Changes included :

Changes included : ## I. additional category parameters from Paramics V3 to V5.2.2

2. new set of categories for "Arterial 60kph"

3. categories 1 to 10 – replace 'highway' with 'urban'

(urban roads have more even lane usage and allow greater throughput -

thought more appropriate for NSW road conditions)

4. indicative cost factors coded to provide hierarchy for route choice

Comments are shown in 'black' proceeded by '##'

Parameters in 'green' should be changed for different models ## parameters in 'red' should NOT be changed and ## parameters in 'blue' may be altered to suit each model

categories: I to 78

Freeway 110 kph (cost factor 0.8) CODED AS URBAN category 1 lanes 1 speed 110 kph width 3.3 m colour 0x0000ff00 type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 0.800 signpost 750.0 m, 1.0 m

category 2 lanes 2 speed 110 kph width 6.6 m colour 0x0000ff00 type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 0.800 signpost 750.0 m, 1.0 m

category 3 lanes 3 speed 110 kph width 9.9 m colour 0x0000ff00 type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 0.800 signpost 750.0 m, 1.0 m

category 4 lanes 4 speed 110 kph width 13.2 m colour 0x0000ff00 type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 0.800 signpost 750.0 m, 1.0 m

category 5 lanes 5 speed 110 kph width 16.5 m colour 0x0000ff00 type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 0.800 signpost 750.0 m, 1.0 m

Freeway 100 kph (cost factor 0.8) CODED AS URBAN

category 6 lanes I speed 100 kph width 3.3 m colour 0x0000aa00 type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 0.800 signpost 750.0 m, 1.0 m

category 7 lanes 2 speed 100 kph width 6.6 m colour 0x0000aa00 type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 0.800 signpost 750.0 m, 1.0 m

category 8 lanes 3 speed 100 kph width 9.9 m colour 0x0000aa00 type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 0.800 signpost 750.0 m, 1.0 m



- category 9 lanes 4 speed 100 kph width 13.2 m colour 0x0000aa00 type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 0.800 signpost 750.0 m, 1.0 m
- category 10 lanes 5 speed 100 kph width 16.5 m colour 0x0000aa00 type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 0.800 signpost 750.0 m, 1.0 m
- ### Arterial 100 kph (cost factor 0.8)
- category 11 lanes 1 speed 100 kph width 3.3 m colour 0x0000ee00 type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 0.800 signpost 250.0 m, 1.0 m
- category 12 lanes 2 speed 100 kph width 6.6 m colour 0x0000ee00 type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 0.800 signpost 250.0 m, 1.0 m
- category 13 lanes 3 speed 100 kph width 9.9 m colour 0x0000ee00 type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 0.800 signpost 250.0 m, 1.0 m
- category 14 lanes 4 speed 100 kph width 13.2 m colour 0x0000ee00 type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 0.800 signpost 250.0 m, 1.0 m
- category 15 lanes 5 speed 100 kph width 16.5 m colour 0x0000ee00 type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 0.800 signpost 250.0 m, 1.0 m
- ### Arterial 100 kph (cost factor 1.0)
- category 16 lanes 1 speed 100 kph width 3.3 m colour 0x0000ffff type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.000 signpost 250.0 m, 1.0 m
- category 17 lanes 2 speed 100 kph width 6.6 m colour 0x0000ffff type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.000 signpost 250.0 m, 1.0 m
- category 18 lanes 3 speed 100 kph width 9.9 m colour 0x0000ffff type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.000 signpost 250.0 m, 1.0 m
- category 19 lanes 4 speed 100 kph width 13.2 m colour 0x0000ffff type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.000 signpost 250.0 m, 1.0 m
- category 20 lanes 5 speed 100 kph width 16.5 m colour 0x0000ffff type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.000 signpost 250.0 m, 1.0 m

Arterial 90 kph (cost factor 1.0)

- category 21 lanes I speed 90 kph width 3.3 m colour 0x0000eeee type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.000 signpost 250.0 m, 1.0 m
- category 22 lanes 2 speed 90 kph width 6.6 m colour 0x0000eeee type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.000 signpost 250.0 m, 1.0 m
- category 23 lanes 3 speed 90 kph width 9.9 m colour 0x0000eeee type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.000 signpost 250.0 m, 1.0 m
- category 24 lanes 4 speed 90 kph width 13.2 m colour 0x0000eeee type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.000

