Tactical Adelaide Model (TAM) Guidelines

TRANSPORT ANALYTICS

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Executive Summary

The Department for Infrastructure and Transport (DIT) works as part of the community to deliver effective planning policy, efficient transport, and valuable social and economic infrastructure. As part of this task, DIT must ensure that the effects of all planned interventions on the strategic road network and proposed developments which are likely to impact this network are thoroughly understood before they are implemented. Comprehensive and accurate modelling which is fit for the intended purpose is necessary to ensure these interventions and proposals can be:

- Fully assessed for impacts and benefits;
- Effectively designed to satisfy the original objectives and mitigate any adverse impacts;
- Clarified to avoid confusion or misinterpretation as the design is developed; and,
- Effectively and efficiently implemented and operated.

A common definition of the term "model" in its most general form is:

"A model can be defined as a simplified representation of a part of the real world which concentrates on certain elements considered important for its analysis from a particular point of view."[1]

It is important to be aware of the simplifications and assumptions that have been made in creating any model and to understand how they affect overall model performance. These simplifications and assumptions can derive from decisions made by the modeller during model development or can be inherent to the particular choice of modelling software used.

DIT uses a range of analytical tools to assess road network performance and to plan future development of the transport network which form part of DIT's Integrated Modelling Framework. The Tactical Adelaide Model (TAM) has been developed to be a versatile model with the capability of informing high-level planning studies, network-wide traffic assessment and forecasting, and highly detailed and specialised project models for concept planning and design. TAM also benefits from improvements to the Aimsun software suite, producing a robust model with the ability to handle many types of tactical assessment.

Aimsun Next is the only traffic simulation software supported by DIT and it is a DIT requirement that all new traffic simulation models be part of, or based on TAM. All traffic models developed by DIT, for DIT or requiring DIT involvement need to be endorsed and accepted by DIT's Manager, Transport Insights as being fit for the intended purpose.

This document provides an overview of TAM, its development and use-cases, as well as guidance on building, calibrating, validating, documenting, auditing all levels of TAM. This forms the primary guide for the development of "fit-for-purpose" models for use by DIT. It draws upon collaborative experience and expertise from DIT and Aimsun Pty Ltd (Aimsun) and the industry more broadly to form a comprehensive source of best practice traffic simulation modelling.

[1] Ortúzar J de D & Willumsen L G, Modelling Transport, 4th Ed., Ch1, Wiley, London, 2011, p2.

This report is structured into three sections which are aimed at different audiences:

- **Chapter 1: Introduction to the Tactical Adelaide Model** is written for the executive level and provides a high-level summary of DIT's Integrated Modelling Framework and the role of TAM within it
- **Chapter 2: Choosing TAM for Transport Planning** is designed to help planners and non-modellers to understand the different tiers of TAM and their use cases, and determine how TAM can be used to inform transport planning projects
- **Chapter 3: Building Models using TAM** is targeted to traffic modellers who will use TAM and summarises the features of TAM for building scenarios, pre-configured elements within the package, and establishes the best practice for developing models using all three levels of TAM.

It is intended that these guidelines will be regularly reviewed and updated so that they remain current, useful, and relevant for users in what is a dynamic environment. This version of the guidelines relates to Aimsun Next Version 23.0.1[3] and TAM Version 1.1.3[4] which are the current versions used by DIT. Before undertaking any traffic simulation modelling, practitioners should ensure that they have the latest version of this document which is available on the DIT website and that they discuss their modelling proposal with the Transport Insights team of DIT.

[3] Aimsun Next version 23.0.1 2024-02-07 (ca61d147b74 x64) using Python 3.10.5.
[4] TAMv1.1.3_20240722.

Disclaimer

These Guidelines do not guarantee that the resulting traffic simulation models will be “fit-for-purpose”. This manual provides a framework for model development, calibration and validation and subsequent model auditing only. Some models, particularly models to be used for financial analysis, might require more stringent standards. It is the modellers' responsibility to ensure that the models they develop are fit for the intended purpose. This document should only be considered relevant in South Australia and for no other purpose than as a guide for modellers and project managers undertaking work for the South Australian Department for Infrastructure and Transport (DIT). DIT and the authors of these guidelines accept no liability or responsibility for any errors or omissions or any damage or loss arising from the application of the information provided.

Acknowledgements

The significant contribution of Aimsun Pty Ltd in preparing these Guidelines is acknowledged. All trade name references in this manual are either trademarks or registered trademarks of their respective companies.

1 Introduction to the Tactical Adelaide Model

1.1 DIT's Integrated Modelling Framework

Transport modelling paradigms can comprise different tiers from strategic travel demand to micro-analytical intersection models. The tiers of transport modelling used in DIT are as shown in **Figure 1.1-1**.

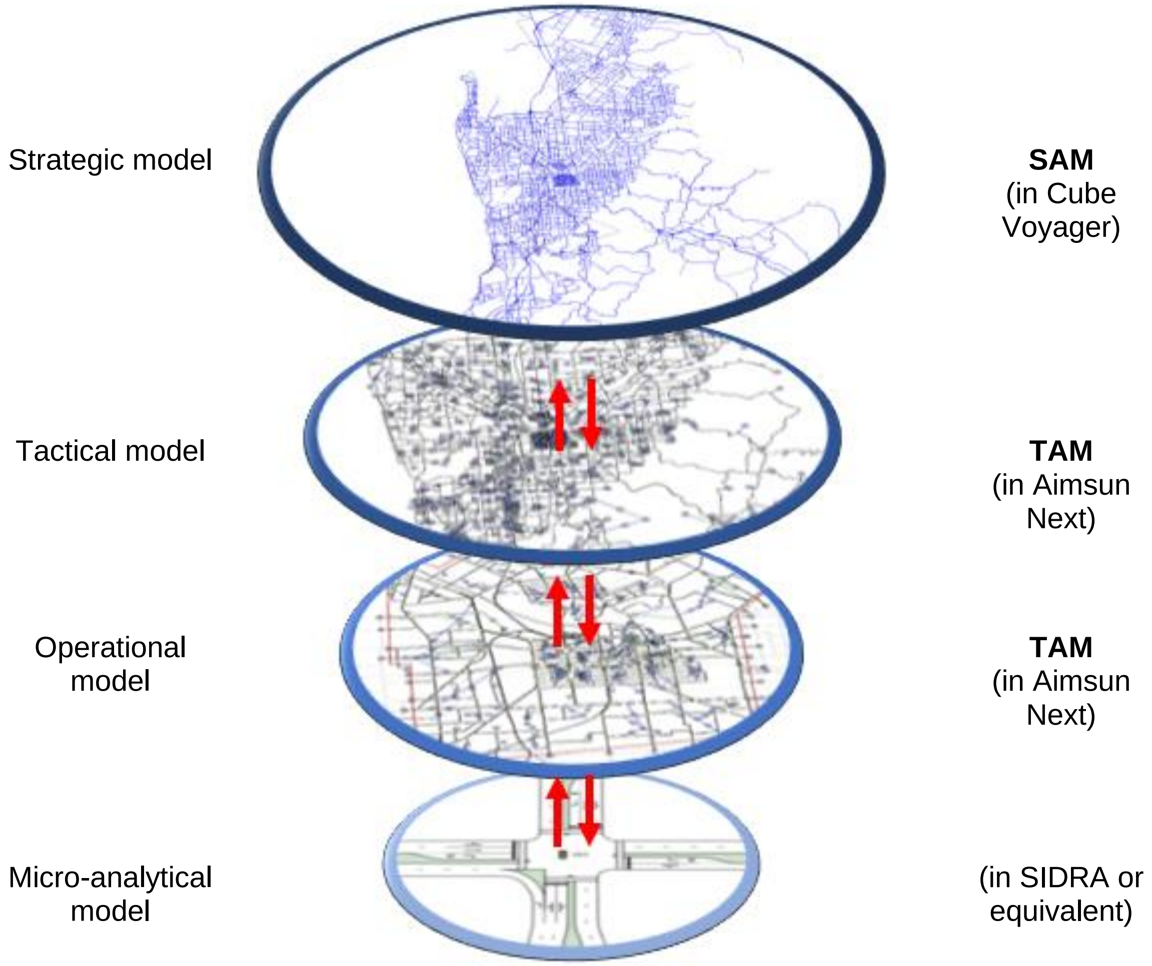

Figure 1.1-1 DIT's Integrated Modelling Framework

Each model informs the other tiers directly and/or indirectly, and together, they form DIT's Integrated Modelling Framework. This document provides guidance for Tactical Modelling and Operational Modelling within the Framework using the Tactical Adelaide Model (TAM).

Heavily-trafficked transportation networks, such as in Greater Adelaide, experience both local and area-wide congestion origination from the interactions of vehicles, lanes, intersections and traffic control systems. Identifying the locations of these hotspots is critical to supporting the effective planning of Adelaide's future transportation network. The role of TAM is to represent these operational aspects which are not explicitly captured at the strategic model level in SAM.

TAM provides:

- An extensive macroscopic network that is suitable for high-level preliminary planning studies and which is used to inform the demand for more detailed modelling;
- A detailed mesoscopic network that covers the whole of Greater Adelaide and can be used to forecast the network impacts of transport projects with consideration for congestion and queueing, traffic signal and level crossing operation, public transport and other operational considerations for network-wide transport assessments; and,
- The network, tools and procedures to develop highly detailed and specialised microsimulation subarea project models for concept planning and design.

Transport Analytics can provide guidance into using DIT's suite of models to help choose a model fit for the intended purpose.

1.2 The Role of SAM and TAM

Conventional trip-based Travel Demand Models (TDM) consist of four steps: trip generation, trip distribution, modal choice, and trip assignment. DIT's Strategic Adelaide Model (SAM) is the travel demand model for the Greater Adelaide area, which follows the conventional four-step methodology at its core. SAM's Highway Assignment Model is a static model with flat demand.

TAM completes the Integrated Modelling Framework and is an integrated, multi-tier modelling package that is designed to support transport projects from the high-level preliminary planning stage through to detailed concept planning and design. TAM provides three tiers of simulation which offer differing levels of detail and outputs for specific project uses and applications:

- **TAM Macro**: High-level preliminary planning studies and used to inform the demand for more detailed modelling;
- **TAM Meso**: Dynamic modelling of the entire Greater Adelaide extent for forecasting the network impacts of road infrastructure projects and for network-wide transport assessments; and,
- **TAM Micro**: Highly detailed and specialised microsimulation project models within a subarea of the wider TAM network for concept planning and design.

TAM is intended to provide a consistent and reliable "source of truth" for answering tactical operational questions from planners, operators, managers, assessors and other stakeholders.

1.3 The Extent of TAM

Figure 1.3-1 illustrates the extent of the TAM study area.

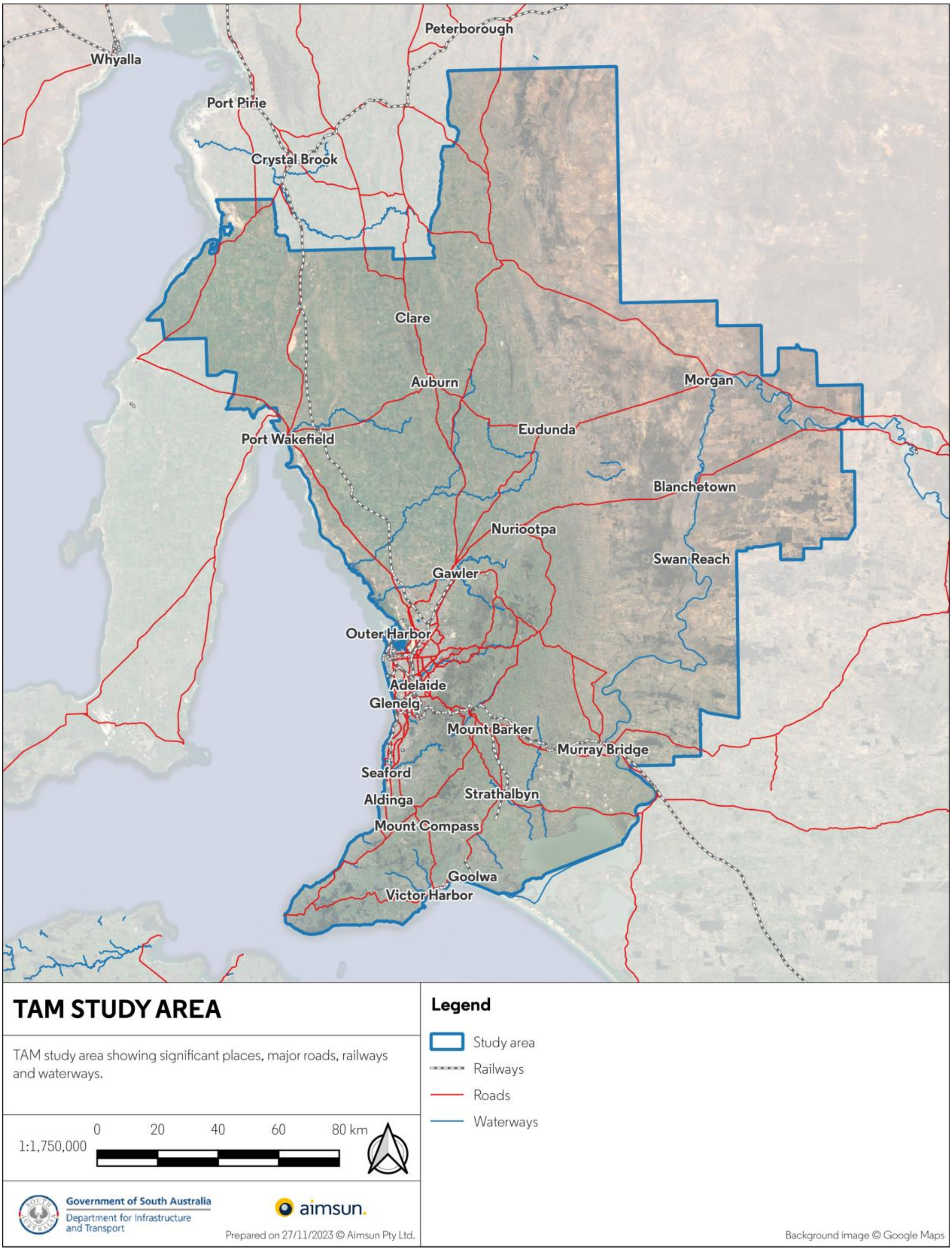

Figure 1.3-1 Study area of TAM

1.4 TAM Attributes

TAM has been developed for five horizon years in five-year intervals from 2021 up to 2041. Each horizon year includes three peaks covering the morning (AM), daytime / interpeak (DT) and afternoon (PM) across a 12-hour period from 7am to 7pm.

TAM is pre-configured with two future network geometries to streamline model development and standardise inputs across different projects:

- **Committed and Funded Network (CF)**: Projects committed to date; and,
- **Planning Network (PN)**: Anticipated additional projects outside those currently committed and funded.

TAM is also configured with eight different vehicle types to provide a comprehensive representation of the transport network, including:

- Cars;
- Three different types of truck (rigid, articulated and B-double);
- Buses;
- Trams; and,
- Trains (suburban trains and freight trains).

Note that not all horizon years, scenarios, peaks and/or vehicle types may be available in every TAM scenario. For further details, refer to **Chapter 3**.

1.5 Overview of this Report

The TAM Guidelines provide an overview of TAM, its development and use-cases, as well as guidance on building, calibrating, validating, documenting and auditing all levels of TAM This forms the primary guide for the development of "fit-for-purpose" models for DIT.

This report is structured into three sections which are aimed at different audiences:

- **Chapter 1: Introduction to the Tactical Adelaide Model** is written for the executive level and provides a high-level summary of DIT's Integrated Modelling Framework and the role of TAM within it
- **Chapter 2: Choosing TAM for Transport Planning** is designed to help planners and non-modellers to understand the different tiers of TAM and their use cases, and determine how TAM can be used to inform transport planning projects
- **Chapter 3: Building Models using TAM** is targeted to traffic modellers who will use TAM and summarises the features of TAM for building scenarios, pre-configured elements within the package, and establishes the best practice for developing models using all three levels of TAM.

2 Choosing TAM for Transport Planning

2.1 Is TAM suitable for my study?

TAM is designed to be a suitable model for most road transport planning exercises. The purpose of TAM is to inform these exercises at the tactical level, including:

- Preliminary project planning:
  - Project problem identification;
  - Longlist options assessment;
  - Shortlist performance analysis; and,
  - Preliminary business case support.
- Concept project planning:
  - Shortlist refinement;
  - Preferred option assessment;
  - Concept design; and,
  - Final business case support.

Factors such as the scale of the project, type of public transport scenario testing, land use and rezoning, etc., should be considered when selecting and scoping the modelling requirements. It is essential to consult Transport Analytics before selecting any of the DIT's suite of models.

2.2 TAM is suitable for my study; what's next?

TAM can be used for static assignments (macroscopic modelling) and dynamic modelling at mesoscopic, microscopic and hybrid levels. The tier of TAM used depends on the requirements of each project and the desired model outputs.

To reduce the time and effort required to develop future scenarios, TAM is pre-coded with:

- Traffic demands for 2019, 2021, 2026, 2031, 2036 and 2041 across three time periods;
- Future network coding including over 150 network upgrades across the horizon years and scenarios;
- Over 1,000 public transport routes for each year/scenario;
- Signal control plans for more than 1,000 signalised intersections, pedestrian crossings and level crossings for each year/scenario; and,
- Scripts, functions, tools and procedures to produce reliable, robust traffic models at all three tiers and seamlessly transition between the different tiers of modelling available within TAM.

Users can choose from combinations of the above that are suitable for the project and can also create new scenarios to for optioneering and assessment.

2.3 TAM Outputs

The outputs that are available are dependent on the tier of TAM used. The tier used depends on the requirements of the project. Transport Analytics can provide guidance into the model tiers to help choose a model fit for the intended purpose.

2.3.1 Common outputs for transport planning projects

Table 2.3-1 lists some of the common outputs used, and the TAM tiers for which they are available.

Table 2.3-1 Outputs available from each tier of TAM

Statistic	Description	TAM Macro	TAM Meso	TAM Micro
Count/ Assigned Volume	Number of vehicles traversing a section or turn	✓	✓	✓
Delay time	Difference between the free flow and simulated travel time	-	✓	✓
Density	Average number of vehicles per kilometre per lane	-	✓	✓
Flow	Average number of vehicles per hour for a section or turn	✓	✓	✓
Harmonic speed	Harmonic mean speed for all vehicles that have completed their journey	-	✓	✓
Max. virtual queue	Number of vehicles that are blocked from entering the network (e.g. by congestion)	-	✓	✓
Mean virtual queue	Average virtual queue	-	✓	✓
Mean queue	Average queue in the network during the simulation	-	-	✓
Number of lane changes	Average number of lane changes per kilometre in the network	-	✓	✓
Number of stops	Average number of stops per kilometre in the network	-	-	✓
Speed	Average speed for all vehicles that have completed their journey	-	✓	✓
Stop time	Average time spent at stop per vehicle per kilometre	-	-	✓
Travel time	Average time to travel one kilometre in the network	✓	✓	✓
Total travel time	Total travel time experienced by all vehicles that have completed their journey	✓	✓	✓
Total distance travelled	Total distance travelled by all vehicles that have completed their journey	✓	✓	✓
Vehicles inside	Number of vehicles inside the network at the end of the simulation	-	✓	✓

Statistic	Description	TAM Macro	TAM Meso	TAM Micro
Vehicles outside	Number of vehicles outside the network at the end of the simulation	-	✓	✓
Vehicles waiting to enter	Number of vehicles blocked from entering the network at the end of the simulation	-	✓	✓
Waiting time in virtual queue	Average time that vehicles remained in a virtual queue for vehicles that have completed their journey	-	✓	✓

Statistics are also available for

- Subpaths (a collection of consecutive sections and turns along a pre-defined route)
- Public transport lines
- Signal operation and performance;
- Centroids;
- Traffic management actions;
- Detectors; and,
- Groupings (a pre-defined set of objects of the same type.

2.3.2 Turning Movement Data

Some of the statistics available from the simulation (e.g. turn volumes) can be transferred to other software packages. A typical example is to transfer turn volumes from TAM to SIDRA for micro-analytical analysis (refer to DIT's Integrated Modelling Framework shown on page 9).

Figure 2.3-1 shows an example of turning movement data that is available at the turn level. The data can be extracted for user classes and time intervals separately.

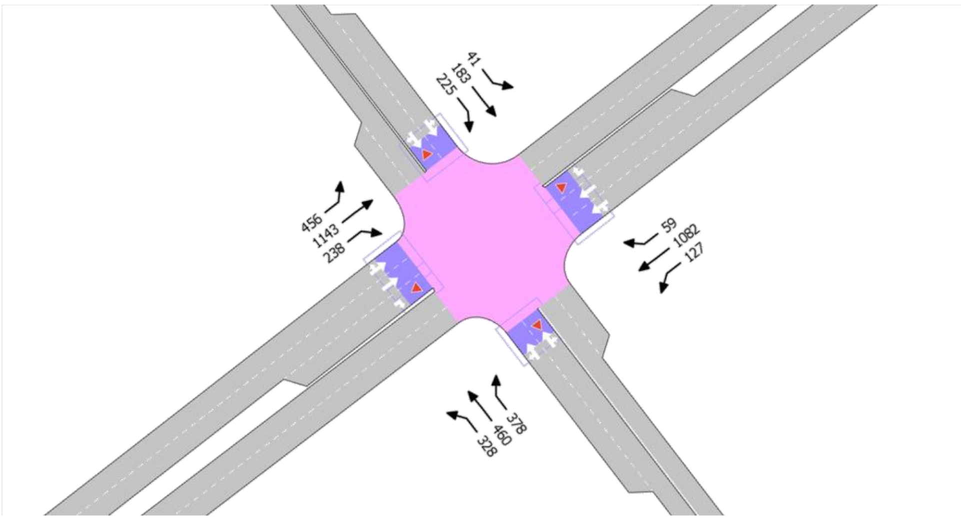

Figure 2.3-1 Example of turning movement data extracted for an intersection

2.3.3 Path Analysis

Path analysis is an inbuilt functionality of Aimsun Next and forms part of the available outputs from TAM to provide insights into traffic routing at the macroscopic, mesoscopic and microscopic level, and the behaviour of drivers in the network. TAM offers a detailed path analysis option after each simulation. The path file allows users to find used paths based on, for example:

- User class (vehicle types or a group of vehicle types);
- Time interval;
- Origin and/or destination;
- Entrance section, exit section or any intermediate section/s;
- Number of vehicles generated; and,
- Path types.

Statistics which are available for paths include:

- Origin and destination;
- Path type;
- Vehicles assigned and vehicles arrived;
- Cost and travel time; and,
- Speed.

A link analysis can also be created for any path or set of paths. The link analysis shows the number of vehicles using each section in the network that belong to the filtered subset of paths.

3 Building Models using TAM

This chapter is the technical chapter of the guidelines, explaining all TAM's elements, parameters, and procedures that a modeller should familiarise themselves with. The sections contained within this chapter are as follows, noting that not all sections will be relevant to all models, depending on the tier/s of TAM being used:

- **Chapter 3.1**: Overview of the TAM Architecture and Modelling Workflow;
- **Chapter 3.2**: Features of TAM for Building Scenarios (common to all TAM tiers);
- **Chapter 3.3**: Building a TAM Macro Scenario;
- **Chapter 3.4**: Building a TAM Meso Scenario;
- **Chapter 3.5**: Building a TAM Micro Scenario; and,
- **Chapter 3.6**: TAM Support.

3.1 Overview of the TAM Architecture and Modelling Workflow

TAM provides three tiers of assignment which provide differing levels of detail and outputs for specific project uses and applications:

- **TAM Macro**: Macroscopic assignment of the SAM peak hour (PH) demands for high-level preliminary planning studies and used to inform the demand for more detailed modelling;
- **TAM Meso**: Mesoscopic modelling covering the entire Greater Adelaide extent used for forecasting the network impacts of transport projects and for network-wide transport assessments; and,
- **TAM Micro**: Highly detailed and specialised microsimulation project models within a subarea of the wider TAM network for concept planning and design.

Table 3.1-1 provides an overview of the three levels and the key inputs into each.

Table 3.1-1 Overview of the TAM Macro, TAM Meso and TAM Micro levels

TAM Level	Extent	Model development process	Demand source	Path assignment source
TAM Macro	Greater Adelaide extent	Macroscopic	SAM PH demands	None
TAM Meso	Greater Adelaide extent	Macroscopic ↓ Mesoscopic	Profiled TAM demand	Generated macroscopic scenario using profiled TAM demand
TAM Micro	Project study area	Macroscopic ↓ Microscopic	Traversal demand from TAM Macro, then adjusted/ profiled using subarea RDS	Generated from macroscopic scenario using adjusted/profiled demand

Table 3.1-2 shows the demands and network geometries that are pre-configured within TAM.

- **TAM Macro** uses the PH demands from SAM which are available for the AM, DT and PM peaks for all network geometry configurations from 2021 to 2041 for CF and PN.
- **TAM Meso** uses AM and PM PH demands from SAM, adjusted and profiled using observed data from 2019, and contains all network geometry configurations for 2019 CF, 2021 CF and all years from 2026 to 2041 for PN only.
- **TAM Micro** does not contain any demands as these are generated from TAM Macro for subarea models. AM, DT and PM are suitable for use in TAM Micro, and all network geometry configurations from 2021 to 2041 are included.

Table 3.1-2 Pre-configured demands and network geometries that are available in TAM

TAM Level	Pre-configured Demands			Pre-configured Network Geometries									
	AM	DT	PM	2019	2021	2026		2031		2036		2041	
				Base	CF	CF	PN	CF	PN	CF	PN	CF	PN
TAM Macro	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓
TAM Meso	✓	-	✓	✓	✓	-	✓	-	✓	-	✓	-	✓
TAM Micro	-	-	-	-	✓	✓	✓	✓	✓	✓	✓	✓	✓

Figure 3.1-1 shows the interactions between the three TAM tiers.

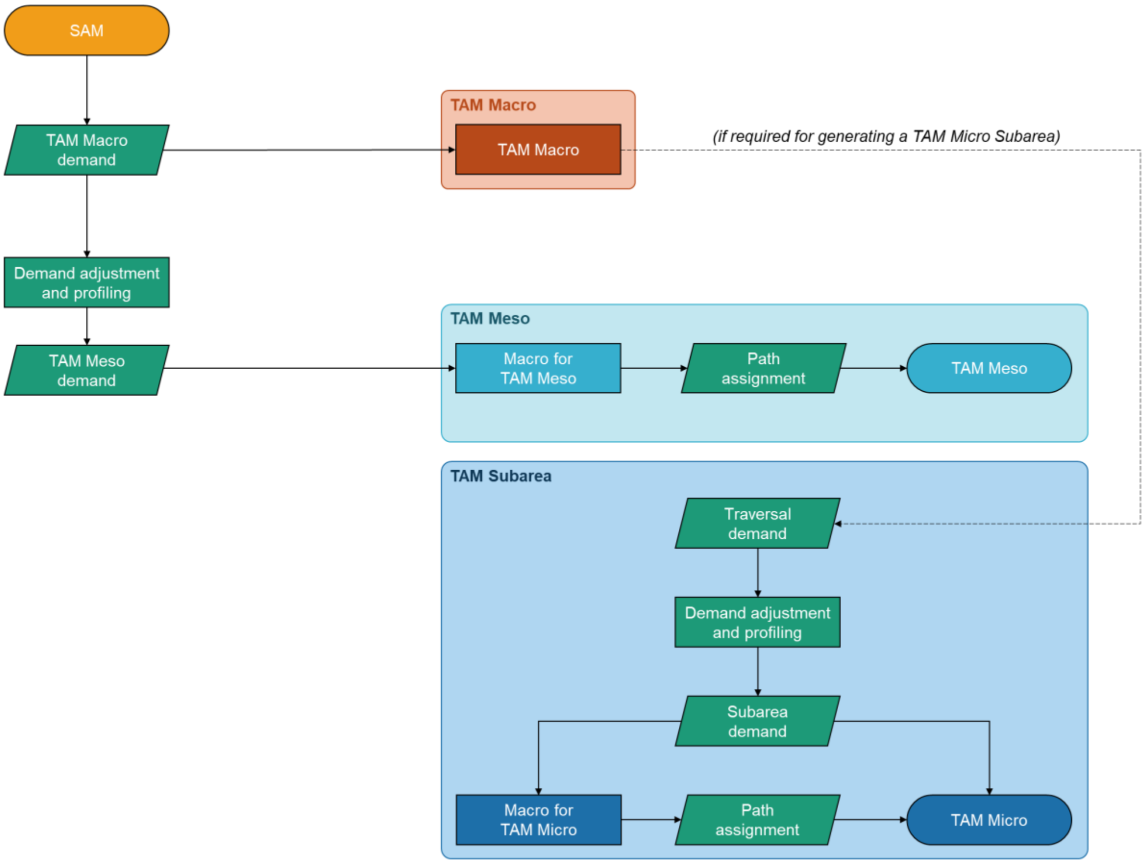

Figure 3.1-1 High-level overview of TAM Architecture showing the interactions between TAM Macro, TAM Meso and TAM Micro, and the demand and path assignment inputs for each

Each level contains its own macroscopic scenario. Macroscopic scenarios use deterministic algorithms based on link volumes and their associated travel costs. Individual vehicles are not simulated; instead these are calculated using cost functions based on factors including assigned volume, distance, capacity, signal timings and junction volumes.

TAM Meso and TAM Micro also each include dynamic scenarios. Dynamic simulations involve the modelling of individual vehicles and their behaviour. The Dynamic Traffic Assignment (DTA) scenarios are run using microscopic, mesoscopic, or hybrid (combination of mesoscopic and microscopic network loading tiers) simulation. The assignment approach in each case is either a Dynamic User Equilibrium (DUE) or a Stochastic Route Choice (SRC) traffic assignment.

Each of the three tiers of TAM are discussed in the following sections.

3.1.1 TAM Macro

TAM Macro is a macroscopic (or static) assignment that uses deterministic algorithms based on link volumes and their associated travel costs. TAM Macro uses discrete functions to evaluate:

- Section costs based on travel time and distance as a function of factors including assigned volume, section length and theoretical capacity;
- Turn costs for signalised and non-priority turns as a function of factors including assigned volume, turn length, theoretical capacity, and signal attributes including green time and cycle time if the turn is signalised; and,
- Turn costs at unsignalised junctions associated with yield time as a function of factors including assigned volume and conflict volume.

These three functions, when combined, provide a high-level calculation of the cost of traversing different routes throughout the network. These route costs are used in the macroscopic assignment to assign the demand across competing routes to minimise the total travel time.

TAM Macro is pre-configured with all the necessary inputs for five horizon years (2021, 2026, 2031, 2036 and 2041), three peaks in each (AM, DT and PM) and two infrastructure scenarios in each (Committed and Funded Network and Planning Network). The purpose of TAM Macro is for high-level preliminary planning studies and for generating traversal demands covering a smaller study area for TAM Micro modelling. TAM Macro is discussed in greater detail in **Chapter 3.3**.

3.1.2 TAM Meso

TAM Meso the mesoscopic level of TAM[18]. Mesoscopic models are an intermediate simulation mode between microscopic and macroscopic modelling. Each traffic modelling methodology defines mesoscopic differently, and historically, it has been given many definitions; some are oriented closer to microsimulation, while others are closer to macroscopic modelling. The definition of mesoscopic in these guidelines aligns with the Aimsun Next software. Individual vehicles are simulated, and these traverse sections with lane-specific representation by applying simplified [19] car-following, lane-changing and gap-acceptance rules. This is computationally more efficient than microscopic simulation, enabling mesoscopic simulation to be applied to solutions in short and medium-term planning, and operational modelling for medium to large-scale citywide models.

Mesoscopic simulation in Aimsun Next represents individual vehicles but adopts a discrete-event simulation approach. An event is an instantaneous occurrence that may change the state of the traffic system (e.g. the number of vehicles in sections and lanes, the status of the traffic signals etc.). Events can be scheduled (known in advance to occur at a particular time in the simulation) or conditional (added to the event list dynamically during the simulation whenever a logical condition is satisfied). Specifically, a mesoscopic simulation includes the following types of events:

- Vehicle generation (vehicle entrance);
- Vehicle system entrance (virtual queue);

[18] TAM Meso also contains a macroscopic scenario that is only used for generating the initial paths for the mesoscopic simulation. This scenario should not be used for outputting macroscopic results or for comparison with TAM Macro.
[19] Compared to microscopic simulation.

- Vehicle node movement (vehicle dynamics);
- Change in traffic light state (control);
- Statistics (outputs); and,
- Matrix change (traffic demand).

