Appendix C: Future Traffic Demand Calculations for Operational Modelling

Contents

C.1 Introduction

There are several different ways to determine suitable future traffic flows for traffic modelling. The overall purpose of this document is to briefly note the various alternatives but to focus on the use of ROM24 to obtain future traffic flows and to provide detailed guidelines for the calibration of ROM24 data primarily for operational modelling assessment. It should be noted that the calibration process presented in this document aligns with ‘Method 1’ in Guideline Document for Road Planning and Development: Using ROM24 road volume outputs for road planning and development work.

It is also important to note that the availability of ROM24 data is not the subject / intention of this document. The decision of ROM24 data publication lies with Main Roads Western Australia (MRWA) Planning and Technical Services (PTS).

This document is developed for Network Operations Directorate use to assist in the calculation of future traffic flows.

C.1.1 Determination of Future Traffic Flows

It is important to confirm that any proposed changes will work in agreed future scenario years. Therefore, part of the traffic modelling includes confirming that appropriate assumptions have been made for determination of future traffic flows.

Alternative methods for determining future traffic flows for Perth metropolitan area are to either use statistical methods to forecast flows based on available historical count information, or to use the traffic volumes produced by Main Roads’ Regional Operations Model (ROM24).

One simplistic statistical approach in forecasting future traffic is the use of historical traffic growth, which is both cost and time effective. However, applying historical traffic growth cannot be relied upon in many instances, as it does not take into account any proposed developments in the area or any significant land-use changes that have occurred or are proposed.

ROM24 on the other hand is a land-use transport model in which traffic projections are based on land use and transport for user specified scenarios. It should be noted that, as is the case with any traffic model, ROM24 has its limitations due to its strategic nature and hence might require adjustments to be made.

It is therefore crucial that, based on the specific context, a decision on the appropriate forecast method is to be made, keeping in mind, the pros and cons of these different approaches.

The recommended methodology for determining future traffic flows using ROM24 data is presented in Section C.2.

C.1.2 ROM24 Overview

ROM24 is Main Roads Western Australia's strategic transport model that covers the entire Perth metropolitan region from Yanchep to Mandurah. ROM24 is used to project travel demand patterns in Perth under different land use, transport and pricing scenarios.

ROM24 uses the traditional four-step modelling process (Trip generation, Trip distribution, Modal split and Trip assignment). It is based on Land Use Data that is provided by the Road Planning Branch, and has separate models for 2011, 2016, 2021 and 2031, which are regularly updated by the Transport Modelling Section within PTS.

The model was initially calibrated against 2011 data. However, it is now possible to utilise 2016 traffic count data for the calibration and adjustment of model outputs, which is particularly relevant for detailed intersection operational analysis.

ROM24 provides forecast traffic volumes for each hour of an average weekday, as well as for the full 24-hour period. However, the data is generally considered to be most accurate over the full 24-hour period. Daily forecast traffic volumes are therefore utilised in most situations described within these guidelines. However, in some situations the use of peak period forecasts (e.g. 7-9am or 6-9am and 4-6pm or 4-7pm) is also recommended as discussed in Section C.4.2.

C.1.2.1 ROM24 Outputs

A wide range of data outputs can be generated from ROM24. It is highly recommended to discuss the availability of the ROM24 outputs in advance with Main Roads Planning and Technical Services Directorate as the decision of ROM24 data publication lies in this Directorate. The data most relevant for the operational modelling process is as follows:

- Link Volume Plots − Provides modelled forecast traffic volumes for each direction on each road link for a selected model area.
- Turning Volumes Diagrams − Provides intersection turning movement volumes at any intersection represented in the modelled network.
- Select Link Plots − Plots showing the distribution of total traffic flows across the network using a specific selected link. These plots can be used to determine traffic distribution and re-routing.
- Sub-Area Matrices - Provides a matrix of traffic flows within a specifically requested sub-area of the overall model. Sub area matrices are useful in the determination of trip distribution in the specified sub area model network. They can also be used to calculate overall modelled growth rate for the selected sub area.

Examples of ROM24 data outputs are presented in Attachment C.2.

Link Volume plots and Select Link plots for daily forecasts are factored down (generally by 100) and rounded, to simplify the output for plotting purposes. In such cases, it is necessary to factor the data back up to produce the daily traffic volumes (noting that the applicable factor is always shown on the traffic model plots). For example, 246 on a volume plot with a factor of 100 represents a traffic volume of 24,600 vehicles per day.

Turning Volume diagrams are unrounded and unadjusted.

Daily forecast data should be obtained in all situations, including when a decision has been made to use peak hour data. If peak hour data is to be used, then forecast volumes should be obtained for three 1-hour periods, including one hour either side of the expected peak hour. It should be noted that if no peak time is specified, ROM24 plots for the peak hours will be generated for 7:00- 9:00 and 16:00-18:00 by default.