signpost 250.0 m, 1.0 m category 25 lanes 5 speed 90 kph width 16.5 m colour 0x0000eeee type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.000 signpost 250.0 m, 1.0 m
<pre>### Arterial 80 kph (cost factor 1.0) category 26 lanes I speed 80 kph width 3.3 m colour 0x0000cdcd type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.000 signpost 250.0 m, 1.0 m</pre>
category 27 lanes 2 speed 80 kph width 6.6 m colour 0x0000cdcd type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.000 signpost 250.0 m, 1.0 m
category 28 lanes 3 speed 80 kph width 9.9 m colour 0x0000cdcd type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.000 signpost 250.0 m, 1.0 m
category 29 lanes 4 speed 80 kph width 13.2 m colour 0x0000cdcd type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.000 signpost 250.0 m, 1.0 m
category 30 lanes 5 speed 80 kph width 16.5 m colour 0x0000cdcd type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.000 signpost 250.0 m, 1.0 m
<pre>### Arterial 70 kph (cost factor 1.0) category 31 lanes 1 speed 70 kph width 3.3 m colour 0x00008b8b type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.000 signpost 250.0 m, 1.0 m</pre>
category 32 lanes 2 speed 70 kph width 6.6 m colour 0x00008b8b type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.000 signpost 250.0 m, 1.0 m
category 33 lanes 3 speed 70 kph width 9.9 m colour 0x00008b8b type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.000 signpost 250.0 m, 1.0 m
category 34 lanes 4 speed 70 kph width 13.2 m colour 0x00008b8b type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.000 signpost 250.0 m, 1.0 m
category 35 lanes 5 speed 70 kph width 16.5 m colour 0x00008b8b type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.000 signpost 250.0 m, 1.0 m
Arterial 60 kph (cost factor 1.0) category 36 lanes I speed 60 kph width 3.3 m colour 0x00008b8b type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.000 signpost 250.0 m, 1.0 m
category 37 lanes 2 speed 60 kph width 6.6 m colour 0x00008b8b type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.000 signpost 250.0 m, 1.0 m
category 38 lanes 3 speed 60 kph width 9.9 m colour 0x00008b8b type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.000 signpost 250.0 m, 1.0 m
category 39 lanes 4 speed 60 kph width 13.2 m colour 0x00008b8b type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.000 signpost 250.0 m, 1.0 m



category 40 lanes 5 speed 60 kph width 16.5 m colour 0x00008b8b type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.000 signpost 250.0 m, 1.0 m

Sub Arterial 80 kph major (cost factor 1.2)

- category 41 lanes I speed 80 kph width 3.3 m colour 0x00ffff00 type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.200 signpost 250.0 m, 1.0 m
- category 42 lanes 2 speed 80 kph width 6.6 m colour 0x00ffff00 type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.200 signpost 250.0 m, 1.0 m
- category 43 lanes 3 speed 80 kph width 9.9 m colour 0x00ffff00 type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.200 signpost 250.0 m, 1.0 m

Sub Arterial 80 kph minor (cost factor 1.2)

- category 44 lanes I speed 80 kph width 3.3 m colour 0x00ddd00 type urban minor headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.200 signpost 250.0 m, 1.0 m
- category 45 lanes 2 speed 80 kph width 6.6 m colour 0x00ddd00 type urban minor headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.200 signpost 250.0 m, 1.0 m
- category 46 lanes 3 speed 80 kph width 9.9 m colour 0x00ddd000 type urban minor headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.200 signpost 250.0 m, 1.0 m

Sub Arterial 70 kph major (cost factor 1.2)

- category 47 lanes I speed 70 kph width 3.3 m colour 0x00ff0000 type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.200 signpost 250.0 m, 1.0 m
- category 48 lanes 2 speed 70 kph width 6.6 m colour 0x00ff0000 type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.200 signpost 250.0 m, 1.0 m
- category 49 lanes 3 speed 70 kph width 9.9 m colour 0x00ff0000 type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.200 signpost 250.0 m, 1.0 m

Sub Arterial 70 kph minor (cost factor 1.2)

- category 50 lanes I speed 70 kph width 3.3 m colour 0x00dd0000 type urban minor headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.200 signpost 250.0 m, 1.0 m
- category 51 lanes 2 speed 70 kph width 6.6 m colour 0x00dd0000 type urban minor headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.200 signpost 250.0 m, 1.0 m
- category 52 lanes 3 speed 70 kph width 9.9 m colour 0x00dd0000 type urban minor headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.200 signpost 250.0 m, 1.0 m

Sub Arterial 60 kph major (cost factor 1.2)

- category 53 lanes I speed 60 kph width 3.3 m colour 0x008d0000 type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.200 signpost 250.0 m, 1.0 m
- category 54 lanes 2 speed 60 kph width 6.6 m colour 0x008d0000 type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.200 signpost 250.0 m, 1.0 m

