PAYGO model user manual – version 2.2

May 2018

NTC AUSTRALIA

National Transport Commission

National Transport Commission

PAYGO model user manual

Report prepared by: Joel Mann
Report reviewed by: Chris Egger

Report outline

Title:	PAYGO model user manual – version 2.2
Purpose:	For information and consultation
Abstract:	This user manual is being released with version 2.2 of the PAYGO model with the aim of helping users to better understand the operation of the model.
Contact:	National Transport Commission L 3/ 600 Bourke Street Melbourne VIC 3000 Ph: (03) 9236 5000 Email: enquiries@ntc.gov.au www.ntc.gov.au

Table of contents

List of tables

List of figures

1. PAYGO model

1.1 Purpose of PAYGO

The pay-as-you-go (PAYGO) model was developed to allocate and recover road costs relating to heavy vehicle operations in Australia. Road costs are defined as the road expenditure required for sustaining, maintaining and operating the current road network in its accepted service condition. In Australia, heavy vehicles are defined as any vehicle or trailer with a Mass Rating for Charging of over 4.5 tonnes. The primary objective of PAYGO is to deliver nationally consistent heavy vehicle charges that recover both capital and operating costs related to heavy vehicle use as they are incurred. These charges are designed to promote the optimal use of the existing network. The National Transport Commission (NTC) has been administering the PAYGO system since 1995. During that time the NTC has completed several heavy vehicle charges determinations aimed at refining the PAYGO system.

Typically, state and local road authorities incur road expenditures independently. The PAYGO model calculates the portion of road costs that are allocated to heavy vehicles based on the vehicle and road usage characteristics of these heavy vehicle classes. The PAYGO model then estimates a set of charges designed to recover these allocated costs.

The PAYGO model estimates the road costs allocated to heavy vehicles by using a cost base, cost drivers and cost allocation rules. The total cost base comprises arterial and local road expenditure reported to the NTC by state/territory road authorities and the Australian Bureau of Statistics (ABS). The cost drivers are derived by using data on vehicle road usage characteristics that are supplied by the ABS in the Survey of Motor Vehicle Use (SMVU) and by state/territory road authorities (heavy vehicle registration data). The NTC then applies a set of cost allocation rules to allocate the cost base to each vehicle class based on the cost drivers.

The objective of the cost allocation process is to ensure that costs are allocated to vehicle classes based on the road usage characteristics of that vehicle. The allocation process ensures that the road user charge (RUC) and registration charges are set so that heavy vehicle classes, as a group, recover their allocated share of road costs.

On 10 November 2017, the Transport and Infrastructure Council (the Council) agreed to freeze charges at 2017-18 levels for a further two years (2018-19 and 2019-20). The roads component of registration charges and the RUC approved by the Council are shown in version 2.2 of the model. The charges shown in the model for the regulatory component of registration charges—which are used to fund the National Heavy Vehicle Regulator—are slightly different to those approved by the Council, despite both sets of charges recovering the same amount of revenue ($148.953m). This difference reflects the fact that the charges approved by the Council were the 2017-18 charges, scaled to recover the desired revenue, whereas those in the model are hypothetical, calculated based on the multi-part allocation method used in the 2014 Determination, with updated usage data.[1] Nevertheless, the model can be used as a basis for any future analytical work to inform Transport Ministers' consideration of heavy vehicle charges.

1.2 Pricing Principles

The NTC has been guided in the development of its heavy vehicle charges recommendations by a number of principles that were endorsed by the Australian Transport Council (ATC). In the 2007 Determination the guiding principles were prescribed as:

[1] This approach was used in order to maintain the formula links in the model showing how the multi-part allocation approach works in practice.

"National heavy vehicle road use prices should promote optimal use of infrastructure, vehicles and transport modes.

This is subject to the following:

- *full recovery of allocated infrastructure costs while minimising both the over and under recovery from any class of vehicle*
- *cost effectiveness of pricing instruments*
- *transparency*
- *the need to balance administrative simplicity, efficiency and equity (e.g. impact on regional and remote communities/access)*
- *the need to have regard to other pricing applications such as light vehicle charges, tolling and congestion."*

The ATC principles provide a degree of flexibility where trade-offs can be made between the principles.

The Council of Australian Governments (COAG) introduced the following additional requirements for heavy vehicle charges:

- On-going cost recovery in aggregate
- The removal of cross-subsidies between vehicle classes.

The COAG requirements reduce flexibility in the calculation of charges.

Both the ATC and COAG principles are standing principles until the relevant authority changes them, and are binding on the NTC.

To achieve the removal of cross-subsidies between vehicle classes, COAG has instructed that all attributable costs must be recovered for each specific vehicle class and that total costs must be recovered in aggregate across all heavy vehicle classes.

Attributable costs are defined in the Productivity Commission's Road/Rail Freight Infrastructure Pricing report as costs which trucks are responsible for creating. This includes the additional level of damage to roads and the deeper pavements required for bearing additional loads to those of light vehicles. Non-attributable costs are defined as costs which are shared with other road users such as light vehicles. These costs include, for example, costs related to provision of street-lighting, signage and traffic management systems.

The PAYGO model's calculation of attributable costs is used to ensure that the registration and fuel charges applied to heavy vehicles are sufficient for vehicle classes to pay, as a group, for their share of road costs according to COAG's requirements. In practice, the pricing principles require that all heavy vehicle classes must pay for their attributable costs as a minimum, and that total costs (non-attributable and attributable costs) for heavy vehicles are recovered in aggregate from all heavy vehicles.

1.3 PAYGO model

The heavy vehicle charges model is based on a PAYGO framework. The model's cost base is calculated on the principle of full cost recovery of both capital and operating road expenditure in any given year. That is, it is not a payment in arrears for expenditure already made on the road network. However, a lag exists due to the difference between the time at which the expenditure and

usage data is collected and the time when the new set of charges is implemented. The use of averaging (over seven years) for the input data—including both expenditure and usage data—is intended to moderate fluctuations and volatility so that there is greater consistency in charges from year to year.

The cost base for charges is calculated using annual arterial road expenditure figures (provided by each state and territory every year against 14 cost categories) as well as local government road expenditure reported by the ABS. These expenditure figures are published in the NTC's annual report and include any contributions made by the Commonwealth Government. Expenditure that is recovered through other sources is excluded from the cost base. This includes an 'amenity' amount from local government that is recovered through local rates. As a result, only 25% of urban local and 50% of rural local road expenditure is included in the model's cost base. The remaining expenditure is known as the allocable cost base, which is then allocated across the entire vehicle fleet to estimate the amount to recover from each vehicle class.

Costs are allocated between light and heavy vehicles and to individual vehicle classes using the cost allocation matrix. The four key parameters used to allocate costs in each cost category to each vehicle class are: average gross mass x kilometres (AGM-km); equivalent standard axles x kilometres (ESA-km); passenger car units x kilometres (PCU-km); and vehicle kilometres travelled (VKT). The cost allocation matrix determines the attributable costs and common costs by vehicle class.

The NTC uses data on fuel consumption from the SMVU and vehicle numbers based on jurisdictional registration data to estimate the revenue collected by governments, overall and for each vehicle class.

2. Model overview, conventions and quick guide

This chapter begins with a short introduction about this manual, followed by an overview of the new version of the PAYGO model. The next sections describe several of the worksheets in the model relating to navigation. The final section of the chapter (section 2.5) provides a quick guide to updating the model in the future.

2.1 Introduction to this manual

This manual has been developed to accompany Version 2.2 of the PAYGO model. The manual is intended to cater to users with differing levels of Microsoft Excel skills and whose purpose of model use ranges from relatively basic to advanced.

Users are likely to find it helpful to read this manual with a copy of the PAYGO model open in front of them so that they can look at the relevant section described by the manual on their screen. Users seeking to achieve a detailed understanding of the model are recommended to read the entire manual; those seeking only a high-level understanding are recommended to read chapters 2, 3 and 5.

2.2 General overview of the PAYGO model and Microsoft Excel

Version 2.0 of the PAYGO model was developed in mid-2014 to show stakeholders the Option A charges recommended by the NTC in its 2014 Determination. Version 2.1 of the model was developed in late 2015 for the purpose of providing updated Option A charges as one of the options for consideration by the Transport and Infrastructure Council in November 2015. This version 2.2 of the model was released in early 2018 to publish more up-to-date usage and expenditure data. The model has been designed with the objective of being more accessible and user-friendly than versions of the model prior to version 2.0. To help achieve this objective, the model uses a number of modelling techniques from a model developed by the Australian Competition and Consumer Commission (ACCC) for pricing telecommunications services called the Fixed Line Services Model.[2] These techniques include the use of masterlists, a model map, lettered/numbered worksheet titles and numbered tables on each worksheet. The model has also been designed with the objective of being relatively easy to update in the future: the model contains space for a variety of model inputs until the 2022/2023 financial year.

The PAYGO model requires Microsoft Excel 2007 (or a later version) to operate.[3] The model is saved as an Excel Macro-Enabled Workbook: it is recommended that users seeking to make changes to the model enable Macros if prompted by Excel. Macros are used in certain worksheets to 'Goal Seek' certain cell values or to return the values in cells to their original values used for Option A charges in the 2014 Determination. Although the model has the option to return certain values (in the two 'assumptions' worksheets) to their original values, users seeking to make any modifications to the model are recommended to save a 'master' version of the model and to make any changes in a different (copied) version of the model.

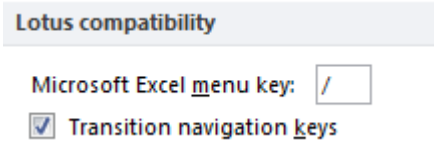
A recommended (but optional) step available to users to improve the hyperlink navigation built into the model is to switch on the 'Transition navigation keys' option listed under 'Lotus compatibility' in Excel (see Figure 1). Enabling this option means that, after clicking on a hyperlink, users will have Excel's 'active cell' displayed at the top of their screen rather than at the bottom (thereby reducing the need to scroll down before seeing their desired section of the worksheet). This option can be

[2] The ACCC's model can be found at the following link: https://www.accc.gov.au/regulated-infrastructure/communications/fixed-line-services/wholesale-adsl-final-access-determination-fad-2013/final-determination .

[3] Certain formulas in the PAYGO model use Excel functions that were unavailable in versions up to and including Excel 2003 (e.g. *IFERROR*), and therefore error messages may appear in the model in older versions of Excel.

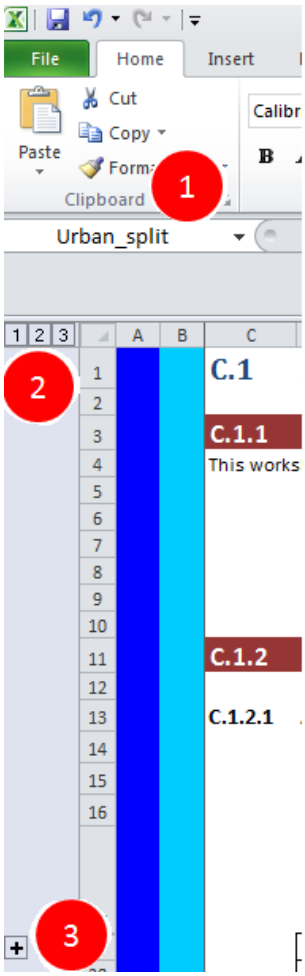
enabled by following these steps: (1) Click on the File menu; (2) Click on 'Options'; (3) Click on 'Advanced'; (4) Navigate down to the 'Lotus compatibility' section—which is near the bottom of 'Advanced'—and tick the box titled 'Transition navigation keys'.

Figure 1. Transition navigation keys



There are other useful navigation features built into the model. Firstly, the model uses 'named cells' for a number of frequently-used cells in the model. Named cells can make it easier for users to understand complex formulas. One example of a 'named cell'—which depicts the urban split percentage—is shown next to the number 1 in Figure 2 below.[4] Secondly, the model makes use of 'cell grouping' in a number of worksheets. Grouping can be used to 'temporarily hide' certain rows or columns in a worksheet that may contain unnecessary or detailed values. To group or ungroup rows, users can either click on the numbers (shown above the number 2 in Figure 2), or click on the plus sign (shown next to the number 3 in Figure 2).

Figure 2. Cell grouping and named cells



[4] Users can see the entire list of named cells used in the model by clicking on the arrow next to the named cell.

2.3 ‘Cover page’

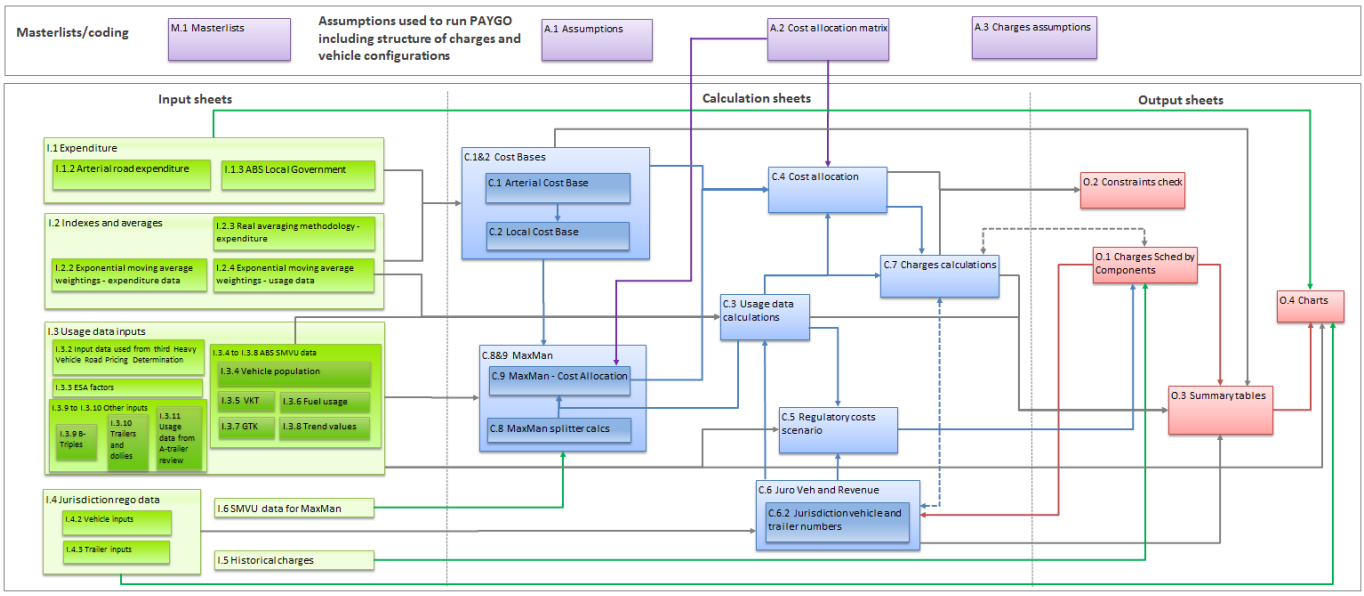
The ‘cover page’ worksheet provides some background details on the model, including: the version of the model; the date on which it was published; and a brief overview of the PAYGO framework and specific details of the model.

2.4 ‘Clickable model map’

The ‘Clickable model map’ worksheet is an important navigational tool in the model. As the worksheet’s name implies, the objects in the map are hyperlinked, meaning users can navigate to a particular worksheet, or section of that worksheet, by clicking on the map. Users seeking a deeper understanding of the model should spend some time familiarising themselves with the contents of this worksheet: the map provides an overview of worksheets’ functionality as well as the flows of information between worksheets.