These events simulate vehicle movements through sections and lanes with simplified car-following, lane-changing and gap-acceptance models. Network nodes are modelled as queue servers. All events have associated time and priority attributes. Both attributes are used to sort the event list, for example, events related to a change in the status of traffic signals or a new vehicle arrival will be applied before events related to statistics or vehicle movements between sections.

TAM Meso is pre-configured with all necessary inputs for five horizon years (2021, 2026, 2031, 2036 and 2041), two peaks in each (AM and PM) and two infrastructure scenarios in each (CF and PN). The purpose of TAM Meso is for forecasting the network impacts of road transport projects and for network-wide transport assessments. TAM Meso is discussed in greater detail in **Chapter 3.4**.

3.1.3 TAM Micro

Microscopic simulation process in Aimsun Next applies a discrete-time simulation approach where consideration is given to every vehicle's speed, lane choice and movement for each time step. Microscopic simulation models can be highly detailed and capture most aspects of the road network and driver behaviour that influence the overall transport network performance.

TAM supports microsimulation modelling within a subarea. In order to develop a model to the high level of detail required for microsimulation modelling, it is more practical to focus on a smaller, defined area of the larger model, called a subarea (or subnetwork). This allows the impacts and benefits of a project to be considered in isolation and greater detail.

TAM is a fully integrated model which supports macroscopic, mesoscopic and microscopic modelling within the same package and using the same network. It provides a seamless transition from the TAM Macro scenario (covering the whole of Greater Adelaide) to a smaller TAM Micro model, including:

- Automated traversal demand generation for the subarea using TAM Macro outputs;
- Automated generation of public transport lines and plans for the subarea; and,
- Geometry that is inherited from, and consistent with, all other TAM scenarios, so only minimal network refinement is required when transitioning from TAM Macro to TAM Micro.

TAM Micro models can be used for economic and transport planning assessments. Although subarea models can be built for macroscopic, mesoscopic or microscopic simulation, it is recommended that they are used for microsimulation modelling only in TAM[20]. TAM Micro is discussed in greater detail in **Chapter 3.5**.

[20] By default, TAM Micro also uses a macroscopic scenario that is only used for generating the initial paths for the microscopic simulation. This scenario should not be used for outputting macroscopic results or for comparison with TAM Macro.

3.2 Features of TAM for Building Scenarios

This section provides an overview of the pre-configured features of TAM which are relevant to all tiers, including:

- Pre-configured TAM supply-side objects such as geometry configurations, control plans, public transport, subpaths, turn and section bans, and traffic management strategies;
- Modifying or creating new TAM supply-side objects for project models; and,
- Model parameters to be used for objects that are common to all levels of assignment in TAM such as sections, turns and macroscopic assignment parameters.

Note: the following sections describe the processes that are specific to TAM Macro (**Chapter 3.3**), TAM Meso (**Chapter 3.4**), and TAM Micro (**Chapter 3.5**).

3.2.1 Layers

Model layers are organised by type and by objects. TAM contains seven top-level layers:

- **Projects:** The default folder used for any changes to the default TAM geometry by the user for project assessment;
- **Groupings:** Objects that are an aggregation of other objects, such as supernodes, groups, subnetworks and subpaths;
- **Base Network:** Base network geometry objects (e.g. nodes and sections);
- **Future Network:** Future network geometry objects (e.g. nodes and sections);
- **Public Transport Network:** Public transport geometry objects and public transport routes;
- **Centroid Configuration:** All TAM centroids (parent and child centroids); and,
- **Decoration:** Decorative layers that have no impact on the model results (e.g. drawings, aerial photographs, shapefiles, etc.).

Figure 3.2-1 shows the top-level layers as they appear in TAM. By default, "Projects" is the active layer.

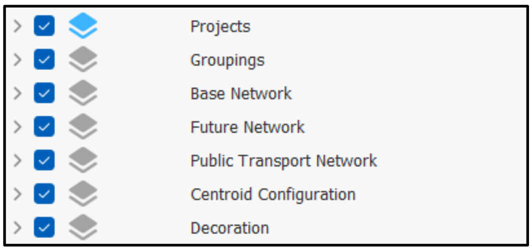

Figure 3.2-1 Top-level layers in TAM

Each top-level layer contains several sublayers to further categorise objects. **Figure 3.2-2** shows the main layers and sublayers in TAM. Layers shown in blue exist only as folders and do not contain any objects (except other layers). Layers shown in grey contain objects.

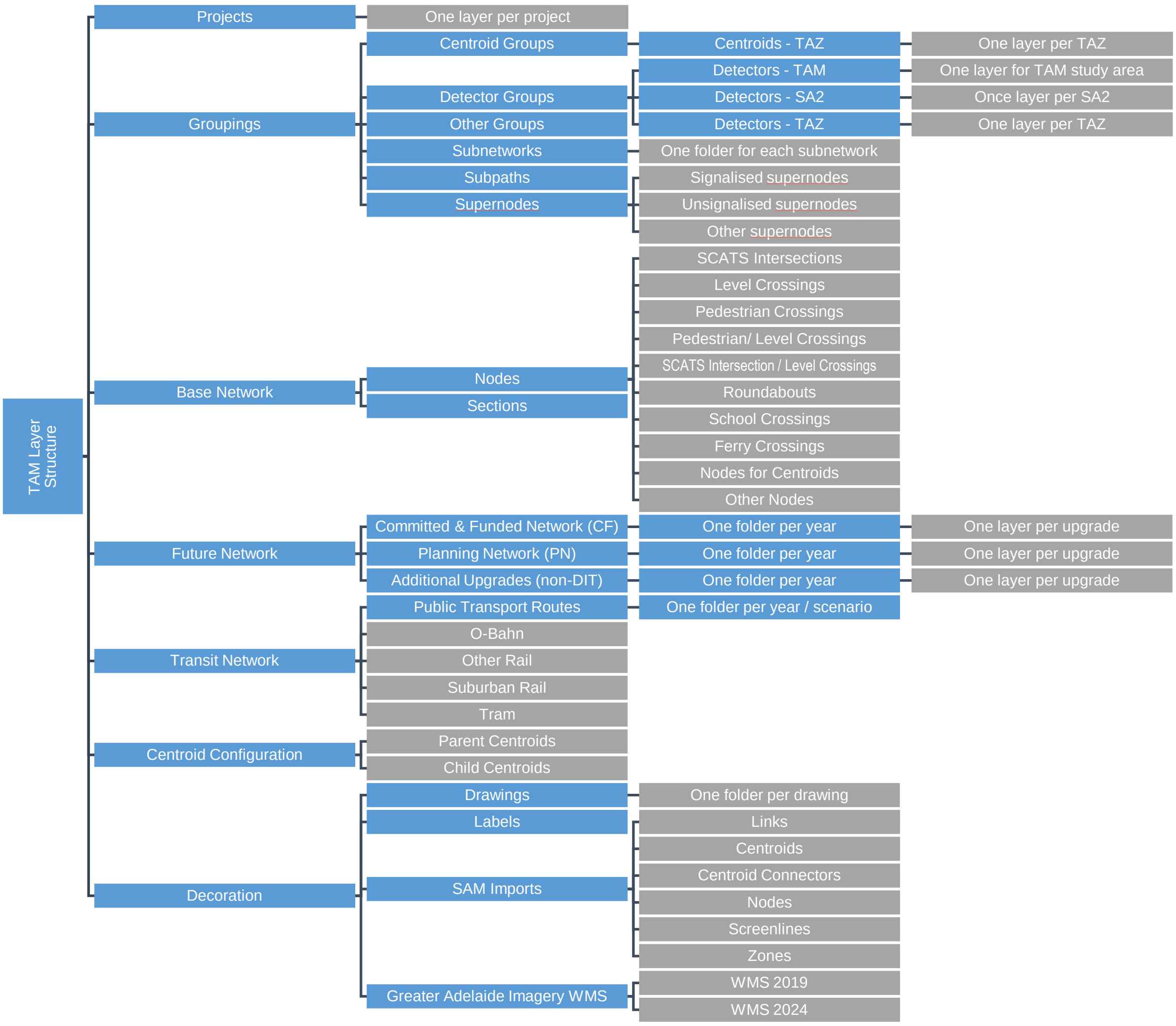

Figure 3.2-2 TAM default layer structure

TAM contains a pre-defined layer for additional geometry in the “Projects” layer. Further sub-layers can be created if warranted by a specific project, such as to contain different options. It is recommended that a layer style is used so that geometric changes belonging to each layer can be easily identified. **Figure 3.2-3** shows how this should be implemented.

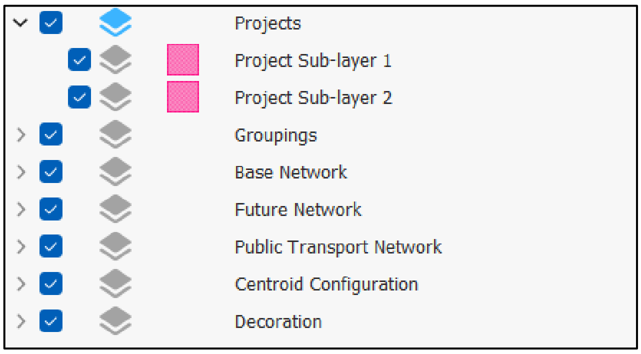

Figure 3.2-3 Example of the creation of project sub-layers in the TAM layer structure

In most cases, it will not be necessary for the user to modify any objects in the other layers.

Layers in TAM have a custom attribute called *Allowed Objects* (GKLayer::allowedObjects) that contains a list of allowed objects for that layer. The allowed objects list is comma separated and uses the Aimsun class name (e.g. to allow section objects, GKSection must be added to the list of allowed objects). **Figure 3.2-4** shows an example of the allowed object types in some layers.

Name	Allowed Objects
Child Centroids	GKCentroid,GKCenConnection
Parent Centroids	GKCentroid,GKCenConnection
Public Transport Routes	GKPublicLine
School Crossings	GKTurning,GKNode
Nodes	GKTurning,GKNode
Sections	GKSection,GKBusStop,GKDetector,GKDetectorStation
Other Nodes	GKTurning,GKNode

Figure 3.2-4 Example of the Allowed Objects attribute set for some layers

TAM contains a script for users to check that all objects are in correct layers. Upon running the script "Check Objects in Correct Layers", a printout in the log will highlight any objects that are in layers that do not support their object type. The user can correct this by moving the object to an appropriate layer or by amending the list of allowed object types in the object's existing layer.

3.2.2 Folder structure

TAM is pre-configured with an established folder structure. The folder structure used is based on the Aimsun Next default folder structure which allows the software to automatically detect files. **Figure 3.2-5** shows the folder structure of the TAM package.

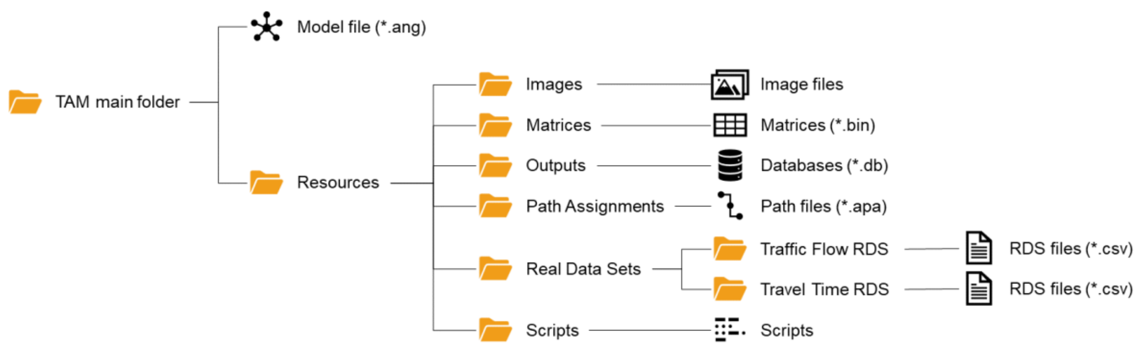

Figure 3.2-5 TAM default folder structure

3.2.3 Pre-configured TAM Supply

TAM uses the integrated, multi-tier modelling capabilities of the Aimsun Next software package. Consequently, once set-up, most objects in the model can be used for macroscopic, mesoscopic or microscopic modelling with little or no intervention from the user.

TAM is pre-configured with all the necessary supply-side objects to run any of pre-existing network-wide scenarios (TAM Macro and TAM Meso) and for developing TAM Micro models. This integrated and versatile approach streamlines the delivery of models using any of the TAM levels and modelling tiers.

This section provides an overview of the main pre-configured TAM supply-side objects. These objects are listed below in the same order that they are found in the Project window:

- **Attribute Overrides**
  - Attribute Overrides (**Chapter 3.2.3.12**)
- **Control**
  - Control Plans and Master Control Plans (**Chapter 3.2.3.1**)
- **Data Analysis**
  - Real Data Sets (**Chapter 3.2.3.2**)
  - View Modes and View Styles (**Chapter 3.2.3.3**)
- **Demand Data**
  - Centroid Configurations and Traffic Demands (**Chapter 3.2.3.4**)
  - Functions (**Chapter 3.2.3.5**)
  - Vehicles and User Classes (**Chapter 3.2.3.6**)
- **Infrastructure**
  - Geometry Configurations (**Chapter 3.2.3.7**)
  - Road Types and Lane Types (**Chapter 3.2.3.8)**
- **Traffic Management**
  - Traffic Conditions (**Chapter 3.2.3.11**)
- **Public transport**
  - Public Transport Lines and Public Transport Plans (**Chapter 3.2.3.9**).

3.2.3.1 Pre-configured Signal Control

TAM includes pre-configured signals for the following intersection types:

- Signalised intersections (using SCATS);
- Signalised pedestrian crossings; and,
- Level crossings.

Each type is discussed in the following sections.

3.2.3.1.1 Signalised Intersections

All signalised intersections within the study area are included in TAM. Signal groups and detector layouts for these intersections are pre-configured based on SCATS.

Naming convention: *Signal groups*

Name	*ID*	where	*ID*	=	SCATS signal group number (00 if unknown)
	e.g. *1* or *2*				

Naming convention: *Detectors (at signalised intersections)*

Name	*DIR*	where	*DIR*	=	Turn direction, e.g. THROUGH. If multiple, use colons to separate.
	e.g. LEFT or LEFT:THROUGH				
External ID	*SiteID_DetID*	where	*SiteID* *DetID*	= =	SCATS site ID (000 if unknown) SCATS detector number (00 if unknown)
	e.g. *101_1* or *101_2*				

For objects in future year geometries, the suffix *_Year_Scenario* is appended to the External ID where *Year* is the future year (e.g. 2026, 2031, etc.) and *Scenario* is the scenario (i.e. CF, PN).

Phase times, sequences and offsets were based on historical SCATS data averaged across weekdays in May 2019. TAM contains the following SCATS regions:

- Adelaide City Council (ACC);
- Modbury (MODBRY);
- Norwood (NRWOOD);
- Reynella (REYNEL);
- Rural sites (RURAL);
- Salisbury (SALBRY);
- St Marys (STMARY);
- Unley (UNLEY);
- Walkerville (WALKVL);
- West Adelaide (WESTAD); and,
- Woodville (WOODVL).

Actuated signals are used in TAM for signalised intersections. These signals respond to demand and provide transit priority (where appropriate). Signalised intersections in TAM use two rings (where appropriate) to simulate variable phases and early cut-offs. **Table 3.2-1** shows the default signal timing parameters for SCATS intersections in TAM.

Table 3.2-1 Default signal timing parameters for SCATS intersections in TAM

<table>
<tr><th>Phase description</th><th>Phase duration (s)</th><th>Minimum green (s)</th><th>Max out (s)</th><th>Interphase duration (s)</th><th>Recall</th></tr>
<tr><td>Coordinated phase</td><td rowspan="3">Based on historical data</td><td>6</td><td rowspan="3">Set to phase duration</td><td>6</td><td>Coord</td></tr>
<tr><td>All other phases</td><td>6</td><td>6</td><td>No</td></tr>
<tr><td>Pedestrian-only phases (if applicable)</td><td>6</td><td>6</td><td>Max</td></tr>
</table>

Minimum green, max out and recall are not applicable for fixed signal timings.

3.2.3.1.2 Pedestrian Crossings

All signalised pedestrian crossings within the study area are included in TAM. Signal groups are pre-configured based on SCATS or general assumptions; detectors are generally not included for pedestrian crossings.

Pedestrian crossings in TAM operate using fixed timings. **Table 3.2-2** shows the default signal timing parameters for pedestrian crossings in TAM. Note that a limited number of pedestrian crossings use different timings as they are attached to a level crossing. These can be found within the “Combined Pedestrian/Level Crossings” layer.

Table 3.2-2 Default signal timing parameters for pedestrian crossings in TAM

Phase description	Phase duration (s)	Minimum green (s)	Max out (s)	Interphase duration (s)	Recall
Vehicle green time	274	n/a	n/a	6	n/a
Pedestrian green time	14	n/a	n/a	6	n/a

Minimum green, max out and recall are not applicable for fixed signal timings.

3.2.3.1.3 Level Crossings

All level crossings in TAM are coded with pre-emption, so the train/tram phase is only triggered by an approaching public transport vehicle. Detectors are used to trigger and cancel the pre-emption phases.

Naming convention: *Detectors (at level crossings)*

Name	*TurnID_On/Off*	where	*TurnID*	=	Aimsun ID of the turn triggered by this pre-emption
			On/Off	=	*On* if this detector triggers a pre-emption phase; *Off* otherwise
	e.g. *62980_On* or *62980_Off*				

Table 3.2-3 shows the default signal timing parameters for level crossings in TAM. Note that a limited number of level crossings use different timings as they are attached to a signalised intersection or pedestrian crossing. These can be found within the “Combined SCATS Intersection/Level Crossing” and “Combined Pedestrian/Level Crossing” layers respectively.

Table 3.2-3 Default signal timing parameters for level crossings in TAM

Phase description	Phase duration (s)	Minimum green (s)	Max out (s)	Interphase duration (s)	Recall
Vehicle green time	14	6	45	6	Max
Train/tram phase*	15	0	3000	25	No

* Train/tram phase pre-emption applied using Minimum Dwell = 40 seconds and Maximum Dwell = 180 seconds. Maximum Dwell was increased to 600 seconds for pre-emption phases triggered by freight trains.

3.2.3.1.4 Master Control Plans

Signal control plans are in TAM and are suitable for tactical models at macroscopic and mesoscopic simulation levels and provide a starting point for the development of detailed control plans for microscopic simulation. There are two types of master control plans in TAM:

- **Fixed** (static): Simplified single-ring representation of all traffic signals (intersections, level crossings and pedestrian crossings) using fixed control
- **Actuated** (dynamic): Detailed single or double-ring representation of traffic signals using vehicle-actuated control (for intersections), pre-emption (for level crossings) and fixed control (for pedestrian crossings).

Dynamic control plans can be converted to static using the script “Convert Actuated Control to Fixed” from the control plan context menu.

TAM contains a separate master control plan for each scenario. The master control plan contains a single control plan zone with all intersections, pedestrian crossings and level crossings for that scenario. **Figure 3.2-6** shows an example of both the static and dynamic master control plans for AM MP scenarios.

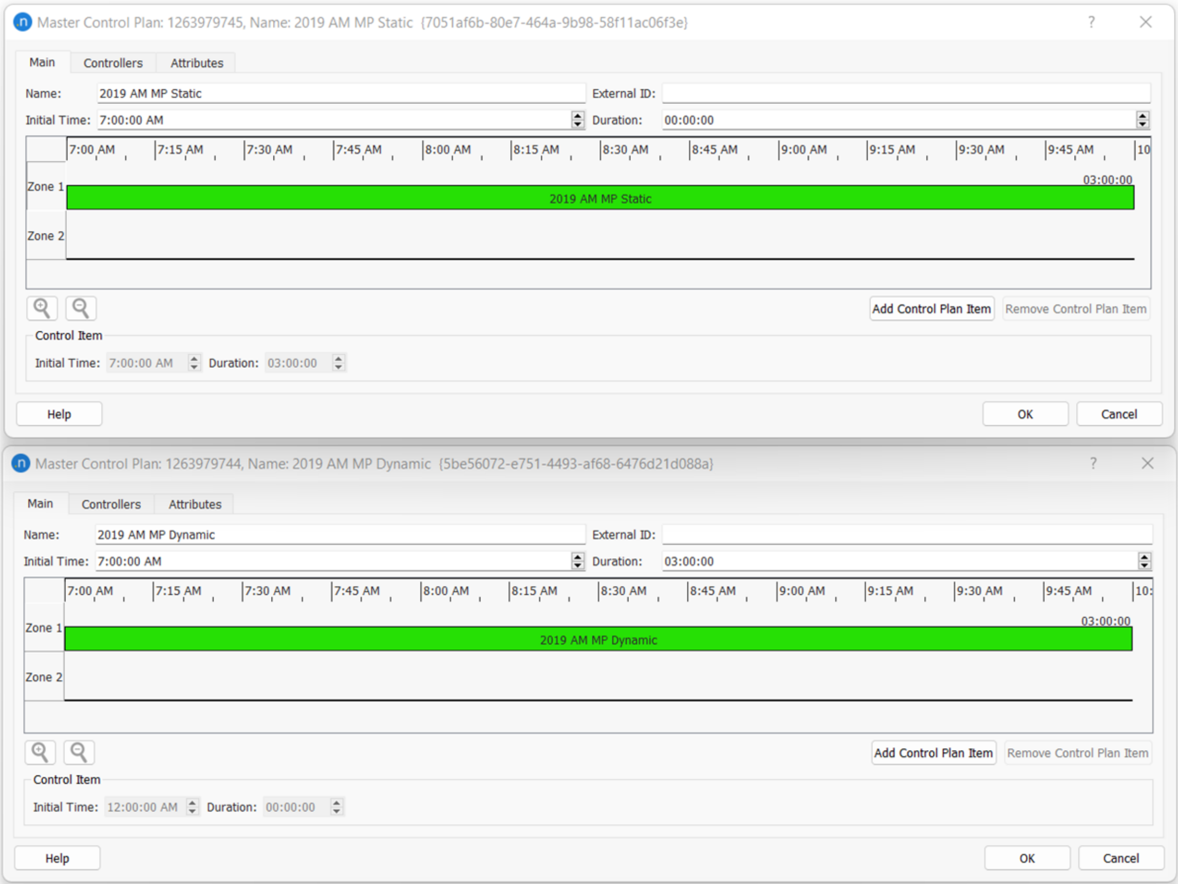

Figure 3.2-6 Example of the static and dynamic master control plans for the 2019 AM MP scenarios

Generally, the modeller should not need to make any changes to the pre-configured TAM control plans. Any changes made should be documented.

3.2.3.2 Pre-configured Real Data Sets

Six real data set (RDS) files are provided in the TAM package:

- **Motorway**: Detector data from motorway detectors (141);
- **SCATS Intersections**: Detector data from SCATS intersections (5,781);
- **SCATS Other**: Detector data from other SCATS detectors, such as at pedestrian crossings and level crossings (683);
- **Travel times**: Travel times on key routes (116); and,
- **Turns**: Turn volumes at major intersections (3,533).

These RDS files were developed using primarily data from May 2019.

Note that subarea building is a new traffic modelling exercise which requires the preparation of an RDS by the user for mode calibration and validation. The TAM Meso RDS files should be used for TAM Meso scenarios only (not TAM Micro).

3.2.3.3 Pre-configured View Modes

TAM is pre-configured with over 20 view modes to assist with data visualisation. These view modes can be found in the relevant folder under the Data Analysis tab of the Project window.

3.2.3.4 Pre-configured Centroid Configurations

TAM is pre-configured with one centroid configuration containing two types of centroid:

- **Parent centroids**: Inherited from SAM with each parent centroid corresponding to a single TAZ and connecting to one or more nodes in TAM; and,
- **Child centroids**: Disaggregated centroids where each child belongs to a single parent and represents a single connection from that parent to the network.

Figure 3.2-7 shows the layer structure for centroids in TAM. Parent centroids are contained within the “Parent Centroids” layer and child centroids are contained within the “Child Centroids” layer. To visualise only parent or only child centroids, the corresponding layer can be turned off.

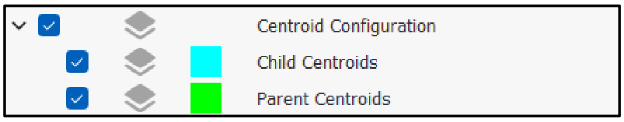

Figure 3.2-7 Centroid configuration layer with sublayers for child and parent centroids

The TAM centroid configuration consists of 2,636 centroids of which 1,003 are parent centroids and 1,633 are child centroids. Each centroid is connected to the network using centroid connectors. Centroid connectors use the *Source* (GKCenConnection::source) attribute to track whether the connection exists in both SAM and TAM or in TAM only.

Naming convention: *Centroids (parent centroids)*

Name	*_SAMID*	where	*SAMID*	=	ID of the corresponding SAM centroid
	e.g. *_1* or *_1001*				
External ID	*SAMID*	where	*SAMID*	=	ID of the corresponding SAM centroid
	e.g. *1* or *1001*				

Naming convention: *Centroids (child centroids)*

Name	*_SAMID_ConObjName_ ConObjEID*	where	*SAMID*	=	ID of the corresponding SAM centroid
			ConObjName	=	Connected object name
			ConObjEID		Connected object External ID
	e.g. *_1_Young Street_11639*				
External ID	*ParCenID_ConObjID*	where	*SAMID*	=	ID of the corresponding SAM centroid
	e.g. *1259075345_1243803934*				

3.2.3.5 TAM Functions

TAM is pre-configured with all functions necessary for all macroscopic, mesoscopic and microscopic scenarios. Details of how to apply these functions are provided in the relevant chapters:

- TAM Macro (**Chapter 3.3**);
- TAM Meso (**Chapter 3.4**); and,
- TAM Micro (**Chapter 3.5**).

3.2.3.6 Vehicles and User Classes

TAM contains eight vehicle types that are pre-configured with parameters relevant for macroscopic, mesoscopic and microscopic modelling. The vehicle types in TAM are divided into two categories:

- **Private vehicle**: trips defined by OD matrices that are routed through the network during the simulation using path assignment algorithms; and,
- **Public transport vehicle**: vehicles that follow defined routes and adhere to a pre-defined timetable for departure and stop times.

Each vehicle type belongs to one or more vehicle classes. Vehicle classes are an aggregation of vehicle types that can impact how vehicles are classified in the network. Each vehicle class may be subject to specific conditions within the network such as turn bans, disallowed routes and/or speed restrictions. There are five vehicle classes in TAM:

- **Adelaide Private Vehicle** (PV): privately-owned vehicles (i.e. not public transport);
- **Adelaide Heavy Vehicle** (HV): heavy vehicles including both trucks and buses;
- **Adelaide Bus**: buses only;
- **Adelaide Tram**: trams only; and,
- **Adelaide Train**: Trains including both suburban (passenger) and freight trains.

Table 3.2-4 summarises the vehicle types and corresponding vehicle classes used in TAM.

Table 3.2-4: Vehicle classification in TAM

Vehicle Type	Vehicle Category	Vehicle Class/es
Car DIT	Private vehicle	Adelaide PV
Truck Rigid DIT	Private vehicle	Adelaide PV, Adelaide HV
Truck Articulated DIT	Private vehicle	Adelaide PV, Adelaide HV
Truck B-Double DIT	Private vehicle	Adelaide PV, Adelaide HV
Bus DIT	Public transport vehicle	Adelaide Bus, Adelaide HV
Tram DIT	Public transport vehicle	Adelaide Tram
Train DIT	Public transport vehicle	Adelaide Train
Freight Train ARTC	Public transport vehicle	Adelaide Train

Note: TAM Macro and TAM Meso use a single, aggregated truck vehicle type.

3.2.3.7 Pre-configured Geometry Configurations

Geometry configurations are an Aimsun Next feature that allows for multiple different geometric layouts to be stored within the same model file. For example, a configuration can be used to code alternative intersection upgrades – including new sections, nodes, turns and public transport stops – enabling simulation of different scenarios with combinations of possible network changes.

TAM is built with a set of geometry configurations pre-configured for future years as shown in **Figure 3.2-8**. Each scenario contains the geometry configuration relevant to that scenario, as well as all the relevant geometry configurations from previous years.

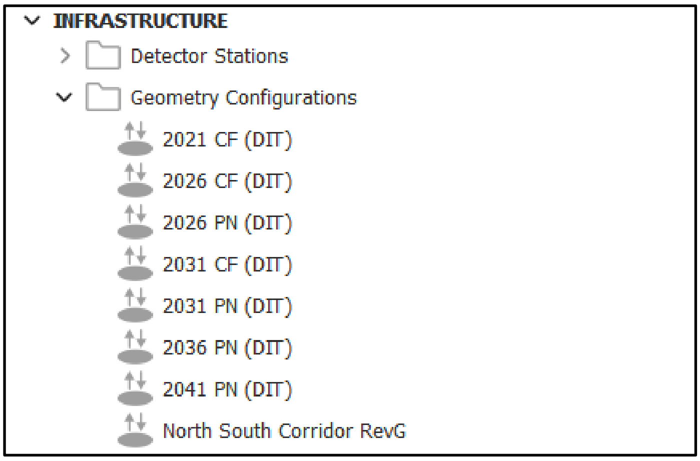

Figure 3.2-8 Pre-configured geometry configurations available in TAM

Geometry configurations contain two lists:

- **Existent only here**: Objects in this list will only exist in scenarios where the geometry configuration is active; and,
- **Non-existent here**: Objects in this list will not exist in scenarios where the geometry configuration is active.

Objects can only belong to the existent list of a single geometry configuration but can be made non-existent by multiple geometry configurations. Objects not included in any geometry configuration are common to all scenarios.

Geometry configurations in TAM contain only sections. By default:

- Turns to or from non-existent sections are also non-existent;
- Nodes with no existent turns are also non-existent; and,
- Section objects such as detectors or public transport stops that are on non-existent sections are also non-existent;

so these objects do not need to be added to geometry configurations.

3.2.3.8 Pre-configured Road Types and Lane Types

TAM includes 45 road types which were inherited from SAM. These include one or more road types covering:

- Freeway;
- Expressway;
- Tunnel;
- Highway;
- Arterial – divided;
- Arterial – undivided;
- Local/collector – divided;
- Local/collector – undivided;
- Tram line;
- Train line;
- Bus-only highway link; and, O-Bahn link.

Generally, the modeller should not need to make any changes to the pre-configured TAM road types. Any changes made should be documented.

TAM includes 14 lane types to account for bus lanes, clearways, restricted vehicle lanes and tidal flow lanes. Lanes that do not have a specific lane type (i.e. lane type = None) may be used by all vehicle types. The lane types that are included in TAM are:

- Bus Lane AM Peak;
- Bus Lane AM and PM Peaks;
- Bus Lane PM Peak;
- Bus Lane All Day;
- Heavy Vehicle Lane;
- O-Bahn;
- Train Line;
- Tram Line;
- Tram/PV Shared Lane; and,
- Tidal Flow Lane.

3.2.3.9 Pre-configured Public Transport

TAM is preconfigured with public transport routes for:

- **Metropolitan buses**: Imported from GTFS;
- **Regional buses and coaches**: Imported using information from bus operators;
- **Trains**: Imported from GTFS;
- **Trams**: Imported from GTFS; and,
- **Freight trains**: Imported using information supplied by ARTC.

Public transport lines for different years and scenarios are pre-configured in TAM:

- **2019**: Based on 2019 GTFS, bus operator timetables and 2019 ARTC timetables;
- **2021**: Based on 2021 GTFS, bus operator timetables and 2021 ARTC timetables; and,
- **2026 onwards**: Timetables, routes, stops and stop times assumed to be consistent with 2021 and updated for the geometry configurations in each scenario.

Public transport plans are pre-configured for each TAM scenario and contain all lines with at least one departure during that scenario.

Public transport lines can be grouped into folders based on attribute values. The default sorting for public transport lines in TAM is:

- Year
  - Scenario
    - Default Vehicle Type.

Other attributes can also be used to sort the public transport lines as desired.

3.2.3.10 Pre-configured Turn and Section Bans

A number of Boolean attributes are defined for turns and sections for macroscopic assignment. These attributes are:

- **Is Rigid Truck Route**: Defines whether the turn/section is allowed to be used by rigid trucks;
- **Is Articulated Truck Route**: Defines whether the turn/section is allowed to be used by articulated trucks (excluding B-Doubles);
- **Is B-Double Truck Route**: Defines whether the turn/section is allowed to be used by B-Double trucks;
- **Is Banned AM**: Defines whether the turn is allowed to be used in the AM;
- **Is Banned DT**: Defines whether the turn is allowed to be used in the DT; and,
- **Is Banned PM**: Defines whether the turn is allowed to be used in the PM.

Figure 3.2-9 shows an example of these attributes defined for a turn.