category 55 lanes 3 speed 60 kph width 9.9 m colour 0x008d0000 type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.200 signpost 250.0 m, I.0 m ## Sub Arterial 60 kph minor (cost factor 1.2) category 56 lanes I speed 60 kph width 3.3 m colour 0x008b0000 type urban minor headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.200 signpost 250.0 m, I.0 m category 57 lanes 2 speed 60 kph width 6.6 m colour 0x008b0000 type urban minor headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.200 signpost 250.0 m, I.0 m category 58 lanes 3 speed 60 kph width 9.9 m colour 0x008b0000 type urban minor headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.200 signpost 250.0 m, 1.0 m ## Collector 60 kph major (cost factor 1.4) category 59 lanes I speed 60 kph width 3.3 m colour 0x0000a5ff type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.400 signpost 250.0 m, 1.0 m category 60 lanes 2 speed 60 kph width 6.6 m colour 0x0000a5ff type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.400 signpost 250.0 m, I.0 m category 61 lanes 3 speed 60 kph width 9.9 m colour 0x0000a5ff type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.400 signpost 250.0 m, I.0 m ## Collector 60 kph minor (cost factor 1.4) category 62 lanes I speed 60 kph width 3.3 m colour 0x00009aee type urban minor headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.400 signpost 250.0 m, 1.0 m category 63 lanes 2 speed 60 kph width 6.6 m colour 0x00009aee type urban minor headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.400 signpost 250.0 m, I.0 m category 64 lanes 3 speed 60 kph width 9.9 m colour 0x00009aee type urban minor headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.400 signpost 250.0 m, I.0 m ## Collector 50 kph major (cost factor 1.4) category 65 lanes I speed 50 kph width 3.3 m colour 0x000085cd type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.400 signpost 250.0 m, 1.0 m category 66 lanes 2 speed 50 kph width 6.6 m colour 0x000085cd type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.400 signpost 250.0 m, 1.0 m category 67 lanes 3 speed 50 kph width 9.9 m colour 0x000085cd type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.400 signpost 250.0 m, 1.0 m ## Collector 50 kph minor (cost factor 1.4) category 68 lanes I speed 50 kph width 3.3 m colour 0x000000ff type urban minor headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.400 signpost 250.0 m, I.0 m

category 69 lanes 2 speed 50 kph width 6.6 m colour 0x000000ff type urban minor headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.400 signpost 250.0 m, 1.0 m



category 70 lanes 3 speed 50 kph width 9.9 m colour 0x000000ff type urban minor headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.400 signpost 250.0 m, 1.0 m

Collector 40 kph major (cost factor 1.4)

- category 71 lanes I speed 40 kph width 3.3 m colour 0x000000ee type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.400 signpost 250.0 m, 1.0 m
- category 72 lanes 2 speed 40 kph width 6.6 m colour 0x000000ee type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.400 signpost 250.0 m, 1.0 m
- category 73 lanes 3 speed 40 kph width 9.9 m colour 0x000000ee type urban major headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.400 signpost 250.0 m, 1.0 m

Collector 40 kph minor (cost factor 1.4)

- category 74 lanes I speed 40 kph width 3.3 m colour 0x000000cd type urban minor headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.400 signpost 250.0 m, 1.0 m
- category 75 lanes 2 speed 40 kph width 6.6 m colour 0x000000cd type urban minor headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.400 signpost 250.0 m, 1.0 m
- category 76 lanes 3 speed 40 kph width 9.9 m colour 0x000000cd type urban minor headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 1.400 signpost 250.0 m, 1.0 m

Local 40 kph minor (cost factor 3.0)

- category 77 lanes I speed 40 kph width 3.3 m colour 0x00fffff type urban minor headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 3.000 signpost 250.0 m, I.0 m
- category 78 lanes 2 speed 40 kph width 6.6 m colour 0x00ffffff type urban minor headway factor 1.000 curve speed factor 1.0 toll 0.000 cost factor 3.000 signpost 250.0 m, 1.0 m


"Configuration" File

RTA NSW Standard "configuration" file.

File prepared by the Roads and Traffic Authority of New South Wales ## File version 4.00 for Paramics V5.2.2 ## Date I July 2008 ## Updated versions of this file will be released periodically ## Please contact Mr. R. Tudge (RTA NSW +61 28588 5675) for information ## regarding new file versions. ## Replacing previous standard 'configuration' file 9/12/2005 ## Changes included : ## I. additional parameters from Paramics V3 to V5.2.2 (date, split seed, ## speed ## drift, maximum diversion ## 2. 'amber time' set to 4 seconds. Note Paramics V5.1 allows individual ## amber ## times for each intersection. Amber time should be coded to reflect the ## effective green time for each intersection ## 3. 'loop length' set to 4.5 m to match default as used in SCATS ### 4. additional 'options' included so that use of TWOPAS gradient model, gap ## reduction for stopped buses, stacking stopline loops, and roundabout ## visibility are default ## 5. Split Seed included in options ### 6. Generalised Cost Coefficients updated to Dec 2007 ## see spreadsheet GeneralisedCostCoefficients.xls ## Comments are shown in 'black' proceeded by '##' ## Parameters in 'green' should be changed for different models ## parameters in 'red' should NOT be changed and ## parameters in 'blue' may be altered to suit each model ## The following ten seed values should be used to provide random variation of ## results 560, 28, 7771, 86524, 2849, 5321, 137, 98812, 601027, 559 start time 06:00:00 on 20040412

simulation time 03:00:00 demand weight 100.0 seed 560 split seed demand matrix tuning level 0 generator 0 loop length 4.50 m speed memory 3 closest origin carpark disabled closest destination carpark enabled file time "-" curve speed factor 1.00 amber time 4.0 speed drift 5 maximum diversion 300 left hand drive units metric timestep detail 2 mean headway 1.00 mean reaction time 1.00 gap 2.000 m cost coefficients 0.467, 0.283 mins per km, 0.417 queue speed 7.2 kph queue distance 10.0 m weight heavy 3.0 tonne



feedback 00:00:00 feedback smoothing factor 0.500 feedback decay factor 0.995 perturbation disabled

option 47 ## TWOPAS HGV Climbing Model option 48 ## Preserve zone release order option 104 ## Gap Reduction For Stopped Buses option 107 ## Allow Stacking Stopline Loops option 121 ## Default Roundabout Visibility