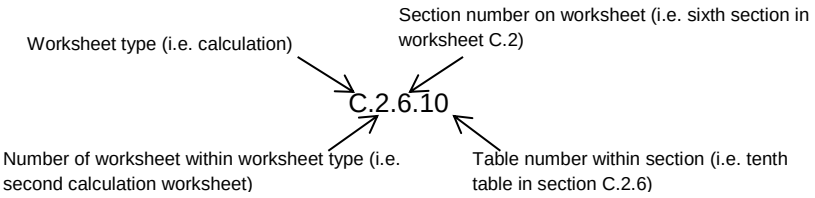
The worksheets depicted in the map (pictured below in Figure 3) are grouped together by colour; the colours of worksheets in the map also correspond to the ‘tab colours’ of those worksheets at the bottom of the Excel workbook. The purple objects at the top of the map represent the worksheets containing masterlists and the model’s assumptions. The green-coloured objects on the left side of the map are the input worksheets: these contain the model’s expenditure and usage data, as well as historical charges and some indexes. The blue objects in the centre of the map are the calculation worksheets which use data from the inputs and assumptions worksheets—as well as referring to other calculations worksheets—to make the necessary calculations for the model. Finally, the red-coloured objects on the right of the map represent output worksheets which mainly rely on the calculations worksheets to produce the model’s outputs. The output worksheets, and to a lesser extent the assumptions worksheets, are likely to be the most relevant parts of the model for most users.

Figure 3. Clickable model map screenshot



As shown in the map, each worksheet’s name starts with a letter indicating whether that worksheet relates to masterlists (M), assumptions (A), inputs (I), calculations (C) or outputs (O). These letters are followed by a number, or series of numbers, to allow each worksheet—and the sections and tables within it—to be ordered in a logical way. For clarity, Figure 4 provides an example of the way in which the lettering and numbering system works in the PAYGO model.

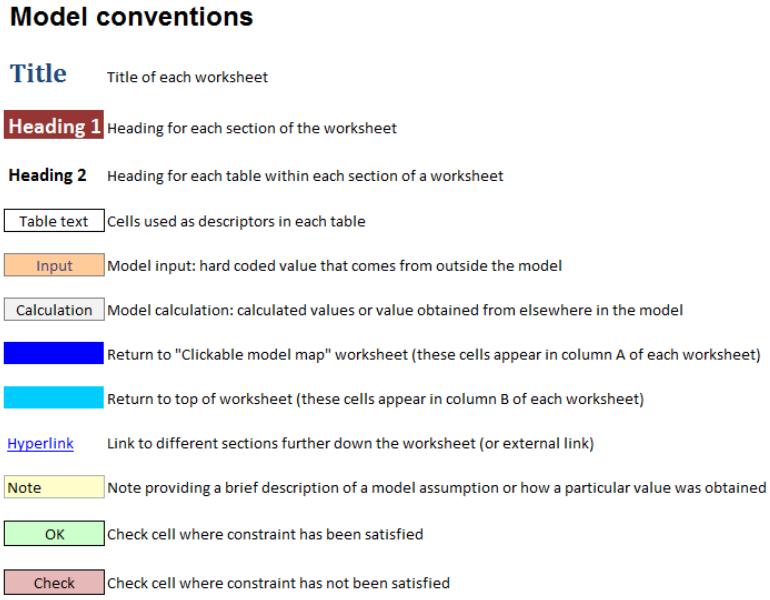
Figure 4. Lettering/numbering system in the PAYGO model



The map's arrows show all the flows of information between worksheets. Typically these flows are from one worksheet to another; however, in some cases there is a mutual flow of information between worksheets (which is depicted in the map with dashed lines). There is a broad correspondence between the colours of the arrows and worksheets in the map (for example, blue arrows with blue worksheets). However, this convention is broken in certain instances to ensure that no two arrows of the same colour cross each other, which will assist users to trace the flows of information between worksheets.

The conventions used in the model for different cells are listed below the map in the 'Clickable model map' worksheet (and are also shown in Figure 5 below). Understanding the conventions depicted in these cells will assist users in navigating through the model's worksheets. The title and headings appear on each worksheet in the model—other than the cover page and clickable model map—to assist with navigation and allow this manual (or users generally) to more precisely describe a section of the worksheet that they are referring to.[5] Sections and tables on a worksheet are numbered sequentially and typically flow vertically down a worksheet, with limited instances of data being off-screen to the right. In many worksheets in the model, the important 'summary' or 'output' information is available in tables in the top section of the worksheet (X.X.2); these tables refer to more detailed calculations underlying them which appear further down that worksheet.

Figure 5. Model conventions



Input cells, shown in orange-coloured cells, are user inputs that are 'hard-coded' values, meaning that they are directly inputted by the user and do not have any formula underlying them.[6] 'Table

[5] The areas under 'Heading 1s' will be referred to in this manual as 'Sections' while those under 'Heading 2s' will be referred to as 'Tables'.

[6] Note that some 'input cells' in the 'A.3 Charges assumptions' worksheet are values established through Excel's 'Goal Seek' function.

text' cells are used to describe the content of each row and column in a table. 'Calculation' cells contain formulas: these may be actual calculations, or simply references to a cell elsewhere in the model.

The next three conventions are useful for navigating the model. The darker blue cell appears in column A of every worksheet: if clicked on, this cell will return a user to the 'Clickable model map' worksheet. The lighter blue cell appears in column B of every worksheet and returns a user to the top of the current worksheet they are on. The hyperlink cells appear near the top of every worksheet and can be used to navigate directly to a section further down in that worksheet without needing to scroll. Together, these tools can be used to navigate around the model with ease: users can reach any section of the worksheet within three mouse-clicks, no matter where they are currently located in the model.

'Note' cells appear in a number of worksheets throughout the model and are used to convey information for a range of purposes. For example, some note cells describe how certain input values were calculated; others explain certain procedures in the model that occur in nearby cells. Finally, the light green and pink cells represent check cells: these use conditional formatting to alert a user as to whether a given check has been satisfied or not.

2.5 Quick guide to updating the model

A number of steps will need to be followed to update the model annually as new data becomes available. Table 1 summarises these steps.

Table 1. Steps needed to update the model

Worksheet	Sections	Description
I.1	I.1.2 and I.1.3	Add expenditure data (for each jurisdiction and expenditure type) for the new year.
I.2	I.2.3	Add updated RCMPI value. Note that the updated value should only be added if the model is being updated—as soon as a value is added, the indexing factors for all previous years will change.
I.3	I.3.4 to I.3.7	Add updated SMVU data (if available for that year). When entering new data, users should be mindful that the units specified in the model's tables may differ to the units reported in the SMVU for each type of data.
	I.3.8	Update trend calculations if new SMVU data is available and has been entered in sections I.3.4 to I.3.7. The following steps are necessary (assuming the trend would continue to be calculated based on the seven most recent years of available SMVU data). (i) Change the years listed in the relevant rows of the worksheet (281, 321, 361, 401), removing the oldest year and adding the latest year; (ii) Link the data for each year to the relevant year in the corresponding tables above (note that the single year in the table column headings is the second year when listed in a financial year format, e.g. 2012 should be linked to 2011/2012).
	I.3.9	Update B-triple vehicle population (if available for that year).
	I.3.2 and I.3.3	[Optional] If new data is available for these use data inputs, amend the relevant tables to add it in. This data is not based on a particular time period (like the expenditure data and SMVU data) and therefore does not require adjustment annually.
I.4	I.4.2 and I.4.3	Add each jurisdiction's registration data (for each vehicle and trailer type) for the four quarters of the new year.

	I.4.8	Add each jurisdiction's registration data (for each type of 2 axle rigid truck) for the four quarters of the new year.
	I.4.9	Add data on the number of B-triples in each jurisdiction for the new year.
I.5	I.5.2	Extend table I.5.2.2 to the next relevant period and input the latest fuel excise and fuel tax credit rate. Then subtract the fuel tax credit rate from the excise to calculate the RUC. Finally, input the calculated RUC into table I.5.2.1.
	I.5.3	Enter registration charges for the previous year into the relevant table(s) in section I.5.3: that is, the roads component and regulatory component of registration charges (the total charges are calculated automatically by summing the two components).
I.6	I.6.2 and I.6.3	If new SMVU data is available, update all tables in these sections with the new data. Change the year in the section headings in rows 10 and 586 of the worksheet—all table headings should then update automatically.
A.1	A.1.2	Change model year to the relevant year.
	All other sections	[Optional] Change any other assumptions as desired.
A.3	A.3.18 and A.3.19	Add updated charges in sections A.3.18 and A.3.19.
	A.3.8 to A.3.10	[Optional] Add updated vehicle shares from the SMVU if new data is available, ensuring that the shares sum to 100 per cent.
	A.3.3 to A.3.5	[Optional] Add updated NHVR budget (section A.3.3), and change parameters for recovery of these costs if desired (sections A.3.4 and A.3.5).
	A.3.2, A.3.7, A.3.11, and A.3.22	Run all Goal Seeks by clicking on the 'Run Goal Seek' button in each of these sections.
	All other sections	[Optional] Change any other assumptions as desired.

3. Assumptions and Masterlists worksheets

This chapter describes the content in the masterlists worksheet and each of the three assumptions worksheets. Any user wishing to change the assumptions used in the model will need to have an understanding of the way these worksheets operate. The sections below describe the worksheet functions and the effect that any changes made in them will have.

3.1 'M.1 Masterlists'

Users should not need to make any changes to the 'M.1 Masterlists' worksheet. The purpose of the masterlists worksheet is to form a single reference point for formulas in other locations in the model. For example, some cells in the worksheet form the options lists for 'data validation' tools such as drop-down menus that appear in the two assumptions worksheets. Other tables are used for the purpose of having titles for table rows and columns in other worksheets (for example, years, vehicle classes or jurisdiction names) using Excel's *VLOOKUP* function. The main benefits of a masterlists/*VLOOKUP* approach are that: names (e.g. vehicle classes) appear in a consistent order throughout the model; all names are spelled consistently throughout the model; and names can be edited very easily throughout the model by simply changing the text in a single cell in the masterlists worksheet (which will update the references to that cell throughout the model).

3.2 'A.1 Assumptions'

The assumptions worksheet contains the model's assumptions relating to the cost base. Assumptions have been centralised in a single worksheet to achieve transparency and to enable users to easily make changes to assumptions and observe the effect this has on the model's results. Many of the input cells contain 'data validation' techniques—such as drop-down menus or restrictions on the ranges of values that can be entered—which prevent users from entering assumptions that would be illogical or have not been built into the model. The use of 'data validation' techniques also helps users to determine what values can be entered: clicking on an orange input cell will generally bring up a dialogue box (with instructions about values that can be entered in that cell) and may bring up an arrow to the right of the box with a drop-down menu. If users enter a value that is outside the range of allowed values they will receive an error message containing instructions on what values can be entered in that cell. Another feature of this worksheet that may assist users is the 'Reset to Option A values' button that appears in section A.1.1 of the worksheet. When clicked on, this button will run a macro that returns all input cell values on the worksheet to their values for Option A charges used for the November 2015 Transport and Infrastructure Council meeting (macros must be enabled for this feature to work). Table 2 describes the sections on the worksheet in more detail and the purpose of the assumptions.

Table 2. Description of assumptions in worksheet 'A.1 Assumptions'

Section	Description
A.1.2	The model year in section A.1.2 is the (financial) year which the model will estimate charges for. This is an important cell that is used in many places in the model. Hence, it is important that users remember to update the cell if using the model for future years. However, users should not change the model year until they have all of the necessary input data for the following year (otherwise error messages may arise in certain parts of the model). The 'Year for usage data' cell below automatically updates whenever the model year is changed.
A.1.3	Section A.1.3 allows users to choose the methodology for averaging expenditure data when calculating the model's cost base: the available choices are EMA (Exponential Moving Average) or Real. Real consists of a simple moving average of RCMPI-indexed expenditure. Changing the option selected here will result in changes to the tables in sections C.1.2 and C.2.2 (and subsequently the cost

Section	Description
	base).
A.1.4	Section A.1.4 allows users to choose how many years of historical expenditure data to average when calculating the cost base, up to a maximum of seven years. The option selected here applies to both arterial and local expenditure.
A.1.5	The PAYGO model splits total expenditure into 'urban' and 'rural' components based on a percentage figure calculated using historical data. The value selected in A.1.5 determines how many years of historical data are used to calculate the percentage figure: up to 7 years of historical data can be selected.
A.1.6	A value for 'alpha' is required as part of the EMA methodology: alpha is the smoothing factor. It must take a value between 0 and 1 (inclusive). Larger values of α reduce the level of smoothing. Section A.1.6 requires users to specify a value for alpha (for expenditure data).
A.1.7	Section A.1.7 requires users to input the percentage of local road expenditure that is allocable for the PAYGO model. Some local road expenditure is for access/amenity purposes and is therefore assumed to not be allocable to the cost base in the model. Users must input an integer/whole number between 0 and 100 (inclusive), for each of urban and rural local road expenditure. The lower the numbers entered, the lower the cost base will be.
A.1.8	The 'H3' expenditure category comprises spending on local access roads in unincorporated areas, which is assumed to occur in rural areas only. Section A.1.8 allows users to specify that the expenditure is occurring only in rural areas. If the 'No' option is selected, expenditure will be split according to the same urban/rural split percentages as other categories of expenditure.
A.1.9	The NTC receives local road expenditure data in a relatively aggregated format; however, the PAYGO model requires all expenditure to be specified in the NTC's expenditure categories. The proportions of (total) arterial expenditure in each expenditure category are used as the basis for allocating local road expenditure to expenditure categories. Section A.1.9 allows users to specify whether nominal or real arterial expenditure is used to determine the proportions (note that the proportions are relatively insensitive to the methodology selected).
A.1.10	Local expenditure data is adjusted to remove expenditure in the H1 and H2 expenditure categories (which involve financial assistance to local governments), and to add expenditure from the H3 to H5 expenditure categories. This net adjustment for H-category expenditure is then apportioned to the 'A to F' local expenditure categories on the basis of the proportion of total arterial expenditure made up by each ('A to F' arterial) expenditure category. Section A.1.10 allows users to select whether nominal or real arterial expenditure data is used to calculate these proportions.
A.1.11	Section A.1.11 allows users to determine which averaging methodology is used to estimate the vehicle population data. The options available are 'EMA', 'Trend' or 'Latest registration data'. The EMA and Trend options use data from the ABS's SMVU, with the averaging settings (for EMA) based on the options selected in sections A.1.13 to A.1.16. The 'Latest registration data' option uses the most recent year of registration data supplied by jurisdictions—averaging the starting and ending values for each quarter and then averaging across the four quarters—to calculate the vehicle population data. Users selecting the 'Trend' option may need to make some adjustments in section I.3.8 of the model to ensure that the correct trend values are calculated (if new SMVU data has been added to the model). See further discussion in section 4.3 below.
A.1.12	Section A.1.12 allows users to select which averaging methodology is used to calculate the VKT, fuel consumption and GTK (Gross Tonne Kilometres) values, using data from the ABS's SMVU (and based on the settings selected in sections A.1.13 to A.1.16). Options available for averaging are 'EMA' or 'Trend'.