Is Articulated Truck Route	True
Is B-Double Truck Route	True
Is Banned	False
Is Banned AM	False
Is Banned DT	False
Is Banned PM	False
Is Rigid Truck Route	True

Figure 3.2-9 Turn attributes for macroscopic assignments

Note: These attributes only apply to macroscopic assignment scenarios. The equivalent for dynamic simulations is achieved by using traffic management strategies (refer to **Chapter 3.2.3.11**).

3.2.3.11 Pre-configured Traffic Management Strategies

TAM contains pre-configured traffic management strategies for dynamic simulations. Traffic management strategies include:

- Bus lane deactivations for bus lanes that are time-dependent;
- Tidal flow lane closures in the off-peak direction;
- Heavy vehicle restrictions including truck speed limits, lane bans and turn bans; and,
- Time-dependent turn bans.

All traffic management strategies in TAM are set-up to apply for the relevant time interval/s so can be applied to all scenarios.

3.2.3.12 Pre-configured Attribute Overrides

Attribute overrides allow specific attributes of the base network to be modified without the need to create new geometry. Attribute overrides can be used to adjust, for example, the look-ahead distance, section capacity, maximum speed or cost functions. By default, TAM does not use any attribute overrides.

3.2.4 Modifying TAM Supply for Project Models

When developing project models using TAM, it is generally necessary to modify the existing TAM geometry to refine the base network for specific use-cases and include different future year options. This section provides a summary of the recommended processes and guidelines for updating the TAM supply-side for project models at macroscopic, mesoscopic and microscopic levels.

The process of building/refining the base year model network is critical to ensure that the model is fit-for-purpose and accurately reflects the base year conditions. The model should be correctly developed before beginning the model calibration/validation process. Generally, the network detail should be suitable for a microscopic model, regardless of the simulation type that is to be used, but the onus is on the modeller to review and update the model if adjustments are required.

The following steps apply to maintain consistent modelling.

Step 1: Add, verify and modify sections

1. Check section <u>Name</u> and <u>External ID</u>. In most cases, the section name should correspond to the road name. The section external ID is based on the corresponding link ID in SAM, if applicable.

2. Check section <u>Road Type</u>. Road Types in TAM are consistent with those in SAM for links that exist in SAM. If the link does not exist in SAM, the most appropriate road type has been used based on other roads in the area and road hierarchy. Details of the road types used in TAM can be found in **Appendix 4.3**.

3. Check section <u>Speed Limit</u>. The speed limit should correspond to the speed limit of the road for state-maintained roads, major local roads and also minor local roads which are the focus of a transport planning exercise. Minor local roads which are not the focus of the study should have a speed limit of 30 km/hr in TAM to avoid intrusion of arterial traffic.

4. Check <u>Lane Change Parameters</u> for merge sections. No lane changing should occur close to the intersections.

   For mesoscopic simulation:

   - The Look-ahead Distance controls the mean location of the lane changing point (lane changes may happen within any sections that fall within this distance plus or minus the Look-ahead Distance Variability set in the mesoscopic experiment).

   For microscopic simulation:

   - The value of the Lane Changing Cooperation should be about 80%;
   - The Side Lane Merging Distance should be about twice the section speed limit; and,
   - First Vehicle On Is First Vehicle Off should be disabled initially.

   By default, the lane change parameters for both mesoscopic and microscopic simulation are taken from the section road type. If needed, they can be adjusted to achieve realistic lane change behaviour. However, this should be thoroughly investigated and defined accordingly in the model to represent the existing operation in terms of lane utilisation and upstream lanes feeding the downstream lanes.

Lane Changing Parameters may need to vary to more closely match observed behaviour such as approach / departure lane utilisation or downstream queuing as part of the model calibration process outlined in **Chapter 3.5.7.3.7**.

Diverge settings should be thoroughly investigated and defined accordingly in the model to represent the existing operation in terms of lane utilisation and upstream lanes feeding the downstream lanes. Check that any merges/lane drops/diverges are achieved by auxiliary lanes within defined road sections.

5. Check that the section parameters / attributes which influence static and dynamic assignments are defined correctly:

    - **Volume delay function**: Dependent on the tier of TAM used, refer to:
        - **Chapter 3.3.3.6** for TAM Macro;
        - **Chapter 3.4.3.6** for TAM Meso; and,
        - **Chapter 3.5.7.5** for TAM Micro;
    - **Capacity**: Based on road type capacity and number of full lanes;
    - **Jam density**: TAM uses default 170 veh/km for all sections;
    - **Lane selection model**: TAM values are pre-configured but may be adjusted during the calibration/validation process if required; and,
    - **Reaction time factor**: TAM uses default 1.00 for all sections.

6. Check the location, type (and length if microscopic simulation is likely to be required) of Public Transport Stops.

7. Check the extent of any auxiliary lanes.

8. Check the possibility of on-street parking – road sections where on-street parking is allowed including time-restricted on-street parking.

9. Check for heavy vehicle restrictions and the restriction time.

10. Check for lane restrictions and the restriction time (i.e., bus-only lanes, T2, T3 lanes, and heavy vehicle restrictions). TAM already contains lane types (which allow section lanes to be reserved for specific vehicle classes) for:

    - Bus lanes (peak-specific and all day);
    - Clearways (not currently used in TAM);
    - Heavy vehicle lanes (mandatory for heavy vehicles, optional for all others);
    - O-Bahn lanes;
    - Tidal flow lanes (in operation on Flagstaff Road);
    - Train lines;
    - Trams running on dedicated tram lines; and,
    - Trams running on-street.

    These are pre-configured in TAM, but may need to be extended for future schemes.

11. Check for school zones. If the study period contains school hours, check the road sections that are affected by speed limit restrictions within the school zone area. Given the time-dependent nature of such zones, these may be best modelled with attribute overrides or traffic management strategies. School zones are not currently modelled.

Step 2: Add, verify and modify junctions

1. Check all approach lane lengths.
2. Check detectors for signalised intersections. Note the following conventions for detectors:
   - Detectors should be located at the end of approach sections;
   - Detectors should be 5.0 metres long; and,
   - Detectors should cover only one lane.
   - Detectors should follow the established naming conventions.
3. Check roundabouts are set up correctly. Circulating road sections should have no external ID as they do not correspond to any SAM links. Internal section speeds and turn speeds should be set to realistic circulating speeds – generally at least 10 km/hr less than the approach section speeds.
4. Check that all turn speeds are set to Automatic to reflect geometric constraints. The geometry of the model should match closely the aerial imagery and/or design drawings to ensure that the turn speeds are calculated accurately.
5. Check that the turn parameters / attributes which influence static and dynamic assignments are defined correctly. These include:
   - **Turn penalty function**;
   - **Junction delay function**;
   - **Initial cost function**; and,
   - **Dynamic cost function**.

   All turn functions are Dependent on the level of TAM used, refer to:

   - **Chapter 3.3.3.6** for TAM Macro;
   - **Chapter 3.4.3.6** for TAM Meso; and,
   - **Chapter 3.5.7.5** for TAM Micro.
6. For microscopic simulations, the turn cost functions reference the following attributes:

   Signal green time attributes:

   - GREEN_AM;
   - GREEN_DT;
   - GREEN_PM;

   Signal cycle time attributes:

   - CYCLE_AM;
   - CYCLE_DT; and,
   - CYCLE_PM

   These attributes are pre-configured in TAM for the base control plans (2019). If new control plans are established, such as for TAM Micro models, these attributes must be updated. The script “Update Macro Signal Attributes” can be used to update these based on the selected control plan/s.

   It should be noted that the parameters associated with filter right turns may need to be adjusted to match observed capacity, particularly when the opposing priority flow is high, while at the same time not reducing the capacity for other conflicting movements. This may involve realigning the turn to increase storage space, carefully locating the stop line within the turn and modifying the give way parameters Visibility to Give Way and Visibility along Main Stream (Micro and Meso) on the Dynamic Model tab.

Step 3: Add, verify and modify section joins

1. Check the section join Name. This should match the section name.
2. Yellow Box should be disabled for section joins.
3. Section joins should be as short as possible.
4. Section joins should have the same number of lanes on each side of the join, except where there is an entry or exit from a short left turn slip lane, or where there is a lane split. Generally it is acceptable for the departure side of a section join to have more lanes than the approach side (i.e. diverge), but not for the approach side to have more lanes than the departure side (i.e. merge).

Step 4: Other refinements

As part of the ongoing improvement of TAM, any enhancements or improvements to the existing geometry should be documented and communicated to DIT's Transport Analytics.

3.2.4.1 Creating New Signal Control Plans

Signal groups are retained when nodes are duplicated. If the future scheme involves changes to the signal groups, these will need to be modified by the modeller.

Control plans are not duplicated when a node is duplicated. However, given that most future schemes involve geometry changes, it is unlikely that control plan settings for the new geometry would remain the same. New control plans for project models must be appropriately coded in accordance with SCATS summaries or outputs of signal optimisation/coordination tools (for project case options). DIT Network Management Services (NMS) should be consulted for signal coding in TAM. The modeller must review and appropriately adjust traffic signal settings in the surrounding intersections to maintain the integrity of the model.

For projects where there are signal changes, such as due to revised geometry, a new master control plan should be created. It is suggested that this is a duplicate of the appropriate pre-configured TAM master control plan.

All the control junctions for each future year and scenario are contained within a single control plan, so each pre-configured TAM master control plan contains only one zone. A new control plan should be created for each project option and placed in Zone 2 of the master control plan for that option. Any control plan changes to existing intersections or new intersections should be contained within this control plan only. Control plans can be copied from the existing control plan to the new control plan using the script "DIT – Copy Control Plan" from the node context menu.

Control junctions in Zone 2 will override the base control junctions in Zone 1. Using this hierarchical structure, any changes to the base control plan (in Zone 1) and control plans for new intersections can be easily identified by opening the Zone 2 control plan. **Figure 3.2-10** shows an example of a master control plan for a project based on the 2026 AM CF mesoscopic scenario.

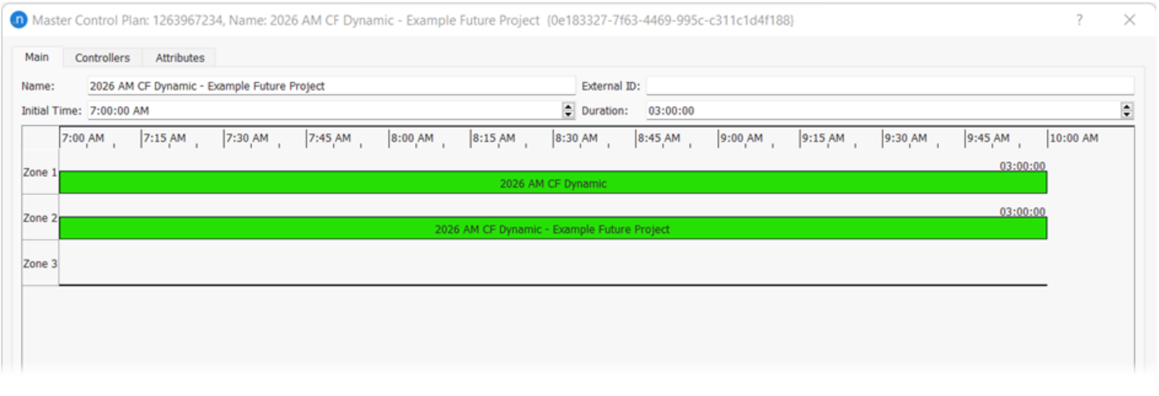

Figure 3.2-10 Example of a project case master control plan

TAM has a fixed control plan equivalent of each actuated control plan for use in macroscopic assignments. The fixed control plan can be updated based on the actuated control plan timings using the script “Convert Actuated Control to Fixed” run from the context menu of the actuated control plan.

3.2.4.2 Creating New Real Data Sets

The pre-configured TAM real data sets (RDS) are suitable for the TAM Meso. TAM Macro (and therefore TAM Micro) do not support the use of 2019 as the base year, so the existing TAM RDS cannot be used for these scenarios. It is also anticipated that TAM Micro models would require a more detailed or expanded RDS.

New RDS files can be created for TAM project models. The new files should contain the following columns:

Traffic Flow RDS columns:

1. Object External ID
2. Volume (Cars)
3. Volume (Trucks)
4. Volume (Buses)
5. Volume (All Vehicles)
6. Time interval (HH:MM:SS format)

Travel Time RDS columns:

1. Object External ID
2. Minimum Travel Time (= Median – 15%)
3. Median Travel Time
4. Maximum Travel Time (= Median + 15%)
5. Time interval (HH:MM:SS format)

The RDS must use objects’ External ID. This means that the External ID of all objects in the RDS must be unique (including across all future years). RDS files must be in comma-separated value format (*.csv).

3.2.4.3 Creating New View Modes

New view modes can be created by the user for additional data visualisation as required.

3.2.4.4 Creating New Geometry Configurations

Additional geometry configurations can be created depending on project requirements. It is recommended that all project-case upgrades are contained within a single geometry configuration (an exception is where there is overlap with more than one pre-configured geometry configuration). Multiple geometry configurations can be created if there are multiple options to be tested. Minor differences for future-year scenarios such as posted speed limit changes, capacity change, lane allocations and turn bans can be implemented using attribute overrides or traffic management strategies rather than coding additional geometry configurations.

The active experiment determines which geometry configurations are visible in the 2D view window. The new geometry configuration should be added to the relevant scenario/s[21]. Once added, the scenario can be activated from the context menu in the Project window as shown in **Figure 3.2-11**.

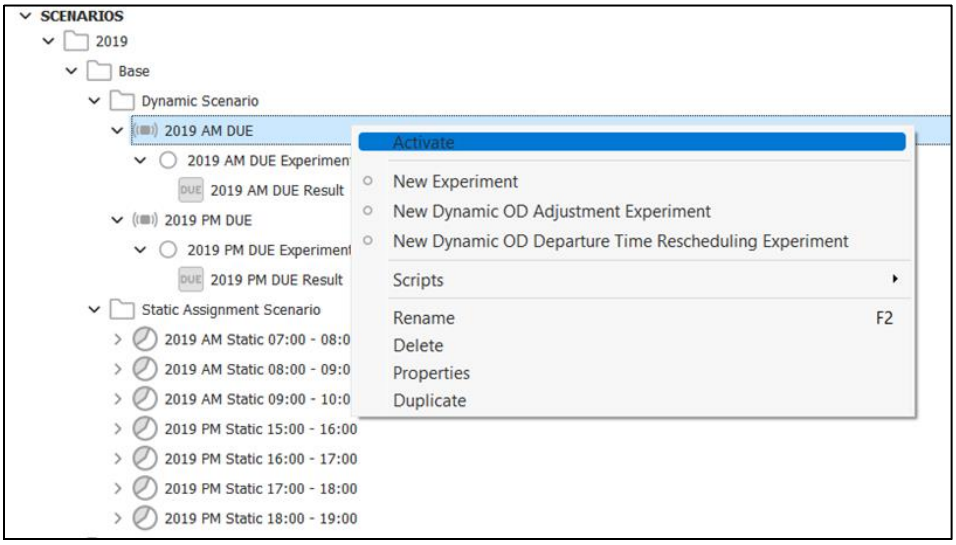

Figure 3.2-11 Activating an experiment in TAM

With the relevant scenario activated, the geometry configuration can be configured. New project infrastructure must be coded and added to the existent list in the new geometry configuration and the geometry to be replaced must be added to the non-existent list. Modellers must ensure that new sections and turn parameters are consistent with the sections/turns that they replace, where applicable.

The modeller must select the best location to build and connect the new geometry to the existing network. To limit changes to the base network, connection points between existing and new geometry should be at minor nodes wherever possible, such as midblocks. The modeller may be required to create cuts in the base network to achieve this.

In most cases, it is simplest to duplicate the existing geometry and then edit the copy in the project area. This ensures that all objects, attributes and values from the base network are copied to the new scheme. The copied geometry must then be moved into the Projects layer

[21] Scenario set-up is specific to each TAM level. Refer to the following chapters for details:

- TAM Macro scenarios (**Chapter 3.3**);
- TAM Meso scenarios (**Chapter 3.4**); and,
- TAM Micro scenarios (**Chapter 3.5**).

or a sub-layer of the Projects layer. **Figure 3.2-12** shows an example of a future geometry scheme that has been created and added to a sub-layer of the Projects folder.

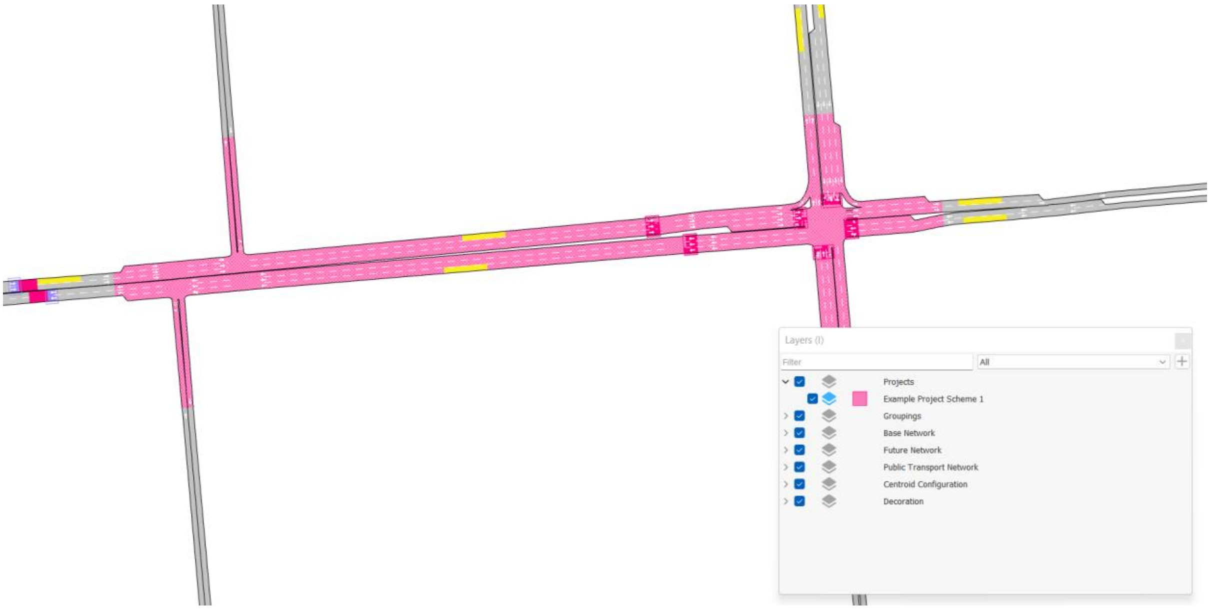

Figure 3.2-12 Future scheme geometry contained within the Projects layer

The new geometry is added to the existent list while the base network that it replaces is added to the non-existent list as shown in **Figure 3.2-13**. As the two geometries overlap, it may be necessary to control which objects are visible by turning on/off specific layers as required when adding sections to the geometry configurations. Note that, as discussed above, only sections need to be included in the geometry configuration.

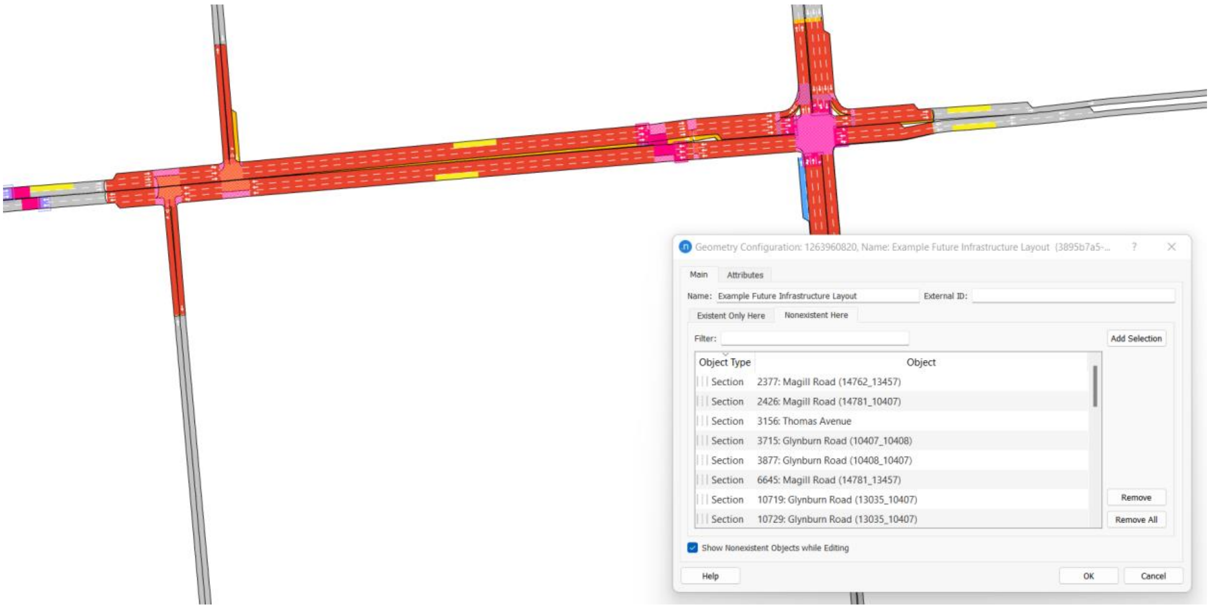

Figure 3.2-13 Future scheme geometry configuration set-up

If any centroid connections are removed as a result of geometry changes, the modeller must add new centroid connections to the same location in the future scheme.

Warning: If a geometry configuration is deleted, all objects in the existent list are also deleted. To retain these objects, they must be removed from the geometry configuration before it is removed.

3.2.4.5 Assigning Functions to New Geometry

TAM contains functions to support macroscopic, mesoscopic and microscopic modelling. The creation of new functions for TAM is not recommended.

The functions applied to new geometry should be consistent with the level of TAM being used. (on page 30) lists the functions that are relevant to each TAM level. These should be applied to new sections, turns and centroid connections as appropriate for the TAM level/s being used.

3.2.4.6 Creating New Vehicles and User Classes

TAM contains eight vehicle types and corresponding user classes. All vehicle types are pre-configured with parameters for macroscopic, mesoscopic and microscopic modelling. Any changes to the default values need to be documented. The creation of new vehicle types for TAM is not recommended.

3.2.4.7 Creating New Centroid Configurations

Except in specific circumstances agreed with DIT, it will generally not be necessary for the user to make any changes to the centroid configuration or create new centroid configurations for TAM Macro or TAM Meso. If a specific project does require the creation of new centroids, the following coding assumptions should be adhered to:

Parent Centroids:

- Parent centroids should connect to at least the same locations as the corresponding centroid in SAM (this is pre-configured in TAM and should not be changed);
- Parent centroids can connect to additional locations in TAM; any centroid connections that are exclusive to TAM have the *Source* attribute (GKCenConnection::Source) set to “TAM”;
- Parent centroids should only connect to nodes;
- All loading points should be bi-directional (i.e. for attraction and generation);

Child Centroids:

- One child centroid should exist for each parent centroid connected object;
- Each child centroid should only connect to a single node;
- Child centroids must be in the same TAZ as their parent centroid and their loading point; and,
- All loading points should be bi-directional (i.e. for attraction and generation).

TAM Micro models will automatically generate a new centroid configuration when the traversal demand is created. The creation of a more refined centroid configuration for subarea models is supported in TAM and covered in greater detail in **Chapter 3.5**.

3.2.4.8 Assigning Road Types and Lane Types

It is not recommended to change the road type of existing sections. Any changes to existing sections should be documented. New sections should be assigned the most appropriate road type based on their function and the road type of surrounding roads. The road type used for any new sections should be documented.

Lane types can be modified for testing project schemes such as heavy vehicle restrictions or bus lanes. Any changes to existing lane types should be documented. The lane type for new sections should be assigned based on their function (e.g. bus lane, heavy vehicle lane, etc.).

3.2.4.9 Creating New Public Transport Routes

The pre-configured 2019 and 2021 public transport lines were imported from GTFS data for May in each year. It is not recommended to change the existing public transport lines for these years.

Future year public transport lines and timetables are based on 2021 in TAM but may be adjusted or reimported using more up-to-date timetable information. The modeller is expected to check and adjust public transport lines and public transport plans as appropriate.

When creating or modifying geometry configurations, if any of the replaced sections carried public transport lines, the modeller must duplicate these lines and edit the new lines to use the new geometry and stops where appropriate[22]. Public transport lines passing through sections affected by a geometry configuration may be identified from the Usage tab of any of the non-existent sections in the geometry configuration, as shown in **Figure 3.2-14**.

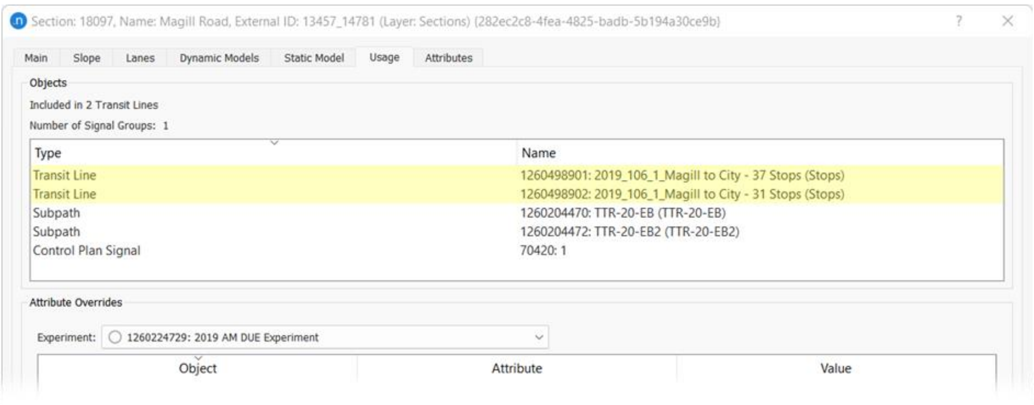

Figure 3.2-14 Public transport lines passing through non-existent geometry

The modeller must update the new public transport line's name, year and scenario attributes to maintain the integrity of the model, as shown in **Figure 3.2-15**. Any changes from the TAM pre-configured public transport lines such as added or removed stops, changes to dwell times or offsets must be noted by the modeller.

[22] It is possible to re-import the GTFS source specifying the newly created scenarios, however the existing refinement of the importation may be lost. This approach will result in significant duplication of information in the model.

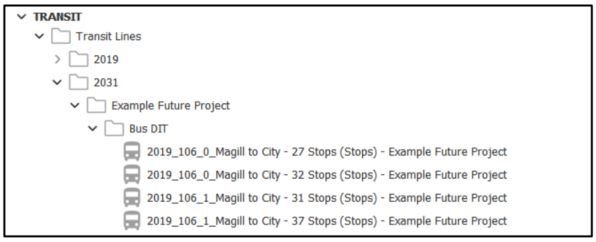

Figure 3.2-15 Duplication of public transport lines running through new geometry

3.2.4.10 Creating New Turn and Section Bans

New turns or sections can be banned for specific vehicle types or in specific peaks using the Boolean attributes described in **Chapter 3.2.3.10**. When creating or modifying geometry configurations, any geometry that is duplicated from the existing TAM geometry will have these values pre-configured. Changes to existing turns or sections can be achieved using attribute overrides. Any changes to the pre-configured values must be documented.

Note that these attributes only apply to macroscopic assignment scenarios. The equivalent for dynamic simulations is achieved by using traffic management strategies (refer to **Chapter 3.2.4.11**).

3.2.4.11 Creating New Traffic Management Strategies

New traffic management strategies can be created to test project schemes. Any new traffic management strategies must be documented.

When creating or modifying geometry configurations, if any of the replaced sections or turns were used by existing traffic management strategies, the modeller must duplicate these actions and edit the actions to use the new geometry. Traffic management strategies in the area may be identified through the Usage tab of any of the non-existent sections in the geometry configuration. Any changes from the TAM pre-configured traffic management strategies, such as if impacted by the future scheme, must be noted by the modeller.

It will generally be sufficient to reproduce any actions within the existing traffic conditions, as shown in **Figure 3.2-16**.

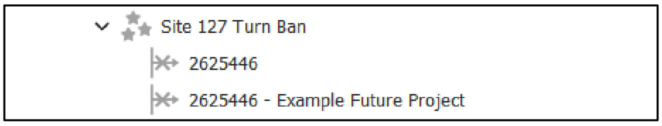

Figure 3.2-16 Traffic management action duplicated for future network geometry

3.2.4.12 Creating New Attribute Overrides

Attributes overrides allow the pre-configured TAM network to be modified while still retaining the original values. Attribute overrides can be used where specific object attributes need to be changed for testing certain project schemes (e.g. a speed limit change). Any new attribute overrides created should be documented by the modeller.

Attribute overrides can be applied to macroscopic, mesoscopic or microscopic scenarios. Note that not all attributes are used by all simulation types (e.g. VDF, TPF are used at macroscopic level only, separate look-ahead distances exist for mesoscopic and microscopic simulation). It is the responsibility of the modeller when implementing attribute overrides to ensure that all used simulation types are covered.

3.3 Building a TAM Macro Scenario

This chapter describes the process for building TAM Macro models. TAM Macro serves two primary functions:

- Providing high-level macroscopic outputs for preliminary planning studies; and,
- Informing the demand for more detailed modelling at the TAM Micro level.

Developing a TAM Macro scenario for both use cases is discussed below. Note that the development of a TAM Macro scenario is a pre-requisite for developing TAM Micro models which are covered in **Chapter 3.5**.

3.3.1 Overview of the TAM Macro work flow

Figure 3.3-1 summarises the inputs, processes and outputs for a TAM Macro scenario.

Inputs:

- Supply-side inputs to TAM Macro scenarios include the base network geometry, any geometry configurations, any attribute overrides, a public transport plan (if applicable), a master control plan and all necessary scenario parameters.
- The demand input for TAM Macro scenarios is the pre-configured SAM PH demand which is available for the AM, DT and PM peak hours for both CF and PN geometries.

TAM Macro scenario:

- TAM Macro scenarios are pre-configured with all the necessary inputs.
- Additional TAM Macro scenarios can be created for testing project schemes.

TAM Macro outputs:

- Macroscopic network statistics (e.g. VKT) can be output from TAM Macro scenarios.
- The path assignment from TAM Macro scenarios can be stored to allow:
    - Link analysis for specific sections, turns and/or centroids; and,
    - Generation of traversal demands for TAM Micro models (covered in **Chapter 3.5**).

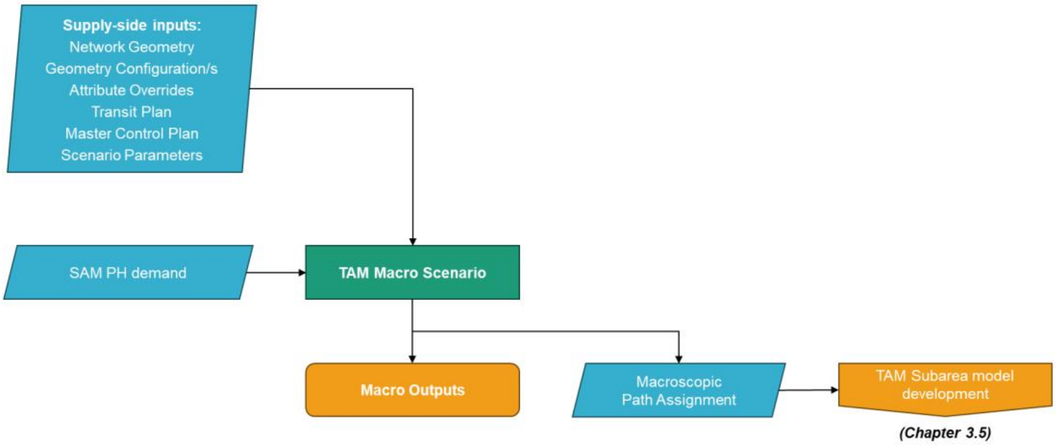

Figure 3.3-1 Overview of the inputs, processes and outputs for a TAM Macro scenario

3.3.2 TAM Macro Base Case Results and Checks

On receipt of TAM, the modeller must first run the pre-configured experiments for the intended model year, period and network (e.g. 2031 AM Committed and Funded) to ensure that the model runs replicate the expected results. Sources of differences could be related to missing external files, undocumented changes in the base model, or a different Aimsun Next software release[24].

TAM replicates the SAM matrices for the AM, DT and PM PH for 2021 up to 2041 for both the Committed and Funded Network and the Planning Network. These models also include appropriate signal timings, public transport and approved static and dynamic cost functions to provide equilibrium at the static level. To run a static assignment using TAM:

1. Run the Static Assignment scenarios covering the peak hour[25] with the TAM Macro demand and save the resultant path files.
2. Verify that the key network statistics shown in **Table 3.3-1** are replicated exactly. Any variation from the expected results suggests that there may be missing external files, undocumented changes in the base model or a different version of Aimsun Next has been used. Any discrepancies identified at this stage must be discussed with DIT before proceeding with further modelling.