"Vehicles" Files

RTA NSW Standard "vehicles" file.
File prepared by the Roads and Traffic Authority of New South Wales
File version 4.00 for Paramics V5.2.2
Date I July 2008
Updated versions of this file will be released periodically
Please contact Mr. R. Tudge (RTA NSW +61 28588 5675) for information
regarding new file versions.

Replacing previous standard 'vehicles' file 9/12/2005
Changes included :
1. light vehicle lengths and proportions based on the RTA's vehicle
registration database (DRIVES)
2. Paramics default acceleration and deceleration profiles
3. heavy vehicle proportions, sizes, power-weight ratios as used for RTA
Strategic Bus Corridor models
4. % familiarity changes to reflect that new versions of Paramics use
category cost factors for unfamiliar vehicles

Comments are shown in 'black' proceeded by '##'

Parameters in 'green' should be changed for different models ## parameters in 'red' should NOT be changed and ## parameters in 'blue' may be altered to suit each model

vehicle types

Private Car Small

type I car width 1.86 m weight 1.14 tonne acc 2.00 mpss dec -3.50 mpss crawl speed 50.00 kph acc profile I dec profile 5 colour 0x000000ff name "small car"

matrix | proportion 26.980 perturbation 5.0 familiarity 50.00

Private Car Medium

type 2 car length 4.40 m width 1.86 m weight 1.37 tonne acc 2.00 mpss dec -3.50 mpss crawl speed 50.00 kph acc profile 1 dec profile 5 colour 0x0000a5ff name "medium car" matrix 1 proportion 36.670 perturbation 5.0 familiarity 50.00

Private Car Large

type 3 car length 4.80 m width 1.86 m weight 1.60 tonne acc 2.00 mpss dec -3.50 mpss crawl speed 50.00 kph acc profile 1 dec profile 5 colour 0x00007fff name "large car" matrix 1 proportion 21.460 perturbation 5.0 familiarity 50.00

Taxi

type 4 car length 4.80 m width 1.86 m weight 1.60 tonne acc 2.00 mpss dec -3.50 mpss crawl speed 50.00 kph acc profile 1 dec profile 5 colour 0x00ffffff name "taxi" matrix 1 proportion 1.300 perturbation 5.0 familiarity 50.00

LGV

type 5 LGV

crawl speed 64.40 kph acc profile 2 dec profile 6 name "lgv" matrix 1 proportion 7.120 perturbation 5.0 familiarity 50.00

STA Mini Bus - fixed

type 6 minibus acc profile 2 dec profile 6 colour 0x00ff0000 name "STA Mini Bus" capacity 48 entry doors 1 exit doors 1 fixed route