Section	Description
	Users selecting the 'Trend' option may need to make some adjustments in section I.3.8 of the model to ensure that the correct trend values are calculated (if new SMVU data has been added to the model). See further discussion in section 4.3 below.
A.1.13	Section A.1.13 allows users to choose how many years of historical usage data to average when calculating the model's usage data using the EMA methodology, up to a maximum of eight years. The option selected here applies to all types of usage data that are averaged using the EMA methodology.
A.1.14	A value for 'alpha' is required as part of the EMA methodology: the alpha must take a value between 0 and 1 (inclusive). Section A.1.14 requires users to specify a value for alpha (for usage data).
A.1.15	The ABS's SMVU is no longer conducted annually. In order to have 7 years of data with which to calculate EMA values, it is possible to repeat data points from the most recent SMVU for years where the SMVU was not conducted. Section A.1.15 allows users to determine whether to repeat existing data points (as the NTC did in calculating Option A charges for the 2014 Determination) or not.
A.1.16	The ABS's SMVU does not currently contain data on B-triples. Therefore, it is necessary to make an adjustment to the SMVU data for the triple road trains vehicle class to impute usage data for B-triples. Section A.1.16 allows users to select whether to make this adjustment or not; it is recommended that users leave this option on 'Yes'.
A.1.17	Section A.1.17 allows users to select which set of ESA factors is used in the model (primarily for cost allocation purposes). A drop-down list is available providing users with all of the possible options.
A.1.18	Section A.1.18 allows users to specify whether or not to adjust the cost base using the outputs of the MaxMan module. The options available (Yes or No) determine which set of costs are used in worksheet 'C.4 Cost allocation'.
A.1.19	Section A.1.19 allows users to specify the percentage of travel on unsealed roads travelled by certain vehicle classes. This is used to calculate a discount for these vehicle classes. Users must input an integer/whole number between 0 and 100 (inclusive), for each vehicle class listed.
A.1.20	Section A.1.20 allows users to specify the CSO discount attributable to certain vehicle classes. Users must input an integer/whole number between 0 and 100 (inclusive), for each vehicle class listed.

3.3 'A.2 Cost allocation matrix'

This worksheet contains the cost allocation matrix. The matrix is used for allocating costs in two worksheets in the model: 'C.4 Cost allocation' and 'C.9 MaxMan - Cost Allocation'.

3.4 'A.3 Charges assumptions'

This worksheet contains the inputs/assumptions used for calculating charges or revenues in the model. As with worksheet 'A.1 Assumptions' there is a button in the top section of the worksheet (A.3.1) that allows users to reset all the assumptions on the sheet to their Option A values. The worksheet also contains a number of buttons titled 'Run Goal Seek' which, when clicked on, run a Macro using Excel's Goal Seek function to determine the input value in that section of the worksheet. As in worksheet 'A.1 Assumptions', some input cells contain data validation techniques to provide instructions to users about what values can be input into those cells and to restrict the inputs to that particular set of values. Table 3 below describes each section of the worksheet in greater detail.

Table 3. Description of assumptions in worksheet 'A.3 Charges assumptions'

Section	Description
A.3.2	Section A.3.2 requires users to input the RUC/fuel charge (in cents per litre) in the orange-coloured cell. Most users will probably need to enter this value by pressing the 'Run Goal Seek' button. When clicked on, this button runs a 'Goal Seek' to ensure that the difference between the total cost recovery and the total cost base—as calculated in worksheet 'C.7 Charges calculations'—is 0. Note that, to achieve plausible results, this Goal Seek calculation relies on there being input values for registration charges entered further down in the worksheet (sections A.3.18 and A.3.19). If users make any changes to inputs or assumptions in the model, they will likely need to run this Goal Seek again to ensure that total cost recovery is equal to the total cost base. The grey-coloured cell below updates automatically and simply rounds the value entered for the RUC to one decimal place.
A.3.3	Section A.3.3 allows users to specify the assumed budget for the National Heavy Vehicle Regulator (NHVR). This value is used in the model to estimate the regulatory component registration charges that apply. Users should input a value (in units of $m) in the orange-coloured cell. The grey-coloured cell below updates automatically and simply specifies the value in the cell above in units of $ rather than $m. Users should re-run the Goal Seeks in sections A.3.7 and A.3.11 (in that order) if they make any changes to the assumed NHVR budget to ensure that the charges specified in the model recover that budget.
A.3.4	The assumed NHVR budget, as specified in section A.3.3, is recovered from most categories of heavy vehicles according to multi-part allocation rules. The allocation rules attribute a certain proportion of the regulatory costs to be recovered via: a fixed fee on each vehicle; the AGM of each vehicle class (recovered via a fixed fee on each vehicle in that vehicle class); and the VKT of each vehicle class (recovered via a fixed fee on each vehicle in that vehicle class). Users are required to specify the proportions allocated according to these rules in section A.3.4. The proportions—and NHVR budget specified in A.3.3—are used to calculate the regulatory component of registration charges for rigid trucks and buses. (Charges for articulated trucks are based on the values specified in sections A.3.5, A.3.6 and A.3.7.) The proportions specified by the user should sum to 100 (per cent). If they sum to less than 100, cell E45 will show an error message stating that the percentages do not sum to 100. If they sum to more than 100, users will receive an error message and they will be prevented from entering that value. To increase a percentage value in one cell, users will first have to decrease the percentage value in a neighbouring cell (or cells) by the corresponding amount.
A.3.5	Section A.3.5 requires users to specify the charge per trailer for the purposes of recovering the NHVR budget.
A.3.6	Section A.3.6 contains the charge per short combination prime mover for the purposes of recovering the NHVR budget. This charge is a calculated value based on the charge for a multi-combination prime mover (specified in section A.3.7) and the relativity between short combination and multi-combination prime movers (specified in section A.3.12).
A.3.7	Section A.3.7 requires users to specify the charge per multi-combination prime mover for the purposes of recovering the NHVR budget. However, most users will probably need to input this value by clicking on the 'Run Goal Seek' button to ensure that the overall NHVR budget specified in section A.3.3 is recovered. This Goal Seek will likely need to be re-run if users make any changes in sections A.3.3

Section	Description
	to A.3.6 or A.3.12.
A.3.8	The registration data collected from jurisdictions contains information on the number of prime movers with a given number of axles (in this case, 2). However, the NTC's vehicle classes—which specify a particular type of vehicle and the total number of axles for that vehicle—can potentially be made up of a number of different prime mover/trailer combinations. The numbers specified in section A.3.8 provide the assumed proportions that are used to assign the 2 axle prime movers in the registration data to the NTC's vehicle classes. The default values in the model were calculated based on the proportions of each vehicle class (that uses a 2 axle prime mover) as a proportion of all vehicle classes that use a 2 axle prime mover, based on data from the 2010 SMVU. If users make any changes to default values, they should ensure that the total sums to 100% (otherwise an error message may appear). To increase a percentage value in one cell, users will first have to decrease the percentage value in a neighbouring cell (or cells) by the corresponding amount.
A.3.9	The same explanation as for section A.3.8 applies here: it is necessary to allocate prime movers with a particular number of axles (in this case, 3) as specified in jurisdictions' registration data to the NTC's vehicle classes. The default values in the model were calculated based on the proportions of each vehicle class (that uses a 3 axle prime mover) as a proportion of all vehicle classes that use a 3 axle prime mover, based on data from the 2010 SMVU. If users make any changes to default values, they should ensure that the total sums to 100% (otherwise an error message may appear).
A.3.10	A similar explanation as for section A.3.8 applies here: it is necessary to allocate prime movers with a particular number of axles (in this case, multi-combination prime movers with 3 axles) as specified in jurisdictions' registration data to the NTC's vehicle classes. Unlike sections A.3.8 and A.3.9, these shares are calculated on a jurisdiction-by-jurisdiction basis. Another difference is that the default values in the model are based on an average of the shares in the 2006, 2007 and 2010 SMVUs, rather than just using the 2010 SMVU (as was the case for the shares in A.3.8 and A.3.9). If users make any changes to default values, they should ensure that the total for each jurisdiction sums to 100% (otherwise an error message may appear).
A.3.11	Section A.3.11 contains a Goal Seek value which is used to 'scale' the regulatory component of registration charges. The regulatory component of registration charges for each vehicle class is initially calculated in worksheet 'C.5 Regulatory costs scenario' using the NTC's vehicle classes. The scaling factor in section A.3.11 is then applied to these charges to ensure that the assumed NHVR budget is also recovered when using jurisdictions' vehicle classes (in section C.6.4 of worksheet 'C.6 Juro Veh and Revenue'). Users may need to re-run the Goal Seek if they make changes to any of the assumptions.
A.3.12	Section A.3.12 contains scaling factors that are applied to certain vehicle classes to obtain differentiated registration charges (for the regulatory component) relative to similar types of vehicles (e.g. vehicles with fewer axles). These scaling factors are applied in table C.5.2.1 of worksheet 'C.5 Regulatory costs scenario'.
A.3.13	Section A.3.13 contains scaling factors that are applied to certain vehicle classes to obtain differentiated registration charges (for the roads component) relative to similar types of vehicles (e.g. vehicles with fewer axles). These scaling factors are applied in table O.1.2.2 of worksheet 'O.1 Charges sched by components'.
A.3.14	Section A.3.14 allows users to select whether rounded or unrounded charges are used to calculate the recovery of the regulatory component of registration charges in worksheet 'C.6 Juro Veh and Revenue'. It is recommended that users leave this

Section	Description
	option on 'Unrounded'.
A.3.15	Section A.3.15 allows users to select which charges structure option is used for trailer charges. This cell determines which set of charges listed in section A.3.18 is used in the charges calculations. Users must select one of the options available from the drop-down list: status quo axle charges; standard axle charges; and axle grouping charges.
A.3.16	Section A.3.16 allows users to specify whether or not a discount should be applied to the roads component of registration charges for dollies. If the 'Yes' option is selected, the charge applied to dollies will be $0; if the 'No' option is selected, the charges for dollies will be those specified in table A.3.18.7.
A.3.17	Section A.3.17 allows users to specify 'floor' charges for certain vehicle components. The floor for powered units determines the minimum price that can be charged for the roads component of registration charges in table C.7.6.1 of worksheet 'C.7 Charges calculations'. If the charge estimated by the model is lower than the 'floor' charge, the floor charge will apply. The 'floor' for trailers works in the same way, and also applies in table C.7.6.1. The floor for total charges is used in table O.2.2.1 in worksheet 'O.2 Constraints check' to ensure that the minimum prime mover registration charge—combining both the regulatory and roads components—exceeds the 'floor' charge specified.
A.3.18	Section A.3.18 allows users to specify the charges applicable to trailers under different charge structures. The charges under different structures are entered in the first three tables. A registration scaling factor for axle grouping charges is entered in table A.3.18.4: this is multiplied by the values in table A.3.18.3 to calculate the values in A.3.18.5. The charges for 'rigid' trailers—that is, trailers towed by rigid trucks—are calculated in table A.3.18.6 in a different way to 'articulated' trailers. The charge for single axle 'rigid' trailers is determined by the charge structure option selected in A.3.15. The charges for 'rigid' trailers with multiple axles are determined by multiplying the single axle charge by the number of axles. The charges for dolly trailers can be specified in table A.3.18.7; however, these charges will not be applied unless the 'No' option is selected in section A.3.16.
A.3.19	Section A.3.19 contains the roads component registration charges for powered units. These are the initial values determined before the application of any 'floor' charges. These charges are used in table C.7.6.1 in worksheet 'C.7 Charges calculations'.
A.3.20	Section A.3.20 outlines the vehicle components, as well as the assumed number of axles per component, in each of the NTC's vehicle classes. The table is used to calculate the charges for each vehicle class in table C.7.2.3 in worksheet 'C.7 Charges calculations'. It is also used in tables O.1.3.2 and O.1.3.3 in worksheet 'O.1 Charges sched by components'. The table may also assist users to better understand the vehicle configuration assumptions underlying the model's calculations.
A.3.21	Section A.3.21 outlines the assumed number of axles for each vehicle class under each of the different charging structure options. These figures are used to calculate the estimated (roads component) trailer registration charge in table C.7.5.2 in worksheet 'C.7 Charges calculations', under each of the charge structure options.
A.3.22	Section A.3.22 contains input values calculated using Excel's 'Goal Seek' function. The Goal Seek is designed to ensure that the cells titled 'Spare trailer percentage' take a value of zero in tables C.6.5.3 and C.6.5.4 in worksheet 'C.6 Juro Veh and Revenue'. That is, it scales the assumed total revenue when calculated using the NTC's vehicle classes (in table C.6.3.4 in worksheet 'C.6 Juro Veh and Revenue') to ensure that it matches the assumed total revenue when calculated using

Section	Description
	jurisdictions' vehicle classes (in table C.6.3.3).

4. Input worksheets

This chapter outlines the model's input worksheets. These worksheets contain the model's expenditure and usage inputs, as well as the indexing and averaging data used to construct the cost base and usage data set. Users seeking only a high-level understanding of the model may wish to skip this chapter and continue by reading chapter 5 of the manual.

4.1 'I.1 Expenditure'

This worksheet contains two sections: one for arterial road expenditure and one for local expenditure. Each section in the worksheet contains 18 numbered tables—one for each year from 2005/2006 to 2022/2023. Within each year, expenditure is disaggregated by the type of expenditure (e.g. expenditure category) and by jurisdiction.

4.1.1 Section I.1.2 Arterial road expenditure

This section contains a series of tables showing arterial expenditure in each year. Australia-wide total expenditure is the left-most table for each year. This table sums the expenditure data for each of the jurisdictions, which is entered in the tables to the right.[7] As new data becomes available for future years it can be entered directly into the relevant tables (in the orange-coloured input cells) for each jurisdiction.

4.1.2 Section I.1.3 ABS Local Government Expenditure Data

Like section I.1.2, this section shows expenditure data disaggregated by jurisdiction and expenditure type for each year in the model. However, because the local expenditure data is not disaggregated to as fine a level of detail as the arterial expenditure data, the data fits in a single table for each year. Users can update the model with new data in the relevant tables as it becomes available in the future.

4.2 'I.2 Indexes and averages'

This worksheet calculates the indexes and averaging methodology parameters that are used to calculate average usage and expenditure data in the model's calculation sheets. Users should not enter any data in this worksheet except for updated values for the Road Construction and Maintenance Price Index (RCMPI) in row 28 of the worksheet (in table I.2.3.1) as they become available in future years. All other values in this worksheet are calculated automatically, mainly based on users' assumption choices in worksheet 'A.1 Assumptions'.

Tables I.2.2.1 and I.2.4.1 are identical in structure: the only difference is that the former is applied to expenditure data and the latter to usage data. The tables conduct the necessary calculations to derive weightings for each year of historical data based on the assumption choices made by users (in worksheet 'A.1 Assumptions') for the model year, how many years of data to average (i.e., the averaging period) and the value for 'alpha'. The weighting values calculated in the tables will update automatically in response to changes to any of these assumptions.

Table I.2.3.1 calculates the index values for the RCMPI which are used for indexing expenditure if the real methodology is selected in section A.1.3 of worksheet 'A.1 Assumptions'.[8] Users should enter updated RCMPI values as the model is updated every year to ensure that the expenditure

[7] This is one of the only areas in the model where users will need to move their screen horizontally to view data. However, users wishing to see detailed expenditure data for individual jurisdictions can look at section O.3.4 in worksheet 'O.3 Summary tables' of the model.