C.1.2.2 ROM24 Calibration and Adjustments

ROM24 is calibrated at a metropolitan wide scale and shows strong correlation at this level, particularly for freeways and highways (R2 = 0.923 for version 4.20) hence, ROM24 provides a macro perspective of future traffic movement for the metropolitan Perth and Peel area. It is a strategic regional model, which is most accurate along major traffic routes and across screen line boundaries (such as the Swan River). The accuracy of the model declines as users move away from the strategic scale and examine specific vehicle classes, time periods, and non-major roads.

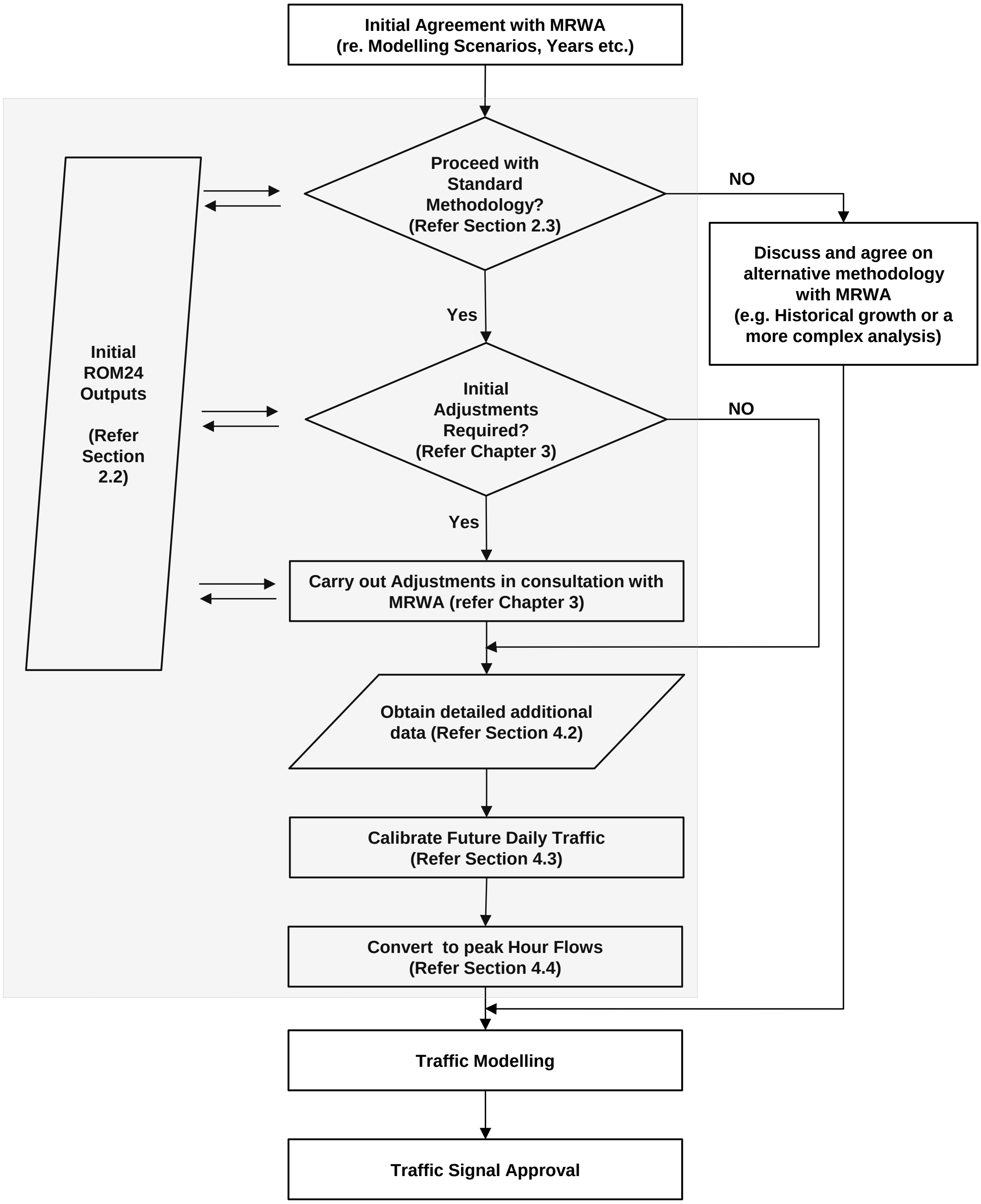
Care must always be taken when using ROM24 for intersection analysis, firstly to ensure that the data obtained sufficiently reflects the intersection being analysed, and then to also undertake an appropriate process of data calibration and adjustment.