Non STA Mini Bus - fixed type 7 minibus acc profile 2 dec profile 6 colour 0x00ccd148 name "Non STA Mini Bus" capacity 48 entry doors I exit doors I fixed route ## STA Bus - fixed type 8 bus length 12.50 m height 3.05 m crawl speed 25.00 kph horsepower 189.00 acc acc profile 2 dec profile 6 colour 0x00ff0000 name "STA Bus" capacity 80 entry doors 1 exit doors 2 fixed route ## Non STA Bus - fixed length 12.20 m height 3.05 m crawl speed 25.00 kph horsepower 189.00 acc acc profile 2 dec type 9 bus profile 6 colour 0x00ccd148 name "Non STA Bus" capacity 80 entry doors 1 exit doors 2 fixed route ## OD Bus type 10 bus top speed 80.00 kph crawl speed 25.00 kph horsepower 256.00 colour 0x00ff0000 name "OD Bus" matrix | proportion 0.100 perturbation 5.0 familiarity 100.00 ## Rigid (Light) type 11 OGV1 length 12.50 m width 2.50 m height 4.30 m weight 5.50 tonne crawl speed 25.00 kph horsepower 128.00 acc profile 2 dec profile 6 colour 0x0001438b name "Rigid (Light)" matrix | proportion 0.670 perturbation 5.0 familiarity 70.00 ## Rigid (Medium) type 12 OGV1 length 12.50 m width 2.50 m height 4.30 m weight 9.90 tonne crawl speed 25.00 kph horsepower 189.00 acc profile 2 dec profile 6 colour 0x0001438b name "Rigid (Medium)" matrix | proportion 4.170 perturbation 5.0 familiarity 70.00 ## Rigid (Heavy) type 13 OGV1 length 12.50 m width 2.50 m height 4.30 m weight 14.50 tonne crawl speed 25.00 kph horsepower 276.00 acc profile 3 dec profile 7 colour 0x0001438b name "Rigid (Heavy)' matrix | proportion 0.670 perturbation 5.0 familiarity 70.00 ## Semi (Light) type 14 OGV2 length 19.00 m height 3.00 m weight 16.96 tonne acc 0.50 mpss dec -2.50 mpss pcus 3.00 crawl speed 25.00 kph horsepower 450.00 acc profile 3 dec profile 7 colour 0x0000d7ff name "Semi (Light)" trailer count l trailer I length 13.70 m height 4.00 m weight 7.96 tonne) matrix | proportion 0.130 perturbation 5.0 familiarity 85.00 ## Semi (Medium) type 15 OGV2 length 19.00 m height 3.00 m weight 20.72 tonne acc 0.50 mpss dec -2.50 mpss pcus 3.00 crawl speed 25.00 kph horsepower 450.00 acc profile 3 dec profile 7 colour 0x0000d7ff name "Semi (Medium)" trailer count l



```
(
               trailer I length 13.70 m
               height 4.00 m
               weight 11.72 tonne
      )
      matrix | proportion 0.740 perturbation 5.0 familiarity 85.00
## Semi (Heavy)
type 16 OGV2 length 19.00 m height 3.00 m weight 28.14 tonne
     acc 0.50 mpss dec -2.50 mpss pcus 3.00 crawl speed 25.00 kph horsepower 450.00 acc profile 4 dec profile 8
colour 0x0000d7ff
     name "Semi (Heavy)"
     trailer count I
      (
               trailer I length 13.70 m
               height 4.00 m
               weight 19.14 tonne
      )
      matrix | proportion 0.130 perturbation 5.0 familiarity 85.00
## B-Double (Light)
type 17 OGV2 length 25.00 m height 3.00 m weight 24.44 tonne
      acc 0.50 mpss dec -2.50 mpss pcus 5.00 crawl speed 25.00 kph horsepower 450.00 acc profile 3 dec profile 7
colour 0x0000d7ff
     name "B-Double (Light)"
      trailer count 2
      (
               trailer I length 10.40 m
               height 4.00 m
               weight 7.72 tonne
               trailer 2 length 13.70 m
               height 4.00 m
               weight 7.72 tonne
      )
     matrix | proportion 0.010 perturbation 5.0 familiarity 85.00
## B-Double (Medium)
type 18 OGV2 length 25.00 m height 3.00 m weight 41.72 tonne
     acc 0.50 mpss dec -2.50 mpss pcus 5.00 crawl speed 25.00 kph horsepower 500.00 acc profile 4 dec profile 8
colour 0x0000d7ff
     name "B-Double (Medium)"
      trailer count 2
      (
               trailer I length 10.40 m
               height 4.00 m
               weight 16.36 tonne
               trailer 2 length 13.70 m
               height 4.00 m
               weight 16.36 tonne
      )
     matrix | proportion 0.040 perturbation 5.0 familiarity 85.00
## B-Double (Heavy)
type 19 OGV2 length 25.00 m height 3.00 m weight 57.52 tonne
      acc 0.50 mpss dec -2.50 mpss pcus 5.00 crawl speed 25.00 kph horsepower 500.00 acc profile 4 dec profile 8
colour 0x0000d7ff
     name "B-Double (Heavy)"
     trailer count 2
      (
               trailer I length 10.40 m
               height 4.00 m
               weight 24.26 tonne
```



trailer 2 length 13.70 m height 4.00 m weight 24.26 tonne

) matrix | proportion 0.010 perturbation 5.0 familiarity 85.00



"Acceleration-profiles" File

RTA NSW Standard "acceleration-profiles" file.

File prepared by the Roads and Traffic Authority of New South Wales
File version 4.00 for Paramics V5.2.2
Date 1 July 2008
Updated versions of this file will be released periodically
Please contact Mr. R. Tudge (RTA NSW +61 28858 5675) for information
regarding new file versions.

The following acceleration profiles are Paramics defaults but have been adopted ### by RTA as representative for vehicle behaviour in NSW. These are referenced in the ### standard 'vehicles' file.

Comments are shown in 'black' proceeded by '##'

Parameters in 'green' should be changed for different models ## parameters in 'red' should NOT be changed and ## parameters in 'blue' may be altered to suit each model

acceleration profile "Car Acceleration" with 17 points

0.00	3.50 mpss
6.25	3.20 mpss
12.50	2.80 mpss
18.75	2.50 mpss
25.00	2.20 mpss
31.25	2.00 mpss
37.50	1.80 mpss
43.75	1.60 mpss
50.00	1.40 mpss
56.25	1.20 mpss
62.50	1.00 mpss
68.75	0.90 mpss
75.00	0.70 mpss
81.25	0.60 mpss
87.50	0.50 mpss
93.75	0.30 mpss
100.00	0.00 mpss

acceleration profile "LGV Acceleration" with 17 points

0.00 3.00 mpss	
6.25 2.80 mpss	
12.50 2.50 mpss	
18.75 2.20 mpss	
25.00 2.00 mpss	
31.25 1.70 mpss	
37.50 I.60 mpss	
43.75 1.50 mpss	
50.00 I.30 mpss	
56.25 I.10 mpss	
62.50 0.80 mpss	
68.75 0.60 mpss	
75.00 0.40 mpss	
81.25 0.20 mpss	
87.50 0.10 mpss	
93.75 0.05 mpss	
100.00 0.00 mpss	

acceleration profile "OGV1 Acceleration" with 17 points 0.00 2.00 mpss 6.25 1.50 mpss 12.50 1.20 mpss