[8] The RCMPI may also be used to calculate real expenditure for allocation purposes, depending on the options selected in sections A.1.9 and A.1.10 of worksheet 'A.1 Assumptions'.

values are indexed to the correct terms. Note that the year in which the last value inputted for RCMPI in table I.2.3.1 should match the year listed in the 'Year for usage data' cell in section A.1.2 of worksheet 'A.1 Assumptions'—that is, the year in both cases should be two years before the model year that is selected in section A.1.2.

Finally, table I.2.4.2 automatically calculates EMA weightings for the scenario where data points are not repeated in the years where SMVU data is unavailable. Essentially, this table determines how many years of SMVU data are available within the historic averaging period selected by the user and assigns EMA weights to the data for each of those years based on the alpha value selected by the user. Note that this table will not be used unless the 'No' option is selected in section A.1.15 (which is not recommended).

4.3 'I.3 Usage data inputs'

This worksheet contains most of the usage data inputs used in the model. Users will need to update a number of sections of the worksheet as new data becomes available, as discussed in more detail below.

4.3.1 Section I.3.2 Input data used from third Heavy Vehicle Road Pricing Determination

This section contains input data, for each vehicle class, on the Average Gross Mass (AGM), Passenger Car Unit (PCU) and assumed percentage of arterial travel. The data in the orange-coloured cells is sourced from the third heavy vehicle charges determination. The data in the grey-coloured cells is based on data from section C.3.2 (which is based on SMVU data). The data in this section is used elsewhere in the model for cost allocation purposes.

4.3.2 Section I.3.3 ESA factors

This section contains a number of different input values for ESA factors (in table I.3.3.1). Users can select which of these options to use in the model's calculations in section A.1.17 of worksheet 'A.1 Assumptions'. Users can also add additional ESA factors if and when they become available in one of table I.3.3.1's columns titled 'Additional option', and rename the column appropriately.

4.3.3 Sections I.3.4 to I.3.7 SMVU data

Sections I.3.4 to I.3.7 contain data from the ABS's SMVU on a number of different model inputs: vehicle population; VKT; fuel usage and GTK. This data is used as the basis for a number of cost allocation calculations, after being averaged using the averaging assumptions specified in sections A.1.11 to A.1.16 of worksheet 'A.1 Assumptions'. Users may need to enter new data as it becomes available in the relevant column of each table. When entering new data, users should be mindful that the units specified in the model's tables may differ to the units reported in the SMVU for each type of data. For example, the ABS may report VKT in 'thousands', in which case it will be necessary to multiply the ABS's figures by 1,000 before entering them into the model.

4.3.4 Section I.3.8 Calculated trend values

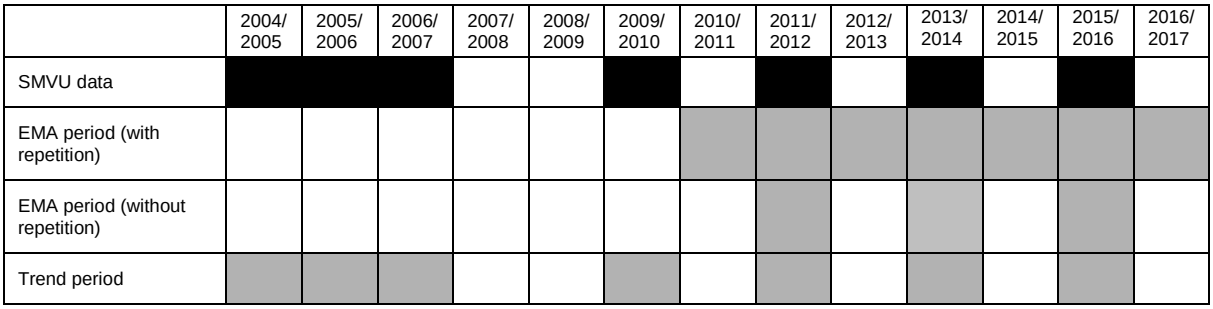
The tables in section I.3.8 use the SMVU data for each input to calculate trend values. The trend values shown in these tables are only used elsewhere in the model if the 'Trend' option has been selected in sections A.1.11 and A.1.12. There are two relatively detailed points to make about the use of the trend methodology which are discussed in the two following paragraphs: non-advanced users of the model may wish to skip to the paragraph after Figure 6.

Firstly, although the trend values listed are correct for the purposes of the charges for 2018-19, the calculations in this section *will not* update automatically in the future when new SMVU data is

added.[9] Although the *TREND* formula (in column P) itself is 'dynamic'—that is, it calculates the trend to the correct year whenever the model year is changed in section A.1.2—the source data underlying the trend is not. Therefore, if new SMVU data becomes available and is entered into sections I.3.4 to I.3.7, users will need to change the seven years of source data used in the trend calculations (in tables I.3.8.1 to I.3.8.4). Hence, if new SMVU data is added, users will need to follow the steps outlined in the relevant section of Table 1 to update the trend calculations.

Secondly, the averaging period used for the trend methodology differs to the averaging period for the EMA methodology. The EMA methodology uses data from the *seven previous years* (with or without repeated data points, depending on the option selected in A.1.15) to calculate an average; the trend methodology uses the *last seven years of available SMVU data* to calculate the trend. The distinction between these terms is illustrated diagrammatically in Figure 6 below, for the assumed charge determination period of 2018/2019.

Figure 6. SMVU data availability and averaging periods for EMA and Trend



4.3.5 Section I.3.9 Assumed B-triple vehicle population

Section I.3.9 contains data on the assumed B-triple vehicle population during any particular financial year. The data in this table is used in the EMA calculations (and indirectly in the Trend calculations) because of the absence of data on B-triples in the SMVU. However, the data will not be used if the 'Latest registration data' option is selected in section A.1.11 of worksheet 'A.1 Assumptions'.

4.3.6 Section I.3.10 Articulated trucks: number of trailers and dollies

Section I.3.10 contains information on the number of trailers and dollies for articulated trucks. The data from this table is used in table C.5.5.1 in worksheet 'C.5 Regulatory costs scenario' to calculate the regulatory component of registration charges for articulated trucks.

4.3.7 Section I.3.11 Usage data from A-trailer review

Section I.3.11 contains usage data—namely GTK and VKT—for each vehicle class, which is sourced from the A-trailer review.

4.4 'I.4 Jurisdiction rego data'

This worksheet contains input data on the vehicle population from jurisdictions' registration data. The key purpose of this worksheet is to calculate annual averages (for each financial year) of the vehicle and trailer population using the registration data supplied by jurisdictions to the NTC. Although this is a very large worksheet, significant parts of it are used to (automatically) perform calculations on the input data to transform it into an annual figure which is used elsewhere in the

[9] It is difficult to use Excel's *TREND* function with non-contiguous data (i.e., data that is not entered into Excel in a consecutive range of cells, such as the SMVU data in sections I.3.4 to I.3.7). Attempting to automate the trend calculation to dynamically update as new (non-contiguous) SMVU data was added would add further difficulty to this process.

model. Additionally, some of the registration data included in the worksheet is relatively old (for previous years) and has been included in the model solely for the purpose of having a consolidated dataset of historical vehicle numbers. Hence, users will only need to focus on and update certain sections of the worksheet, namely: I.4.2, I.4.3, I.4.8 and I.4.9. Each section of the worksheet is described in more detail below.

4.4.1 Section I.4.2 Vehicle data by jurisdiction and quarter

The tables in this section contain vehicle (powered unit) data disaggregated by jurisdiction and quarter.[10] Table I.4.2.1 contains the Australia-wide (total) number of vehicles for each quarter, and is calculated by summing the values in each of the jurisdiction tables below it (tables I.4.2.2 to I.4.2.9). Tables I.4.2.2 to I.4.2.9 contain each jurisdiction's registration data for each quarter. Users will need to update the quarterly data in these tables in future years as it becomes available.

4.4.2 Section I.4.3 Trailer data by jurisdiction and quarter

The tables in this section contain trailer data disaggregated by jurisdiction and quarter. Table I.4.3.1 contains the Australia-wide (total) number of trailers for each quarter, and is calculated by summing the values in each of the jurisdiction tables below it (tables I.4.3.2 to I.4.3.9). Tables I.4.3.2 to I.4.3.9 contain each jurisdiction's registration data for each quarter. Users will need to update the quarterly data in these tables in future years as it becomes available.

4.4.3 Sections I.4.4 to I.4.7 Calculation of vehicle and trailer numbers

Sections I.4.4 to I.4.7 all perform calculations used in the annual averaging process for the vehicle population data: users do not need to make any changes in these sections. The top table in each section from I.4.4 to I.4.7 is the Australia-wide total; each total table is followed by tables for each individual jurisdiction in the remainder of that section.

The annual average is calculated in two steps. First, an average is taken for each quarter by averaging its starting and ending values. For example, for the quarter ending on 30 September 2012, the quarterly average is calculated by averaging the June 2012 and September 2012 data points. This quarterly averaging is done in sections I.4.4 and I.4.5 for vehicles and trailers, respectively. Second, the four quarterly averages in a financial year are averaged to calculate an annual average.[11] This is done separately for vehicles and trailers in sections I.4.6 and I.4.7, respectively.

4.4.4 Section I.4.8 Split of 2 axle rigid trucks into different vehicle classes according to their GVM

Section I.4.8 contains data on 2 axle rigid trucks. It is used to split the jurisdictions' registration data on 2 axle rigid trucks with a Gross Vehicle Mass (GVM) under 12 tonnes into the NTC's vehicle classes (which have separate vehicle classes for 2 axle rigid trucks with a GVM: below 7 tonnes; and above 7 tonnes (but less than 12 tonnes)). Section I.4.8 conducts identical calculation steps to the previous sections in the worksheet—that is, entering quarterly data, converting it to quarterly averages and then averaging the four quarters to calculate an annual average. Users will need to enter updated quarterly values into tables I.4.8.1 to I.4.8.8 as they become available.

4.4.5 Section I.4.9 B-triple vehicle population estimates

Section I.4.9 contains data on B-triples, by jurisdiction and by year. This table is used in table C.6.2.2 in worksheet 'C.6 Juro Veh and Revenue' to calculate the number of B-triples for the

[10] The jurisdictional registration data is available quarterly since June 2012 and half-yearly prior to that. However, the manual will refer to the data as being 'quarterly' for readability purposes.

[11] For example, the 2012/2013 annual figure is calculated by averaging the quarterly averages for the September 2012, December 2012, March 2013 and June 2013 quarters.

relevant year for usage data. B-triples are treated somewhat separately to other vehicle classes because most jurisdictions do not collect data on B-triples separately. Therefore, the B-triple numbers are entered into the model on an annual basis—rather than quarterly as for other types of vehicles and trailers—and are generally based on estimates by jurisdictions or the NTC. Users will need to enter updated numbers for B-triples as they become available in future years.

4.4.6 Section I.4.10 Axle count for trailers

Table I.4.10.1 lists the number of axles on each type of trailer. This table is used in a number of tables on worksheet 'C.6 Juro Veh and Revenue' to calculate the cost recovery from each type of trailer. This table does not need to be updated by users.

4.5 'I.5 Historical charges'

The main purpose of this worksheet is to serve as a consolidated database of historical charges. The worksheet is not used anywhere in the charge calculation process. However, data from the worksheet is used to calculate some of the summary tables which compare previous charges/revenues to the new charges/revenues. Therefore, it is important that users update the tables with charges for previous years each time the model is updated.

In section I.5.3, users will need to update the tables for the roads component of registration charges (which are in columns L to P) and the regulatory component of registration charges (which are in columns S to W); the table displaying total registration charges for each year (in columns E to I) will then update automatically since it sums the values from the two component tables. Users will also need to update the RUC levels, following the steps described earlier in Table 1.

4.6 'I.6 SMVU data for MaxMan'

This worksheet contains data from the ABS's SMVU that is needed for the MaxMan module. The MaxMan module requires usage data on VKT and GTK, disaggregated into separate urban and rural components. The tables in sections I.6.2 and I.6.3 provide this data in the required format for the calculations, which take place in worksheet 'C.8 MaxMan splitter calcs'. Section I.6.4 displays the jurisdictions that are included in the MaxMan calculations (separately for urban and rural areas). Section I.6.5 displays AGM values that were calculated using data from the SMVU prior to the most recent one: the data in this table will only be used if there are errors when using the latest SMVU (which may occur due to missing data for a vehicle class). Users will only need to make changes to this worksheet if a new SMVU dataset becomes available.

5. Output worksheets

This chapter describes the four output worksheets in the model. Users can read this section to assist with their interpretation of the tables and graphs displayed in the output sheets.

5.1 'O.1 Charges sched by components'

This worksheet calculates and displays the output tables from the model. The output tables display the charges by powered unit or trailer (section O.1.2) as well as the registration charges for each vehicle class (section O.1.3). This is done separately for the roads component and regulatory component of registration charges; a total table summing these two components is also available. Finally, the previous year's charges are displayed in section O.1.5.

5.1.1 Section O.1.2 Output tables - charges per vehicle component

This section contains three tables showing the registration charges per vehicle component. Table O.1.2.1 displays the total charges by summing the values from the corresponding cells in the roads component and regulatory component tables (tables O.1.2.2 and O.1.2.3).

Table O.1.2.2 displays the roads component registration charges for each vehicle component. Many of the powered unit charges in the table are sourced from table C.7.6.1 in worksheet 'C.7 Charges calculations'. Others are calculated by using those charges and the 'scaling factors' shown in table A.3.13 of worksheet 'A.3 Charges assumptions'. The charges for trailers are displayed on a 'per axle' basis, and are sourced from the relevant tables in section A.3.18.

Table O.1.2.3 displays the regulatory component registration charges for each vehicle component. This table displays the charges shown in table O.1.4.1: the trailer charges are taken directly from table O.1.4.1, while the prime mover charges are multiplied by the Goal Seek value in section A.3.11 of worksheet 'A.3 Charges assumptions'.[12]

5.1.2 Section O.1.3 Output tables: charges for a sample of vehicle classes

In contrast to the tables in section O.1.2, which display the charges for each vehicle component, this section displays the total registration charges for a vehicle/rig in each of the NTC's vehicle classes.

Table O.1.3.1 displays the total registration charges, calculated by adding the roads and regulatory components displayed in tables O.1.3.2 and O.1.3.3.

Table O.1.3.2 displays the roads component registration charges for a vehicle in each vehicle class. The charges in the table are sourced from table O.1.2.2. Data on trailer axles, which is used to calculate the trailer charges, is sourced from table A.3.20.1.

Table O.1.3.3 displays the regulatory component registration charges for a vehicle in each vehicle class. The charges in the table are sourced from table O.1.2.3. Data on trailer axles, which is used to calculate the trailer charges, is sourced from table A.3.20.1.

5.1.3 Section O.1.4 Regulatory component (before Goal Seek)

Table O.1.4.1 displays the regulatory component registration charges per vehicle component. The charge for all trailers is sourced from section A.3.5 of worksheet 'A.3 Charges assumptions'. The charges for powered units are sourced from table C.5.2.1 of worksheet 'C.5 Regulatory costs scenario'.

[12] The Goal Seek value is used to ensure that the NHVR budget is recovered when calculating cost recovery under both the NTC's vehicle classes and jurisdictions' vehicle categories.

Table O.1.4.2 displays the number of axles for each trailer. The values in this table are used to calculate the 'per axle' regulatory component charge for trailers in table O.1.4.1, by dividing the total trailer charge by the number of axles.

5.1.4 Section O.1.5 Tables of previous charges

The tables in this section display the previous year's charges; the tables are linked to the tables in worksheet 'I.5 Historical charges' and will update automatically if the model year is changed.