The reliability of the model is generally high at intersections of major traffic routes, and the raw ROM24 output data can be input directly into the 'Calibration and Adjustment' process described in this document.

C.2 Determination of future traffic with ROM24

This section presents an overview of the detailed methodology for determining future traffic flows using ROM24.

The flow chart below sets out the process to be followed, including references to relevant sections within this report where further details are documented noting that only the highlighted portion of the flow chart is dealt with, in this report. A brief description of each step within the flow chart is provided within the following sections.



C.2.1 Initial Agreement with Main Roads Stakeholders

The overall process begins with an initial discussion with Main Roads WA. Decisions regarding the assumptions for the year of assessment of intersection operations such as, future model years (up to 10 years), modelling scenarios to be utilised for the analysis etc. are made at this stage. Any other modelling requirements are also discussed and it is recommended that a traffic model instruction form, available from the OMV team, is completed at this stage.

C.2.2 Initial ROM24 Outputs

Initial ROM24 outputs should be referred to at various stages of the process to inform the decisions made on the most appropriate methodology for calculating future traffic flows.

As discussed in Section C.1.2, ROM24 outputs can be available in various forms, with each providing different kinds of information. It is recommended to request Link Volume Plots for the study area to give a basis for commencing the process, for instance, Link Volume Plots can provide the modelled traffic flows and also give an insight into the model network/ intersection coding. This information will be useful in making initial judgements on whether or not to follow a standard calibration procedure (Refer to Section C.2.3) or whether to undertake any initial adjustments to the data (Refer to Section C.2.4).

Based on the situation, data availability and the amount of detail required to support a decision, additional ROM24 outputs may need to be requested. An example is the request of a subarea matrix for a specific area, additional centroid connections to get a more realistic traffic distribution or select link volume plots to identify major traffic routes.

C.2.3 Agree Methodology

Following an initial review of ROM24 data, a decision should be made at this stage, in consultation with Main Roads WA, on whether it is appropriate to proceed with the standard calibration methodology for obtaining future traffic flows.

In situations where it is clear from the available ROM24 data that it is not fit-for-purpose in the form produced, for instance, the model network coding (from ROM24 Link Volume Plots) or traffic distribution (from ROM24 Select Link Plots and or Sub Area Matrices) seems to be incorrect, a methodology should be formulated in consultation with Main Roads WA, to address the situation in the best possible way, with the available data. This could include either partially utilising ROM24 or updating ROM24 to reflect the required situation or to completely disregard ROM24 outputs by formulating an alternative methodology.

Since this decision is context specific and requires professional judgement, the scope of these guidelines is limited to a standard calibration methodology.

C.2.4 Initial Adjustments

Once the decision to proceed with the standard calibration methodology is made, initial adjustments of the traffic estimates are likely to be necessary in some situations.

For example:

- Two or more parallel roads where small changes in the network may cause large volumes of traffic to switch from one road to the other;
- Simplified sections of the road network where links contained in the model actually represent a number of local roads rather than one specific road;
- Links directly adjoining centroid connectors where traffic is loaded onto the networks;
- Areas which are known to have inaccuracies in the location and/or type of land use;
- Minor roads which carry relatively low traffic volumes.

In these situations, it is necessary to first carry out a series of checks and adjustments on the raw data outputs, before proceeding with any specific intersection analysis. A number of alternative scenarios that may require initial adjustments are therefore identified and discussed in Section C.3.

However, it is important to note that there will be many different situations, which may require different aspects of these examples to be combined or varied. Professional judgement must therefore be exercised and due care must be taken in every situation.

C.2.5 Calibration of Daily Traffic Flows

C.2.5.1 Obtain Detailed Additional Data

As noted in Section C.2.2 above, initial ROM24 outputs are required at every decision making stage of the process. Detailed data is then required for the calibration of daily traffic flows, which includes both ROM24 outputs and observed existing data, and forms the basis for calibration of the ROM24 outputs.

It should be noted that some of the outputs required at this stage would already have obtained for earlier stages in the process. In that case, only the additional data must be requested. The data required for calibration of Daily Traffic Flows is discussed in detail in Section C.4.2.

C.2.5.2 Methodology

A detailed methodology for the calibration of Daily Traffic Flows from ROM24, for an isolated intersection is discussed in Section C.4.3. The general calibration and adjustment method for the use of ROM24 data for intersection operational analysis is a 3-step process that is applied when the model is considered to be fit-in-purpose in its current form, after considering the various issues raised above in the preceding stages.

C.2.6 Conversion to Peak Hour Flows

The methodology to be adopted for the conversion of calibrated daily traffic flows to peak hour flows is discussed in Section C.4.4 of this report. The calculated peak hour flows can then be used as input to the traffic modelling to undertake intersection operational analysis.