18 75	0.90 mpss
25.00	0.70 mpss
21.00	0.70 mpss
31.23	0.30 mpss
37.30 43.75	0.40 mpss
43.75	0.30 mpss
50.00	0.20 mpss
56.25	0.10 mpss
62.50	0.08 mpss
68.75	0.07 mpss
75.00	0.06 mpss
81.25	0.05 mpss
87.50	0.02 mpss
93.75	0.01 mpss
100.00	0.00 mpss
accelerat	ion profile "OGV2 Acceleration" with 17 points
0.00	2.20 mpss
4.25	1.70 mpss
12 50	
12.50	
18.75	1.00 mpss
25.00	0.80 mpss
31.25	0.60 mpss
37.50	0.50 mpss
43.75	0.40 mpss
50.00	0.30 mpss
56.25	0.20 mpss
62.50	0.10 mpss
68.75	0.08 mpss
75.00	0.07 mpss
81.25	0.06 mpss
87.50	0.05 mpss
07.50	0.02 mpss
75.75	
100.00	0.00 mpss
accelerat	ion profile "Car Decceleration" with 17 points
0.00	-7.50 mpss
6.25	-7.40 mpss
12.50	-7.30 mpss
18.75	-7.20 mpss
25.00	-7.10 mpss
31.25	-7.00 mpss
37.50	-6.90 mpss
43.75	-6.80 mpss
50.00	-6.70 mpss
56.25	-6 60 mpss
62 50	-6 50 mpss
49 75	-0.50 mpss
75 00	-0.70 mpss
75.00	-6.30 mpss
81.25	-6.20 mpss
87.50	-6.10 mpss
93.75	-5.90 mpss
100.00	-5.80 mpss
accelerat	ion profile "LGV Decceleration" with 17 points
0.00	-7.00 mpss
6.25	-6.80 mpss
12.50	-6.60 mpss
18.75	-6.40 mpss
25.00	-6.20 mpss
31.25	-6.10 mpss
37.50	-6.00 mpss
43 75	-5.80 mpss
50.00	-5.70 mpss
50.00	-5.70 mpcc
JO.23	-5.00 mpss
02.30	-5.50 mpss

RТ



68.75	-5.40 mpss
75.00	-5.30 mpss
81.25	-5.20 mpss
87.50	-5.10 mpss
93.75	-4.90 mpss
100.00	-4.80 mpss
accelerat	ion profile "OGVI Decceleration" with 17 points
0.00	-6.70 mpss
6.25	-6.50 mpss
12.50	-6.30 mpss
18.75	-6.10 mpss
25.00	-5.90 mpss
31.25	-5.60 mpss
37.50	-5.30 mpss
43.75	-5.10 mpss
50.00	-4.80 mpss
56.25	-4.50 mpss
62.50	-4.20 mpss
68.75	-3.90 mpss
75.00	-3.70 mpss
81.25	-3.40 mpss
87.50	-3.10 mpss
93.75	-2.80 mpss
100.00	-2.50 mpss
accelerat	ion profile "OGV2 Decceleration" with 17 points
0.00	-6.00 mpss
6.25	-5.70 mpss
12.50	-5.40 mpss
18.75	-5.20 mpss
25.00	-4.90 mpss
31.25	-4.60 mpss
37.50	-4.30 mpss
43.75	-4.10 mpss
50.00	-3.80 mpss
20.23	-3.30 mpss
62.30 20 75	-3.20 mpss
75 00	-2.70 mpss
91.25	-2.70 mpss
87.50	-2.10 mpss
93 75	-2.10 mpss
100.00	-1.50 mpss
100.00	-1.50 111955



"Behaviour File"

RTA NSW Standard "behaviour" file.

File prepared by the Roads and Traffic Authority of New South Wales
File version 4.00 for Paramics V5.2.2
Date I July 2008
Updated versions of this file will be released periodically
Please contact Mr. R. Tudge (RTA NSW +61 28858 5675) for information
regarding new file versions.

 $\#\!\#$ The following aggression and awareness levels are Paramics defaults. These are $\#\!\#$ based on normal distribution patterns.

The RTA have adopted these Paramics default distributions as there is no data to ### suggest that other distributions are more appropriate. As the effect of changing ### these distributions are significant, it is considered prudent to lock these values.