The tables in section O.1.5 are ordered in a similar way to the tables in section O.1.2. Table O.1.5.1 displays the total registration charges per vehicle component, being the sum of the roads and regulatory components. The roads component and regulatory component registration charges are displayed in tables O.1.5.2 and O.1.5.3, respectively. Finally, table O.1.5.4 displays the previous year's RUC (fuel charge): the value in the table is linked to table I.5.2.1.

5.2 'O.2 Constraints check'

This worksheet displays the model's constraints and provides colour-coded check cells showing whether the constraint has been satisfied or not.

The constraints in table O.2.2.1 are general model constraints. The first constraint checks whether the minimum prime mover charge (the smallest total registration cost recovery for prime movers in table C.7.2.3 of worksheet 'C.7 Charges calculations') exceeds the minimum prime mover charge specified in section A.3.17 of worksheet 'A.3 Charges assumptions'. The second constraint checks whether the total revenue (or cost recovery) for heavy vehicles—as calculated in table C.7.2.1 of worksheet 'C.7 Charges calculations'—is equal to the total allocated cost for heavy vehicles calculated in table C.4.2.1 of worksheet 'C.4 Cost allocation'.

Table O.2.2.2 displays constraints for each vehicle class. The first column in the table displays the cost recovery (per vehicle) for each vehicle class, as calculated in table C.7.2.2 of worksheet 'C.7 Charges calculations'. The second table displays the attributable cost (per vehicle) for each vehicle class, as calculated in table C.7.3.2. The final column then checks whether the cost recovery is at least as high as the attributable costs for each vehicle class.

5.3 'O.3 Summary tables'

This worksheet provides a number of summary tables relating to cost recovery (section O.3.2) and expenditure (sections O.3.3 and O.3.4).

5.3.1 Section O.3.2 Revenue under previous and new charges

Table O.3.2.1 displays the jurisdictional cost recovery under both the previous charges (first three columns of data) and new charges (last three columns of data). The usage data (i.e. fuel consumption and the vehicle population) is assumed to be the same for both previous and new charges; the only differences between the two parts of the table are the charges. The data for previous charges is sourced from section C.6.6 of worksheet 'C.6 Juro Veh and Revenue'. For new charges, the data is sourced from section C.6.3 (for the roads component) and section C.6.4 (for the regulatory component).

The graphs to the right of the table both summarise the information contained in the 'new charges' section of the table. The first graph displays a column chart comparing each jurisdiction's roads and regulatory revenues. The second chart shows the information in two pie charts (and in units of $m). The first pie chart displays the relative share of Commonwealth (i.e., RUC) revenue and registration revenue (including both the roads and regulatory components). The second pie chart disaggregates the registration revenue into the relative amount of registration revenue collected by each jurisdiction.

5.3.2 Section O.3.3 Total nominal expenditure by year and jurisdiction

This section displays total nominal expenditure for each year and jurisdiction. The data is sourced from worksheets 'C.1 Arterial Cost Base' and 'C.2 Local Cost Base'. The expenditure displayed in the table is the sum of urban and rural expenditure for both arterial and local expenditure. The expenditure in the table sums: expenditure categories A to G1 for arterial expenditure; and expenditure categories A to F3 for local expenditure. It then subtracts the Net H-category cost, as calculated (for the relevant year) in the final row of each table in section C.2.4.

5.3.3 Section O.3.4 Nominal expenditure by jurisdiction and expenditure category

The tables in section O.3.4 display nominal expenditure by jurisdiction and expenditure category, with each table presenting the data for a single year. Each table is structured identically and sources data from the corresponding table for that year in section C.1.3 of worksheet 'C.1 Arterial Cost Base'. The final row of each table displays net local expenditure, which is sourced from the relevant table in section C.2.4 of worksheet 'C.2 Local Cost Base'.

5.4 'O.4 Charts'

This worksheet contains a number of charts depicting expenditure and usage data used in the model. The charts may be useful not only as a visual depiction of the data contained in the model, but also as a means of checking for any outliers or errors in the data.

5.4.1 Section O.4.2 Annual expenditure by jurisdiction

Each subsection in this section has charts depicting expenditure for a *single* jurisdiction over *multiple* years. The left-hand chart in each subsection depicts arterial expenditure, while the right-hand chart shows local expenditure. Each chart is disaggregated into four sub-categories of expenditure; users wishing to see expenditure disaggregated further can look at the charts in section O.4.4. The data for all charts in this section is sourced from worksheet 'I.1 Expenditure'.

5.4.2 Section O.4.3 Jurisdictional expenditure by year

Each subsection in this section has charts showing expenditure for *multiple* jurisdictions for a *single* year. This provides an alternative form of comparison to the charts in section O.4.2, by making it easier to compare the relative levels of expenditure across jurisdictions in a particular year. The left chart in each subsection depicts nominal arterial expenditure for each year for expenditure categories A to F, based on data from worksheet 'I.1 Expenditure'. The middle chart shows local expenditure for each year for all four subcategories of local expenditure, also using data from worksheet 'I.1 Expenditure'. The pie chart on the right in each subsection depicts 'total' expenditure for each jurisdiction,[13] showing the data from table O.3.3.1 in worksheet 'O.3 Summary tables' in a graphical format.

5.4.3 Section O.4.4 Jurisdictional arterial expenditure by year, disaggregated by expenditure category

Each subsection in this section has charts showing expenditure for *multiple* jurisdictions for a *single* year. The left-hand chart in each subsection is a stacked column chart showing expenditure by jurisdiction, disaggregated by expenditure category. The right-hand chart is a '100% stacked column' chart: it shows similar information to the left-hand chart, but in percentage terms. That is, each chart shows the percentage of total expenditure made up by each expenditure category. This makes it easier to see what expenditure categories the total expenditure is comprised of in the left-hand chart for jurisdictions which have relatively low expenditure. Both charts show nominal arterial expenditure sourced from section O.3.4 of worksheet 'O.3 Summary tables'.

[13] With the net H-category adjustment applied.

5.4.4 Section O.4.5 Usage data - SMVU

Each subsection in this section has charts showing SMVU data for ten selected vehicle classes over time (the same five (rigid or articulated) vehicle classes are shown in all four charts). The left-hand charts in each subsection display data for rigid trucks, and the right-hand charts show the corresponding data for articulated trucks. The data in the charts is sourced from worksheet 'I.3 Usage data inputs'. In order, the charts in the four subsections depict data on vehicle population; VKT; fuel usage; and GTK.

5.4.5 Section O.4.6 Usage data - Jurisdiction registration data

This section graphically shows how the vehicle population is changing over time using jurisdictions' registration data. The data in the charts is sourced from worksheet 'I.4 Jurisdiction rego data'. Each chart shows data for a different type of vehicle or trailer: the vehicle types with the largest populations in each category are included in the charts. In order, the charts in this subsection show data on rigid trucks; combination trucks; prime movers; buses; pig and dog trailers; and lead- and semi-trailers.

6. Calculation worksheets

This chapter describes the operation of the model's calculation worksheets. These worksheets are likely to be of interest only to advanced users of the model, for two main reasons. Firstly, the calculation worksheets are automated and will update automatically when users change assumptions and/or add new inputs. That is, users do not need to make any changes or updates to the calculation worksheets. Secondly, the automation of the worksheets results in the use of some relatively complicated Excel formulas which may take users time to understand, particularly if they do not have advanced Excel skills.

Nonetheless, users wishing to understand the calculation worksheets in greater detail can read the sections below for a description of each.

6.1 'C.1 Arterial Cost Base'

This worksheet calculates the arterial cost base using the expenditure data inputs from worksheet 'I.1 Expenditure' and the assumption settings specified in worksheet 'A.1 Assumptions'. The output/summary table is displayed in section C.1.2; the sections below contain the more detailed calculations underlying it. Each section of the worksheet is described in more detail under the following subheadings.

6.1.1 Section C.1.2 Arterial cost base

Table C.1.2.1 contains the arterial cost base, disaggregated by jurisdiction, expenditure category and geographic location (urban/rural). The cost base displayed in the table is calculated based on the expenditure averaging assumptions specified in sections A.1.3 to A.1.6 of worksheet 'A.1 Assumptions'. If users change any of these assumptions, the cost base calculated in table C.1.2.1 will update automatically.

6.1.2 Section C.1.3 Nominal expenditure for arterial roads by expenditure category

This section displays the nominal expenditure calculations for arterial roads. Tables C.1.3.1 and C.1.3.2 display arterial expenditure by year and expenditure category (for urban and rural expenditure, respectively). The annual data displayed in these two tables summarises the Australia-wide total expenditure data displayed in tables C.1.3.4 to C.1.3.21.

Table C.1.3.3 calculates the urban/rural split using: the expenditure data from tables C.1.3.1 and C.1.3.2; and the averaging period for the urban/rural split specified in section A.1.5 of worksheet 'A.1 Assumptions'. The split calculation will update automatically if any relevant model assumptions—such as the model year or averaging period—are changed.

Tables C.1.3.4 to C.1.3.21 display arterial expenditure for each year from 2005/2006 through to 2022/2023. The left part of each table calculates urban expenditure and the right part calculates rural expenditure. This data is sourced from the relevant input tables in section I.1.2 of worksheet 'I.1 Expenditure'.

6.1.3 Section C.1.4 EMA expenditure for arterial roads by expenditure category

Section C.1.4 calculates arterial expenditure using the EMA methodology. The EMA calculations will update automatically if any changes are made to relevant assumptions—such as the model year, averaging period or alpha value—in worksheet 'A.1 Assumptions'.

Tables C.1.4.1 and C.1.4.2 summarise total (Australia-wide) EMA expenditure by year, for urban and rural expenditure, respectively. The numbers in these tables are linked to tables C.1.4.3 to

C.1.4.20 and are the expenditure for each year after being multiplied by the EMA weight for that year.[14]

Tables C.1.4.3 to C.1.4.20 are all structured identically: each table calculates the EMA-weighted expenditure for a particular year. The left part of each table calculates urban expenditure and the right part calculates rural expenditure. Each cell calculates EMA-weighted expenditure by multiplying nominal expenditure (from the corresponding table in section C.1.3) by the EMA weight for that year (as calculated in table I.2.2.1 in worksheet 'I.2 Indexes and averages').

Table C.1.4.21 calculates total EMA arterial expenditure over the averaging period specified in worksheet 'A.1 Assumptions'. Total EMA expenditure is calculated as the sum of EMA-weighted expenditure from tables C.1.4.3 to C.1.4.20: data from all 18 tables above are summed because years outside of the averaging period will have an EMA weight of zero (and therefore EMA-weighted expenditure of zero). This table is the source of data for table C.1.2.1 (if the EMA option has been selected for averaging expenditure in worksheet 'A.1 Assumptions').

6.1.4 Section C.1.5 Real expenditure for arterial roads by expenditure category

Section C.1.5 calculates arterial expenditure in real terms. The real expenditure calculations will update automatically if any changes are made to relevant assumptions—such as the model year or the number of years included in the averaging period—in worksheet 'A.1 Assumptions', or if additional RCMPI values are added in section I.2.3.

Tables C.1.5.1 and C.1.5.2 summarise total (Australia-wide) real expenditure by year, for urban and rural expenditure, respectively. The numbers in these tables are linked to tables C.1.5.3 to C.1.5.20 and are the expenditure for each year after being multiplied by the indexing factor for that year from table I.2.3.1.

Tables C.1.5.3 to C.1.5.20 are all structured identically: each table calculates the amount of real expenditure for a particular year, where the year that the expenditure is being indexed to is two years before the year that charges are being determined for.[15] The left part of each table calculates urban expenditure and the right part calculates rural expenditure. Each cell calculates real expenditure by multiplying nominal expenditure (from the corresponding table in section C.1.3) by the indexing factor for that year (as calculated in table I.2.3.1 in worksheet 'I.2 Indexes and averages').

Tables C.1.5.21 to C.1.5.36 then display each jurisdiction's real expenditure over time. The first eight of these 16 tables display each jurisdiction's urban arterial expenditure; the remainder display each jurisdiction's rural arterial expenditure. These tables differ in format, and serve a different purpose, to those above. Each table in the first set of tables, C.1.5.3 to C.1.5.20, displays *all* jurisdictions' expenditure for *one* particular year. This is useful for the purpose of inflating the expenditure, which is input in nominal terms, to real terms at the relevant year (since all expenditure in a table needs to be indexed by the same indexing factor). Each table in the second set of tables, C.1.5.21 to C.1.5.36, displays *one* jurisdiction's expenditure for *all* (18) years specified in the model. This is useful for the purpose of determining which years of expenditure to include in the averaging period specified in worksheet 'A.1 Assumptions'.

Table C.1.5.37 averages expenditure from tables C.1.5.21 to C.1.5.36: expenditure is averaged if it is within the averaging period specified in worksheet 'A.1 Assumptions'. This table is used to populate table C.1.2.1 if the 'Real' option is selected in section A.1.3 of worksheet 'A.1 Assumptions'.

---

[14] This explains why the expenditure in the table tends to be higher for recent years than prior years—the EMA methodology places greater weight on more recent data points.

[15] For example, when the charges are being determined for 2014/2015, the expenditure is indexed to 2012/2013 terms.

6.2 'C.2 Local Cost Base'

This worksheet calculates the local cost base using the expenditure data inputs from worksheet 'I.1 Expenditure' and the assumption settings specified in worksheet 'A.1 Assumptions'. The output/summary tables are displayed in section C.2.2; the sections below contain the more detailed calculations underlying them. Each section of the worksheet is described in more detail under the following subheadings.

6.2.1 Section C.2.2 Local cost base

Table C.2.2.1 contains the local cost base, disaggregated by jurisdiction, expenditure category and geographic location (urban/rural). The cost base displayed in the table is calculated based on the expenditure averaging assumptions specified in sections A.1.3 to A.1.6 of worksheet 'A.1 Assumptions'. If users change any of these assumptions, the cost base calculated in the table will update automatically.

Table C.2.2.2 calculates the adjusted local cost base: it uses the data from table C.2.2.1 and multiplies it by the percentage figures specified in section A.1.7 of worksheet 'A.1 Assumptions'.

6.2.2 Section C.2.3 7 year split of expenditure

This section calculates the split of expenditure between expenditure categories for arterial expenditure (in percentages). These percentages are then applied to local road expenditure to assign it into the model's expenditure categories.

The first five tables in this section simply replicate data from other worksheets in the model. Tables C.2.3.1 and C.2.3.2 replicate tables C.1.3.1 and C.1.3.2 from worksheet 'C.1 Arterial Cost Base'. Similarly, tables C.2.3.3 and C.2.3.4 replicate tables C.1.5.1 and C.1.5.2. Table C.2.3.5 replicates table I.2.2.1 from worksheet 'I.2 Indexes and averages'.

The data from these tables is then used to calculate the percentage splits in tables C.2.3.6 and C.2.3.7. Table C.2.3.6 calculates the expenditure splits, separately, for expenditure categories A to E; and F.[16] The model performs this calculation separately for urban and rural expenditure; and for nominal and real expenditure. Table C.2.3.7 performs a similar calculation but calculates the percentage for each expenditure category as a proportion of total A to F expenditure (rather than 'A to E' or F separately). This table is used for assigning net H-category expenditure to expenditure categories A to F in tables C.2.5.20 and C.2.6.37.