Table 3.3-1 Expected VKT for TAM Macro scenarios

Scenario	Year	Expected VKT (All Veh)		
		AM	DT	PM
CF	2021	3.24302×10^6	2.61523×10^6	3.26831×10^6
	2026	3.46838×10^6	2.85509×10^6	3.50611×10^6
	2031	3.71071×10^6	3.07312×10^6	3.75707×10^6
	2036	3.89778×10^6	3.24065×10^6	3.92604×10^6
	2041	4.06932×10^6	3.38884×10^6	4.07855×10^6
PN	2026	3.46921×10^6	2.85511×10^6	3.50576×10^6
	2031	3.71374×10^6	3.07719×10^6	3.75650×10^6
	2036	3.90152×10^6	3.24481×10^6	3.92834×10^6
	2041	4.07110×10^6	3.39597×10^6	4.07873×10^6

[24] TAM has been developed using Aimsun Next 23.0.1 2024_02_07. Any scenario modelling in TAM should be done using this version of Aimsun Next.
[25] TAM contains one Static Assignment Scenario for each hour of each model period. All scenarios covering the model period must be run before proceeding to the dynamic scenarios.

3.3.3 Scenario Testing in TAM Macro

This chapter of TAM Guidelines details the steps, processes, methodologies and best practices for developing a TAM Macro scenario.

The processes discussed in this chapter involve the determination of the project base year and future years, choosing the demand matrices, the initial supply side of the model (control plans, geometry configurations, attribute overrides, public transport plans, etc.), additional network coding requirements, the suitable parameters for the model, model outputs and reporting requirements.

3.3.3.1 Choosing the Year(s) for TAM Macro Scenarios

Each TAM Macro year and network configuration corresponds to a SAM scenario. The scenarios that exist in TAM Macro are:

Committed and Funded Network:

- 2021;
- 2026;
- 2031;
- 2036;
- 2041;

Planning Network:

- 2026;
- 2031;
- 2036; and,
- 2041.

All scenarios exist for the AM, DT and PM peak hours only.

3.3.3.2 Choosing the Demand for TAM Macro Scenarios

A set of demand matrices are available for AM, DT and PM PHs for all the analysis years and each pre-configured scenario. TAM Macro scenarios must be developed for one of the pre-existing years and network configurations. If an intermediate year is to be used for TAM Micro assessment, the demand can be interpolated as part of the subarea model development as discussed later in **Chapter 3.4.3.2**.

TAM Macro is designed to be a more detailed assignment of the SAM PH matrices. As such, the demand for TAM Macro scenarios is loaded through parent centroids only. For further details on the centroid configuration of TAM, refer to **Chapter 3.2.3.7**.

3.3.3.3 Choosing the Initial Supply for TAM Macro Scenarios

All supply-side objects for TAM Macro are pre-configured as discussed in **Chapter 3.2.3**. The project-case model (scenario) network must be built using a new geometry configuration. Any new signal control plans, public transport routes, subpaths, turn and section bans, traffic management strategies and attribute overrides must be configured as explained in **Chapter 3.2.4**.

If the TAM Macro scenario is being used to inform the demand for a TAM Micro model and the intended subarea year falls between two TAM Macro years, Transport Analytics must be consulted. In these circumstances, it is recommended that the TAM Macro year that is closest to the project year is applied as the base case. Transport Analytics will provide further guidance in these circumstances.

3.3.3.4 Creating New TAM Macro Scenarios

Regardless of whether TAM Macro is being used for project assessment or to inform TAM Micro modelling, new scenarios must be created. The recommended method for creating a new project case scenario is by duplicating the most appropriate pre-configured TAM Macro scenario and then renaming it.

The new scenarios will retain the original:

- Public transport plan;
- Master control plan;
- Real data set, if applicable;
- Geometry configurations;
- Attribute overrides;
- Experiment parameters; and,
- Output file locations for databases and path assignment files.

The modeller must review each of these inputs and outputs to determine whether they should be retained or modified.

New scenarios can be grouped into folders based on attribute values. The default sorting for scenarios in TAM is:

⌊ Scenario
  ⌊ Year
    ⌊ Object Type Name

as shown in **Figure 3.3-2**. Other attributes can also be used to sort the scenarios as desired.

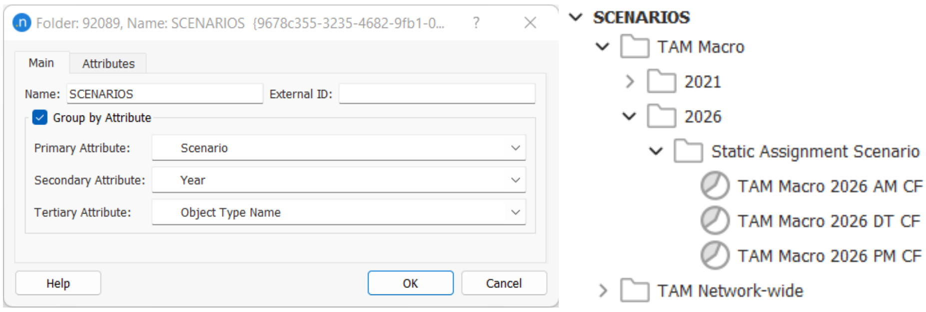

Figure 3.3-2 Recommended grouping of scenarios into folders

3.3.3.5 Modifying the TAM Supply-side for TAM Macro Scenarios

The pre-configured TAM network can be modified for new TAM Macro scenarios, such as for developing and testing new project schemes. Any changes to the network should be in accordance with the processes discussed in **Chapter 3.2.4**.

3.3.3.6 Choosing the Correct Parameters for TAM Macro Scenarios

TAM Macro scenarios should be set-up using the default TAM parameters discussed below. Any deviation from the default value/s must be documented.

The script “Check Turn and Section Attributes” should be run to verify that all relevant attributes have been set-up correctly.

Turn capacities in the TAM package use a standardised formula based on the turn origin and destination capacity and number of lanes. TAM users must refer to **Appendix 4.1** for details on default TAM turn capacities and the implications for developing their own models using the TAM package.

3.3.3.6.1 Section Parameters for TAM Macro

Table 3.3-2 lists key section parameters, the default value/s in for TAM Macro and any relevant implementation notes.

Table 3.3-2 Default section parameters for TAM Macro scenarios

Parameter	Default value	Notes
Road type	Based on SAM	Pre-configured for existing sections based on the road type of the corresponding section in SAM; for new sections, the most appropriate road type should be selected
Speed limit	As posted, or 30 km/hr	Pre-configured for existing sections; for new sections, speed limit should be the posted speed limit, or 30 km/hr for local roads not expected to carry any through traffic
User-defined costs	0.0	Not used for TAM Macro
Capacity	By road type	Pre-configured for existing sections; for new sections, calculated based on the road type capacity per lane and the number of lanes using the script “Update Section Parameters”
Volume delay function (VDF)	TAM Macro – VDF Section	TAM Macro – VDF Section is used for all sections
Additional volume	0.0 veh	
Is Banned	As appropriate	Pre-configured for existing sections; for new sections, these attributes can be set to True to ban sections in specific peaks or for specific heavy vehicle types (refer to **Chapter 3.2.3.10**)

3.3.3.6.2 Turn Parameters for TAM Macro

Table 3.3-3 lists key turn parameters, the default value/s in TAM and any relevant implementation notes. The script "Update Turn Capacity" can be run if the capacity of any turns is to be updated[26].

Table 3.3-3 Default turn parameters for TAM Macro scenarios

Parameter	Default value	Notes
Turn speed	Automatic	
Capacity[26]	Manual	Pre-configured for existing turns; for new turns, calculated using the script "Update Turn Parameters"
User-defined cost	0.0	Not used for TAM Macro
Turn penalty function (TPF)	TAM Macro – TPF Turn	TAM Macro – TPF Turn is used for all turns
Junction delay function (JDF)	TAM Macro – JDF Turn	TAM Meso – JDF Turn applies to all unsignalised priority turns (yield, stop left turn on red) and signalised priority turns that are filter only (i.e. no green arrow)
Additional volume	0.0 veh	
Is Banned	As appropriate	Pre-configured for existing turns; for new turns, these attributes can be set to True to ban turns in specific peaks or for specific heavy vehicle types (refer to **Chapter 3.2.3.10**)

3.3.3.6.3 Static Assignment Parameters for TAM Macro

Table 3.3-4 lists key parameters for TAM Macro scenarios, the default value/s in TAM and any relevant implementation notes.

Table 3.3-4 Default static assignment parameters for TAM Macro scenarios and experiments

Parameter	Default value	Notes
Assignment engine	MSA	
Maximum iterations	200	More iterations should be used if convergence is not reached
Relative gap	1.00%	

[26] TAM users must refer to **Appendix 4.1** for details on default TAM turn capacities and the implications for developing their own models using the TAM package.

3.3.4 TAM Macro Outputs

The outputs from TAM Macro vary depending on the use case:

- TAM Macro statistics can be used directly for high-level preliminary planning studies; and,
- TAM Macro outputs (i.e. path assignments) can be used to generate traversal demands for input into a TAM Micro model.

These are discussed below.

3.3.4.1 TAM Macro Statistics

Table 3.3-5 lists some of the TAM Macro statistics that can be output.

Table 3.3-5 Available statistics for key TAM Macro objects

	Section	Turn	Subpath*	Public transport	Network
Assigned percentage		✓			
Assigned volume	✓	✓	✓		
Cost	✓	✓	✓		✓
Flow	✓	✓	✓	✓	
Mean occupancy					✓
Total distance				✓	✓
V/C ratio	✓	✓			

* Subpath statistics gathering must be enabled.

3.3.4.2 TAM Macro Outputs for Informing TAM Micro Models

TAM Macro scenarios are used in TAM to generate the traversal demand for TAM Micro models. To generate traversal demands, the path assignment from TAM Macro must be stored. This is available on the Outputs to Generate tab of the Static Assignment Experiment and is enabled by default in TAM.

The process of generating traversal demands for TAM Micro models is covered in **Chapter 3.5.6**.

3.4 Building a TAM Meso Scenario

This chapter describes the process for building TAM Meso models. The purpose of TAM Meso is to forecast and assess the network impacts of projects at a network-wide level.

3.4.1 Overview of the TAM Meso work flow

Developing a TAM Meso scenario is discussed below. **Figure 3.4-1** summarises the inputs, processes and outputs for a TAM Macro scenario.

Inputs:

- Supply-side inputs to TAM Meso scenarios include the base network geometry, any geometry configurations, traffic management strategies, any attribute overrides, a public transport plan, a master control plan and all necessary scenario parameters.
- The demand input for TAM Meso scenarios is the pre-configured adjusted and profiled TAM MP demand which is available for the AM and PM model periods for the 2019 base network geometry, 2021 CF network geometry and 2026-41 PN network geometries.

TAM Meso scenarios:

- Macro for TAM Meso scenarios are used for each hour to build the initial paths that then feed into the mesoscopic scenarios. TAM is pre-configured with these scenarios and all necessary inputs. The path assignments from each hour are output and combined into a path assignment plan covering the whole model period.
- TAM Meso scenarios use the same inputs as the macroscopic scenario with the addition of the macroscopic path assignment plan. TAM is pre-configured with these scenarios and all necessary inputs.
- Additional TAM Meso scenarios can be created for testing project schemes. This involves the creation of a macroscopic scenario for each hour of each peak and a mesoscopic scenario covering the whole of each peak.

TAM Meso outputs:

- It is not recommended to use the scenario outputs from Macro for TAM Meso scenarios for analysis. The purpose of these scenarios is solely to provide the initial paths for mesoscopic simulation.
- Mesoscopic network statistics (e.g. VHT, VKT) and object statistics (for sections, turns, subpaths, public transport lines, etc.) can be output from TAM Meso scenarios.
- The path assignment from TAM Meso scenarios can be stored to allow link analyses for specific sections, turns and/or centroids.

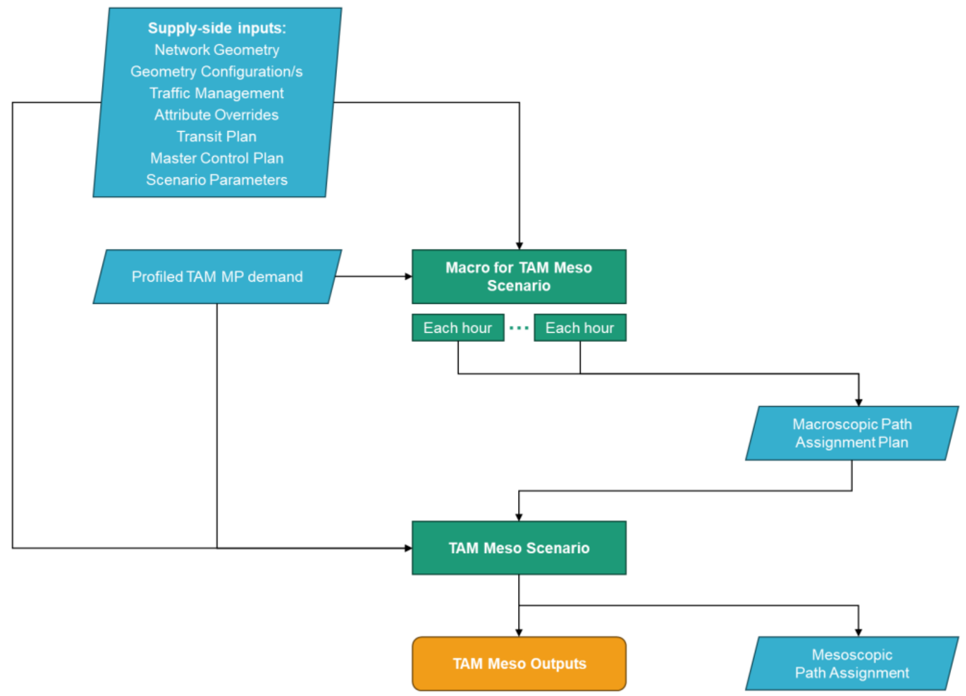

Figure 3.4-1 Overview of the inputs, processes and outputs for a TAM Meso scenario

3.4.2 TAM Base Case Results and Checks

On receipt of TAM, the modeller must first run experiments for the intended model year, period and network (e.g. 2031 AM CF) to ensure that the model runs replicate the expected results. Sources of differences could be related to missing external files, undocumented changes in the base model, or a difference in the Aimsun Next software release[27].

TAM Meso includes an approved set of adjusted demand matrices for future modelled years and periods (AM and PM only) for both the Committed and Funded Network and the Planning Network. The future-year models are also refined with appropriate signal timings, public transport, and approved static and dynamic cost functions to provide equilibrium paths at static and dynamic levels. To run the dynamic simulation within TAM:

1) Run the Static Assignment scenarios covering the full model period[28] with the profiled demand and save the resultant path files.
2) Run a Dynamic User Equilibrium Scenario with the Path Assignment Plan that covers the full model period from Step 1. To verify the results, the Path Assignments must be those generated from Step 1, not those included with the TAM package.
3) Verify that the key network statistics shown in **Table 3.4-1** are replicated exactly. Any variation from the expected results suggests that there may be missing external files, undocumented changes in the base model or a different version of Aimsun Next has been used. Any discrepancies identified at this stage must be discussed with DIT before proceeding with further modelling.

[27] TAM has been developed using Aimsun Next 23.0.1 2024_02_07. Any scenario modelling in TAM should be done using this version of Aimsun Next.
[28] TAM contains one Static Assignment Scenario for each hour of each model period. All scenarios covering the model period must be run before proceeding to the dynamic scenarios.

Table 3.4-1 Expected VHT and VKT for TAM Meso scenarios

Scenario	Year	AM		PM	
		Expected VHT (All Veh)	Expected VKT (All Veh)	Expected VHT (All Veh)	Expected VKT (All Veh)
Base	2019	197,915	8,205,472	290,534	11,991,496
CF	2021	202,129	8,511,046	296,604	12,346,926
PN	2026	214,969	8,831,458	317,771	12,999,414
	2031	225,680	9,237,091	346,058	13,915,916
	2036	240,117	9,640,029	357,987	14,254,440
	2041	255,903	9,976,141	387,392	15,189,532

3.4.3 Scenario Testing in TAM Meso

This chapter of TAM Guidelines details the steps, processes, methodologies, and best practices for developing a TAM Meso model.

The processes discussed in this chapter involve the determination of the project base year and future years, choosing the demand matrices, the initial supply side of the model (control plans, geometry configurations, attribute overrides, public transport plans, etc.), additional network coding requirements, the suitable parameters for the model, model outputs and reporting requirements.

3.4.3.1 Choosing the Year(s) for TAM Meso Scenarios

TAM Meso contains the following scenarios:

Calibrated and validated to existing conditions:

- 2019;

Committed and Funded Network:

- 2021;

Planning Network:

- 2026;
- 2031;
- 2036; and,
- 2041.

All scenarios exist for the AM and PM model periods only. It is highly recommended that users select a future model year that matches the available years in TAM. If this is not possible, the chosen model years should be discussed with DIT's Transport Analytics and Network Management Services before preparing the Modelling Scope Document.

3.4.3.2 Choosing the Demand for TAM Meso Scenarios

A set of demand matrices are available for AM and PM model periods for all the analysis years (e.g. 2019, 2021, 2026, 2031, 2036 and 2041) and for each pre-configured scenario (i.e. Committed and Funded Network and Planning Network). The demand for TAM Meso scenarios is loaded through the child centroids only.

If the intended model year falls between two available years in TAM, an interpolated demand based on an agreed process can be discussed with DIT's Transport Analytics and Network Management Services. The script "Demand Interpolation" can be used to provide an interpolated demand for the whole TAM model extent.

3.4.3.3 Choosing the Initial Supply for TAM Meso Scenarios

TAM is developed with two network configurations: Committed and Funded Network (CF) and Planning Network (PN). **Note:** TAM Meso only contains scenarios for PN, but the CF geometry is included in all PN scenarios up to the same year. The geometry configurations within TAM are pre-configured with the latest upgrades for each network for each year. Additionally, North South Corridor (NSC) exists as a separate geometry configuration due to its size and complexity.

The project-case model (scenario) must be built using a new Geometry Configuration, as explained in **Chapter 3.2.4.4.**

When the proposed model year is inconsistent with TAM's future years, Transport Analytics must be consulted. In these circumstances, it is recommended that TAM model year closest to the project year is applied as the base case. For example, if the intended model year is 2033, falling between TAM model years of 2031 and 2036, the Base Case network of 2031 is recommended rather than 2036.

3.4.3.4 Creating New TAM Meso Scenarios

New scenarios can be created for different project cases. The recommended method for creating new project case scenarios is by duplicating the most appropriate pre-configured TAM scenario and then renaming it. Note that the creation of new TAM Meso scenarios involves the creating of macroscopic scenarios for each hour of the model period and a single mesoscopic scenario covering the whole model period.

The new scenarios and experiments will retain the original:

- Public transport plan;
- Path assignment plan;
- Master control plan;
- Real data set, if applicable;
- Geometry configurations;
- Attribute overrides;
- Experiment parameters (e.g. behavioural parameters, DUE parameters, etc.);
- Traffic management strategies and conditions (mesoscopic only); and,
- Output file locations for databases and path assignment files.

The modeller must review each of these inputs and outputs to determine whether they should be retained or modified. The following sections explain how each of these should be considered.

Scenarios can be grouped into folders based on attribute values. The default sorting for scenarios in TAM is:

- Year
  - Scenario
    - Object Type Name

as shown in **Figure 3.4-2**. Other attributes can also be used to sort the scenarios as desired.

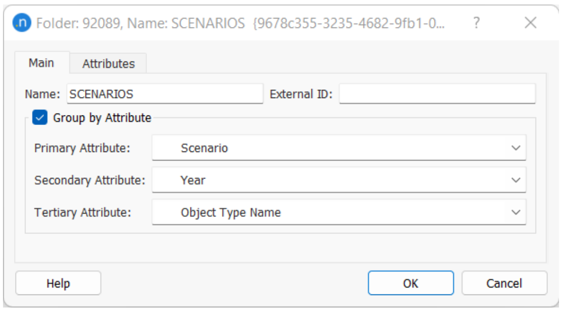

Figure 3.4-2 Recommended grouping of scenarios into folders

3.4.3.5 Modifying the TAM Supply-side for TAM Meso Scenarios

The pre-configured TAM network can be modified for the new TAM Meso scenarios, such as for developing and testing new project schemes. Any changes to the network should be in accordance with the processes discussed in **Chapter 3.2.4**.

3.4.3.6 Choosing the Correct Parameters for TAM Meso Scenarios

TAM Meso scenarios should be set-up using the default TAM parameters discussed below. Any deviation from the default value/s must be documented.

The script “Check Turn and Section Attributes” should be run to verify that all relevant attributes have been set-up correctly.

Turn capacities in the TAM package use a standardised formula based on the turn origin and destination capacity and number of lanes. TAM users must refer to **Appendix 4.1** for details on default TAM turn capacities and the implications for developing their own models using the TAM package.

3.4.3.6.1 Section Parameters for TAM Meso

Table 3.4-2 lists key section parameters, the default value/s in for TAM Meso scenarios and any relevant implementation notes.

Table 3.4-2 Default section parameters for TAM Meso scenarios

Parameter	Default value	Notes
Road type	Based on SAM	Pre-configured for existing sections based on the road type of the corresponding section in SAM; for new sections, the most appropriate road type should be selected
Speed limit	As posted, or 30 km/hr	Pre-configured for existing sections; for new sections, speed limit should be the posted speed limit, or 30 km/hr for local roads not expected to carry any through traffic
User-defined costs	0.0	Not used for TAM Macro
Capacity	By road type	Pre-configured for existing sections; for new sections, calculated based on the road type capacity per lane and the number of lanes using the script “Update Section Parameters”
Lane types	As appropriate	Pre-configured for existing sections; for new sections, lane types should be appropriate to the existing or project scheme geometry
Jam density	170.0 veh/ln	
Reaction time factor	1.0	
Penalise shared lanes	False	
Take into account fast/slow lanes	False	Can be set to True for entry sections only
Volume delay function (VDF)	TAM Macro – VDF Section	TAM Macro – VDF Section is used for all sections
Additional volume	0.0 veh	
Is Banned	As appropriate	Pre-configured for existing sections; for new sections, these attributes can be set to True to ban sections in specific peaks or for specific heavy vehicle types (refer to **Chapter 3.2.3.10**)

3.4.3.6.2 Turn Parameters for TAM Meso

Table 3.4-3 lists key turn parameters, the default value/s in for TAM Meso scenarios and any relevant implementation notes.

The script “Update Turn Capacity” can be run if the capacity of any turns is to be updated[29].

Table 3.4-3 Default turn parameters for TAM Meso scenarios

Parameter	Default value	Notes
Turn speed	Automatic	
Capacity[29]	Manual	Pre-configured for existing turns; for new turns, calculated using the script “Update Turn Parameters”
User-defined cost	0.0	Not used for TAM Meso
K-initials cost function	Default	
Initial cost function	TAM Meso – ICF	TAM Meso – ICF is used for all turns
Dynamic cost function	TAM Meso – DCF	TAM Meso – DCF is used for all turns
Use values from road type for look-ahead/yield parameters	True	Adjustable during calibration; any changes should be documented
Turn penalty function (TPF)	TAM Macro – TPF Turn	TAM Macro – TPF Turn is used for all turns
Junction delay function (JDF)	TAM Macro – JDF Turn	TAM Meso – JDF Turn applies to all unsignalised priority turns (yield, stop left turn on red) and signalised priority turns that are filter only (i.e. no green arrow)
Additional volume	0.0 veh	
Is Banned	As appropriate	Pre-configured for existing turns; for new turns, these attributes can be set to True to ban turns in specific peaks or for specific heavy vehicle types (refer to **Chapter 3.2.3.10**)

[29] TAM users must refer to **Appendix 4.1** for details on default TAM turn capacities and the implications for developing their own models using the TAM package.

3.4.3.6.3 Static Assignment Parameters for TAM Meso

Table 3.4-4 lists key parameters for Macro for TAM Meso scenarios, the default value/s in TAM and any relevant implementation notes. Note that TAM Meso requires one static assignment to be set up for each hour of the model period.

Table 3.4-4 Default static assignment parameters for TAM Meso scenarios and experiments

Parameter	Default value	Notes
Assignment engine	MSA	
Maximum iterations	100	More iterations should be used if convergence is not reached
Relative gap	1.00%	

3.4.3.6.4 DUE Parameters for TAM Meso

Table 3.4-5 lists key parameters for TAM Meso (DUE) scenarios, the default value/s in TAM and any relevant implementation notes.

Table 3.4-5 Default DUE parameters for TAM Meso scenarios, experiments and results

Parameter	Default value	Notes
Network loading parameters (for meso)		
Warm-up	1 hr	Pre-configured warm-up demand for the analysis year and time period should be used
Look-ahead distance variability	40%	
Reaction time	1.50 sec	
Reaction time at traffic lights	1.80 sec	
Arrival type	Exponential	Or “uniform” subject to DIT approval
Dynamic traffic assignment parameters		
Interval	00:15:00	
Number of intervals	1	
Attractiveness weight	3.0	Adjustable during model calibration
User-defined cost weight	0.0	Adjustable during model calibration with justification in the model report if user-defined costs have been used; note that by default, user-defined costs are not considered
Path cost	Experienced	
DUE model	Gradient-based	
Initial step size	Start the assignment process	
Maximum iterations	20	More iterations should be used if convergence is not reached
Relative gap	1.00%	
Do not consider paths with percentage below	2.00%	
Maximum number of initial paths to consider	4	
Calculate additional paths	Yes	
Algorithm	A-Star	
Maximum paths per interval	4	
DUE result parameters		
Random seed	1	

3.4.4 TAM Meso Model Outputs

The model evaluation results must be included in the modelling report and presented in tabular or graphical forms. The model outputs must include those shown in **Table 3.4-6**.

Table 3.4-6 Model evaluation outputs

Output type	Output name	Evaluation method	Time period
Network-wide	• Delay time • Density • Flow • Mean queue • Mean virtual queue • Number of lane changes • Speed • Stop time • Travel time • Total travel time • Total distance travelled • Vehicles inside • Vehicles outside • Vehicles waiting to enter • Waiting time in virtual queue	Mesoscopic DUE Result Summary table of results; time series plots for density, flow, speed and vehicles waiting to enter	Summary table for the total analysis period Time series plots with 15-minute intervals
Critical corridor	• Delay time • Density • Flow • Speed • Stop time • Travel time • Total travel time • Total distance travelled • Waiting time in virtual queue • Heat map of speed over time	Section/subpath time series variables	Time series plots with 15-minute intervals
Critical route (details to be defined in TMSD)	Route information such as: • Vehicles arrived • Cost • Distance • Travel time • Speed	Path analysis showing all alternative paths used with the Simulated Shortest Path view mode	Simulation period (without warm-up) Peak/critical period/s
Critical intersections (details to be defined in TMSD)	• Turning movement volume • Average approach delay • Level of service	Time series as applicable from: • Section • Node • Turn • Supernode trajectory	Time series plots with 15-minute intervals

Static Convergence

Checking that the static assignment has converged (in accordance with the convergence criteria) is the first step. The modeller must ensure that static assignment finishes because the criteria are met and not because maximum number of iterations was reached. The modeller must check that the convergence has not been achieved too quickly. If this is suspected, this implies that the costs are not changing within the network during the assignment process. This may be a result of some very high fixed costs or problems with the cost functions.

Premature convergence is an indication that there are configuration errors. Similarly, if convergence is not achieved and large oscillations are noted in the convergence graph, this is also an indication of errors. This is often observed when junction delays change rapidly at each iteration. The source of the problem might be identified by comparing costs for assignments between adjacent iterations and by static component analysis.

Static Component Analysis

The outputs tab of the static assignment experiment allows inspection of the cost for individual sections, turns, connections and subpaths. The output should be checked for any high costs. Additionally, if function components have been specified within the model, a more detailed breakdown of any sources of unexplained costs such as speed, distance, stated capacity, or even green and cycle values from the Turning Penalty Functions might be examined.

A set of comparisons with the project case and base case should be included in the report.

3.4.4.1 Compare the Project Case with the Base Case at the Global Level

The project report should include a detailed comparison with the base model. Different types of comparisons must be made. The overall network statistics should be compared side-by-side in a table. A list of network statistics that must be included can be found in .

The Data Comparison tool in Aimsun Next allows the comparison of static experiments and dynamic results. Typically, this involves the comparison of flows for sections, turns, detectors or subpaths, but it may also be used to compare costs, speeds, and travel times. An example of such a comparison is shown in **Figure 3.4.4-1**.

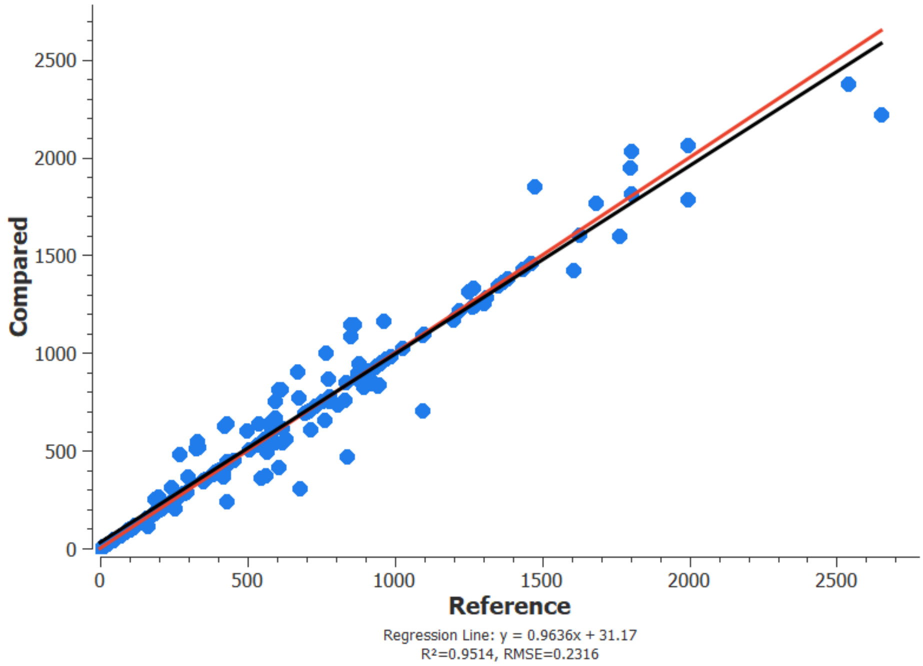

Figure 3.4.4-1 Comparison of volumes from two different experiment results using Data Comparison

The Time Series Viewer tool can be used to compare base and project case simulation results. **Figure 3.4.4-2** compares two dynamic experiments based on total travel time; other indicators used could be density, delay time, etc.

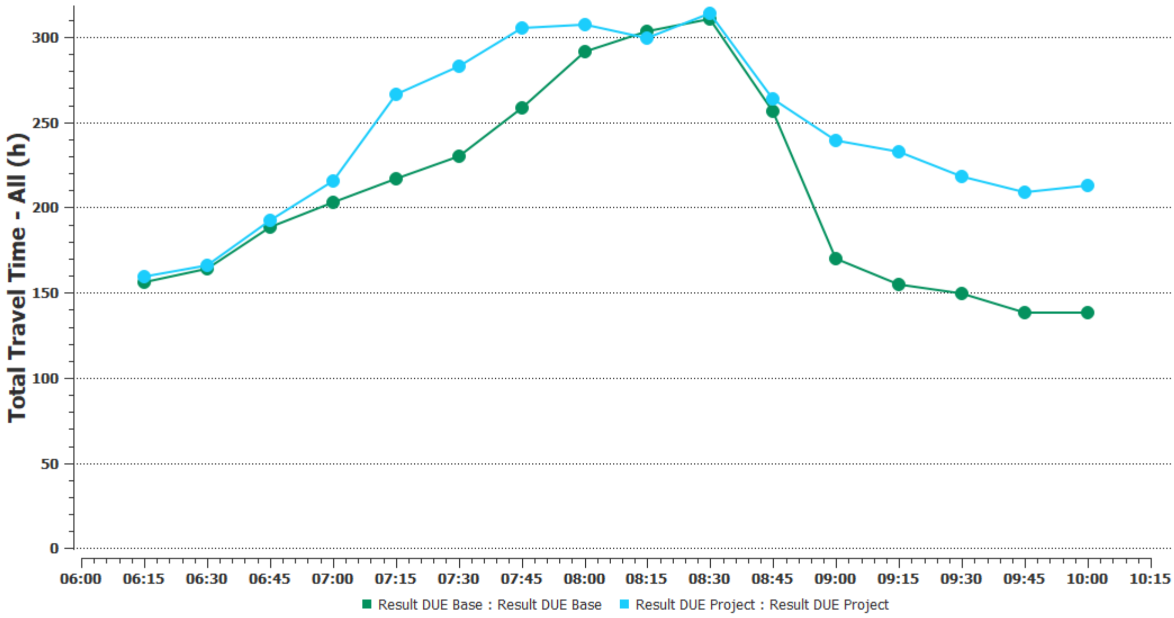

Figure 3.4.4-2 Comparison of total travel time from two different experiment results using Time Series Viewer

3.4.4.2 Compare Project Case and Base Case at the Project Site Statistics Level

A comparison of project site statistics with the base model must be provided in the modelling report for all key sites. The site objects for comparison can be sections, turns, subpaths, public transport and object groupings. A list of site statistics that should be included can be found in .