Comments are shown in 'black' proceeded by '##'

Parameters in 'green' should be changed for different models
parameters in 'red' should NOT be changed and
parameters in 'blue' may be altered to suit each model

aggression multiple I sliders I 4 II 2I 26 2I II 4 I awareness multiple I sliders I 4 II 2I 26 2I II 4 I



Appendix F – Plug-ins



F.I Plug-in use

Through experience, the RTA has recognised the functionality and benefits that various plugins add to the Paramics core. Plug-ins have been developed by Azalient and are commonly used on RTA projects. Some plug-ins are fully funded and owned by the RTA. These are available for use on any RTA project. Other plug-ins must be purchased and licensed on a dongle by dongle basis.

Plug-ins currently work in version 5.2 of Paramics. Compatibility of plug-ins with version 6 and any associated dot release versions is yet to be determined. Currently version 6 does not support plug-ins, but this situation may change in the future. If plug-ins are considered important for a particular model, consideration should be given to the use of the appropriate version of Paramics.

F.2 List of plug-ins

PAR: Archiver Plug-in

- Allows reversion of the network to a previous version.
- Automatically saves all network data files to the Log/run-NNN directory as soon as simulation starts.
- Log message window displays information about which files have been copied.
- Network data stored with run measurements for convenience entire folder can be zipped and passed to a colleague.

PAU: Auditor Plug-in

- Rapidly check model parameters against standard central values.
- Core configuration: green light/red light highlights modifications at a glance.
- Per-link parameters show changes to speed, cost and headway factors.
- Sortable tables can be saved as CSV for wider distribution or analysis.

PBL: Layover plug-in

- Model the effects of public transport vehicles waiting in the network until a timetabled departure time.
- Can be used in city-centre models to model the effect of inbound buses parking on-street until outbound departure time.
- End of layover time specified relative to initial departure time delays on inbound trip will foreshorten layover time.

PBN: Banner plug-in

- Display a logo or message on the network display window.
- Useful for presentation and attribution.
- Insert a JPEG image in any corner of the display.

PBQ: Lane signal plug-in

- Also known as Bus Queue-jump Plug-in.
- Define lane-specific signals at an intersection.
- Add a lane restriction to allow only certain vehicles to pass when lane signal is green.
- Can be used for any type of vehicle.

PCF: Tram plug-in

- Also known as Constant Headway Plug-in.
- Define an arrival interval for vehicles on a fixed route, for example five minutes.
- Vehicles are held at stops just long enough to ensure one vehicle leaves at the end of each interval.
- Used to model trams or other traffic-affected vehicles where a fixed regular arrival interval is required.

PDC: Destination choice plug-in

- Modify the destination of any subset of vehicles in the model, as those vehicles move through the network, in response to prevailing conditions.
- Select vehicle subsets using:
 - o vehicle type
 - o restrictions
 - o origin and/or destination zones
 - o origin and/or destination sectors
 - o variable message signs
 - o number of open lanes
 - o familiarity
 - o **next turn choice**



- Overrides previous choice of destination.
- Default route choice algorithm used at all other locations.

PEC: Economic evaluation plug-in

- Also known as RTA Simulation Evaluation Module.
- Comprehensive output detailing time, distance, stops and economic cost of every trip in the network.
- Trips classified as complete, incomplete or unreleased.
- Allows comparison of alternative design schemes and/or future projections.
- Central costs table defines monetary cost for distance, travel time and stops.
- All input and output formatted as XLS files, can be analysed with standard spreadsheets.

PFB: Fleet builder plug-in

- Define any number of fleets, where a fleet is an arbitrary set of vehicle types.
- Each vehicle type may be in any number of fleets.
- Name each fleet for easy reference.
- A fleet is to a vehicle type what a sector is to a zone.

PLC: Lane choice plug-in

- Specify lane range on current and next link for each subset of vehicles.
- Select vehicle subsets using:
 - o vehicle type
 - o restrictions
 - o origin and/or destination zones
 - o origin and/or destination sectors
 - o familiarity
 - \circ variable message signs
 - o number of open lanes
 - o public transport route
 - o next turn choice

PLS: Level of service plug-in

- Report level of service for each approach to an intersection.
- Level of service is reported in 6 bands A-F, thresholds are variable.
- Can configure each approach to consist of any number of links, to account for queuing back from the intersection.
- All measurements are saved to file.

PMC: Obstruction monitoring and clearance plug-in

- Also known as OMAC
- Prevent deadlock caused by a blocked turn across opposing traffic.
- Define a maximum threshold time for stopped vehicles: any vehicle that is stationary for more than this time is removed to a "quarantine" area.
- Identify problem trips or turns by examining the quarantine table display.
- Quarantine table shows:
 - o trip origin and destination
 - trip departure time and quarantine time
 - o vehicle type
 - o driver behaviour parameters
 - o location of problem: link, lane and intended turn

PPT: Passenger trip plug-in

- Model stop-to-stop passenger trips on public transport.
- Generate per-route passenger trips.
- Visualise queue length at stops or stations.
- Analyse passenger waiting times, journey times and journey speeds.
- Analyse queue lengths at stops, and aggregations of stops at a physical stand.
- Analyse boarding and alighting times.
- Analyse bus/train/tram loading (fullness), dwell times, layover times, speed.
- Analyse adherence to timetables.