6.2.3 Section C.2.4 Nominal local government expenditure by expenditure category

This section displays the nominal expenditure calculations for local roads. Tables C.2.4.1 to C.2.4.18 display local expenditure for each year from 2005/2006 through to 2022/2023. The left part of each table calculates urban expenditure and the right part calculates rural expenditure. The underlying local expenditure data is sourced from the relevant input tables in section I.1.3 of worksheet 'I.1 Expenditure'. This is multiplied by the relevant percentage split[17] calculated in table C.2.3.6 to assign local expenditure to the model's expenditure categories. Each table also calculates a 'Net H-category' adjustment using the following formula: (H1 + H2) – (H3 + H4 + H5).

[16] For example, category A's percentage is: the sum of category A's expenditure over the averaging period divided by the sum of all expenditure in categories A to E over the averaging period.

[17] The 'relevant' split is the percentage split for that expenditure category in the corresponding geographic area (urban/rural). It is also depends on the option selected in section A.1.9—that is, whether to use real or nominal arterial expenditure to calculate the percentage splits.

6.2.4 Section C.2.5 EMA local government expenditure by expenditure category

This section calculates local expenditure using the EMA methodology. The EMA calculations will update automatically if any changes are made to relevant assumptions—for example, the model year, averaging period or alpha value—in worksheet 'A.1 Assumptions'.

Tables C.2.5.1 to C.2.5.18 are all structured identically: each table calculates the EMA-weighted expenditure for a particular year. The left part of each table calculates urban expenditure and the right part calculates rural expenditure. Each cell calculates EMA-weighted expenditure by multiplying nominal expenditure (from the corresponding table in section C.2.4) by the EMA weight for that year (as calculated in table I.2.2.1 in worksheet 'I.2 Indexes and averages'). The EMA weights applied to expenditure for a given year are different for categories 'A to F' and H: this is because the H-category expenditure is arterial expenditure and the 'A to F' category expenditure is local government expenditure.[18]

Table C.2.5.19 calculates total EMA arterial expenditure over the averaging period specified in worksheet 'A.1 Assumptions'. Total EMA expenditure is calculated as the sum of EMA-weighted expenditure from tables C.2.5.1 to C.2.5.18: data from all 18 tables above are summed because years outside of the averaging period will have an EMA weight of zero (and therefore EMA-weighted expenditure of zero).

Table C.2.5.20 calculates total EMA expenditure after adjusting for any double-counted expenditure in the 'H' expenditure categories. The expenditure for each expenditure category in A to F (from table C.2.5.19) is reduced by a proportional amount—as determined in table C.2.3.7—of the 'Net H-category' adjustment calculated in table C.2.5.19. This table is the source of table C.2.2.1 (if the EMA option has been selected for averaging expenditure in worksheet 'A.1 Assumptions').

6.2.5 Section C.2.6 Real local government expenditure by expenditure category

Section C.2.6 calculates local expenditure in real terms. The real expenditure calculations will update automatically if any changes are made to relevant assumptions—such as the model year or the number of years included in the averaging period—in worksheet 'A.1 Assumptions', or if additional RCMPI values are added in section I.2.3.

Tables C.2.6.1 to C.2.6.18 are all structured identically: each table calculates the amount of real expenditure for a particular year, where the year that the expenditure is being indexed to is two years before the year that charges are being determined for. The left part of each table calculates urban expenditure and the right part calculates rural expenditure. Each cell calculates real expenditure by multiplying nominal expenditure (from the corresponding table in section C.2.4) by the indexing factor for that year (as calculated in table I.2.3.1 in worksheet 'I.2 Indexes and averages').

Table C.2.6.19 displays the period coverage for the averaging period: that is, whether or not the year is included within the averaging period specified in section A.1.4. This information is based on table I.2.2.1.

Tables C.2.6.20 to C.2.6.35 then display each jurisdiction's real expenditure over time. The first eight of these 16 tables display each jurisdiction's urban local expenditure; the remainder display each jurisdiction's rural local expenditure. These tables differ in format, and serve a different purpose, to those above. Each table in the first set of tables, C.2.6.1 to C.2.6.18, displays *all* jurisdictions' expenditure for *one* particular year. This is useful for the purpose of inflating the expenditure, which is input in nominal terms, to real terms at the relevant year (since all expenditure in a table needs to be indexed by the same indexing factor). Each table in the second

[18] The NTC receives local government expenditure with a greater time lag than arterial expenditure.

set of tables, C.2.6.20 to C.2.6.35, displays *one* jurisdiction's expenditure for *all* (18) years specified in the model. This is useful for the purpose of determining which years of expenditure to include in the averaging period specified in worksheet 'A.1 Assumptions'.

Table C.2.6.36 averages expenditure from tables C.2.6.20 to C.2.6.35: expenditure is averaged if it is within the averaging period specified in table C.2.6.19 (which is based on the assumptions specified in worksheet 'A.1 Assumptions').

Table C.2.6.37 calculates total real expenditure after adjusting for any double-counted expenditure in the 'H' expenditure categories. The expenditure for each expenditure category in A to F (from table C.2.6.36) is reduced by a proportional amount—as determined in table C.2.3.7—of the 'Net H-category' adjustment calculated in table C.2.6.36. This table is used to populate table C.2.2.1 if the 'Real' option is selected in section A.1.3 of worksheet 'A.1 Assumptions'.

6.3 'C.3 Usage data calculations'

This worksheet calculates usage data for a range of different measures of usage. The calculations are generally averages using the methodology and number of years specified in worksheet 'A.1 Assumptions'. The usage data specified on the worksheet is mainly sourced from worksheet 'I.3 Usage data inputs', although some vehicle population data is sourced from worksheet 'C.6 Juro Veh and Revenue' (this vehicle population data is based on jurisdiction registration data from worksheet 'I.4 Jurisdiction rego data').

6.3.1 Section C.3.2 Usage data output values

Table C.3.2.1 is an output/summary table displaying total usage, based on the data and methodology assumptions specified in worksheet 'A.1 Assumptions'. The table will update automatically if users change any of the relevant assumptions in sections A.1.11 to A.1.17 of worksheet 'A.1 Assumptions' Seven different types of usage data are shown: vehicle population; VKT; fuel consumption; GTK; ESA factors; PCU; and AGM. Table 4 summarises the averaging methodologies available and source data for table C.3.2.1.

Table 4. Summary of averaging methodologies and source data in table C.3.2.1

Type of data	Averaging methodology	Data source
Vehicle population	EMA, Trend or latest registration data	SMVU data for EMA or Trend, which are based on tables C.3.3.2 and I.3.8.1, respectively. Table C.6.2.2 for the latest registration data. For B-triples and triple road trains, values under the EMA methodology will be sourced from table C.3.7.3 if the 'Yes' option is selected from section A.1.16.
VKT	EMA or Trend	SMVU data for EMA or Trend, which are based on tables C.3.4.2 and I.3.8.2, respectively. For B-triples and triple road trains, values under the EMA methodology will be sourced from table C.3.7.3 if the 'Yes' option is selected from section A.1.16.
Fuel consumption	EMA or Trend	SMVU data for EMA or Trend, which are based on tables C.3.5.2 and I.3.8.3, respectively. For B-triples and triple road trains, values under the EMA methodology will be sourced from table C.3.7.3 if the 'Yes' option is selected from section A.1.16.
GTK	EMA or Trend (or product of VKT and AGM data)	SMVU data for EMA or Trend, which are based on tables C.3.6.2 and I.3.8.4, respectively. For B-triples and triple road trains, values under the EMA methodology will be sourced from table C.3.7.3 if the 'Yes' option is selected from section A.1.16.

Type of data	Averaging methodology	Data source
		Note that the formula for GTK differs slightly for buses because the SMVU does not provide any data on GTK for buses.
ESA	N/A	Table I.3.3.1 in worksheet 'I.3 Usage data inputs', based on the ESA factor methodology specified in section A.1.17 of worksheet 'A.1 Assumptions'.
PCU	N/A	Table I.3.2.1 in worksheet 'I.3 Usage data inputs'.
AGM	N/A	Table I.3.2.1 in worksheet 'I.3 Usage data inputs'.

Table C.3.2.2 transforms the usage data from table C.3.2.1 into a format that is used for cost allocation purposes. The table reports VKT, PCU-km, ESA-km and AGM-km, on both a total and disaggregated (arterial and local) basis.

6.3.2 Section C.3.3 Vehicle population data

This section calculates the EMA values for the vehicle population, based on the EMA assumptions specified in worksheet 'A.1 Assumptions'. Table C.3.3.1 displays the vehicle population data from the SMVU, either with or without repeated data points for years where SMVU data is unavailable (depending on the user's choice in section A.1.15 of worksheet 'A.1 Assumptions'). Table C.3.3.2 calculates the EMA-weighted values for each year using the data from table C.3.3.1 and the EMA weights from either table I.2.4.1 or I.2.4.2 (depending on whether data points are repeated or not).

6.3.3 Section C.3.4 VKT

This section calculates the EMA values for VKT, based on the EMA assumptions specified in worksheet 'A.1 Assumptions'. Table C.3.4.1 displays the VKT data from the SMVU, either with or without repeated data points for years where SMVU data is unavailable (depending on the user's choice in section A.1.15 of worksheet 'A.1 Assumptions'). Table C.3.4.2 calculates the EMA-weighted values for each year using the data from table C.3.4.1 and the EMA weights from either table I.2.4.1 or I.2.4.2 (depending on whether data points are repeated or not).

6.3.4 Section C.3.5 Fuel consumption

This section calculates the EMA values for fuel consumption, based on the EMA assumptions specified in worksheet 'A.1 Assumptions'. Table C.3.5.1 displays the fuel consumption data from the SMVU, either with or without repeated data points for years where SMVU data is unavailable (depending on the user's choice in section A.1.15 of worksheet 'A.1 Assumptions'). Table C.3.5.2 calculates the EMA-weighted values for each year using the data from table C.3.5.1 and the EMA weights from either table I.2.4.1 or I.2.4.2 (depending on whether data points are repeated or not).

6.3.5 Section C.3.6 GTK

This section calculates the EMA values for GTK, based on the EMA assumptions specified in worksheet 'A.1 Assumptions'. Table C.3.6.1 displays the GTK data from the SMVU, either with or without repeated data points for years where SMVU data is unavailable (depending on the user's choice in section A.1.15 of worksheet 'A.1 Assumptions'). Table C.3.6.2 calculates the EMA-weighted values for each year using the data from table C.3.6.1 and the EMA weights from either table I.2.4.1 or I.2.4.2 (depending on whether data points are repeated or not).

6.3.6 Section C.3.7 Calculation of EMA values for B-triples and triple road trains

The tables in this section calculate values for B-triples and triple road trains when using the EMA methodology. The SMVU does not collect data on B-triples; instead, B-triples are assumed to be

within the triple road trains data in the SMVU. Therefore, it is necessary to adjust the triple road train data in the SMVU to separate out information on B-triples.

Table C.3.7.1 calculates the percentage of B-triples in the triple road trains vehicle class, based on information from jurisdictions' registration data in the latest available year.

Table C.3.7.2 displays the initial EMA values for the triple road trains vehicle class, as calculated in sections C.3.3 to C.3.6.

Table C.3.7.3 calculates the adjusted EMA values for B-triples and triple road trains. The vehicle population data uses B-triple data from section I.3.9; other types of usage data use the percentage split from table C.3.7.1 and multiply it by the initial EMA values in table C.3.7.2 to calculate the B-triple usage data values.

6.4 'C.4 Cost allocation'

The main purpose of this worksheet is to calculate the adjusted cost base for each vehicle class, as well as the costs allocated to each vehicle class by each of the cost allocators.

6.4.1 Section C.4.2 Adjusted cost base and cost allocation output

Table C.4.2.1 is an output/summary table which displays a variety of cost base information, including the total cost base as determined by the user's input assumptions. The table will update automatically if any changes to relevant assumptions are made in worksheet 'A.1 Assumptions', such as those in sections A.1.18 to A.1.20.

The first column of data displays pre-MaxMan attributable costs for each vehicle class, using data from tables C.4.4.1 and C.4.4.2. The second column displays post-MaxMan attributable costs for each vehicle class, using data from tables C.4.4.3 and C.4.4.4. The third column displays data from either the first or the second column, depending on whether the user's selection in section A.1.18 of worksheet 'A.1 Assumptions' is 'No' or 'Yes', respectively. The fourth column of data displays each vehicle class's allocation by VKT, as calculated in table C.4.2.2.

The fifth column of table C.4.2.1 displays the adjusted allocation by VKT for each vehicle class. There are two steps to the 'adjustment'. Firstly, the relevant unsealed road discount and CSO discount is applied to the B-triple vehicle class and the two road train vehicle classes, reducing their allocated cost. Secondly, the foregone allocated cost from the unsealed road discount and CSO discount is redistributed to all other vehicle classes. That is, each vehicle class (other than road trains and B-triples) is allocated its VKT cost allocation *plus* a proportion of the foregone allocated costs arising from the two discounts. This ensures that the two discounts do not reduce the total costs allocated to vehicles.

The sixth column in the table displays the adjusted attributable costs by subtracting the initial 'Allocation by VKT' (column four) and adding the 'Adjusted allocation by VKT' (column five) to the selected attributable costs (column three). The seventh column displays non-attributable costs for each vehicle class (taken from table C.4.2.2). Finally, the eighth column sums columns six and seven.

Table C.4.2.2 contains the cost allocation output for each cost allocator and vehicle class. The numbers in this table will vary depending on whether the user selects 'No' or 'Yes' for the MaxMan adjustment in section A.1.18 of worksheet 'A.1 Assumptions'. The data is taken either from tables C.4.4.1 and C.4.4.2 or tables C.4.4.3 and C.4.4.4.

6.4.2 Section C.4.3 Allocated expenditure

This section calculates allocated road expenditure, on both a pre- and post-MaxMan basis.

Table C.4.3.1 contains allocable road expenditure. The arterial expenditure data is sourced from table C.1.2.1; the local expenditure data is sourced from table C.2.2.2.

Table C.4.3.2 contains allocated road expenditure on a pre-Maxman basis. This is calculated by multiplying the data in each column of table C.4.3.1 by the relevant column for each of the allocators in the cost allocation matrix (in worksheet 'A.2 Cost allocation matrix').

Table C.4.3.3 takes the data from table C.4.3.2 and subtracts the MaxMan output for that allocator (in tables C.9.2.1 and C.9.2.2) for each of double and triple road trains.

6.4.3 Section C.4.4 Allocated expenditure by vehicle class

This section allocates the allocable expenditure (calculated in section C.4.3) to each vehicle class. Tables C.4.4.1 and C.4.4.2 allocate pre-MaxMan expenditure (for arterial and local expenditure, respectively). Tables C.4.4.3 and C.4.4.4 carry out the same calculations for post-MaxMan expenditure, with one exception: the expenditure allocated to both double and triple road trains is based on the outputs from tables C.9.2.1 and C.9.2.2.

The structure of calculations in each of the four tables is identical. Allocable expenditure is allocated to a vehicle class on the basis of that vehicle class's proportion of the total value for all vehicle classes (excluding road trains) for a particular allocator.[19] The allocator data for each vehicle class is sourced from table C.3.2.2 in worksheet 'C.3 Usage data calculations'.

6.4.4 Section C.4.5 Calculation of unsealed road and CSO discounts

This section calculates the unsealed road discount and CSO discount for B-triples, double road trains and triple road trains.

Table C.4.5.1 contains the cost allocation by vehicle class and allocator, calculated either on a pre- or post-MaxMan basis (depending on which assumption has been specified by the user in section A.1.18).