When geometry configurations are used, data will be stored only for the objects that exist in each scenario. This means it is not always possible to directly compare the results between some objects such as sections, turns and detectors as they may be duplicated as separate objects in different scenarios. In such cases, groupings can be used to compare statistics between scenarios involving geometry configurations, as discussed below.

3.4.4.2.1 Objects Useful at the Project Site Statistics Level

Table 3.4-7 provides an overview of some useful groupings and project site statistics.

Table 3.4-7 Overview of useful groupings for project site statistics

Type	Description
Groupings of boundary sections or detectors	Groupings for objects immediately outside a geometry configuration boundary can be used to determine the change in inbound or outbound traffic statistics.
Groupings of centroids internal to the geometry configuration area	This allows statistics such as count, delay time and travel time to be provided for origin or destination vehicles.
Groupings of all sections within the project site area	While for some statistics, it may be possible to place shared, existing and non-existing objects in the same grouping (for example, a total travel time for all vehicles), for other statistics, it may be better to create separate groupings for base and project objects, then assess with a group of groupings as described in the following section for working between geometry configurations.

3.4.4.2.2 Grouping example working between geometry configurations

Groupings can be established for many different types of objects in TAM, such as sections, turns and subpaths.

Consider an example network with a base and future scenario. Where geometry differences exist, detectors and subpaths (the subject of the example below) can be used to provide useful comparisons of volumes and travel times. An equivalent subpath object is created each different geometry configuration, including the base as shown in **Figure 3.4-3**.

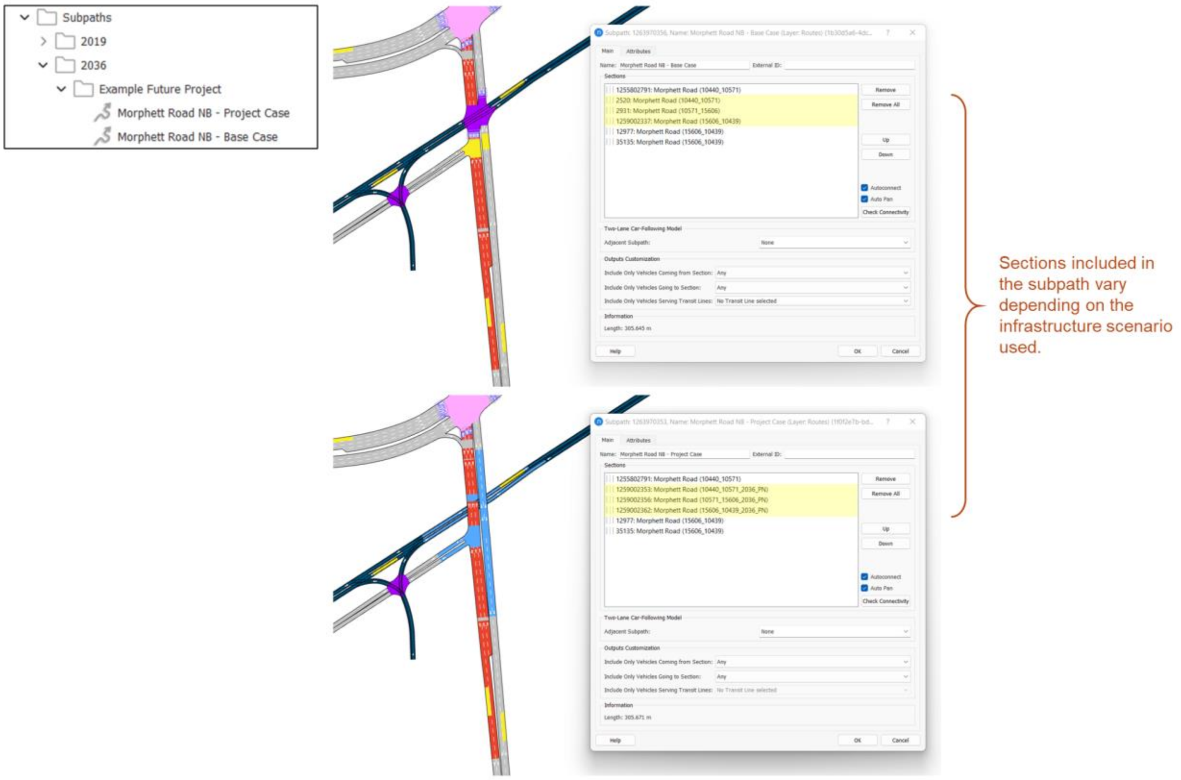

Figure 3.4-3 Example of subpaths created for base and project case geometry configurations

A new grouping category for objects of type subpath is created for the Example Project. A separate grouping can be added for each route within this grouping category, and all subpaths pertaining to that route added. **Figure 3.4-4** shows an example for a subpath grouping that contains a base case and project case subpath.

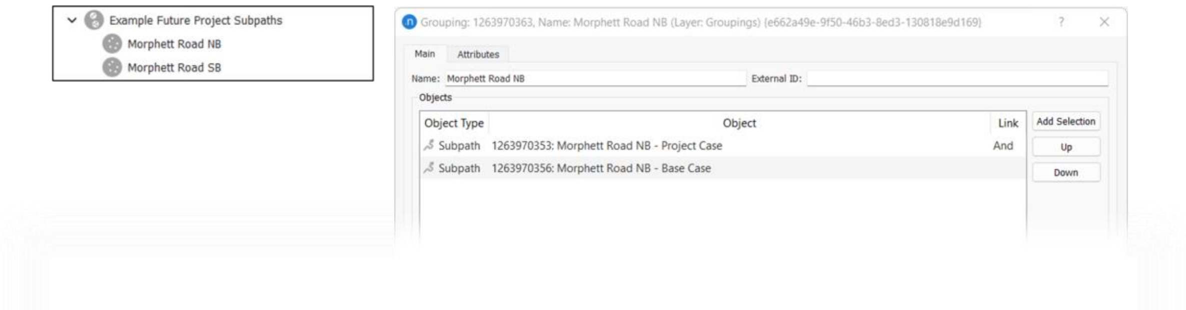

Figure 3.4-4 Grouping of subpaths along the same route to allow for statistics gathering and comparison

Statistics for the groupings can be refreshed after running simulations to allow outputs such as volumes and travel times to be easily compared between the two subpaths using a single object. **Figure 3.4-5** shows the results of a data comparison of two subpaths using a grouping.

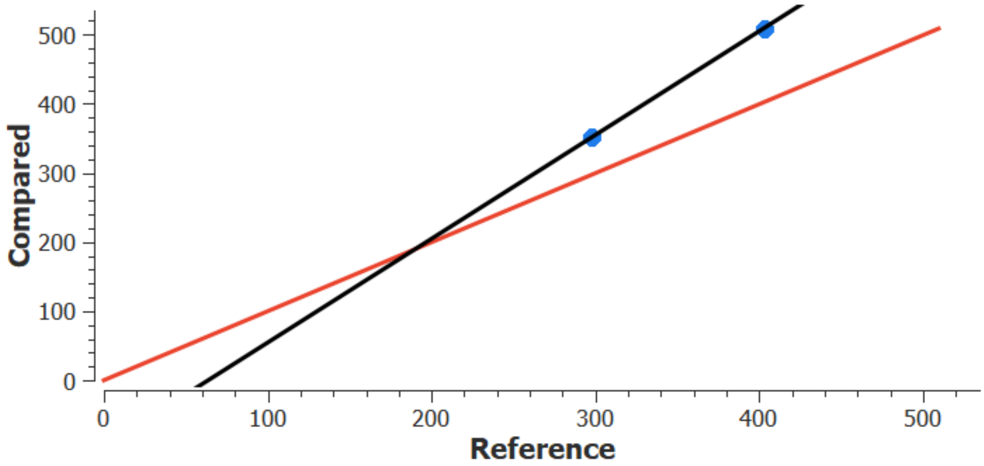

Figure 3.4-5 Example of data comparison across subpath objects using a grouping

3.4.4.3 Extracting Node Turning Movements

The statistics available from any simulation can be easily exported for use outside Aimsun Next. A typical example is to transfer turn volumes with SIDRA for detailed signal planning.

3.5 Building a TAM Micro Scenario

This section explains the processes and methodology for developing TAM Micro microscopic models. The purpose of TAM Micro is to develop highly detailed and specialised microsimulation project models within a subarea of the wider TAM network for concept planning and design.

3.5.1 What is a subarea?

The TAM covers the total area of the Greater Adelaide Region as defined by PlanSA[30]. However, to model projects on a more practical scale, a smaller area can be used to assess the project which reduces modelling noise from the rest of the network. This provides localised impacts and benefits of a project considered on its own merits and not as a network-wide project. A subarea (also known as a subnetwork) can be extracted from TAM for project-level economic and transport planning assessment purposes only.

Subarea models can be built at macroscopic, mesoscopic and microscopic levels in TAM. However, unless expressly agreed by Transport Analytics within DIT, a “TAM Subarea” means a model built at the microsimulation level (TAM Micro).

3.5.2 Overview of the TAM Micro work flow

Developing a TAM Micro scenario is discussed below. This includes determination of the subarea seed matrices, subarea base year calibration and validation, future year demand preparation, future year network building, modelling outputs, and report/documentation requirements. TAM subarea model governance is also explained in this section, including the modelling scoping document hold points and the model audit process. **Figure 3.5-1** summarises the inputs, processes and outputs for a TAM Micro scenario.

Traversal generation:

- The starting point for TAM Micro demands is the TAM Macro scenario. Once the subarea boundary has been defined in TAM, the TAM Macro path assignment can be used to generate the traversal demands for the subarea.
- Traversal demands can be generated for multiple TAM Macro scenarios including for different peaks, years and network configurations.
- The traversal generation process will also create public transport lines and public transport plans for the subarea.

Inputs:

- Supply-side inputs to TAM Micro scenarios include the base network geometry, any geometry configurations, traffic management strategies, any attribute overrides, a public transport plan, a master control plan and all necessary scenario parameters.
- The demand input for TAM Micro scenarios is the traversal demand from TAM Macro. Once this has been generated for the subarea, the demand may be expanded, adjusted and profiled based on the project requirements.

[30] https://plan.sa.gov.au/__data/assets/pdf_file/0005/282974/G16_2015.pdf

TAM Micro Scenarios:

- Macro for TAM Micro Scenarios are used to build the initial paths that then feed into the microscopic scenarios. Macro for TAM Micro scenarios use specific cost functions that are separate to those used for TAM Macro and TAM Meso.
- The TAM Micro scenarios use the same inputs as the macroscopic scenario with the addition of the macroscopic path assignment plan.
- Additional TAM Micro scenarios can be created for testing project schemes. Depending on the project requirements, it may or may not be necessary to re-run the TAM Macro scenarios and regenerate the traversal demands. Each TAM Micro scenario requires a corresponding macroscopic scenario for each modelled hour.

TAM Micro outputs:

- It is not recommended to use the scenario outputs from Macro for TAM Micro scenarios for analysis. The purpose of these scenarios is solely to provide the initial paths for microscopic simulation.
- Microscopic network statistics (e.g. VHT, VKT, number of stops, lane changes, delay time, etc.) and object statistics (for sections, turns, subpaths, public transport lines, etc.) can be output from the TAM Micro microscopic scenarios.
- The path assignment from the TAM Micro scenarios can be stored to allow link analyses for specific sections, turns and/or centroids.

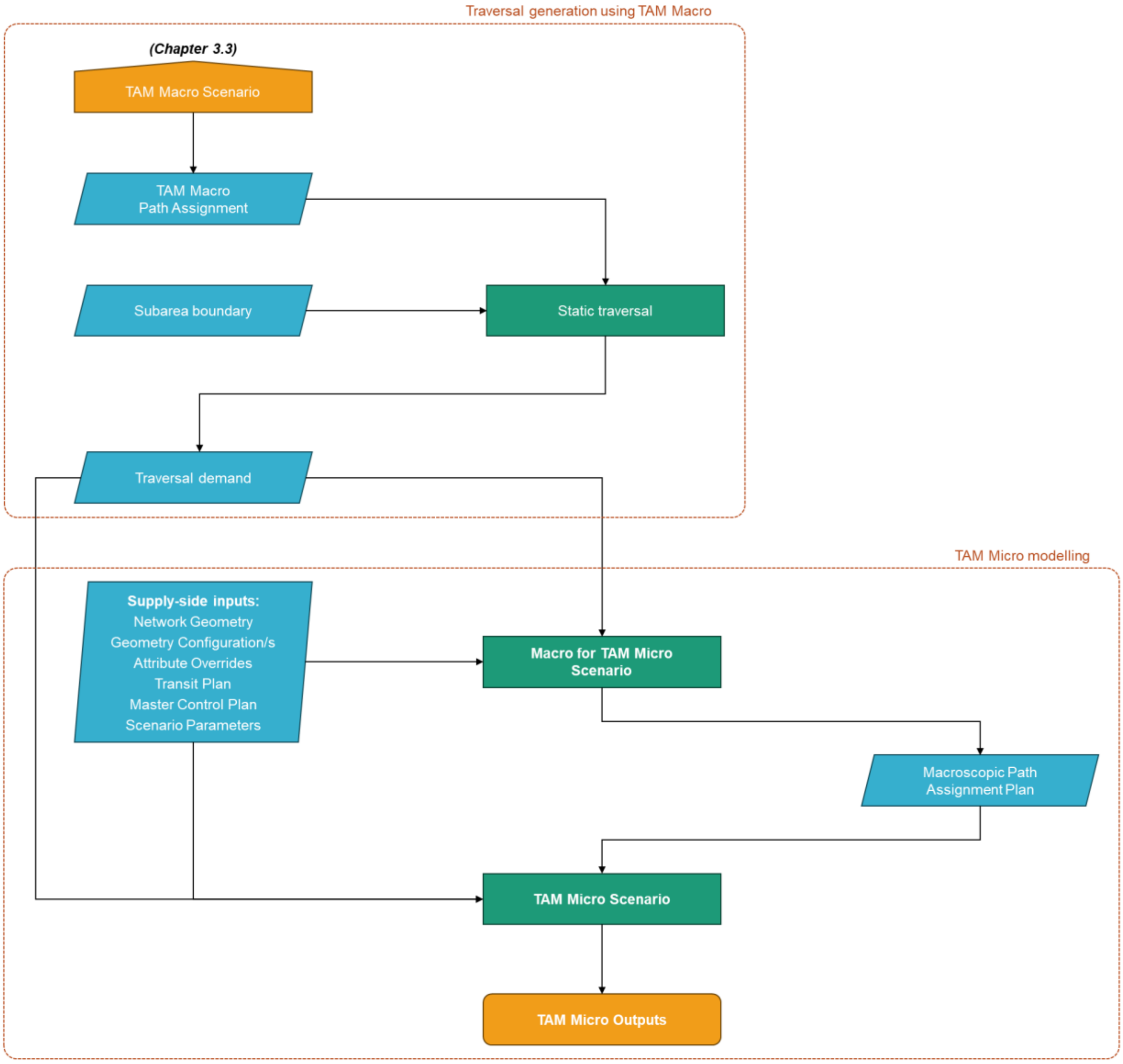

Figure 3.5-1 Overview of the inputs, processes and outputs for a TAM Micro scenario

3.5.3 Factors to Consider when Determining the Boundary of a Subarea

Choosing an appropriate study area is crucial for a successful transport planning exercise. When microsimulation traffic modelling is required, the extent of the subarea model must encompass the study area. Depending on the location, the condition of the network, transport assessment zones, and the available observed traffic data the subarea boundary can extend beyond the project study area. The following points should be considered when determining the extent of the traffic modelling study area:

- The study area of the transport planning project;
- The road network structure and the requirement to consider alternative routes choices within the subarea model extent;
- The internal and boundary centroids; and,
- The SCATS link groups and marriage chains.

The subarea boundary must be drawn in such a way that there are no new boundary centroids for future year models, that is, the entrance/exit sections for the subarea should be the same in the base year and all future years. Planned road sections that do not exist in the base year must not intersect with the boundary of the subarea. The future scenarios should also be considered when determining the model subarea.

Parent centroids and all their connections must be either wholly inside or wholly outside the study area. The subnetwork boundary must be defined in such a way that it does not cross over any centroid connections.

3.5.4 Preparing the Transport Modelling Scope Document[31]

The Transport Modelling Scope Document (TMSD) **must be** prepared at the commencement of modelling process to determine how the analysis will inform the project's requirements. The TMSD must include details of the techniques, methods, inputs, and data included to ensure the model is fit-for-purpose.

In addition, the TMSD must cover the following items:

1. The context of the study and justification for creating a TAM subarea model at the microsimulation level;
2. The model extent;
3. The future years;
4. Modelled time periods;
5. The required data and the provider of the data;
6. Travel time validation routes within the subarea; and,
7. Miscellaneous: other project-specific requirements.

The TMSD must be prepared by the transport modelling service provider or consultant after consultation with DIT (DIT project manager/transport planner nominated for the study, Transport Analytics representative, and Network Management Services representative) and signed off jointly by DIT-Transport Analytics and DIT-Network Management Services prior to the commencement of the microsimulation subarea model development.

A full understanding of the project area and outcome is required before preparing a TMSD. Familiarisation with the network and site characteristics is an important step in developing a model. It is recommended that appropriate site visits are undertaken, and the transport modelling service provider/consultant review any data provided and obtain additional information required to complete the modelling task. It is good practice to undertake some preliminary modelling activities to ensure that project-specific modelling issues can be identified and addressed as part of the model scope.

[31] It is important that a project inception meeting is held between the project team, the transport modeller(s) and DIT’s Transport Analytics and Network Management Services prior to preparing the Transport Modelling Scope Document.

3.5.5 Determine the Seed Demand Matrices for a TAM Micro Scenario

Seed matrices for TAM Micro models are the traversal matrices extracted from a TAM Macro assignment. Each scenario within the subarea (e.g. base case, project case, etc.) for each future year and peak requires its own corresponding TAM Macro scenario in order to generate the traversal demands. Depending on the study, this may include:

Base year scenarios:

1. Base Year Base Case (Do Nothing);
2. Base Year Project Case;

Future year scenarios:

3. Future Year/s Base Case (Do Nothing, usually using the Committed and Funded Network[32] unless the project to be tested is included in this network already);
4. Future Year/s Planned Upgrades (Planned Upgrades using the Planning Network); and,
5. Future Year/s Project Case (Project Case with Do Nothing and Planned Upgrades as per the requirements of the study).

Base Case scenarios may use the Committed and Funded Network and/or the Planning Network (to be selected with consideration of the purpose of the study, which must be discussed and justified in the TMSD). Project Case scenarios are the study-specific upgrades to be tested on top of the base-case scenario (i.e. the Committed and Funded Network or the Planning Network).

The static assignments for all the Base Case and Project Case scenarios and future years (as required for the subarea analysis) must be for the full duration of each peak period (07:00 – 10.00 and 15:00 – 19:00), and the paths built before progressing to the next step[33].

The selection of the seed demand matrices, especially for the future base case and project case scenarios, should be discussed with DIT, reflected in the TMSD and endorsed by TA (and Network Management Services)

Step by step procedure in generating the traversal matrices are detailed in the table in the following page.

Note: Using project specific seed matrices (output of static traversal) for each project case scenario is not a generic instruction. Depending on the project and the interventions being tested, it may be more suitable to use either the base case future seed matrices or intervention specific seed matrices. Transport Analytics (TA) should be consulted with regards to this matter.

[32] Please refer to Chapter 1 of TAM Guidelines for details regarding the Committed and Funded Network as well as the Planning Network.

[33] When the proposed upgrade is known to have little impact on the sub-area demand, future year base case demand for the sub-area can be used for the project case as well. It needs to be discussed with Transport Analytics at the commencement of the modelling exercise, reflected in the Transport Modelling Scope Document (TMSD) and signed-off by Transport Analytics. Failure to obtain agreement and sign-off from Transport Analytics can result in the model not being endorsed as fit-for-purpose.

3.5.6 Creating a Subarea

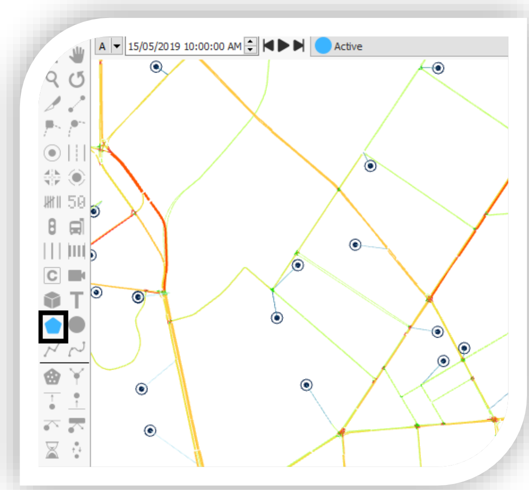

Figure 3.5-2 Create polygon

Step 1: Draw the subarea boundary

Select icon to create a polygon (shown in **Figure 3.5-2**) from the toolbar and draw the extent of your subarea considering the requirements discussed in **Chapter 3.5.3** and in accordance with the approved TMSD. The polygon boundary can also be imported from a shapefile.

Step 2: Create the subarea

Convert the polygon to a subnetwork from the polygon context menu (shown in **Figure 3.5-3**) and rename the created subarea (subnetwork) to the name representing your Study, e.g. Example Subarea 1.

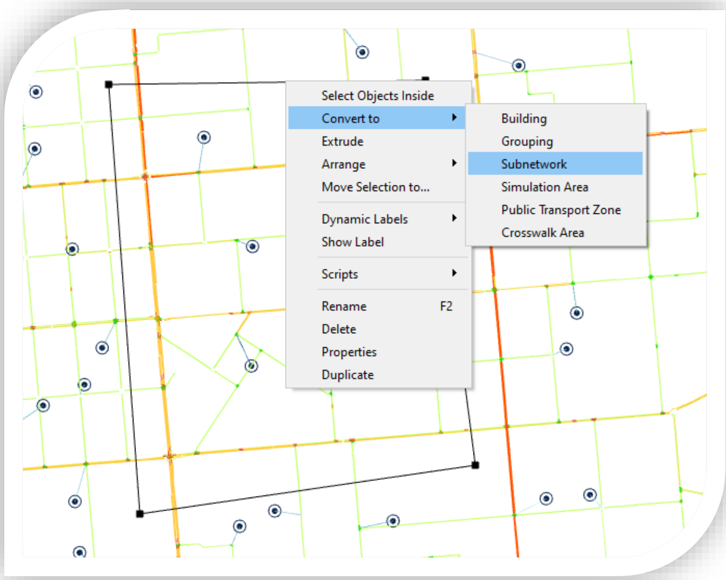

Figure 3.5-3 Convert polygon to a subnetwork

Step 3: Generate Static Traversal

From the list of subnetworks in the Project window, right-click on the new subarea and click on “Generate Static Traversal” (shown in Figure 3.5-4).

The corresponding TAM Macro scenario must be run and loaded (with path assignment) before generating the static traversal.

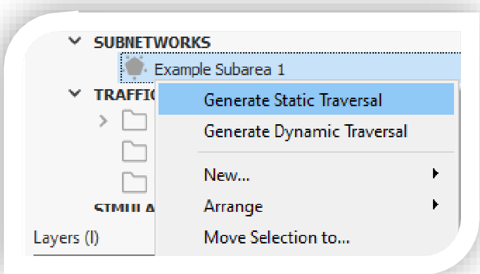

Figure 3.5-4 Generate static traversal

In the dialogue box (shown in **Figure 3.5-5**), select:

- The static path building assignment experiment for the whole model period for each of the model years, time periods, Base Case and Project Case.
- For public transport select “Travel Time in Free Flow Conditions”
- Internal Centroid Percentages (Dynamic), select “Keep Original Percentages”.

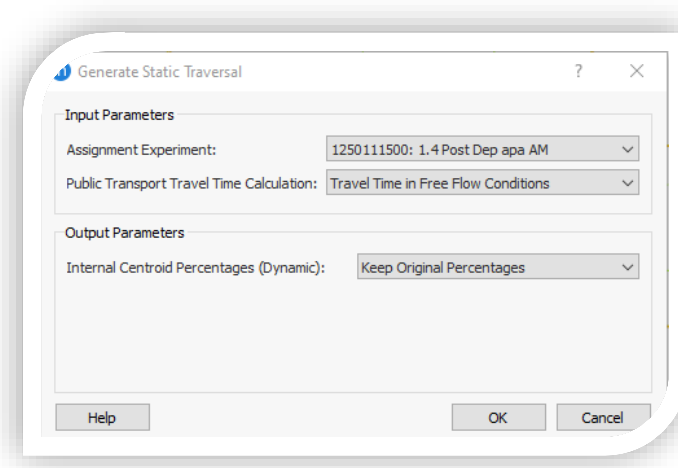

Figure 3.5-5 Generate static traversal dialog box

The process will create the traversal matrices for cars and trucks for the model year and period as in the selected static path building assignment experiment. Public transport lines and plans will also be created for the subarea at the end of this process.

Naming convention: *Traversal matrices for TAM Micro models*

Name	*“Traversal” Year PP “PH” VehicleType SubareaName*	where	*Year*	=	Base model year[34]
			PP	=	Peak period (i.e. AM, DT or PM)
			VehicleType	=	Vehicle type name[35]
			SubareaName	=	Name of the subarea
	eg. *Traversal 2021 AM PH Car DIT Example Subarea*				
External ID	*“Traversal”*				

Warning: Scripts in TAM are sensitive to the naming conventions. If the naming convention explained in these Guidelines are not followed precisely, errors will occur when running the scripts in the next steps of model development.

[34] The traversal year/s should correspond to one of the TAM Macro scenario years.
[35] Unless identified in the modelling scope document, the vehicle type for Subarea model built from TAM will be “Car DIT” and “Truck and Semi DIT”

3.5.7 Model Development for TAM Micro Scenarios

This section summarises the model development process for TAM Micro scenarios including the folder structure, base year model development, calibration and validation, future year model developing and the correct parameters to use for TAM Micro scenarios.

3.5.7.1 Model Folder Structure

Figure 3.5-6 shows the folder structure that must be adopted by the modeller. The folder structure contains:

- **TAM Macro folder**: This folder contains the TAM model package provided by DIT Transport Analytics and all files relevant to the TAM Macro scenarios; and,
- **TAM Micro folder**: This folder contains all files relevant to the TAM Micro scenarios (macroscopic and mesoscopic) including image files, matrices (if stored externally), databases, path assignments, RDS files and any scripts used.

The Project, TAM Macro and TAM Micro folder names should contain the project name.

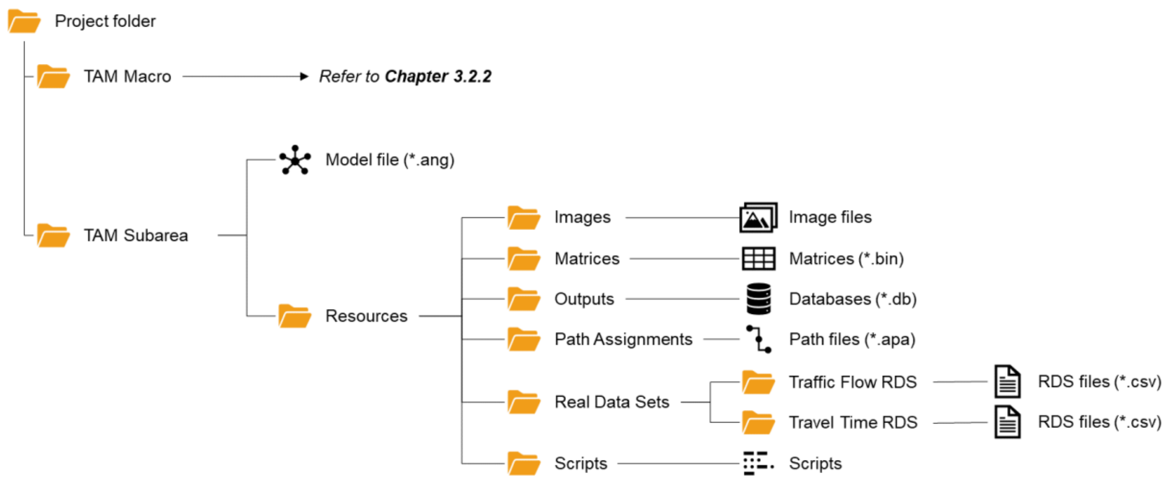

Figure 3.5-6 TAM and Subarea folder structure

The TAM model package supplied by DIT Transport Analytics will follow the folder structure described in **Chapter 3.2.2**. This must be maintained and any additional files created as part of TAM Macro (e.g. path assignments, databases, etc.) must be stored within the TAM Macro folder.

The TAM Micro folder will contain the subarea model file (*.ang format) along with the model inputs (e.g. matrices, RDS files, etc.) and outputs (e.g. path assignments, databases, etc.). When storing the model database, the user can choose from:

- **Automatic Using SQLite**: All scenarios are stored in a single database file within the Outputs folder; or,
- **Custom**: Scenarios may be stored in separate database files, but these must still be stored in the Outputs folder.

The use of automatic or custom is at the modeller's discretion. For larger projects or subareas involving a large number of scenarios, splitting the outputs between multiple scenarios is recommended to reduce the individual file size.

The process for building a standalone model derived from TAM is explained in **Appendix 4.5**.

3.5.7.2 Data Exchange

For all model development involving TAM, DIT will provide a complete copy of TAM including all inputs and outputs for all scenarios. All model edits, updates or changes must be made in the TAM Macro/TAM Meso model first. Outputs from these runs will be required to generate the subarea seed matrices.

The first hold point for independent review and DIT review will be required for the Project Case scenario delivery, the model output generation at the static level, and the preparation of the seed matrices. Please refer to **Chapter 3.5.5** for more details regarding subarea seed matrix generation.

DIT must be consulted to provide the model input data where appropriate, including the SCATS signal operations details, VS[36] data and manual turning movement data. Specific data must be requested via the following contact emails;

SCATS Signal Operations Summary and VS data:
DIT.TrafficOpsData@sa.gov.au

Manual Turning Movement Surveys:
DIT.RoadTrafficData@sa.gov.au

Travel time information for subpaths should be extracted from the Addinsight platform, using the procedure in **Appendix 4.6.**

[36] Volume Storage

3.5.7.3 Base Year Model

The model development, calibration, and validation process for the base-year model is outlined in **Figure 3.5-7**.

Figure 3.5-7 Base model calibration and validation process for a TAM Micro model

The developed model must accurately represent existing conditions, and the process of developing this model involves:

1. Defining the subarea, creation of the centroid configuration and seed matrix generation (**Chapter 3.5.7.3.1**);
2. Creation of the Real Data Sets (**Chapter 3.5.7.3.2**);
3. Building/refining the base model, including both the network and the centroid configuration (**Chapter 3.5.7.3.3**);
4. Coding, adjusting and verifying the public transport routes (**Chapter 3.5.7.3.4**);
5. Coding, adjusting and verifying the signal control plans (**Chapter 3.5.7.3.5**);
6. Creation of the traffic demands (**Chapter 3.5.7.3.6**);
7. Calibration and validation of the base-year model (**Chapter 3.5.7.3.7**); and,
8. Documentation of the base model development process and model performance (**Chapter 3.5.9**).

3.5.7.3.1 Define the Subarea, Centroid Configuration and Seed Matrices

The boundary of the subarea should be larger than the study area. In addition to covering the study area, other factors such as the base and future year centroid connectivity and the base and future road networks will play a role in determining the extent of the subarea. For details about the factors to consider in determining the subarea extent, refer to **Chapter 3.5.3**.

Centroid configuration and seed matrices (base year and future years) should be created as in accordance with **Chapter 3.5.5**.

3.5.7.3.2 Create Real Data Sets

The Real Data Set (RDS) will usually consist of a set of turning movement data for each intersection in the subarea model. The data set should include as a minimum;

- Cars;
- Trucks;
- Buses; and,
- Total.

Depending on the scope of the project, there may be circumstances where more detailed vehicle categorisation is required, for example single and multi-occupant private vehicles, or light and heavy commercial vehicles. It is preferable to create a single data set for both the morning and evening peak periods rather than creating a separate data set for each time period.