PRC: Route choice plug-in

- Specify turn (exit) at any intersection for each subset of vehicles.
- Select vehicle subsets using:



- o vehicle type
- o **restrictions**
- origin and/or destination zones
- o origin and/or destination sectors
- o variable message signs
- o number of open lanes
- o familiarity
- Overrides default route choice at selected intersections.
- Default route choice algorithm used at all other locations.

PRM: Ramp metering plug-in

- Define any number of single or dual-lane ramp meters.
- Define dual-lane meters as concurrent green or alternating green.
- Define number of vehicles per green for single lane meters.
- Define initial, minimum and maximum cycle length.
- Define logic call interval. A short interval will make a meter more responsive to changes in the main flow, but will also make the output value less stable, and may make it more prone to oscillation between large and small values.
- Define additional parameters as appropriate to the logic.

PTD: Lane control plug-in

- Also known as reversible lane plug-in.
- Build overhead lane control gantries, showing open, closed or speed restriction.
- Build longitudinal moveable lane barriers, guiding traffic into reversible lanes.
- Control changes between reversible states using automatic timed programs or traffic demand triggers based on queue length.
- Control state changes manually for testing or scenario analysis.
- Create timed wave transitions, closing a reversible lane gradually in one direction, then opening it in the other direction for opposing traffic.

PTF: Trail follower plug-in

• Control route choice of all or a subset of vehicles.



- Selected vehicles joining a trail at its first link will follow all links on the trail to its end.
- Select vehicles by type or fleet.
- Select vehicle by origin and/or destination zone.
- Select vehicle by origin and/or destination sector.

PTM: Trail maker plug-in

- Define any number of trails.
- Use colour-coded buttons to choose exit at each intersection.
- A trail can have any number of links.
- A trail can loop back on itself any number of times.
- Prune or extend existing trails.
- Join two existing trails to form a new single trail.

PTP: Toll plaza plug-in

- Define any number of booth payment types (manned, auto, auto cash only, electronic tag, etc).
- Define any number of toll plazas per network, where each plaza can span multiple links.
- Build any number of booths in each plaza.
- Assign a stop time profile to each payment type. Electronic payment booths can have zero stop time vehicles can pass through the booth at the speed assigned to the link.
- Control the vehicle types passing through each booth using standard lane restrictions. Driver queue choice is affected by queue length.
- Vehicles using the plaza can choose any booth that suits the payment type they can make. A vehicle driver carrying the exact cash can choose an auto payment booth or a manned booth.

PVD: Validator plug-in

- Compare model results with observed counts.
- See comparisons as % differences and GEH statistic.
- Comparisons can be made on:



- o links
- o turns
- zones (cordons)
- o screen lines a screen line is a named set of links
- Traverses a traverse is a pair of links, labelled start and finish, where any vehicle following its own path between start and finish will be counted.
- Trails a trail is a sequence of links, where a vehicle is counted only if it follows all links in the trail, in sequence..
- Use observed data in the same format as used for Estimator (matrix estimation).
- Compare data for all vehicles, or a subset by vehicle type.
- Sort comparison sites in order of difference between modelled and observed, to rapidly identify problem areas.
- Save all comparison measurements to CSV files for analysis in standard spreadsheets or databases.

PWK: Wake-up plug-in

- Causes drivers to re-assess route choices every minute.
- Overrides standard behaviour where route choices are assessed once, on entering a link.
- Diverts traffic around rapidly forming congestion.
- Can prevent gridlock from happening in congested networks.

Plug-ins having a 3-letter acronym starting with Q are available to all users at no cost. Several of these rely on RTA software (such as SCATSIM) for correct operation.

QEC ECW Aerial Plug-in

Allows the display of aerial photographs in ECW format as a background layer on the network display.

QSB Signal Builder Plug-in

A user interface for coding the detectors, turns, groups, phases, and the relationships between them for use with the SCATS plug-in (QSC).

QLR Loop Report Plug-in

Enhances the standard reporting available at loop detectors.

QPD SCATS Ped Plug-in

Models the effect of delays caused by pedestrians on left or right turning traffic at signalised intersections. This was the original pedestrian plug-in, with fewer features than the developmental "Footwork" plug-in (which is no longer available) but is still useful for modelling pedestrians in a SCATS-controlled network.

QPT SCATS PTIPS Plug-in

Allows connection of the simulator to PTIPS (public transport information system) that can operate with SCATS.

QRM SCATS SRMS Plug-in

Allows connection of the simulator to SRMS (SCATS ramp metering system)

QSC SCATS Plug-in

A plug-in that implements the SP38 specification, allowing the simulator to connect to SCATS through the WinTraff controller.

Roads and Traffic Authority

May 2009 RTA/Pub. 09.166