Table C.4.5.2 is used to calculate the unsealed road discount. The first four columns of data in the table summarise some of the relevant information from table C.4.5.1 for B-triples, double road trains and triple road trains. The final column calculates the unsealed road discount—separately for each vehicle class—by multiplying the *allocation by ESA-km* by the *percentage of travel on unsealed roads* specified in section A.1.19 of worksheet 'A.1 Assumptions'.

Table C.4.5.3 is used to calculate the CSO discount. There are two steps for this calculation. Firstly, the adjusted attributable costs are calculated: these are calculated by subtracting the unsealed road discount from the original attributable costs for each vehicle class. Secondly, the CSO discount amount is calculated by multiplying the adjusted attributable costs by the CSO discount percentages specified in section A.1.20 of worksheet 'A.1 Assumptions'.

Table C.4.5.4 calculates the total discount—incorporating both the unsealed road discount and CSO discount—applicable to each of the vehicle classes. These figures are calculated by summing the final columns of tables C.4.5.2 and C.4.5.3.

6.5 'C.5 Regulatory costs scenario'

This worksheet calculates the regulatory component of registration charges that need to be recovered from each vehicle to recover the NHVR budget. The calculations use data from a number of different worksheets in the model, including 'A.3 Charges assumptions', 'C.3 Usage data calculations' and 'C.6 Juro Veh and Revenue'.

---

[19] For example, costs are allocated to B-triples for the PCU-km allocator as follows: *PCU-km for B-triples* divided by *PCU-km for all vehicle classes (excluding road trains)*.

6.5.1 Section C.5.2 Regulatory costs output

This section contains the worksheet's output/summary tables which are based on the more detailed calculations further below in the worksheet. Table C.5.2.1 displays the regulatory charge per powered unit. The data used in the table are from table C.5.2.2, table C.5.5.1 or from worksheet 'A.3 Charges assumptions'.

The first column of data in table C.5.2.2 displays the regulatory cost recovery per vehicle, which is sourced from table C.5.4.2, table C.5.4.3 or table C.5.5.1. The second column multiplies the cost recovery per vehicle by the vehicle population (excluding WA and NT) for each vehicle class to calculate total cost recovery of the NHVR budget.

6.5.2 Section C.5.3 Input data

This section calculates and collates the input data used for the regulatory cost calculations. The vehicle population data for each vehicle class is sourced from worksheet 'C.6 Juro Veh and Revenue': this is done on both an Australia-wide basis (column J of the worksheet) and for all jurisdictions except WA and NT (column K). Data on VKT, GTK and PCU are sourced from table C.3.2.1 in worksheet 'C.3 Usage data calculations'. The values in column G (for VKT excluding WA and NT) are estimated by multiplying the values in column F (VKT) by the values in column K (vehicle population excluding WA and NT) and then dividing by the values in column J (Australia-wide vehicle population). The AGM data in column I is calculated by dividing the GTK data by the VKT data for each vehicle class. The final column of the table calculates PCU-squared by squaring the PCU data.

6.5.3 Section C.5.4 Multi-part allocation for NHVR costs

This section calculates the regulatory component of cost recovery for various vehicle classes based on the multi-part allocation rules specified in worksheet 'A.3 Charges assumptions'. The regulatory component of cost recovery for articulated trucks are calculated in section C.5.5.

Table C.5.4.1 calculates the proportion of total regulatory costs to be recovered through each component of the multi-part allocation rules for regulatory costs. The data used in this table—the percentages to be recovered through each component and the total NHVR budget—are sourced from sections A.3.3 and A.3.4 of worksheet 'A.3 Charges assumptions'.

Table C.5.4.2 calculates the charges per vehicle needed to recover the assumed NHVR budget. Each of the columns calculates one of the three components specified in table C.5.4.1. The fixed component per vehicle is calculated by dividing the amount to be recovered via the fixed component by the total number of heavy vehicles (excluding WA and the NT). The AGM component per vehicle is calculated as follows:

$$AGM\ component\ *\left(\frac{AGM_{VC}*Vehicle\ population_{VC}}{Total\ AGM}\right)/Vehicle\ population_{VC}=AGM\ component*\left(\frac{AGM_{VC}}{Total\ AGM}\right),$$

where $AGM\ component$ is the revenue (in dollars) to be recovered via the AGM component, AGM_{VC} is the AGM for a vehicle class, $Vehicle\ population_{VC}$ is the vehicle population for a vehicle class, and $Total\ AGM$ is the sum of $(AGM_{VC}*Vehicle\ population_{VC})$ for all (heavy vehicle) vehicle classes. The VKT component per vehicle is calculated as:

$$VKT\ component\ *\left(\frac{VKT_{VC}}{Total\ VKT}\right)/Vehicle\ population_{VC},$$

where $VKT\ component$ is the revenue (in dollars) to be recovered via the VKT component, VKT_{VC} is the VKT for a vehicle class, $Vehicle\ population_{VC}$ is the vehicle population for a vehicle class, and $Total\ VKT$ is the sum of VKT for all (heavy vehicle) vehicle classes.

Table C.5.4.3 takes the original regulatory component charge for the two types of 2 axle rigid trucks under 12 t GVM from table C.5.4.2 and calculates a weighted average regulatory component charge for them. This means that the same regulatory component charge applies to the two vehicle classes. The weights used in the weighted average are the vehicle population (excluding WA and the NT) for each vehicle class.

6.5.4 Section C.5.5 Regulatory component calculations for articulated trucks

This section performs calculations for the regulatory component of registration charges for articulated trucks. Table C.5.5.1 calculates the regulatory component charge for articulated trucks. The table uses inputs from table I.3.10.1 (the number of trailers for each vehicle) and sections A.3.5 to A.3.7 of worksheet 'A.3 Charges assumptions' (the charges for trailers and each type of prime mover). It also uses the spare trailer percentage calculated in table C.5.5.2 (which is sourced from table C.6.5.1 in worksheet 'C.6 Juro Veh and Revenue').

6.6 'C.6 Juro Veh and Revenue'

This worksheet has a number of functions. Firstly, it automatically calculates the number of vehicles/trailers for the relevant year from the jurisdictions' registration data. Secondly, it calculates the revenue recovered from the roads component and regulatory component of registration charges, using the estimated vehicle population. Thirdly, it calculates spare trailer percentages.

6.6.1 Section C.6.2 Jurisdiction powered units and trailer numbers

This section automatically calculates the vehicle populations for both powered units and trailers and displays them in two different formats: in jurisdictions' categories and in the NTC's vehicle classes.

Table C.6.2.1 displays the number of powered units in each vehicle class, in the jurisdictions' vehicle categories, for the relevant year. The table draws on data from the tables in section I.4.6 from worksheet 'I.4 Jurisdiction rego data'. The table will update automatically to display the numbers for the correct year whenever the model year is changed.

Table C.6.2.2 displays the same information, but with vehicles assigned to the NTC's vehicle classes rather than jurisdictions' categories. The total number of vehicles, for each jurisdiction and Australia, are the same in the two tables. Most of the data in the table is taken directly from table C.6.2.1. However, some data in table C.6.2.2 is taken from worksheet 'I.4 Jurisdiction rego data' and other data requires transformation of the data in table C.6.2.1. For example, short combination prime movers and multi-combination prime movers in the jurisdictions' categories are assigned to the NTC's vehicle classes using the percentage figures specified in sections A.3.8 to A.3.10 of worksheet 'A.3 Charges assumptions'.

Table C.6.2.3 displays the number of trailers for the relevant year (in the jurisdictions' vehicle categories). The table draws on data from the tables in section I.4.7 from worksheet 'I.4 Jurisdiction rego data'. The table will update automatically to display the numbers for the correct year whenever the model year is changed.

Table C.6.2.4 displays the number of trailers in the NTC's categories for the relevant year. The numbers of trailers in this table differs to the numbers in table C.6.2.3. This is because the number of trailers in this table is calculated by multiplying the number of powered units (from table C.6.2.2) by the assumed number of trailers for that vehicle class (from table I.4.11.1 in worksheet 'I.4 Jurisdiction rego data').

6.6.2 Section C.6.3 Registration charge revenues ($): roads component

This section calculates the revenue for each jurisdiction from the roads component of registration charges. These calculations are done in four separate tables: two for powered units (one in

jurisdictions' categories and one in the NTC's vehicle classes); and two for trailers (one in jurisdictions' categories and one in the NTC's vehicle classes).

Table C.6.3.1 calculates the roads component registration charge revenues for powered units in each jurisdiction (with vehicles classified in jurisdictions' categories). The (roads component) registration charge for each vehicle category is shown in column Q, and is sourced from table O.1.2.2 in worksheet 'O.1 Charges sched by components'. This is multiplied by the number of vehicles from table C.6.2.1 to estimate the recovery of registration revenues for each type of powered unit in each jurisdiction.

Table C.6.3.2 calculates the roads component registration charge revenues for powered units in each jurisdiction (with vehicles classified in the NTC's vehicle classes). This table transforms the data to the NTC's vehicle classes in an identical manner to the transformation of data used in table C.6.2.2.

Table C.6.3.3 calculates the roads component registration charge revenues for trailers in each jurisdiction (with trailers classified in jurisdictions' categories). The registration charge (per axle) for each vehicle category is shown in column Q, and is sourced from table O.1.2.2 in worksheet 'O.1 Charges sched by components'. The number of axles on each trailer is shown in column R: this data is sourced from table I.4.10.1 in worksheet 'I.4 Jurisdiction rego data'. Columns Q and R are multiplied together (to calculate the charge per trailer) and then multiplied by the number of trailers from table C.6.2.3 to determine total recovery of registration revenues for each type of trailer in each jurisdiction.

Table C.6.3.4 calculates the roads component registration charge revenues for trailers in each jurisdiction (with vehicles classified in the NTC's vehicle classes). The revenue for each vehicle class is calculated as follows:

$$Trailer\ population * Registration\ charge\ for\ trailers * (1 + Goal\ Seek\ value)/Number\ of\ trailers,$$

where $Trailer\ population$ is the number of trailers in that vehicle class (as calculated in table C.6.2.4), $Registration\ charge\ for\ trailers$ is the total amount of registration paid for *all* trailers in a particular vehicle configuration[20] (sourced from table C.7.5.1), $Goal\ Seek\ value$ is the value for the relevant vehicle type (rigid or articulated) calculated in section A.3.22 of worksheet 'A.3 Charges assumptions', and $Number\ of\ trailers$ is the number of trailers used in the relevant vehicle configuration (as sourced from column Q of the relevant row in table C.6.3.4).

6.6.3 Section C.6.4 Registration charge revenues ($): regulatory component

This section calculates the revenue for each jurisdiction from the regulatory component of registration charges.

Table C.6.4.1 calculates the recovery of regulatory component registration charge revenues for powered units in each jurisdiction (with vehicles classified in jurisdictions' categories). The (regulatory component) registration charge for each vehicle category is shown in column Q, and is sourced from table O.1.2.3 in worksheet 'O.1 Charges sched by components'. This charge is multiplied by the number of vehicles from table C.6.2.1 to estimate the recovery of registration revenues for each type of powered unit in each jurisdiction.

Table C.6.4.2 calculates the recovery of regulatory component registration charge revenues for trailers in each jurisdiction. The number of trailers is sourced from table C.6.2.3. This is multiplied by the number of trailer axles and the (per axle) regulatory component registration charge. The per axle charges specified may be rounded or unrounded, depending on the option specified by the

[20] For example, the combined registration charges for both trailers in a B-double.

user in section A.3.14 of worksheet ‘A.3 Charges assumptions’. Data on the number of axles and rounded and unrounded charges is shown in columns Q to U of table C.6.4.2.

Table C.6.4.3 sums the total rows for powered units and trailers in each jurisdiction (from tables C.6.4.1 and C.6.4.2) to estimate the recovery of total regulatory component registration revenues.

6.6.4 Section C.6.5 Calculation of spare trailer percentages

This section calculates various spare trailer percentages using either vehicle population data or revenue data. The spare trailer percentage is calculated, in all tables in this section, as:

$$\left(\frac{\text{number of trailers in the jurisdiction registration data}}{\text{implied number of trailers when powered units are classified in the NTC's vehicle classes}}\right) - 1.$$

This gives an estimate of the number of extra or ‘supernumerary’ trailers, relative to the number of trailers implied by the NTC’s vehicle classes.

Table C.6.5.1 calculates the spare trailer percentage for trailers used for articulated trucks, using vehicle population data. The data in the table is sourced from tables C.6.2.3 and C.6.2.4.

Table C.6.5.2 calculates the spare trailer percentage for trailers used for rigid trucks, using vehicle population data. The data in the table is sourced from tables C.6.2.3 and C.6.2.4.

Table C.6.5.3 calculates the spare trailer percentage for trailers used for articulated trucks, using revenue data. The data in the table is sourced from tables C.6.3.3 and C.6.3.4.

Table C.6.5.4 calculates the spare trailer percentage for trailers used for rigid trucks, using revenue data. The data in the table is sourced from tables C.6.3.3 and C.6.3.4.

6.6.5 Section C.6.6 Calculation of revenues under previous charges

This section calculates the cost recovery that would have been achieved under previous charges. These calculations are used to populate the relevant sections of table O.3.2.1 in worksheet ‘O.3 Summary tables’. The calculations in this section will update automatically whenever the model year is changed.

Table C.6.6.1 calculates the roads component of registration revenue for powered units that would have been earned under the previous year’s charges. The previous year’s charge for each vehicle class is shown in column Q and is sourced from table O.1.5.2 in worksheet ‘O.1 Charges sched by components’. This charge is multiplied by the number of powered units calculated in table C.6.2.1.

Table C.6.6.2 calculates the roads component of registration revenue for trailers that would have been earned under the previous year’s charges. The previous year’s charge (per axle) for each type of trailer is shown in column Q and is sourced from table O.1.5.2 in worksheet ‘O.1 Charges sched by components’. The number of axles for each trailer is shown in column R; this is sourced from table I.4.10.1 in worksheet ‘I.4 Jurisdiction rego data’. The number of trailers (from table C.6.2.3) is multiplied by the total charge per trailer (the product of columns Q and R) to calculate the total revenue for each type of trailer.

Table C.6.6.3 calculates the regulatory component of registration revenue for powered units that would have been earned under the previous year’s charges. The previous year’s charge for each vehicle class is shown in column Q and is sourced from table O.1.5.3 in worksheet ‘O.1 Charges sched by components’. This charge is multiplied by the number of powered units calculated in table C.6.2.1.

Table C.6.6.4 calculates the regulatory component of registration revenue for trailers that would have been earned under the previous year’s charges. The number of trailers is sourced from table C.6.2.3. This is multiplied by the number of trailer axles and the (per axle) regulatory component

registration charge. The per axle charges specified may be rounded or unrounded, depending on the option specified by the user in section A.3.14 of worksheet 'A.3 Charges assumptions'. Data on the number of axles and rounded and unrounded charges is shown in columns Q to U of table C.6.6.4.

6.7 'C.7 Charges calculations'

This worksheet calculates the charges per vehicle and the revenue that is recovered from each vehicle class. It also calculates the revenue recovered from the RUC.

6.7.1 Section C.7.2 Charges calculations output

This section displays the output/summary tables for the worksheet. The more detailed calculations underlying these tables are shown further below in the worksheet.