Data that may assist the development of this Real Data Set includes:

- Intersection turning movement data;
- SCATS Volume Storage (VS) data;
- Mid-block vehicle classification data; and
- Origin-destination surveys.

Manual turning movement data and SCATS VS data will need to be used in most circumstances, as manual turning counts are required to provide turning proportions of the different vehicle types, the use of shared lanes and undetected/uncontrolled movements (in Adelaide, left turns at signalised locations or all turning movements at un-signalised locations do not have SCATS loop detectors). SCATS VS data provides information about vehicle flows at particular locations within the model across a consistent date/time period.

There must be an assessment of changes to traffic flows between adjacent intersections which may identify the need for additional/changes to network loading points. In undertaking this assessment, it is important to understand the difference between demand and supply which is evidenced by the remaining queue of vehicles which could not pass the stop line at the end of each period. Consequently, a traffic count at the stop line/detector may not represent the actual demand for the movement. In these situations, the traffic demand should be captured from the upstream links or estimated by taking account of the residual queues.

The RDS may include travel time data covering routes within the model and sourced from the Addinsight platform, which must be clearly documented in the TMSD. This data set should include information about the range of observed values by including the minimum and maximum values, derived by applying factors 0.85 and 1.15 to the median travel time value for minimum and maximum travel time respectively. The procedure to extract travel time data from the Addinsight platform is explained in **Appendix 4.6** of this document.

All real data set files should be comma-separated value format (*.csv) and include the following columns (in order):

Traffic Flow RDS columns:

1. Object External ID
2. Volume (Cars)
3. Volume (Trucks)
4. Volume (Buses)
5. Volume (All Vehicles)
6. Time interval (HH:MM:SS format)

Travel Time RDS columns:

1. Object External ID
2. Minimum Travel Time (= Median – 15%)
3. Median Travel Time
4. Maximum Travel Time (= Median + 15%)
5. Time interval (HH:MM:SS format)

Note: In Aimsun Next RDS files, the time represents the end of the time interval.

The RDS must use objects' External ID; Aimsun ID should not be used for the RDS. This means that the External ID of all objects in the RDS must be unique (including across all future years).

Naming convention: *RDS*

Name	*Year TT Type SubareaName*	where	*Year*	=	Base model year
			TT	=	Time period* (i.e. AM, DT or PM)
			Type	=	Type of data in RDS
			SubareaName	=	Name of the subarea
	eg. *2021 AM Traffic Flow Example Subarea*				

* If the RDS includes all peak periods (i.e 07:00 – 19:00), the time period should be "Daily"

The sources of all data used to construct the RDSs and the process adopted to develop, verify, validate and calibrate them must be included in the TMSD documentation.

3.5.7.3.3 Build/Refine the Base Year Model

The process of building / refining the base year model network is aimed at ensuring that the model is well constructed and accurately reflects the base year conditions. It is important to ensure that the model is well constructed, before beginning the model calibration/validation process as relatively minor changes to the way the model has been constructed can significantly affect this process. In general, network details should be suitable for a microscopic model regardless of the model type intended to be used.

The process of building and refining the base year network is consistent across all levels of TAM so is discussed in **Chapter 3.2.4**.

If need be, additional road sections within the subarea can be added to represent local roads which have not been coded in TAM. In adding any road sections in a TAM Micro (Base Year and Future as well as Base Case and Project Case), care should be exercised so as not have any added road sections intersecting with the subarea boundary. This is to avoid having additional boundary centroid.

The subarea geometry configuration should be modified to improve road network flows and loadings. This is discussed in the following sections.

3.5.7.3.4 Code/Refine the Public Transport Routes

TAM includes public transport routes for metropolitan buses, regional buses, trains (including freight trains) and trams. **Chapter 3.2.3.9** provides details of the pre-configured public transport routes within TAM that are suitable for use in all TAM levels.

The pre-configured public transport timetables were imported using GTFS[37]. Transit line timetables are based on the 2021 GTFS for all TAM Macro scenarios. Changes to the public transport lines or schedules may be required (e.g. for different years, peaks or days) if this is a focus of the project. The modeller must check and adjust public transport lines and public transport plans for the subarea. The process of refining public transport lines is consistent across all levels of TAM so is discussed in **Chapter 3.2.4.9**.

For buses, the stopping patterns must be checked and adjusted to ensure that the arrival of buses at stops is randomised sufficiently so that instances of vehicles waiting to access stops are minimised.

[37] General Transit Feed Specification

3.5.7.3.5 Code the Signal Control Plans

Pre-configured signal control plans exist in TAM as discussed in **Chapter 3.2.3.1**. These control plans are suitable for tactical models using TAM Macro and TAM Meso only. All signal control plans for TAM Micro models built at the microsimulation level must be appropriately coded as per the SCATS summaries[38] and signal design details.

The following steps need to be followed when coding the signal control plans:

1. Create the control plan/s for the subarea. A separate control plan will need to be created for each scenario that will be tested (including the base). The control plan should follow the established naming convention.

Naming convention: *Control plans for TAM Micro models*

Name	*Year TT Type SubareaName*	where	*Year*	=	Base model year
			TT	=	Time period* (i.e. AM, DT or PM)
			Type	=	Control plan type (i.e. static or dynamic)
			SubareaName	=	Name of the subarea
	eg. *2021 AM Static Example Subarea*				

2. Create the master control plan/s for the subarea. A separate master control plan will need to be created for each scenario that will be tested (including the base). The master control plan should follow the established naming convention.

Naming convention: *Master control plans for TAM Micro models*

Name	*Year TT Type SubareaName*	where	*Year*	=	Base model year
			TT	=	Time period* (i.e. AM, DT or PM)
			Type	=	Control plan type (i.e. static or dynamic)
			SubareaName	=	Name of the subarea
	eg. *2021 AM Static Example Subarea*				

3. Signal offsets should be based on SCATS values, noting that offsets should refer to the start of the coordinated phase in the model.
4. Yellow time should match the SCATS value for existing signals and as per DIT TS001 (Traffic Signal Standard: Signal Timings) for new signals.

   Note: Non-integer phase times are supported in TAM but must be set using the Phase Duration input box.
5. Cycle time is based on the SCATS average value and should be consistent for all linked locations.
6. Interphase times should match SCATS values, and the interphases should be placed at the end of each phase in the control plan.

   Note: The established convention for TAM is that the last phase should be the coordinated phase. This means that the interphase for the last phase will occur at the beginning of the phase diagram in TAM as shown in **Figure 3.5-8**.

[38] Request for SCATS summaries should clearly specify that the signal information is being used for building a Subarea microsimulation model. All signalised intersections and pedestrian crossings within the Subarea need to be identified in the request with linkage, coordination and offset information requested.

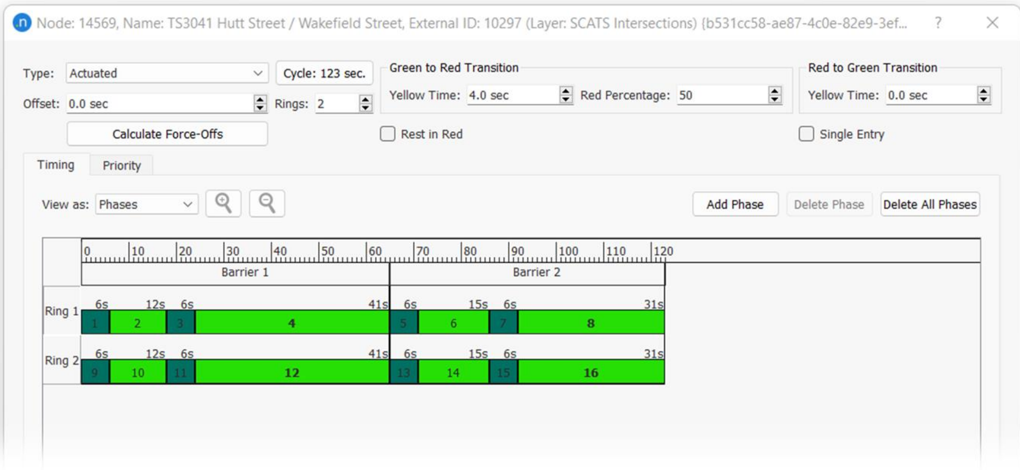

Figure 3.5-8 Example of the interphase layout for control plans in TAM

7. Late start or early cut-offs should be used to provide realistic operation of filter turns either opposed by pedestrian movements or by conflicting traffic movements. Assumptions for late start or early cut-offs must be documented in the modelling reports.

8. Suggested signal settings for actuated control plans are:

   - The SCATS stretch phase should be set as coordinated. This phase should be the last phase in the control plan.

   - Minimum green time should be set to incorporate the minimum green time required to service the frequency of concurrent pedestrian crossings. If no crossings operate during the phase, the minimum green should be set to the SCATS phase minimum green value.

   - The max-out time for infrequent phases that do not run every cycle due to low demand is set in the control plan to the green time when the phase ran, not the cycle average time. For phases that infrequently run due to programmed phase skipping, other techniques should be used to replicate the operation, such as multiple cycle control plans or detector setback, which is not actuated until a short queue forms.

   - Passage time should be set to 2 seconds unless there is a significant proportion of heavy commercial vehicles or a single upstream lane feeding multiple turning lanes. In which circumstances, a longer passage time may be appropriate. Note that passage time can increase the minimum green time of a phase, so the minimum green value should be adjusted accordingly when applying increased passage time.

   - The Calculate Force-Offs button can be used to calculate the permissive period and force-off parameters. However, these parameters must be manually set when phases include Time Gain or False Green features. Max Out values would also require adjustment for these phase features.

   - The detectors allocated to phases or movements need to reflect the active detectors for that phase or movement. For example, only the detectors for the right turn movement should be selected for leading/trailing right turn phases.

9. Suggested signal settings for rail crossings are:

   - Actuated control with transit pre-emption should be used.

- Cycle time should be 60 seconds, unless the level crossing is connected to a signalised intersection or pedestrian crossing.
- Phase times should be configured as shown in **Table 3.5-1**.

Table 3.5-1 Default signal timing parameters for level crossings in TAM

Phase description	Phase duration (s)	Minimum green (s)	Max out (s)	Interphase duration (s)	Recall
Vehicle green time	14	6	45	6	Max
Train/tram phase*	15	0	3000	25	No

* Train/tram phase pre-emption applied using Minimum Dwell = 40 seconds and Maximum Dwell = 180 seconds. Maximum Dwell was increased to 600 seconds for pre-emption phases triggered by freight trains.

- Passage time for the rail phase should be 5 seconds. The passage time for the vehicle phase should remain 2 seconds.
- A separate pre-emption should be defined for each track and direction of travel.
- **Table 3.5-2** shows the distance for priority request and cancel detectors, the suggested minimum dwell time and maximum dwell time.

Table 3.5-2 Priority request and cancel distances, minimum and maximum dwell times for level crossings

Vehicle type	Priority request distance (s)	Priority cancel distance (m)	Minimum dwell (s)	Maximum dwell (s)
Train pre-emption	25 seconds at track speed limit	140	60	60*
Tram pre-emption	25 seconds at track speed limit	40	40	60

* Maximum dwell can be increased if there is a station immediately downstream of the level crossing (use about 90 seconds) or if the pre-emption is triggered by freight trains (use up to 600 seconds).

10. Alternative software applications such as SIDRA Intersection, Transyt or LinSig must be used to determine the phase sequence and phase timings for new signal installations.

3.5.7.3.6 Create Traffic Demands

Traffic demands are in the form of origin-destination matrices. Centroids within the study area will initially consist of:

- Parent centroids inside the subarea boundary inherited from TAM Macro;
- Child centroids inside the subarea boundary inherited from (but not used by) TAM Macro; and,
- Boundary centroids created at the start/end of sections leading to/from the subarea.

There are several specific sets of matrices which are produced as part of the development of any base year traffic simulation model. These different types of traffic demands and the processes for deriving them are discussed in the following sections.

Traversal Demands

Traversal demands are created using TAM Macro and represent the portion of the Greater Adelaide demand that passes through the subarea. The generation of traversal demands was discussed in **Chapter 3.5.5**.

Naming convention: *Traversal matrices for TAM Micro models*

Name	*“Traversal” Year PP Scenario “PH” VehicleType SubareaName*	where	*Year*	=	Base model year[39]
			PP	=	Peak period (i.e. AM, DT or PM)
			Scenario	=	Scenario (i.e. CF or PN)
			VehicleType	=	Vehicle type name[40]
			SubareaName	=	Name of the subarea
	eg. *Traversal 2021 AM CF PH Car DIT Example Subarea*				

Note: The DIT scripts are sensitive to naming conventions, so the traversal matrices must be named using the format above.

Prior Demands

Prior demands represent the traversal demands once they have been disaggregated to the child centroid level. The child centroids that are generated within the subarea boundary can be modified by the user, and additional child centroids can also be created. The process for creating additional child centroids is described below.

1. Add any additional network loading points as child centroids[41]. It is recommended that the coding conventions for centroids from TAM are maintained (discussed in **Chapter 3.2.3.4**).
2. All new child centroids should be linked to the parent centroid using the appropriate naming convention (see below).
3. The volume delay function (VDF) of child centroid connectors should match that of the parent centroid connectors. The default VDF should not be used.

[39] The traversal year/s should correspond to one of the TAM Macro scenario years.
[40] Unless identified in the modelling scope document, the vehicle type for Subarea model built from TAM will be “Car DIT” and “Truck and Semi DIT”
[41] Adding additional loading points as child centroids should be done after building the Centroid configuration and generating the traversal matrices.

Naming convention: *Centroids (child centroids)*

Name	*_SAMID_ConObjName_ ConObjEID*	where	*SAMID*	=	ID of the corresponding SAM centroid
			ConObjName	=	Connected object name
			ConObjEID		Connected object External ID
	e.g. *_1_Young Street_11639*				
External ID	*ParCenID_ConObjID*	where	*SAMID*	=	ID of the corresponding SAM centroid
	e.g. *1259075345_1243803934*				

Note: The DIT scripts are sensitive to naming conventions, so the child centroids must be named using the format above.

Once the user is satisfied that all new centroids have been created, the prior matrices can be generated using the script “Traversal to Prior Matrix”. If necessary, the prior demands can be interpolated between years by using the script “Demand Interpolation”.

Once the prior demands have been generated, an expansion factor must be determined to increase the duration from the peak hour (PH) to the model period (MP). DIT’s recommended method for determining the expansion factor is as follows:

1. Using the RDS for each vehicle type, determine the maximum hourly flow (MHF). This is the one-hour interval within the model period (i.e. four consecutive 15-minute intervals) that has the highest traffic volume. The MHF does not necessarily align with the traversal time period and does not need to start on the hour.
2. Calculate the expansion factor by dividing the MHF by the total flow across the MP:

$$\text{expansion factor} = \frac{\text{MHF}}{\text{MP flow}}.$$

3. Repeat the calculation for each vehicle type.

Once the expansion factors have been determined, the prior traffic demand can be set up. The prior matrices are added to the traffic demand and then stretched to fill the whole MP. A separate Traffic Demand Item factor is applied in the bottom left corner of the dialog with the expansion factor for that vehicle type, as shown in **Figure 3.5-9**.

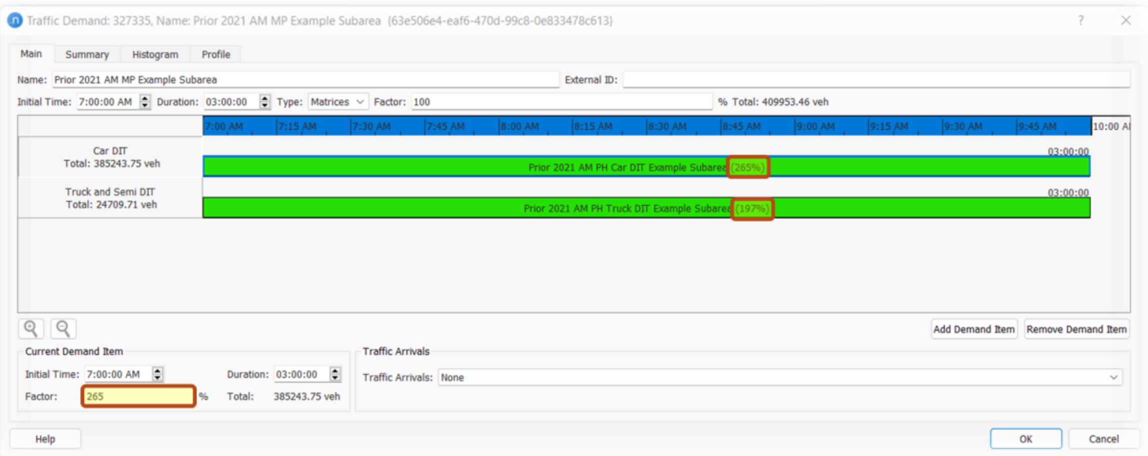

Figure 3.5-9 Implementation of the expansion factor using the Traffic Demand Item factor

Unless otherwise agreed and documented in the Transport Modelling Scope Document, the MP for each peak should be:

- AM MP: 07:00 – 10:00; and,
- PM MP: 15:00 – 19:00.

Naming convention: *Prior matrices for TAM Micro models*

Name	*"Prior" Year PP Scenario "PH" VehicleType SubareaName*	where	*Year*	=	Base model year[42]
			PP	=	Peak period (i.e. AM, DT or PM)
			Scenario	=	Scenario (i.e. CF or PN)
			VehicleType	=	Vehicle type name[43]
			SubareaName	=	Name of the subarea
	eg. *Prior 2021 AM CF PH Car DIT Example Subarea*				

Adjusted Demands

Matrix adjustment is the process by which the prior matrix is adjusted to match the RDS values. The adjustment process uses a bi-level model that is solved heuristically by a gradient algorithm. Further details of the adjustment process are provided in the Aimsun Next User Manual.

Before running the Static OD Adjustment, the modeller must update the macroscopic cost functions for turns and sections within the subarea to use the TAM Micro functions. Generally, it is best to do this using an attribute override so that the original functions for TAM Macro are maintained.

The recommended settings and inputs for Static OD Adjustment are provided in **Chapter 3.5.7.5.3**. The Static OD Adjustment should cover the whole MP using the expanded prior demand from the previous step. The path assignment input for the Static OD Adjustment should be based on either:

- Static assignment for the PH; or,
- Static assignment for the MHF.

Note: The Static OD Adjustment should not be run using a path assignment or path assignment plan for the whole MP.

Naming convention: *Adjusted matrices for TAM Micro models*

Name	*"Adjusted" Year Scenario PP "MP" VehicleType SubareaName*	where	*Year*	=	Base model year[44]
			PP	=	Peak period (i.e. AM, DT or PM)
			Scenario	=	Scenario (i.e. CF or PN)
			VehicleType	=	Vehicle type name[45]
			SubareaName	=	Name of the subarea
	eg. *Adjusted 2021 AM CF MP Car DIT Example Subarea*				

[42] The traversal year/s should correspond to one of the TAM Macro scenario years.
[43] Unless identified in the modelling scope document, the vehicle type for Subarea model built from TAM will be "Car DIT" and "Truck and Semi DIT"
[44] The traversal year/s should correspond to one of the TAM Macro scenario years.
[45] Unless identified in the modelling scope document, the vehicle type for Subarea model built from TAM will be "Car DIT" and "Truck and Semi DIT"

Profiled Demands

Static OD Departure Adjustment is the process by which the adjusted demand is profiled into smaller time intervals across the MP. The objective is to reproduce the observed traffic counts in the RDS for each time interval. For TAM Micro models, the recommended time interval is 15 minutes. Further details of the adjustment process are provided in the Aimsun Next User Manual.

The recommended settings and inputs for Static OD Adjustment are provided in **Chapter 3.5.7.5.3**. The Static OD Adjustment should cover the whole MP using the expanded prior demand from the previous step. The path assignment input for the Static OD Adjustment should be based on either:

- Static assignment for the PH; or,
- Static assignment for the MHF.

Note: The Static OD Departure Adjustment should not be run using a path assignment or path assignment plan for the whole MP.

Naming convention: *Profiled matrices for TAM Micro models*

Name	*"Adjusted" Year PP Scenario "MP" VehicleType TimePeriod SubareaName*	where	*Year*	=	Base model year[46]
			PP	=	Peak period (i.e. AM, DT or PM)
			Scenario	=	Scenario (i.e. CF or PN)
			VehicleType	=	Vehicle type name[47]
			TimePeriod	=	Time period (HH:MM – HH:MM)
			SubareaName	=	Name of the subarea
	eg. *Adjusted 2021 AM CF MP Car DIT 07:00 – 07:15 Example Subarea*				

Summary of Demands for a TAM Micro Model

Figure 3.5-10 shows a summary of the demands for a TAM Micro model.

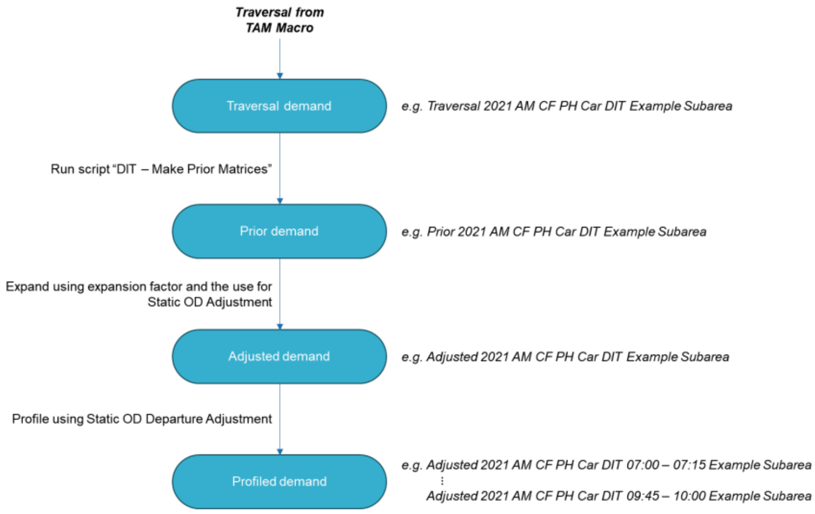

Figure 3.5-10 Summary of the demand preparation process for TAM Micro

[46] The traversal year/s should correspond to one of the TAM Macro scenario years.
[47] Unless identified in the modelling scope document, the vehicle type for Subarea model built from TAM will be "Car DIT" and "Truck and Semi DIT"

3.5.7.3.7 Calibrate/Validate Base Year Model

Model calibration involves adjustment of appropriate model parameters (to improve the ability of the model to reproduce observed vehicle and driver behaviour) and the origin-destination matrices (to improve the match between modelled and observed traffic movements). The more closely the base model is calibrated against observed traffic conditions, the higher the confidence that the future year models will appropriately model future traffic conditions across a range of different scenarios. While calibration criteria will generally be model specific and depend on the purpose of the model, suggested values are provided in **Chapter 3.5.7.3.8.**

Modifying model parameters to influence vehicle/driver behaviour tends to be an iterative process and must be carefully planned and managed. The following guidelines are provided to assist this process and provide consistency between different models.

Aimsun Next modelling parameters that may be adjusted to improve calibration generally fall into one of two groups:

- Those that affect capacity; and,
- Those that affect route choice.

It is suggested that those parameters affecting capacity are checked and adjusted first before parameters influencing route choice (if relevant).

Checking and Adjusting Parameters Affecting Capacity[48]

The capacity of most urban arterial networks is generally determined by the capacity of the signal-controlled intersections/junctions. Accurately calibrating the capacity of traffic signals presents a number of challenges. Primarily, it is difficult to measure intersection capacity in the field, and frequently other analytical tools such as SCATS (at existing sets of signals) or SIDRA Intersection (at proposed sets of signals) should be used to provide reasonable estimates of individual movement capacities that are useful for calibration purposes.

The global parameters that are permitted be changed to improve the calibration of intersection capacity against measured, observed, or estimated capacity are Reaction Time, Reaction Time at Stop and Reaction Time at Traffic Light, defined in the Reaction Time tab for each Stochastic Route Choice Experiment. The same values must be used for all model years but may be different between the AM and PM time periods (justification for using different values in AM and PM time periods need to be provided in the TMSD). **Table 3.5.7-1** provides guidance on the range of acceptable values for these parameters.

Table 3.5.7-1 Range of Acceptable Values for Simulation Step, Reaction Time at Stop and Reaction Time at Traffic Light

Parameter / Model	Simulation Step (Seconds)	Reaction Time at Stop (s)	Reaction Time at Traffic Light (s)
Microscopic Simulation Models	0.75 – 0.90	Simulation Step × 1.50	Simulation Step × 2.00

Notes:

1. The initial value adopted for Simulation Step for microscopic models must be set to 0.90 seconds with the Initial Reaction Time at Stop set to 0.90 × 1.50 = 1.35 seconds and the initial Reaction Time at Traffic Light set to 0.90 × 2.00 = 1.8 seconds.

[48] TAM users must refer to **Appendix 4.1** for details on default TAM turn capacities and the implications for developing their own models using the TAM package.

2. While these parameter values may change to achieve the calibration criteria in response to high levels of congestion, this must not happen until all operational issues have been identified and addressed. The highest value for Reaction Time that results in the calibration criteria being met must be adopted, and the values adopted for each of these parameters are to be included in the TMSD and all relevant documentation.
3. It may also be necessary to adjust the signal control plan settings, which is generally focused on phase times so that the modelled capacity better matches the observed capacity across the full model period. Modelled phase times are to be included in relevant documentation and compared against SCATS and/or SIDRA Intersection values, as should the results of the Aimsun Next Discharge Rate Evaluation Extension for stop lines identified in the TMSD.

   It is generally accepted by DIT that no changes will be necessary to model parameters that provide reasonable levels of mid-block capacity; however, some specific circumstances where this may be necessary, including:

   - **Merge section performance:**
     The value of Lane Changing Cooperation, Side Lane Cooperation Distance and Side Lane Merging Distance should be varied appropriately so that modelled performance reflects observed behaviour such as the approach or departure lane utilisation or upstream queuing. Changes to the default behaviour must be included in the TMSD.

   - **Irrational lane changing, lane blockages, etc.:**
     Observed instances should be minimised, and details of any regularly occurring instances must be included in the TMSD.

Checking and Adjusting Parameters Affecting Route Choice

For models that include route choice, and in the absence of specific routing data, routing behaviour must be calibrated to modelled turning/mid-block counts/flows against observed data. All available path-building approaches are based on estimated perceived travel costs involving both time and distance components, and the relative differences between these components influence route choices.

For all models, path files should be created and used for each model period. Path files must be produced as a model period static assignment output using the adjusted model period matrices and adopting the appropriate assignment approach. The output files must be stored in the Path Assignments folder for the subarea and follow the established naming convention.

Naming convention: *Path assignments and path assignment plans for TAM Micro*

Name	*Year PP Type SubareaName Time*	where	*Year*	=	Base model year
			PP	=	Peak period (i.e. AM, DT or PM)
			Type	=	Path assignment type (i.e. Static or Micro SRC)
			SubareaName	=	Name of the subarea
			Time	=	Time interval
	eg. *2021 AM Static MP Example Subarea 07:00 – 08:00*				

A path assignment plan (following the same naming convention), should contain the path assignments.

Note: Static OD Departure Adjustment scenarios use a single path assignment file. It is recommended that these scenarios are run using a path assignment generated for the PH or MHF (refer to **Chapter 3.5.7.3.6**).

Updating GREEN and CYCLE Attributes for Static Assignments

The TPFs for Macro for TAM Micro scenarios reference the following attributes:

Signal green time attributes:

- GREEN_AM;
- GREEN_DT;
- GREEN_PM;

Signal cycle time attributes:

- CYCLE_AM;
- CYCLE_DT; and,
- CYCLE_PM.

These attributes are pre-configured in TAM for the base control plans (2019). If new control plans are established for TAM Micro models, these attributes must be updated. The methodology for updating these attributes is as follows:

1. Ensure that the script “Update Macro Signal Attributes” is present in the model.
2. Ensure that each experiment is set up correctly prior to running the script, including:
    - The scenario must have a traffic demand of the correct duration;
    - The scenario must have a master control plan; and,
    - The scenario must contain the name of the MP (AM, DT or PM).
3. Select the turns within the model to be updated. To update all the turns in a node, selecting the node itself is sufficient.
4. Run the script. The script requires one user input which is the experiment/s for which the macro signal attributes will be updated. Multi-selection is supported, so multiple MPs can be processed at once.

Warning: Each time the script is run, any existing values will be overridden for the selected turns. It is contingent on the modeller to ensure that only the desired turns are updated when running the script.

It should be noted that the parameters associated with filter right turns may need to be adjusted to match observed capacity, particularly when the opposing priority flow is high, while at the same time not reducing the capacity for other conflicting movements.

Checking and Adjusting Parameters for Static Assignments

The correct turn and section functions must be used to influence routing and compare paths in a static assignment. The default values for these parameters are discussed in **Chapter 3.5.7.5**. These attributes must be checked as part of the network build phase and documented in the TMSD. The turn attributes for GREEN and CYCLE times must also be updated. The output path file must be carefully checked to ensure that the set of paths is reasonable and appropriate.

Note: Because TAM Micro models use a JDF, the Frank and Wolfe assignment engine must not be selected for the static scenarios. Method of Successive Average (MSA) is DIT’s preferred assignment engine for static assignment of a network model. All-or-Nothing (AoN) is DIT’s preferred assignment method for linear models.

Checking and Adjusting Parameters for Dynamic Assignments

DIT considers that the default values are appropriate for most dynamic assignment experiments, provided that a Path Assignment file is selected on the Main tab of the Dynamic Scenario. The default setting will assign all trips between each origin–destination pair to the Origin-Destination Route if one has been defined, or to the available paths in the stored path file if provided, otherwise, in accordance with the defined SRC approach.

Note that the use of “exponential” arrival type is required by DIT for all TAM Micro experiments.

The turn attributes Initial Cost Function and Dynamic Cost Function influence paths and must be checked as part of the network build step.

The path assignment results for at least one replication must be checked to ensure that the route choice process performs as intended.

3.5.7.3.8 Calibration and Validation Criteria

Table 3.5.7-2 details the criteria for model calibration and validation.

Table 3.5.7-2 Calibration and validation requirements for a TAM Micro microsimulation model

Check	**Criteria and Measures –** Model period, starting hour and core simulation period must be reported	Acceptability Level
Calibration Check	**Turning Movements** GEH Statistic for individual flows / movements Defined non-critical flows / movements (Any values > 5.0 to be documented) All other flows / movements (Any values > 3.0 to be documented) Average GEH Statistic for all flows / movements Plot of observed vs modelled individual flows / movements Line of Best Fit Slope R^2 (Slope equation to be included, intercept = 0)	 All < 5.0 All < 3.0 < 1.5 1.00 ± 0 01 > 0.99
	Queue Lengths Comparison required	Maximum modelled queue lengths to match the maximum observed queue lengths
Validation Check	**Travel Times** Plot for the full model period minimum and maximum observed vs average modelled travel times required. Note: If using Addinsight, minimum and maximum travel time must be determined by ±15% of the median travel time for at least 80% of routes/times. For remaining routes/times, the minimum and maximum travel time can be determined by ±25% of the median trave time.	Average modelled travel time to fit within the observed minimum-maximum travel time band.

Note: For model calibration, all movements associated with datapoints, determined for creating traffic flow Real Data Set (RDS) for a subarea, are *critical* movements unless otherwise agreed with DIT Transport Analytics and Network Management Services and documented in the TMSD.

3.5.7.4 Future Year Models

Future Year/s Base Case (Do Nothing, usually using the Committed and Funded Network)

The Committed and Funded Network must be used as the base case future for economic assessment purposes (to be compared against project options built within the Committed and Funded Network model). The Committed and Funded Network incorporates the DIT funded projects (and projects deemed to be funded) as of March 2023.

Future Year/s Planned upgrades (using the Planning Network)

The Planning Network must be used as the base case future network for transport planning purposes (to be compared against the project options built within the Planning Network).In addition to the projects incorporated in the Committed and Funded Network, the Planning Network includes interventions for locations identified as part of the network assessment and planning exercise.

Future Year/s Project Case (also known as the Option Models)

Depending on the purpose of the project the Future Year Project Case models must be built using the Committed and Funded Network or the Planning Network as a base scenario.

Preparing the Demand for Future Year Subarea Models

The preparation of the seed matrices to be used for the future-year models is detailed in **Chapter 3.5.5**. After the appropriate seed matrices are determined based on the intended horizon and network, subarea prior matrices are prepared by running python script "Adjusted Profiled Future Demand" that is embedded in TAM.

Use of Geometry Configurations for Future Year Models

Geometry configurations must be used to define the future year geometry. Details on the existing TAM geometry configurations and creating new geometry configurations are provided in **Chapter 3.2.3.7** and **Chapter 3.2.4.7**.

3.5.7.5 *Choosing the Correct Parameters for TAM Micro Scenarios*

TAM Micro scenarios should be set-up using the default TAM parameters discussed below. Any deviation from the default value/s must be documented.