Table C.7.2.1 displays the revenue recovered from various components: revenue from the RUC (column F, sourced from table C.7.4.1); revenue from registration charges for powered units (column G, sourced from table C.6.3.2); and revenue from registration charges for trailers (column H, sourced from table C.6.3.4). Column I sums the revenue for the first three components in the table. Column J shows the cost base for each vehicle class, sourced from table C.7.3.1. The final column in the table compares the total revenue and total cost base for each vehicle class.

Table C.7.2.2 compares each vehicle class's cost recovery and allocated cost on a *per vehicle* basis. The first and second columns in the table take data on cost recovery and allocated cost from table C.7.2.1 and divide by the vehicle population for that vehicle class (as calculated in table C.3.2.1).

Table C.7.2.3 summarises the 'cost recovery per vehicle' under the model's estimated 2018/2019 charges. This 'cost recovery' is split—and subsequently aggregated—in several ways. The first two columns in the table show roads component cost recovery (separately for powered units and trailers). The next two columns show the regulatory component cost recovery (separately for powered units and trailers). The fifth column (column J in the worksheet) shows the total cost recovery by summing the first four columns. The following four columns each aggregate two of the first four columns in a different way. In order, they sum together: both powered unit columns; both trailer columns; both roads component columns; and both regulatory component columns. The data for the roads component in the first two columns is sourced from table C.7.6.1. The data for the regulatory component in columns three and four are sourced from various tables in worksheet 'C.5 Regulatory costs scenario'. The final column in the table displays the RUC (which is the same for all vehicle classes).

Table C.7.2.4 depicts the same information as table C.7.2.3, but for the previous year's charges. The underlying charge information is sourced from the tables in section O.1.5 of worksheet 'O.1 Charges sched by components'.

6.7.2 Section C.7.3 Cost base

Table C.7.3.1 depicts cost base information for each vehicle class. This data is sourced directly from table C.4.2.1, and converted to units of $ rather than $m.

Table C.7.3.2 reports the same data as table C.7.3.1, but on a 'per vehicle' basis. This means that the cost base is divided by the vehicle population (as calculated in table C.3.2.1).

6.7.3 Section C.7.4 Fuel revenue

This section calculates the estimated fuel (RUC) revenue for each vehicle class. The estimated fuel revenue is calculated by multiplying fuel consumption for each vehicle class (as specified in table

C.3.2.1 of worksheet 'C.3 Usage data calculations'[21]) by the RUC specified in section A.3.2 of worksheet 'A.3 Charges assumptions'.

6.7.4 Section C.7.5 Estimated cost recovery from trailers per vehicle

This section calculates the estimated cost recovery from trailers per vehicle. Table C.7.5.1 is the output table for trailer cost recovery. It is linked to the three columns in table C.7.5.2 and will display the estimated cost recovery per vehicle according to the charge structure methodology selected by the user in section A.3.15 of worksheet 'A.3 Charges assumptions'. That is, one of: status quo axle charges; standard axle charges; or axle grouping charges.

Table C.7.5.2 displays the estimated cost recovery from trailers per vehicle under each of the different charge structure options for trailers. These are calculated by multiplying the number of axles or trailer type (as shown in the relevant table in section A.3.21 of worksheet 'A.3 Charges assumptions') by the charges specified in section A.3.18 for that charge structure.

6.7.5 Section C.7.6 Vehicle registration cost recovery with floor constraints

This section displays the vehicle cost recovery from (roads component) registration charges for each vehicle class. The table takes into account the floor constraints specified in section A.3.17 (of worksheet 'A.3 Charges assumptions'), for both the powered unit and trailer(s) for each vehicle class, by using Excel's *MAX* function. That is, the estimated cost recovery for a vehicle will be based on the charges specified in sections A.3.18 and A.3.19 of worksheet 'A.3 Charges assumptions' unless this cost recovery is less than the specified floor constraints in section A.3.17 for the relevant vehicle component. The final column in the table sums the cost recovery from each of the vehicle components to calculate total cost recovery.

6.8 'C.8 MaxMan splitter calcs'

This worksheet splits the aggregated figures from the SMVU for VKT and GTK into separate Urban/Rural, Arterial/Local components. The split data is then used in worksheet 'C.9 MaxMan - Cost Allocation' for cost allocation purposes in the MaxMan module. The worksheet also calculates AGM measures for each vehicle class in separate Urban/Rural, Arterial/Local components.

6.8.1 Section C.8.2 VKT splitter

This section splits the VKT data from worksheet 'I.6 SMVU data for MaxMan' into separate Urban/Rural, Arterial/Local components.

Tables C.8.2.1 and C.8.2.2 are the output/summary tables for the VKT data which depict data on an Australia-wide and 'subset' basis, respectively. The tables sum data from tables C.8.2.4, C.8.2.5, C.8.2.7 and C.8.2.8.

Table C.8.2.3 displays urban VKT for each jurisdiction and vehicle class by summing the relevant data from worksheet 'I.6 SMVU data for MaxMan'. For all jurisdictions other than the ACT, urban VKT is calculated as the sum of VKT in the capital city of the state of registration and VKT in other urban areas in the state of registration, displayed in tables I.6.2.1 and I.6.2.2 of worksheet 'I.6 SMVU data for MaxMan'. For the ACT, the table also sums interstate VKT in the ACT (table I.6.2.12) because all of the ACT is considered to be urban.

Tables C.8.2.4 and C.8.2.5 split the urban VKT into urban arterial and urban local components. This is done by multiplying the data in table C.8.2.3 by the arterial percentages (or 1 minus the arterial percentages) for each vehicle class specified in table I.3.2.1 of worksheet 'I.3 Usage data inputs'.

[21] That is, using the SMVU data averaged using the methodology and number of years specified in worksheet 'A.1 Assumptions'.

Table C.8.2.6 displays rural VKT for each jurisdiction and vehicle class by summing the relevant data from worksheet 'I.6 SMVU data for MaxMan'. For all jurisdictions other than the ACT, this is simply the sum of VKT in 'other areas of state of registration' (table I.6.2.3) and interstate VKT in that jurisdiction (one of the tables from I.6.2.5 to I.6.2.11). For the ACT, the table hard-codes values of zero because all of the ACT is considered to be urban.

Tables C.8.2.7 and C.8.2.8 split the rural VKT into rural arterial and rural local components. This is done by multiplying the data in table C.8.2.6 by the arterial percentages (or 1 minus the arterial percentages) for each vehicle class specified in table I.3.2.1 of worksheet 'I.3 Usage data inputs'.

6.8.2 Section C.8.3 GTK splitter

This section splits the GTK data from worksheet 'I.6 SMVU data for MaxMan' into separate Urban/Rural, Arterial/Local components.

Tables C.8.3.1 and C.8.3.2 are the output/summary tables for the GTK data which depict data on an Australia-wide and 'subset' basis, respectively. The tables sum data from tables C.8.3.4, C.8.3.5, C.8.3.7 and C.8.3.8.

Table C.8.3.3 displays urban GTK for each jurisdiction and vehicle class by summing the relevant data from worksheet 'I.6 SMVU data for MaxMan'. For all jurisdictions other than the ACT, urban GTK is calculated as the sum of GTK in the capital city of the state of registration and VKT in other urban areas in the state of registration, displayed in tables I.6.3.1 and I.6.3.2 of worksheet 'I.6 SMVU data for MaxMan'. For the ACT, the table also sums interstate GTK in the ACT (table I.6.3.12) because all of the ACT is considered to be urban.

Tables C.8.3.4 and C.8.3.5 split the urban GTK into urban arterial and urban local components. This is done by multiplying the data in table C.8.3.3 by the arterial percentages (or 1 minus the arterial percentages) for each vehicle class specified in table I.3.2.1 of worksheet 'I.3 Usage data inputs'.

Table C.8.3.6 displays rural GTK for each jurisdiction and vehicle class by summing the relevant data from worksheet 'I.6 SMVU data for MaxMan'. For all jurisdictions other than the ACT, this is simply the sum of GTK in 'other areas of state of registration' (table I.6.3.3) and interstate GTK in that jurisdiction (one of the tables from I.6.3.5 to I.6.3.11). For the ACT, the table hard-codes values of zero because all of the ACT is considered to be urban.

Tables C.8.3.7 and C.8.3.8 split the rural GTK into rural arterial and rural local components. This is done by multiplying the data in table C.8.3.6 by the arterial percentages (or 1 minus the arterial percentages) for each vehicle class specified in table I.3.2.1 of worksheet 'I.3 Usage data inputs'.

6.8.3 Section C.8.4 AGM calculations

This section calculates the AGM for each vehicle class in separate Urban/Rural, Arterial/Local components. The AGM is calculated by dividing the GTK data from table C.8.3.1 by the VKT data in table C.8.2.1, for each of the four geographic components.

6.9 'C.9 MaxMan - Cost Allocation'

This worksheet calculates the MaxMan adjustment for double and triple road trains: the output of this worksheet, as shown in section C.9.2, serves as the post-MaxMan attributable costs for road trains.

6.9.1 Section C.9.2 MaxMan Adjustment Output

This section displays the output/summary tables of the MaxMan module: the cell values from this section are used in tables C.4.4.3 and C.4.4.4 for the two road trains vehicle classes (and ultimately used in table C.4.2.1).

Tables C.9.2.1 and C.9.2.2 are structured identically and display the MaxMan adjustment output for double and triple road trains, respectively. The tables display attributable costs, disaggregated by geographic component and allocator. The data for the two tables is sourced from the tables in section C.9.3 and section C.9.4. The calculation involves multiplying the relevant expenditure split from table C.9.4.1 by the relevant allocator proportion for road trains in the tables in section C.9.3.

6.9.2 Section C.9.3 Allocators for subset

This section displays the allocators for the MaxMan 'subset' of jurisdictions, for each of the four geographic components (Urban/Rural, Arterial/Local).

Table C.9.3.1 simply displays the VKT data—for each vehicle class and each geographic component—calculated in table C.8.2.2 of worksheet 'C.8 MaxMan splitter calcs'.

Each of the tables further down in the section multiply the VKT from table C.9.3.1 by the other allocator which is being displayed (PCU, ESA or AGM). Table C.9.3.2 multiplies VKT by the PCU values specified in table I.3.2.1 of worksheet 'I.3 Usage data inputs'. Table C.9.3.3 multiplies VKT by the ESA values in table C.3.2.1 of worksheet 'C.3 Usage data calculations'.[22]. Table C.9.3.4 multiplies VKT by the AGM calculated in table C.8.4.1 of worksheet 'C.8 MaxMan splitter calcs'.

6.9.3 Section C.9.4 Expenditure split for subset

This section calculates the expenditure split, disaggregated by allocator and geographic component.

Table C.9.4.1 is the output table for the expenditure split (for the MaxMan subset of jurisdictions). It summarises data from the 'total' rows of the relevant table in sections C.9.5 to C.9.8.[23] The table uses Excel's *SUMIF* function to sum the data from the relevant jurisdictions for the MaxMan subset (the subset jurisdictions are displayed in table C.9.4.2).

As noted above, table C.9.4.2 is an information table showing the jurisdictions included in the MaxMan subset; the data is sourced from table I.6.4.1 of worksheet 'I.6 SMVU data for MaxMan'.

6.9.4 Section C.9.5 VKT expenditure split for subset

This section calculates the expenditure split as allocated by VKT.

The four tables in this section are structured identically: each displays the expenditure split disaggregated by expenditure category and jurisdiction. The values in the table are calculated by multiplying the appropriate cost base figure for the geographic component (Urban/Rural, Arterial/Local) by the cost allocation matrix value for that expenditure category and allocator (in this case VKT).

6.9.5 Section C.9.6 PCU-km expenditure split for subset

This section calculates the expenditure split as allocated by PCU-km.

The four tables in this section are structured identically: each displays the expenditure split disaggregated by expenditure category and jurisdiction. The values in the table are calculated by multiplying the appropriate cost base figure for the geographic component (Urban/Rural, Arterial/Local) by the cost allocation matrix value for that expenditure category and allocator (in this case PCU-km).

---

[22] This table displays the ESA values selected in section A.1.17.

[23] For example the cell displaying Urban Arterial VKT sums data from table C.9.5.1.

6.9.6 Section C.9.7 ESA-km expenditure split for subset

This section calculates the expenditure split as allocated by ESA-km.

The four tables in this section are structured identically: each displays the expenditure split disaggregated by expenditure category and jurisdiction. The values in the table are calculated by multiplying the appropriate cost base figure for the geographic component (Urban/Rural, Arterial/Local) by the cost allocation matrix value for that expenditure category and allocator (in this case ESA-km).

6.9.7 Section C.9.8 AGM-km expenditure split for subset

This section calculates the expenditure split as allocated by AGM-km.

The four tables in this section are structured identically: each displays the expenditure split disaggregated by expenditure category and jurisdiction. The values in the table are calculated by multiplying the appropriate cost base figure for the geographic component (Urban/Rural, Arterial/Local) by the cost allocation matrix value for that expenditure category and allocator (in this case AGM-km).

7. Glossary

Term	Definition
Attributable costs	Costs of providing and maintaining roads that vary depending on the use of the road system by different types of vehicles. These costs are directly attributable to vehicles.
Average gross mass (AGM)	An average of the total mass of a vehicle and its load per kilometre travelled.
Common (or non-attributable) costs	Costs of providing roads that have little relation to road use. Examples include the costs of repairing storm or flood damage and the costs of building a minimum possible standard of road or bridge. Some pavement wear occurs because road building materials deteriorate with age and weather. This wear would occur regardless of whether vehicles used the road or not and is therefore non-attributable to vehicles.
Community service obligation (CSO)	Non-commercial requirements of government business enterprises for identified social purposes.
Equivalent standard axle (ESA)	A measure of the relative road wear of different axles carrying different loads, calculated as: $ESA = \left(\frac{load}{reference\ \ load} \right)^4$ This applies where the reference load varies depending on the number of axles in the axle group and the types of tyres it is fitted with.
General mass limits (GML)	Mass limits for general access vehicles.
Gross vehicle mass (GVM)	The maximum mass the manufacturer or road authority has rated the vehicle as safe to carry.
Heavy vehicle	A vehicle weighing 4.5 tonnes or heavier GVM.
Pay As You Go (PAYGO)	An approach used to determine the amount to be recovered from heavy vehicles through the pricing system. Current levels of construction and maintenance expenditure are assumed to reflect the annualised costs of providing and maintaining roads for the current level of traffic.

8. Abbreviations

Abbreviation	Definition
ABS	Australian Bureau of Statistics
AGM	Average gross mass
ANPR	Automatic number plate recognition
ATC	Australian Transport Council
BITRE	Bureau of Infrastructure, Transport and Regional Economics
COAG	Council of Australian Governments
COTI	Council on Transport and Infrastructure – Now known as the Transport and Infrastructure Council (or 'the Council').
CPI	Consumer Price Index
CSO	Community service obligation
EMA	Exponential moving average
ESA	Equivalent standard axle
GML	General mass limits
GTK	Gross tonne kilometres
GVM	Gross vehicle mass
HVCI	Heavy Vehicle Charging and Investment
NHVR	National Heavy Vehicle Regulator
NTC	National Transport Commission
PAYGO	Pay As You Go
PCU	Passenger car unit
RCMPI	Road Construction and Maintenance Price Index
RSE	Relative standard error
RUC	Road user charge
SCOTI	Standing Council on Transport and Infrastructure – Now known as the Transport and Infrastructure Council (or 'the Council').
SMVU	Survey of Motor Vehicle Use
VKT	Vehicle kilometres travelled
WIM	Weigh-in-motion