Turn capacities in the TAM package use a standardised formula based on the turn origin and destination capacity and number of lanes. TAM users must refer to **Appendix 4.1** for details on default TAM turn capacities and the implications for developing their own models using the TAM package.

3.5.7.5.1 Section Parameters for TAM Micro

Table 3.5-3 lists key section parameters, the default value/s in for TAM Micro scenarios and any relevant implementation notes.

Table 3.5-3 Default section parameters for TAM Micro scenarios

Parameter	Default value	Notes
Road type	Based on SAM	Pre-configured for existing sections based on the road type of the corresponding section in SAM; for new sections, the most appropriate road type should be selected
Speed limit	As posted, or 30 km/hr	Pre-configured for existing sections; for new sections, speed limit should be the posted speed limit, or 30 km/hr for local roads not expected to carry any through traffic
User-defined costs	0.0	Not used for TAM Macro
Capacity	By road type	Pre-configured for existing sections; for new sections, calculated based on the road type capacity per lane and the number of lanes using the script “Update Section Parameters”
Lane types	As appropriate	Pre-configured for existing sections; for new sections, lane types should be appropriate to the existing or project scheme geometry
Jam density	170.0 veh/ln	
Reaction time factor	1.0	
Volume delay function (VDF)	TAM Macro – VDF Section	TAM Macro – VDF Section is used for all sections
Additional volume	0.0 veh	

3.5.7.5.2 Turn Parameters for TAM Micro

Table 3.5-4 lists key turn parameters, the default value/s in for TAM Micro scenarios and any relevant implementation notes.

Table 3.5-4 Default turn parameters for TAM Meso scenarios

Parameter	Default value	Notes
Turn speed	Automatic	
Capacity[49]	Manual	Pre-configured for existing turns; for new turns, calculated using the script "Update Turn Parameters"
User-defined cost	0.0	Not used for TAM Macro
K-initials cost function	Default	
Initial cost function	TAM Micro – ICF	TAM Micro – ICF is used for all turns
Dynamic cost function	TAM Micro – DCF	TAM Micro – DCF is used for all turns
Use values from road type for look-ahead/yield parameters	True	Adjustable during calibration; any changes should be documented
Turn penalty function (TPF)	Most appropriate TAM Micro TPF	The most appropriate TPF should be selected based on the available TPFs within TAM Micro
Junction delay function (JDF)	Most appropriate TAM Micro JDF	The most appropriate JDF should be selected based on the available JDFs within TAM Micro
Additional volume	0.0 veh	

[49] TAM users must refer to **Appendix 4.1** for details on default TAM turn capacities and the implications for developing their own models using the TAM package.

3.5.7.5.3 Static OD Adjustment Parameters for TAM Micro

Static OD adjustment is used for the base case, base year model. This process adjusts the prior demands based on the RDS, as explained in **Chapter 3.5.7.3.6.**

The Static OD Adjustment scenario must have the correct traffic demand, public transport plan, RDS and master control plan selected so that the cost calculations are accurate. **Table 3.5-5** lists the key parameters for TAM Micro Static OD Adjustment scenarios, the default value/s in TAM and any relevant implementation notes.

Table 3.5-5 Default static OD adjustment parameters for TAM Micro scenarios

<table>
<tr><th>Parameter</th><th>Default value</th><th>Notes</th></tr>
<tr><td>Assignment engine</td><td>MSA</td><td></td></tr>
<tr><td>Stopping criteria</td><td>100</td><td></td></tr>
<tr><td>Target R^2</td><td>0.95</td><td></td></tr>
<tr><td>Target slope</td><td>1.00 ± 0.00</td><td></td></tr>
<tr><td>Gradient descent iterations</td><td>1</td><td></td></tr>
<tr><td>Static assignment maximum iterations</td><td>100</td><td></td></tr>
<tr><td>Relative gap</td><td>1.00%</td><td></td></tr>
<tr><td>Matrix elasticity</td><td>Defined by the user</td><td rowspan="2">Matrix elasticity and trip length elasticity values can be defined by the user. The Transport Analytics team must provide approval for the values used.</td></tr>
<tr><td>Trip length elasticity</td><td>Defined by the user</td></tr>
<tr><td>Weight function</td><td>TAM AWF</td><td></td></tr>
</table>

It is recommended that all other parameters use the default Aimsun Next 23 values. Any changes to the parameters not listed in **Table 3.5-5** requires approval from Transport Analytics.

Static OD Adjustment is to be used for the calibration process of the base year base case model only and must not be used for future year and project case options.

3.5.7.5.4 Static Assignment Parameters for TAM Micro

Table 3.5-6 lists the key parameters for Macro for TAM Micro scenarios, the default value/s in TAM and any relevant implementation notes. Note that TAM Micro requires one static assignment to be set up for each hour of the model period.

Table 3.5-6 Default static assignment parameters for TAM Micro scenarios and experiments

Parameter	Default value	Notes
Assignment engine	MSA	
Maximum iterations	100	More iterations should be used if convergence is not reached
Relative gap	1.00%	

In addition to storing the path assignment from each static assignment, the modeller must also store a subset of the 5 most used paths. This is available in the Outputs to Generate tab of the Static Assignment Experiment.

3.5.7.5.5 Static OD Departure Adjustment Parameters for TAM Micro

The Static OD Adjustment scenario is used as part of the base-year model calibration process. This scenario adjusts the demand for each unit of time (i.e. 15 minutes), in the traffic flow RDS to time-slice and adjust the demand accordingly. The output of the process is the adjusted profiled demand, described in **Chapter 3.5.7.3.6**.

The number of iterations is recommended to be set at 1000 under the main tab of the experiment. Transport Analytics must approve the values for matrix elasticity.

Table 3.5-7 Default static OD adjustment assignment parameters for TAM Micro scenarios and experiments

Parameter	Default value	Notes
Warm-up	01:00:00	
Iterations	1000	
Matrix elasticity	Defined by the user	Matrix elasticity and trip length elasticity values can be defined by the user. The Transport Analytics team must provide approval for the values used.
Trip length elasticity	Defined by the user	

3.5.7.5.6 Microscopic SRC Parameters for TAM Micro

The Aimsun Next 23 User Manual[50] contains details of the items within the scenario dialog. For most items, the default values provided in Aimsun Next 23 are considered acceptable for building the model[51]. However, values for parameters and model elements explained in this document supersede any Aimsun Next 23 default values.

The model period for subarea models built from TAM are:

- **AM**: 07:00 – 10:00;
- **DT**: 10:00 – 15:00; and,
- **PM**: 15:00 – 19:00.

In addition to the modelled periods, each Micro SRC Experiment must have a warm-up period as the initial state for the simulation, which must be at least twice the longest expected travel time through the model (rounded up to the nearest 15 minutes) but must not be less than 30 minutes.

At the experiment level, in the main tab, the modeller must select Using Warm-Up in the Initial Simulation State section and Use Scenario Demand[52] from the drop-down menu.

Values for Simulation Reaction Time at Stop, and Reaction Time at Traffic Light within the Reaction Time tab of the micro SRC experiment must be updated in accordance with **Chapter 3.5.7.3.7**. Note that the use of "exponential" arrival type is required by DIT for all TAM Micro experiments.

In Dynamic Traffic Assignment, under the section for Fixed Routes the modeller must use a value of 80% for Following Input Path Assignment.

For microscopic SRCs, the standard DIT replication seed values are:

Standard values for the first five replications:

- Replication 1 6422;
- Replication 2 12841;
- Replication 3 17906;
- Replication 4 18370;
- Replication 5 22744;

Additional values if more than five replications are required[53]:

- Replication 6 7234;
- Replication 7 9560;
- Replication 8 16855;
- Replication 9 18829; and,
- Replication 10 19199.

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50 https://docs.aimsun.com/next/23.0.1/

51 Change of the default values not covered in this document may be required based on the project specific requirements of the transport modelling exercise. Details of these requirements should be captured in the modelling scope document and signed off by DIT Transport Analytics and Network Management Services.

52 Agreements from DIT (Transport Analytics) is required if an alternative demand is to be used for the initial simulation state warm-up.

53 Additional replications (i.e. more than 5 replications) may be required to ensure model stability.

3.5.8 Model Auditing

It is recognised best practice that all traffic simulation models are audited at defined stages during the model development process. The purpose of model auditing is to ensure that all models have been developed, calibrated, and validated in accordance with the specified guidelines.

DIT must be able to use the model outputs and results with confidence. Therefore, to be useful in generating analytical information for projects, models must be sufficiently accurate and robust for their intended purpose. To attain this level of confidence it is mandatory for all modelling that is to be recognised as valid and fit-for-purpose by DIT to be audited at specified "Hold Points". Audits must only be carried out by suitably qualified and experienced practitioners, who are wholly independent of the project team.

At each Hold Point, relevant model parameters and characteristics should be checked to ensure that acceptable values and approaches have been adopted. A checklist has been developed by DIT to assist this process, which is included in **Appendix 4.7** and can be downloaded from https://dit.sa.gov.au/documents/transport_modelling_and_analysis in Microsoft Excel format. At each Hold Point, the auditor must complete the relevant column in the checklist and return the checklist for DIT's review. DIT's response will be based on the points identified by the auditor and reflect DITs views. The checklist is then be provided to the modeller to make any necessary modelling changes and to add the modeller's response to the points identified.

All calibrated and validated base year models are subject to operational reviews by DIT to confirm the operation of the model is reasonably accurate compared to observed traffic operations. Details of this review must be included as part of the audit results.

- Submission of the TMSD to Transport Analytics and Network Management Services for approval and sign-off;
- Submission of base year model calibration/validation and associated reports to Transport Analytics and Network Management Services for endorsement;
- Submission of future year, project-case adjusted demands to Transport Analytics for endorsement; and,
- Submission of project-case models to Transport Analytics and Network Management Services for endorsement.

3.5.9 Model Outputs and Documentation

This section summarises the model outputs and documentation for TAM Micro scenarios.

3.5.9.1 Reporting Model Outputs

Model outputs will vary depending on the nature of each traffic simulation model. For base-year models, as a minimum, the following model calibration/validation results must be reported separately for each model period and the individual hours (including the warm-up period):

- GEH values comparing observed and modelled turning movements;
- Regression analysis of observed and modelled turning movements; and,
- Comparison of observed and modelled travel times both through the model and between adjacent stop lines along defined routes.

For all models, the following model outputs are to be reported as a minimum for each model period as well as for each of the individual peak hours:

- Average network delay, a comparison of input and modelled vehicle flows, density, number of stops, and overall vehicle travel time and distance for the complete model, or any defined portion of the model;
- Turning movement data;
- Intersection cycle and phase times;
- Turning movement flows / capacities / saturation flow rates;
- Intersection delay;
- Intersection queue lengths;
- Mid-block merge performance;
- Virtual queues at the model boundary; and,
- Lost vehicles.

Any additional required outputs should be included in the TMSD.

For models using SRC assignment, there must also be analysis of variability of results between replications to indicate the degree of model stability. If analysis shows significant variability between the replications, this is likely to be the result of issues related to the development and/or calibration of the model that must be addressed. In some circumstances, additional replications may be necessary to ensure model stability.

The analysis of model variability must consider the results for Travel Time and Flow for each 15-minute time period, and must include:

- A scatter plot showing the result for all replications;
- A box plot showing the range of values for all replications and the reported result value;
- A frequency histogram showing the results for all replications; and
- Some analysis of:
  - Mean value;
  - Median value;
  - Standard deviation;
  - 95 percentile;
  - Range;
  - Inter-quartile range;
  - Minimum value;
  - Maximum value;
  - Sample size; and,
  - Confidence intervals.

The model results reported and used for the comparison of future year scenarios will depend on which assignment approach has been adopted. If the SRC approach has been adopted, the average results for all replications must be compared and reported in the TMSD. If the DUE approach has been adopted, one run will be available, which must be reported and used for comparison. In all cases, the seed value/s for all scenario models must be the same as the seed value/s used in the calibrated and validated base year model.

3.5.9.2 Using Model Outputs

It is best practice to ensure that model outputs are applied appropriately, with full understanding, for subsequent analysis or to input into another model.

Model variables which are used as part of base year model calibration and reflect base year observed values can be used with confidence. However, other model outputs must be subject to a validation process by comparing base year model outputs and base year observed, measured, and estimated values. Where differences exist, model outputs should be adjusted before being applied. For model outputs which are adjusted before application, the rationale, justification, and details of the adjustment process are to be described in the TMSD.

For Aimsun Next 23 models output traffic flow data, including total travel time, total travelled distance, individual turning movements, mid-block traffic flows, vehicle speeds (for the routes/road sections used for validation) and section densities can be used directly. However, other outputs must not be used unless they have been rigorously reviewed and adjusted.

3.5.9.3 Model Documentation Requirements

All project-specific requirements must be clearly defined in the TMSD, including the minimum requirements; Base Model Development, Calibration and Validation Report and the Future-Year Model Analysis Report, which addresses the future-year base and project options models. These reports must be accompanied by the completed audit checklists (for base and future year models), and the results of the operational review (base year model).

All reports should clearly reference the sources of all data used, specify the land use / network scenarios (Committed and Funded or Planning Network) used for future traffic forecasts, document all changes to default model parameters and provide an analysis of network operation consistent with the purpose of the model.

The Base Model Development, Calibration and Validation Report, must contain commentary on the following where applicable:

- Comparative SIDRA Intersection results and the traffic simulation model results for each of the signal-controlled intersections. SIDRA Intersection models must be calibrated in accordance with the Traffic Modelling Guidelines (SIDRA Intersection), which can be accessed from: https://www.dpti.sa.gov.au/standards/transport_modelling_and_analysis; and,
- Comparative SCATS signal operation data and modelled signal operation data, and appropriate commentary on the results.

Model documentation must also include commentary on the visual results of the simulation and the identification of any model limitations/operational issues. For all models involving the use of API plug-ins not developed by DIT, full documentation of these API plug-ins must be included or referenced with evidence that they were applied appropriately and performed as intended.

3.6 TAM Support

DIT has established a dedicated support email address for TAM:

DIT.TAMSupport@sa.gov.au.

If you are contacting support to report a model issue, please ensure that you include the following information:

- A detailed description of the bug or error;
- The version of TAM you are using;
- The version of Aimsun Next you are using;
- Your TAM model (as a *.zip file); and,
- The steps necessary to reproduce the error.

DIT will endeavour to respond to all TAM support requests within three business days.

4 Appendices

4.1 Turn capacities in TAM

TAM users are expected to familiarise themselves with the following information regarding turn capacities in TAM, and, in particular, the implications for developing their own models using the TAM package. All users are assumed to have sufficient transport modelling experience and the understanding of TAM structures and that they can make reasonable judgements in the interpretation of the model inputs and results.

TAM v1.1.3 uses new cost functions for its macroscopic assignment. To calculate delay experienced by road users at the turn level, these new functions utilise saturation flow, instead of theoretical turn capacity[54] that is stored under 'turn capacity' attribute. However, theoretical turn capacity is still being used as an indicator for the relative attractiveness of each turn and link movement.

Hence, it is to note that any change in the theoretical turn capacity can lead to a change in the TAM v1.1.3 modelling results across all modelling tiers.

The impact of the turn capacity on the macroscopic assignment informing the microscopic simulation models (Macro for TAM Micro) is more pronounced due to the cost functions used for this level of assignment (i.e., the new functions are not used).

It is, therefore, the responsibility of TAM users to review, change and/or update the theoretical turn capacity at each turn movement before running any scenario in the model. DIT must be consulted for technical advice about determining theoretical turn capacities.

[54] Turn capacities in the TAM package use a standardised formula based on the turn origin and destination capacity and number of lanes.

4.2 Mesoscopic simulation in Aimsun Next 23

Dynamic models in Aimsun Next 23 are used to simulate the behaviour of each individual vehicle using the microscopic, **mesoscopic** or hybrid network loading. Traffic assignment approaches can be either a Dynamic User Equilibrium (DUE) or Stochastic Route Choice (SRC).

Figure 4.2-1 provides a useful illustration of the difference between the 3 levels of simulation.

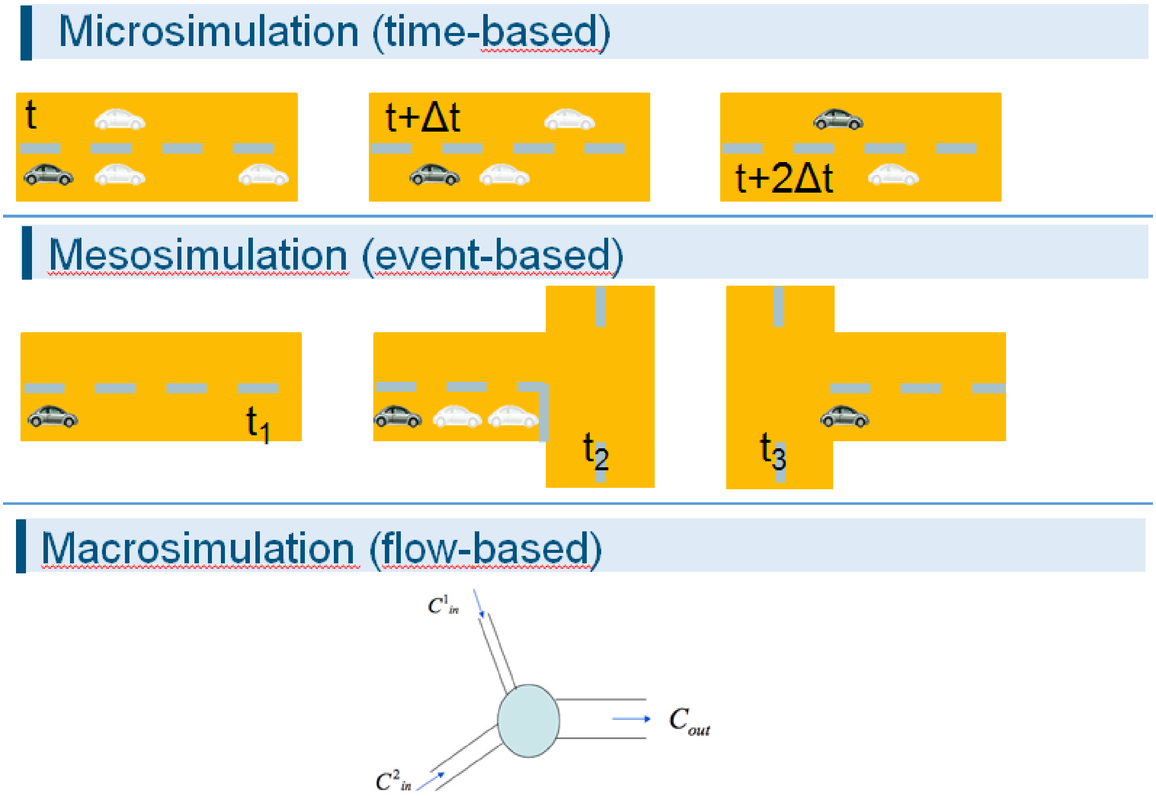

Figure 4.2-1 The difference of each modelling tiers

In **Microsimulation,** time is incremented by Δt at every time step, every vehicle considers its speed and lane choice and is moved by the distance determined for that time step.

In **Mesoscopic simulation,** time is moved to the next event where the event is a vehicle entering or leaving a section or node. In the figure, at time t1, the vehicle enters a section, at t2 it leaves that section and a predicted speed, and in a predicted lane and t3, it enters the next section. Not all vehicles are updated every time; only those vehicles at the head of the queue are considered leading to a significant reduction in computer time required to run the simulation.

In **Macroscopic simulation,** individual vehicles are not represented, vehicles are aggregated to flows assigned to the network to balance the load and minimise journey time across a defined time-period, such as a 2-hour morning peak.

The core models in the dynamic simulation of Aimsun Next 23 deal with individual vehicles. Each vehicle has assigned behavioural attributes when they enter the system; those attributes remain constant during their trip. The difference between the core models at the mesoscopic and microscopic levels relates to the abstraction level and the process employed to update each vehicle's status.

Microscopic simulation process

The microscopic simulation process in Aimsun Next 23 is illustrated in **Figure A-1**. It can be considered a 'time-slice' based simulation with an additional scheduled event calendar. During a vehicle's the network, its position is updated according to two driver behaviour models: ' car following' and 'lane changing'. The premise behind the models is that drivers tend to travel at their desired speed in each road section, but the environment (i.e. preceding vehicles, adjacent vehicles, traffic signals, signs, blockages, etc.) conditions their actions. Simulation time is split into discrete time intervals called simulation cycles or simulation time steps (Δt).

Mesoscopic simulation process

Mesoscopic vehicle movement in Aimsun Next 23 is modelled depending on the location of a vehicle:

- Modelling vehicle movement in sections: car following and lane changing;
- Modelling vehicle movement in nodes (node model):
  - Modelling vehicle movement in turnings;
  - Modelling vehicle movement from sections to turnings: apply gap-acceptance model; and,
  - Modelling vehicle movement from turnings to sections: apply lane selection model.

Vehicles are assumed to move through sections and turns, so sections and turns are vehicle "containers". Each section capacity (in terms of the number of vehicles that can traverse the section in a specific period) is calculated by using the jam density (a user-defined parameter) multiplied by the section length and the number of lanes. Car-following and lane-changing models are applied to calculate the section travel time. This is the earliest time a vehicle can reach the end of the section, considering the current status of the section (number of vehicles in the section). The modelling of vehicle movements inside sections in the Aimsun mesoscopic simulator is based on the work of Mahut (1999).

The node model transitions vehicles from one section to the next downstream section of its path. This paradigm contains two actions that take place in all nodes:

- **Serving sections.** This server calculates the next vehicle to enter the node. This is done by applying the gap-acceptance model and then using the exit times calculated by the car-following and lane-changing models mentioned above.
- **Serving turnings.** This server calculates the next vehicle to leave the node. The selection is done by applying the car-following and lane-changing models to calculate the travel time and getting the earliest time when a vehicle can enter in its downstream section.

<u>References:</u>

Mahut M (1999) Speed-maximizing car-following models based on safe stopping rules. Transportation Research Board, 78th annual meeting, January 10–14, 1999 Washington DC, US

4.3 Relationship between SAM and TAM

TAM is a highway assignment model which completes DIT's integrated transport modelling framework. TAM is not a travel demand model. Its traffic demand is, therefore, informed by the Strategic Adelaide Model (SAM).

4.3.1 Supply-side SAM-TAM Relationship

SAM and TAM are closely aligned geometrically. Both models share:

- The same boundary and network extent;
- The same modelled years (2021, 2026, 2031, 2036 and 2041);
- The same road types, road hierarchy and key section attributes;
- At least all the roads in SAM[55]; and,
- The same infrastructure for both Committed and Funded (CF) and Planning Network (PN) scenarios up to and including 2041[56];

Note: For most objects that can exist in both SAM and TAM, such as road sections or turns, the *Source* (GKObject::source) attribute records whether it is inherited from SAM or is exclusive to TAM.

4.3.2 Demand-side SAM-TAM Relationship

SAM and TAM have the same zone structure, and as such have a like-for-like system of centroids which facilitates seamless transfer of demands between the two models. This section describes how the demand matrices are derived and supplied to TAM from SAM.

The TAM base year is 2019 which falls between the SAM scenarios for years 2016 and 2021[57]. The 2016 and 2021 SAM matrices were interpolated to 2019 and imported into TAM. The matrices were then expanded to cover the TAM model periods using turn data from the Real Data Set.

TAM uses a parent-child system of centroids. Each zone in SAM has one centroid which is referred to as the **parent centroid** of that zone in TAM. Each parent centroid can have one or more loading point in SAM, and all loading points from SAM have been replicated in TAM. To provide more granularity in TAM, each zone was further disaggregated where appropriate resulting in additional centroid connections. The *Source* attribute for each centroid connection in TAM records whether it is inherited from SAM or has been added for TAM. Parent centroids are used to load the network for TAM Macro scenarios.

Each parent centroid in TAM can have multiple **child centroids** where each child centroid belongs to a single parent and represents a single connection from that parent to the network. All child centroids in TAM are two-way (i.e. attraction and generation centroids) and connected to the same object (node). Child centroids are used to load the network for TAM Meso and TAM Micro scenarios.

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[55] TAM also includes additional roads not present in SAM as befitting a more detailed tactical-level model.

[56] TAM also includes some minor additional upgrades such as roundabouts and pedestrian crossings that have limited strategic significance so are not included in SAM.

[57] The SAM model years are 2016, 2021, 2026, 2031, 2036 and 2041.

For TAM Meso, trips for each parent centroid are initially transferred to the corresponding child centroids proportionally, such that the sum of the trips to and from all child centroids in a zone corresponds to the trips to and from the parent centroid for that zone in SAM. However, these weightings are then adjusted through the matrix estimation process according to observed traffic counts across the zone and surrounding zones from the Real Data Set.

Future demand matrices (seed matrices) are inputs from the SAM modelling process. TAM Macro uses the future year SAM matrices directly, while TAM Meso uses a sectorised approach to interface between SAM and TAM. This "delta method" pivots TAM base year (2019) sectorised matrices to provide adjusted sectorised future-year matrices, which are disaggregated at the child-centroid level of TAM and time-sliced as per the distribution and demand profile of the base year (2019). **Figure 4.3-1** illustrates the demand pivoting process within TAM.

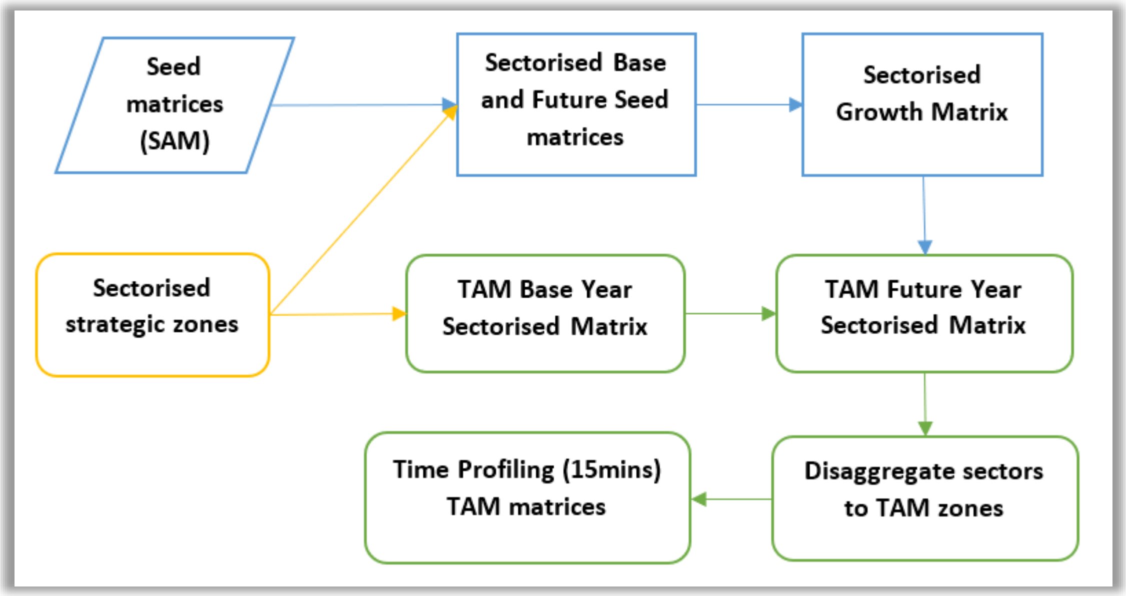


Figure 4.3-1: Demand Pivoting Process in TAM

The only time the SAM to TAM matrix development process will be required is when there is a material change in the future land-use scenario, public transport service, or a significant infrastructure project resulting in a considerable shift in trip distribution.

4.4 Road types

The road types used in TAM are carefully matched with the foundation network Link definitions as shown in **Table 4.4-1**.

Table 4.4-1 Foundation network Link definitions and corresponding TAM road types

Name	Type	#	Capacity
Freeway	Urban/Suburban	1	2,200
	Rural	2	2,200
Expressway	Urban/Suburban	3	2,000
	Managed	4	2,000
Tunnel	Unmanaged	5	1,800
	Managed	6	1,800
	Ramp	7	1,500
	Ramp lane gain	8	1,800
Highway	Low access	9	1,800
	High access	10	1,350
Arterial-Divided	Urban low access	21	1,500
	Urban high access	22	1,450
	Urban CBD	23	1,050
	Suburban limited access	24	1,650
	Suburban low access	25	1,400
	Suburban high access	26	1,250
	Rural low access	27	1,400
	Rural high access	28	1,250
	Rural high quality	29	1,500
Arterial-Undivided	Urban low access	41	1,150
	Urban high access	42	1,150
	Urban CBD	43	850
	Suburban limited access	44	1,550
	Suburban low access	45	900
	Suburban high access	46	900
	Rural low access	47	700
	Rural high access	48	600
	Rural high quality	49	900
Local/Collector-Divided	Urban low access	61	600
	Urban high access	62	500
	Urban CBD	63	850
	Suburban low access	64	900
	Suburban high access	65	500
	Rural low access	66	600
	Rural high access	67	500
Local/Collector-Undivided	Urban low access	68	600
	Urban high access	69	500
	Urban CBD	70	800
	Suburban low access	71	600
	Suburban high access	72	500
	Rural low access	73	500

4.5 Standalone Subarea Model Creation from TAM

After defining the subarea in TAM with demand matrices and Public Transport demand traversed into the subarea in accordance with the process shown in to for the base and future years, the following steps shown in **Figure 4.5-1** must be followed to create a standalone subarea network model.

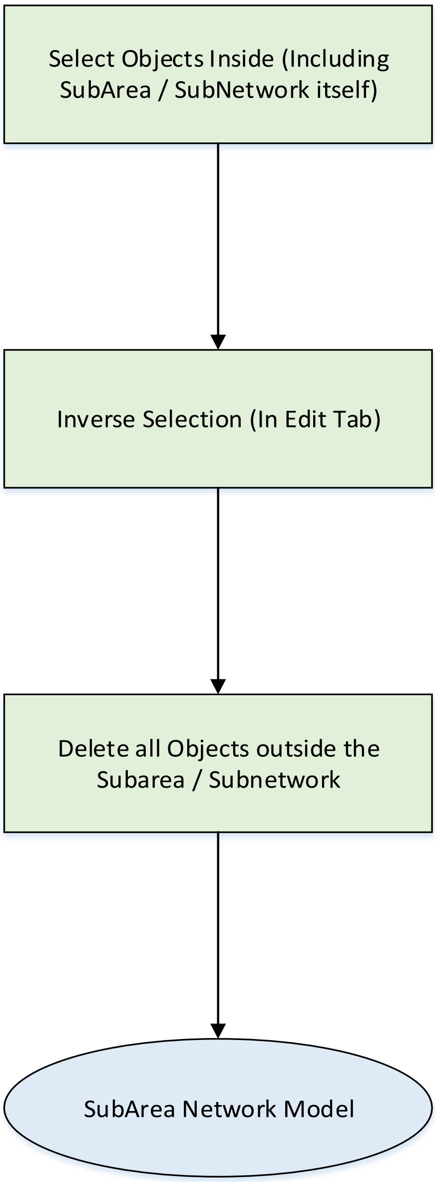


Figure 4.5-1 Process for creating a standalone subarea model creation for TAM

Note: TAM applies an incremental geometry configuration. For selecting objects within the boundary of the subarea, the modeller must ensure the active scenario is selected with the base-year and project-case and future years accordingly to ensure all objects in all scenario-specific geometry configurations are selected before inversing and deleting objects.

4.6 Bluetooth Travel Time Extraction Procedure

Setting up Addinsight Replica to Obtain O-D Travel Time

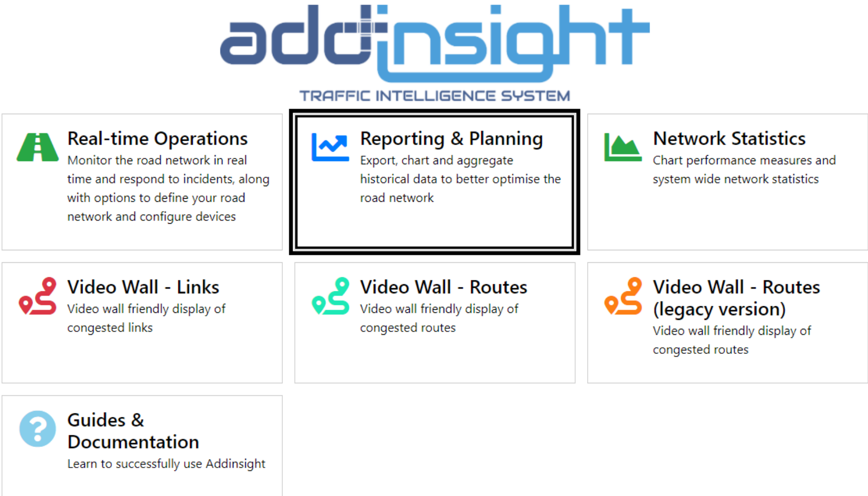
Disclaimer: This procedure must be read in conjunction with the Planning Client Guide and any relevant documentation available within the Addinsight Replica environment.

Travel time on selected routes during different time periods has been conventionally recorded using methods such as floating car surveys. Newly implemented technologies such as Bluetooth traffic systems have made it easier to collect traffic data, including travel time on selected routes.

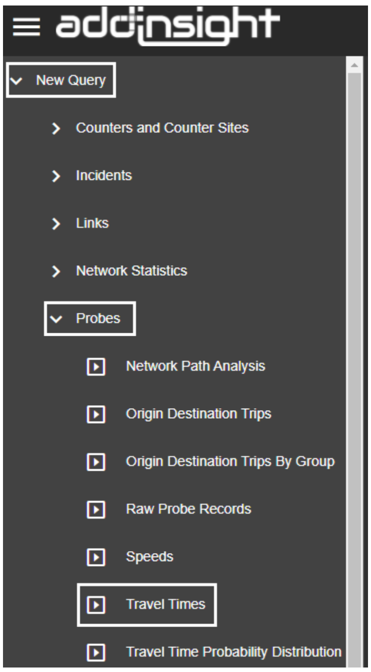
This document is a recommended procedure with the intention to adopt a consistent approach for collecting travel time from the Addinsight platform.

4.6.1 Setting up Addinsight to Obtain Travel Time

Step 1: Upon logging into Addinsight Replica, select *"Reporting & Planning"*.



Step 2: From the menu panel on the left-hand side of the screen, under *"New Query*", expand *"Probes"* and select *"Travel Times*".

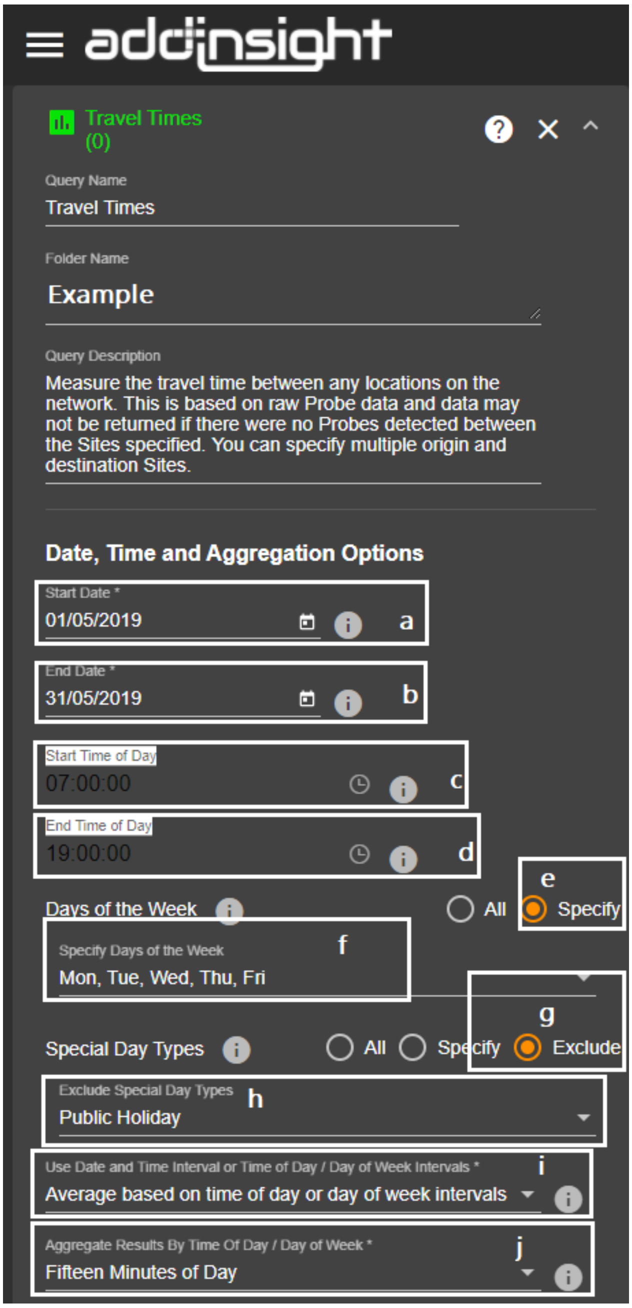


Step 3: Fill in the following required information:

a. Start Date, e.g. 01/05/2019
b. End Date, e.g. 31/05/2019
c. Start Time of Day: e.g. 07:00:00
d. End Time of Day: e.g. 19:00:00
e. From the two radio buttons *"All"* and *"Specify"*, choose *"Specify".*
f. Click on the downward arrow to open the dropdown box. Select the days, Monday to Friday.
g. From the three radio buttons *"All", "Specify",* and *"Exclude",* choose "exclude".
h. Click on the downward arrow to open the dropdown box. Select the periods not representing the traffic pattern for your study, e.g. public holidays.

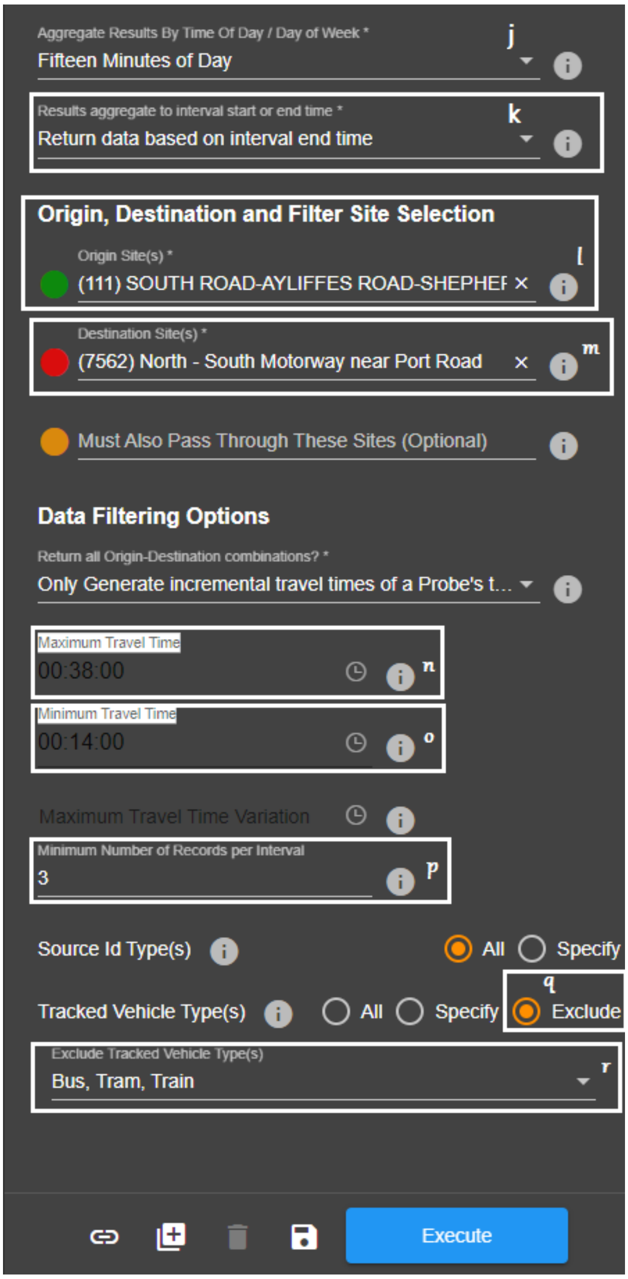
Note: Periods to exclude depends on the purpose for which the travel time data is used. It should be determined accordingly by the user (and for DIT projects, in consultation with DIT).

i. Click on the downward arrow to open the dropdown box. Choose *"Average based on time of day or day of week intervals"* from the two options. This option gives an aggregate output for the time intervals within the time period of the day for the days defined by the start date and the end date.
j. Click on the downward arrow to open the dropdown box. Select "**Fifteen Minutes of Day**".



Step 3 (Cont'd): Fill in the following required information:

k. From the dropdown menu, select *"Return data based on interval end time"*.
l. Select the origin BT detector from the interactive map or by typing in the BT number (if known).
m. Select the destination detector from the interactive map or by typing in the BT number (if known).
   NB: In case alternative route are available between the selected OD, you can specify the route you want by selecting detector(s) between the origin and destination on the route of your choice. To do this, click on the box for *"Must Also Pass Through These Sites"* and from the interactive map, select one, some, or all of the detectors on your subject route. The more detectors you choose, the better the route is specified; however, it increases the likelihood of data not being available and no outputs being generated. It is recommended to limit the number of in-between detectors to one or just a few.
n. Enter the maximum estimated travel time from Origin to Destination on the subject route. Please see the section (next page) on the estimation of the maximum travel time.



o. Enter the minimum estimated travel time from Origin to Destination on the subject route. Please see the section (next page) on the estimation of the minimum travel time.
p. Enter the minimum number of records per interval. DIT (Transport Analytics) recommends at least 10 records per interval. You can set this number to be less than 10 but you need to analyse the outputs and highlight any interval with counts less than 10.
q. From the three radio buttons for *"Tracked Vehicle Type(s)*", select *"Exclude".*
r. Within *"Exclude Tracked Vehicle Type(s)"* choose *"Bus", "Tram", "Train"* unless your analysis includes any of these public transport sub modes.

Press the ***"Execute"*** button to run the enquiry.

4.6.2 Outputs

Addinsight returns chart reports and grid reports for:

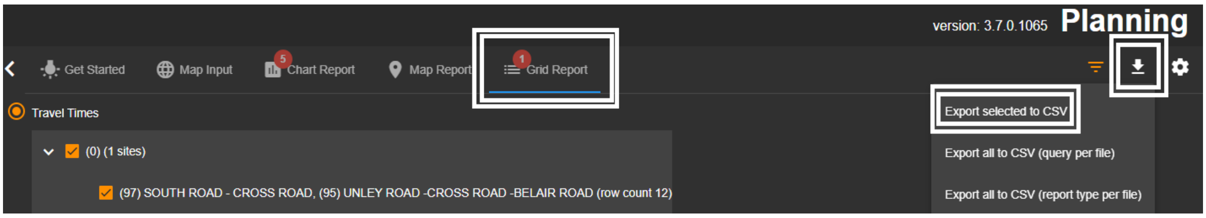
- Number of recorded Bluetooth data (Count)
- All recorded travel times within a given interval
- Average travel time
- Standard deviation for the recorded travel times
- Median travel time
- Start of the interval (time at Origin)

Determining the minimum and maximum travel time from Addinsight outputs requires applying filters and/or post processing and data cleansing to remove the outliers. This is the same with using the average travel time.

To make it easier to use Addinsight outputs for transport/traffic model travel time validation, it is recommended to use the median travel time.

The bandwidth to be defined as the ±15% of the median value.

From the *Grid Report* tab, press the download icon and from the menu select "*Export selected to CSV*".



4.6.3 Example

A subarea model has been developed from the TAM and calibrated to the traffic flow data of May 2021. The model includes a section of Cross Road from Unley Road/Belair Road to South Road. This section of Cross Road has been selected for travel time validation for both eastbound and westbound traffic.

Travel time extraction procedure and the outputs are explained below for the AM model period (7:00 AM to 10:00 AM).

Westbound traffic

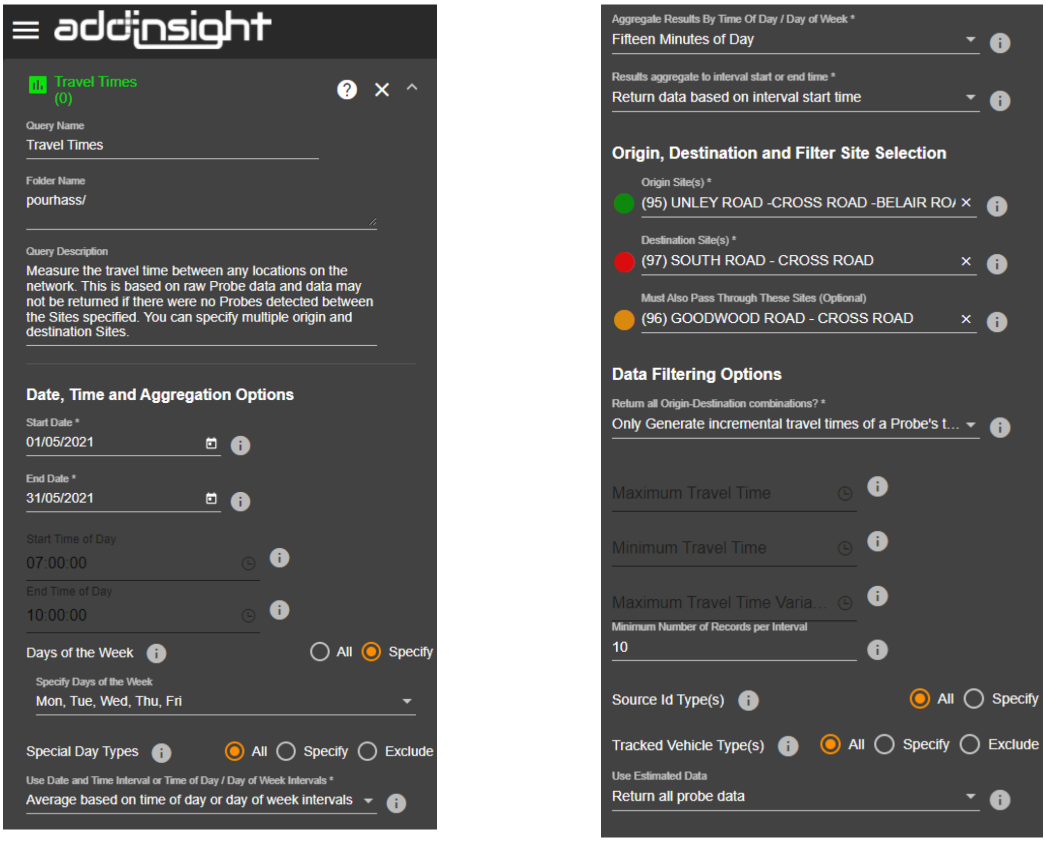


Figure 4.6.3-1 Addinsight Set-up (Westbound Traffic)

Table 4.6.3-1 Addinsight Probe Travel Time Output (Westbound Traffic)

Origin Site	Dest Site	Count	Travel Times (TT) (Seconds)	Avg TT (Seconds)	St Dev TT (Seconds)	Median TT (Seconds)	Time at Origin
95	97	220	[76,197, 205, …]	358	247	316	7:00:00
95	97	288	[211, 216, 219, …]	414	362	336	7:15:00
95	97	326	[228, 228, 232, …]	463	368	383	7:30:00
95	97	269	[257, 262, 265, …]	497	356	425	7:45:00
95	97	299	[249, 259, 281, …]	621	460	518	8:00:00
95	97	221	[316, 329, 329, …]	720	524	559	8:15:00
95	97	205	[328, 334, 335, …]	785	626	617	8:30:00
95	97	211	[282, 297, 302, …]	653	439	555	8:45:00
95	97	315	[217, 228, 229, …]	614	594	441	9:00:00
95	97	244	[203, 210, 218, …]	508	485	368	9:15:00
95	97	269	[18, 215, 223, …]	529	507	360	9:30:00
95	97	244	[212, 221, 221, …]	546	546	357	9:45:00

Table 4.6.3-2 Median Travel and Travel Time Bandwidth (Westbound Traffic)

Origin Site	Dest Site	Time at Origin	Median TT (Seconds)	Median TT – 15% Median TT (Seconds)	Median TT + 15% Median TT (Seconds)
95	97	7:00:00	316	269	363
95	97	7:15:00	336	286	386
95	97	7:30:00	383	326	440
95	97	7:45:00	425	361	489
95	97	8:00:00	518	440	596
95	97	8:15:00	559	475	643
95	97	8:30:00	617	524	710
95	97	8:45:00	555	472	638
95	97	9:00:00	441	375	507
95	97	9:15:00	368	313	423
95	97	9:30:00	360	306	414
95	97	9:45:00	357	303	411

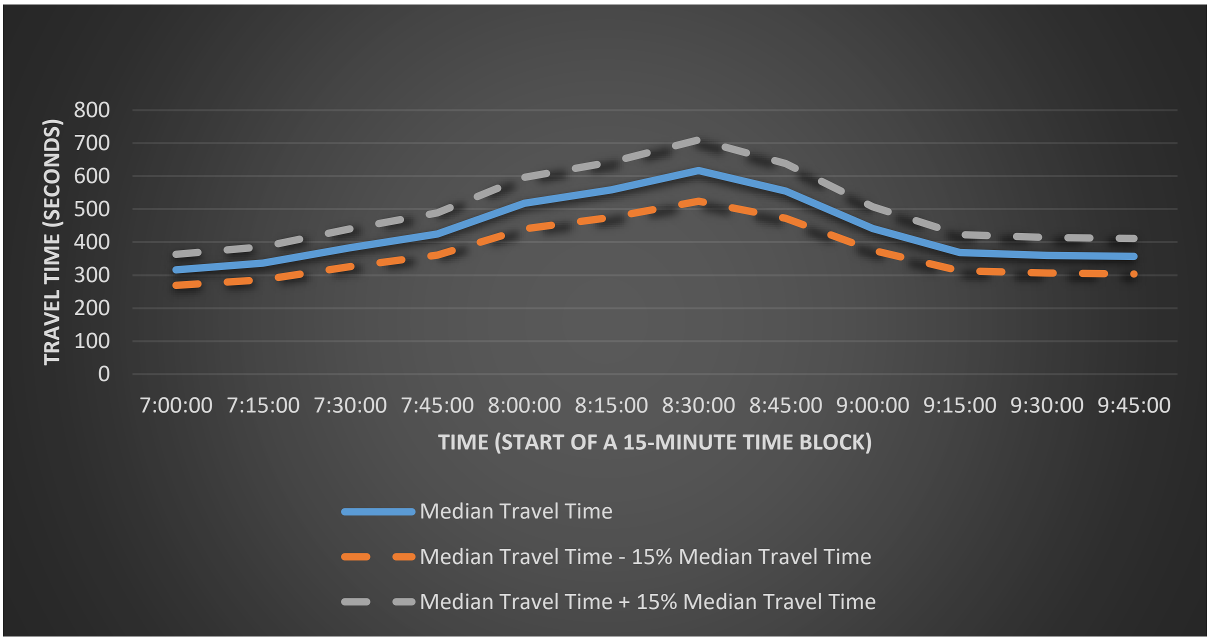
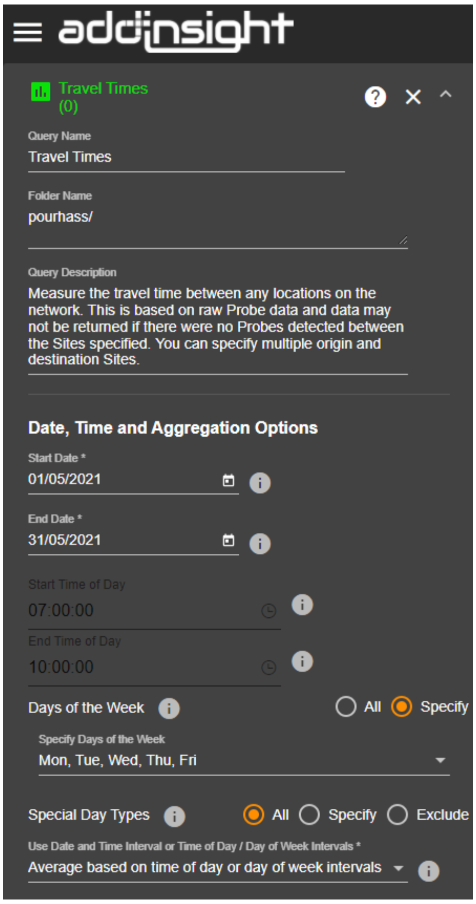


Figure 4.6.3-2 Westbound Traffic Travel Time and Time of Day

Eastbound Traffic



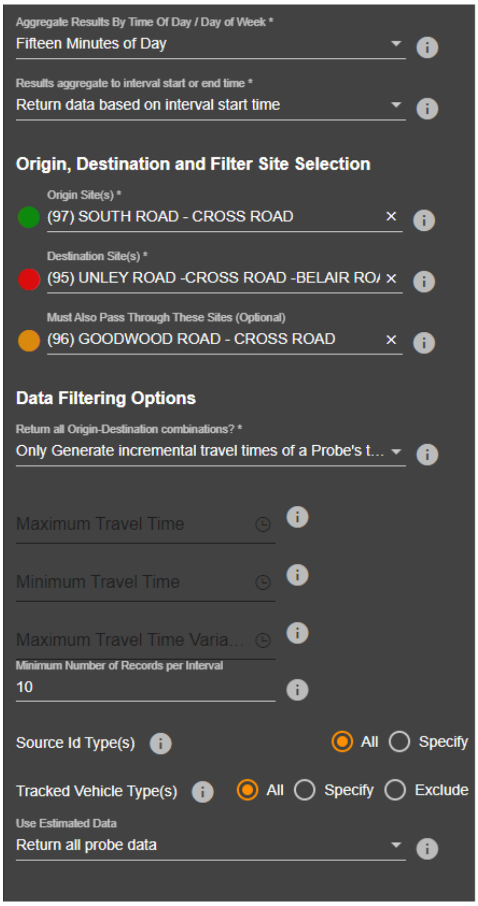


Figure 4.6.3-3 Addinsight Set-up (Eastbound Traffic)

Table 4.6.3-3 Addinsight Probe Travel Time Output (Eastbound Traffic)

Origin Site	Dest Site	Count	Travel Times (TT) (Seconds)	Avg TT (Seconds)	St Dev TT (Seconds)	Median TT (Seconds)	Time at Origin
97	95	297	[162, 171, 207, …]	452	465	332	7:00:00
97	95	299	[252, 267, 270, …]	484	425	387	7:15:00
97	95	383	[209, 257, 266, …]	543	375	449	7:30:00
97	95	428	[266, 273, 355, …]	635	334	556	7:45:00
97	95	516	[258, 289, 361, …]	768	341	726	8:00:00
97	95	339	[326, 328, 376, …]	856	400	771	8:15:00
97	95	336	[299, 324, 365, …]	723	331	638	8:30:00
97	95	337	[285, 317, 319, …]	592	360	495	8:45:00
97	95	330	[31, 223, 224, …]	479	448	370	9:00:00
97	95	294	[200, 202, 208, …]	476	536	344	9:15:00
97	95	363	[231,234,236, …]	474	441	348	9:30:00
97	95	384	[208,210,221, …]	473	453	353	9:45:00

Table 4.6.3-4 Median Travel and Travel Time Bandwidth (Eastbound Traffic)

Origin Site	Dest Site	Time at Origin	Median TT (Seconds)	Median TT – 15% Median TT (Seconds)	Median TT + 15% Median TT (Seconds)
97	95	7:00:00	332	282	382
97	95	7:15:00	387	329	445
97	95	7:30:00	449	382	516
97	95	7:45:00	556	473	639
97	95	8:00:00	726	617	835
97	95	8:15:00	771	655	887
97	95	8:30:00	638	542	734
97	95	8:45:00	495	421	569
97	95	9:00:00	370	315	426
97	95	9:15:00	344	292	396
97	95	9:30:00	348	296	400
97	95	9:45:00	353	300	406

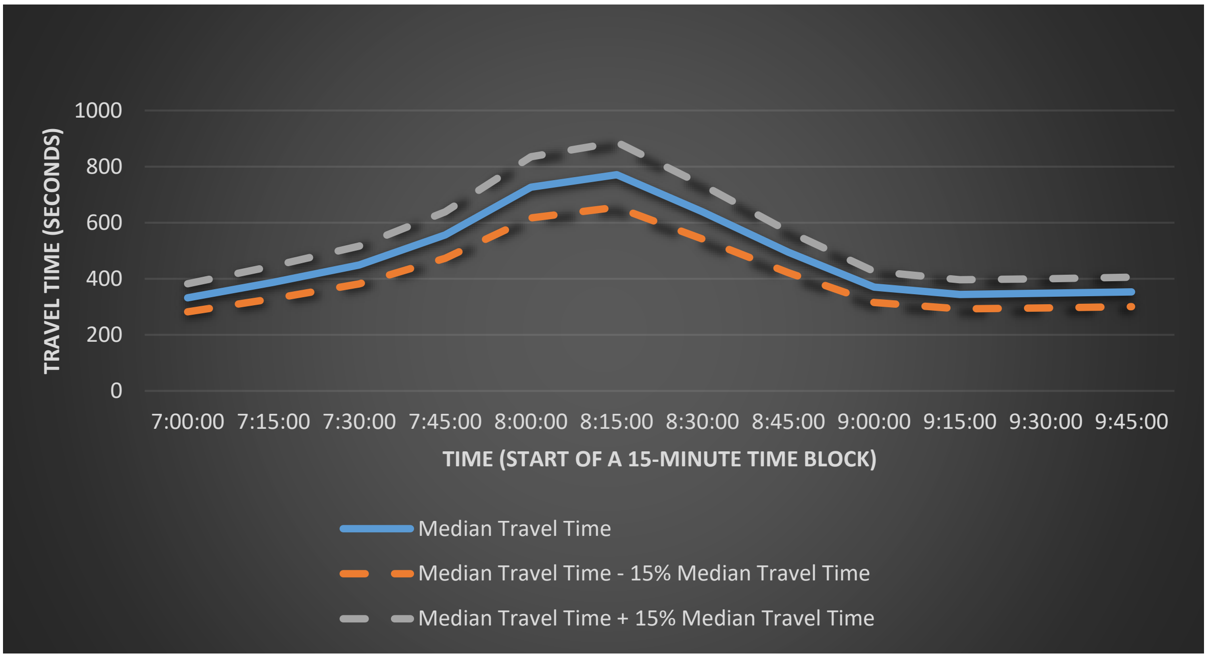


Figure 4.6.3-4 Eastbound Traffic Travel Time vs Time of Day

Notes:

Travel time extraction procedure explained in this document is for use in transport/traffic model travel time validation. An alternative method of travel time extraction from Addinsight may be more suitable for other purposes. Refer to the Addinsight guides and documents for further details and if in doubt, contact the Addinsight team via email support@addinsight.com.

In the example (**Chapter 4.6.3**), Addinsight extracts, including the median travel time, are presented in **Table 4.6.3-1** and **Table 4.6.3-4**. Microsoft Excel is used to calculate ±15% of the median travel time (**Table 4.6.3-2** and **Table 4.6.3-4**). Graphs in **Figure 4.6.3-1** and **Figure 4.6.3-3** are produced in Microsoft Excel based on the data presented in **Figure 4.6.3-2** and **Figure 4.6.3-4** respectively.

> When choosing the travel time routes for a subarea model validation, location of Bluetooth transceivers and the number of Bluetooth counts need to be taken into consideration. Determining the travel time validation routes is part of the Transport Modelling Scope Document discussed in **Chapter 3.2.3** of TAM Guidelines.

4.7 Microsimulation Model Audit Checklist

The following checklist must be used to audit the model. The model must be independent audited only after the modeller (or modelling team) has used the self-audit checklist as a quality assurance checklist and is confident that the model satisfies the requirements for the model to be designated fit-for-purpose.

Project Name - Subarea Model - Independent Audit Comments Register
Model Description:

Status	Issue Comment
1	**Major Issue** - requires immediate resolution
2	**Moderate Issue** - needs clarification prior to release of next milestone
3	**Minor issue** - to be addressed in next milestone
4	**Closed**

Item	Model Elements	Built / Refined Base Year Model	Calibrated / Validated Base Year Model	Built Future Year Base Model(s)	Completed Future Year Base Models	Built Future Year Project Case Models	Completed Future Year Project Case Models	Screenshot	Review Status	DIT Response	Modeller Response	Final Status
1	**Model Setup**											
1.1	Aimsun Version											
1.2	Model Folder Structure											
1.3	Model Scope											
1.4	Layers											
1.5	Naming conventions											
1.5.1	Subarea Name											
1.5.2	Centroid Configuration Name											
1.5.2.1	Centroid Names											
1.5.3	Traffic Demands Names											
1.5.4	Origin - Destination Matrix Names											
1.5.5	Path Assignment Names											
1.5.6	Control Plan names											
1.6	Model Time Periods											
1.6.1	Warm-Up											
1.6.2	Peak Hour(s)											
1.6.3	Cool Down											
1.7	Model Year(s)											
2	**Model Development**											
2.1	Model layout and configuration											
2.1.1	Centroid Configuration											
2.1.2	Intersections / Junctions / Section Joins											
2.1.3	Sections											
2.2	Traffic Demands											
2.3	Origin – Destination Matrices											
2.4	Public Transport Plans / Lines											
2.4.1	Source / Model Year											
2.4.2	Train / Tram / Bus Stopping Patterns											
2.5	Vehicle types											
2.6	Road and Lane types											
3	**Real Data Sets**											
3.1	Turning Movement											
3.1.1	Source											
3.1.2	Verification											
3.2	Travel Time											
3.2.1	Source											
4	**Model Parameters**											
4.1	Assignment Type											
4.2	Reaction Times											
4.2.1	Model Step / Reaction Time											

4.2.2	Reaction Time at Stop											
4.2.3	Reaction Time at Signals											
4.3	Arrival Type											
4.4	Turn attributes											
4.4.1	Paths											
4.4.2	Speeds											
4.4.3	Yellow Box Speeds											
4.4.4	Distance Zone 1											
4.4.5	Distance Zone 2											
4.4.6	Initial Cost Functions											
4.4.7	Dynamic Cost Functions											
4.4.8	Turn Penalty Functions											
4.4.9	Junction Delay Functions											
4.5	Section Attributes											
4.5.1	Road Type											
4.5.2	Speeds											
4.5.3	Capacity											
4.5.4	Auxiliary Lanes											
4.5.4.1	Lane Length											
4.5.5	Reserved lanes											
4.5.6	Merge lanes											
4.5.6.1	Cooperation											
4.5.6.2	Cooperation Distance											
4.5.6.3	Merge Distance											
4.5.6.4	Merge: First Vehicle on Is first Vehicle Off											
4.5.7	Volume Delay Function											
4.5.8	Bus Stops											
4.5.8.1	Location / Type											
4.5.8.2	Operation											
4.5.9	Detectors											
4.5.9.1	Location / Type											
4.5.9.2	length											
4.5.9.3	Measuring Capability											
4.6	Section Joins											
4.6.1	Yellow Box											
4.6.2	Lane Changes											
5	**Signal Control Plans**											
5.1	Control Type											
5.2	Yellow Time											
5.3	Red Percentage											
5.4	Single / Dual Ring											
5.5	Phases											
5.5.1	Sequences											
5.5.2	Interphase Times											
5.5.3	Permitted Movements											
5.5.4	Late Start / Early Cut Off											
5.5.5	Call Type											
5.5.6	Green Time											
5.5.6.1	Phase Definitions											
5.5.6.2	Min / Max Green Time											
5.5.7	Permissive Period											
5.5.8	Passage Time											
5.5.9	Detectors											

5.6	Rail Crossings											
5.7	Pedestrian Crossings											
5.8	Coordination											
6	**Model Performance**											
6.1	Route Choice											
6.1.1	Path Files											
6.2	Replication Seeds (SRC Meso / Micro simulations)											
6.2.1	Number of replications											
6.2.2	Seed values											
6.2.3	Model Stability											
6.3	Assignment / Demand warning messages											
6.4	Visual checks											
6.5	Vehicle behaviour											
7	**Model Documentation**											
7.1	Transport Modelling Scope Document Sign off											
7.2	Model Development											
7.3	Modelling Approach											
7.3.1	Description / Justification											
7.3.2	Assumptions											
7.3.3	Limitations											
7.4	Route Choice Approach											
7.5	Model Calibration											
7.5.1	Turns (All)											
7.5.1.1	Full Model period											
7.5.1.2	Warm-Up period											
7.5.1.3	Peak Hour(s)											
7.5.2	Turns (Cars)											
7.5.2.1	Full Model period											
7.5.2.2	Warm-Up period											
7.5.2.3	Peak Hour(s)											
7.5.3	Turns (Trucks)											
7.5.3.1	Full Model period											
7.5.3.2	Warm-Up period											
7.5.3.3	Peak Hour(s)											
7.5.4	Queue Lengths / Formation / Discharge											
7.6	Model Validation - Travel time											
7.6.1	Full Model Period By 15-Minutes											
7.7	Model Stability											
7.7.2	Total Travel Time											
7.7.3	Travel Time Subpaths											
7.7.4	Traffic Flows											
7.8	Model Performance											
7.8.1	Network statistics											
7.8.2	Control Plan											
7.8.2	SIDRA Comparison											
7.9	Conclusions / Recommendations											