C.3 Alternative Scenarios and initial adjustments

If the raw data obtained from ROM24 is considered not to be sufficiently fit-for-purpose when considering the various issues raised above in Section C.2.4, then a more detailed methodology is required to obtain suitable future traffic data for intersection analysis purposes.

Once again, a general overview of several possible scenarios is described here, with more detailed descriptions and worked examples provided in Attachment C.4.

C.3.1 Scenario 1: Two or More Parallel Roads

Parallel roads create an issue if the model sensitivity causes a large shift of traffic from one route to another, in either the Existing Model, the Future Model, or both.

In this situation, it is necessary to assess the total traffic volumes on a screen line that crosses each of the affected routes, and to either adjust the ROM24 raw data before proceeding with the calibration process, or to determine an overall growth rate across the screen line to be able to apply to the existing actual data, as described in Attachment C.4.

C.3.2 Scenario 2: Simplified Road Network

Since ROM24 is a regional model, it is often necessary to combine several local roads that intersect a more major route into a single road link or centroid connector within the model.

It is therefore necessary to either separate the ROM24 raw data out into the relevant number of individual roads, or to utilise a growth factor from the combined link to apply to the existing traffic flows on the local road as described in Attachment C.4.

It is important to note, however, that the growth rate method must be applied carefully, since (for example) the road to be analysed could be the first of several roads to be constructed, and all of the subsequent growth could be taken up by the additional roads, with little or no growth at all on the initial road.

C.3.3 Scenario 3: Links Adjoining Centroid Connectors

Where large areas of development are combined together and represented as a single centroid, the traffic volumes on the road links adjoining the centroid connector will be distorted. If the intersection to be analysed is adjacent to a centroid connector of this type, it may be necessary to adjust the traffic flow on the affected road link, especially if the centroid in question shows significant traffic growth between the existing and future modelled years.

In this situation, it may also be necessary to utilise a historical growth rate for traffic growth along the main route, or to apply an applicable modelled growth rate from a nearby location, or to identify an area-wide modelled growth rate for the surrounding area, as described in Attachment C.4.

C.3.4 Scenario 4: Known Inaccuracies

If the intersection to be analysed is in an area in which ROM24 is known to have inaccuracies in that location and/or type of land use, then it may only be possible to utilise the modelled data if it is first updated.

This could include the splitting up of centroids into a more detailed representation of a development area, or simple adjustments to the number and/or location of centroid connectors to better reflect the overall road network.

The ROM24 model could also be updated to better reflect the expected land uses within a particular area.

C.3.5 Scenario 5: Network-wide Calibration

If analysing a number of intersections in a network, it might not be possible to get intersection ROM24 data for all the intersections.

In this case, calibration of the various links in the network is recommended. This process involves the determination of growth between the future years for the whole network (global growth or different growths due to development) and then the application of identified growth/s to existing traffic data to calculate future traffic flows.

In cases where there is no data available, even at the network level, it is recommended that an appropriate methodology be discussed with Main Roads WA.

C.4 Calibration and Adjustment Methodology

This chapter presents the calibration and adjustment process of ROM24 data for a specific intersection in further detail. The calibration process presented here is aligns with 'Method 1' documented in Guideline Document for Road Planning and Development: Using ROM24 road volume outputs for road planning and development work.

C.4.1 General Overview

Each step in the calibration process is described in detail in Sections C.4.2 to C.4.4, based on the following general overview:

Step 1: Obtain Relevant Data

- Existing (Actual) intersection turning movements for AM, PM and 24-hour periods (for 2016).
- Existing (Modelled)[1] daily intersection turning movements for the same year (2016).
- Future (Modelled) daily intersection turning movements for the analysis year (2021 or 2031).

Refer to Section C.4.2 for detailed explanation and worked examples.

Step 2: Calibrate Future Daily Flows

- Determine relevant calibration adjustments for each traffic movement.
- Apply calibration adjustments to obtain future calibrated volumes.
- Check appropriateness of directional split for each OD pair through the intersection.
- Apply directional split corrections, if necessary, to obtain final calibrated daily traffic volumes.

Refer to Section C.4.3 for detailed explanation and worked examples.

Step 3: Convert to Peak Hour Flows for Analysis

- Analyse existing (actual) intersection data to identify each individual peak hour traffic movement as a percentage of the corresponding daily flow.
- Apply individual percentages to each future calibrated daily flow to determine the corresponding future peak hour flow.

Refer to Section C.4.4 for detailed explanation and worked examples.

The resulting peak hour traffic flows can then be input directly into the traffic model for detailed intersection analysis.

[1] Modelled traffic refers to ROM24 modelled traffic.

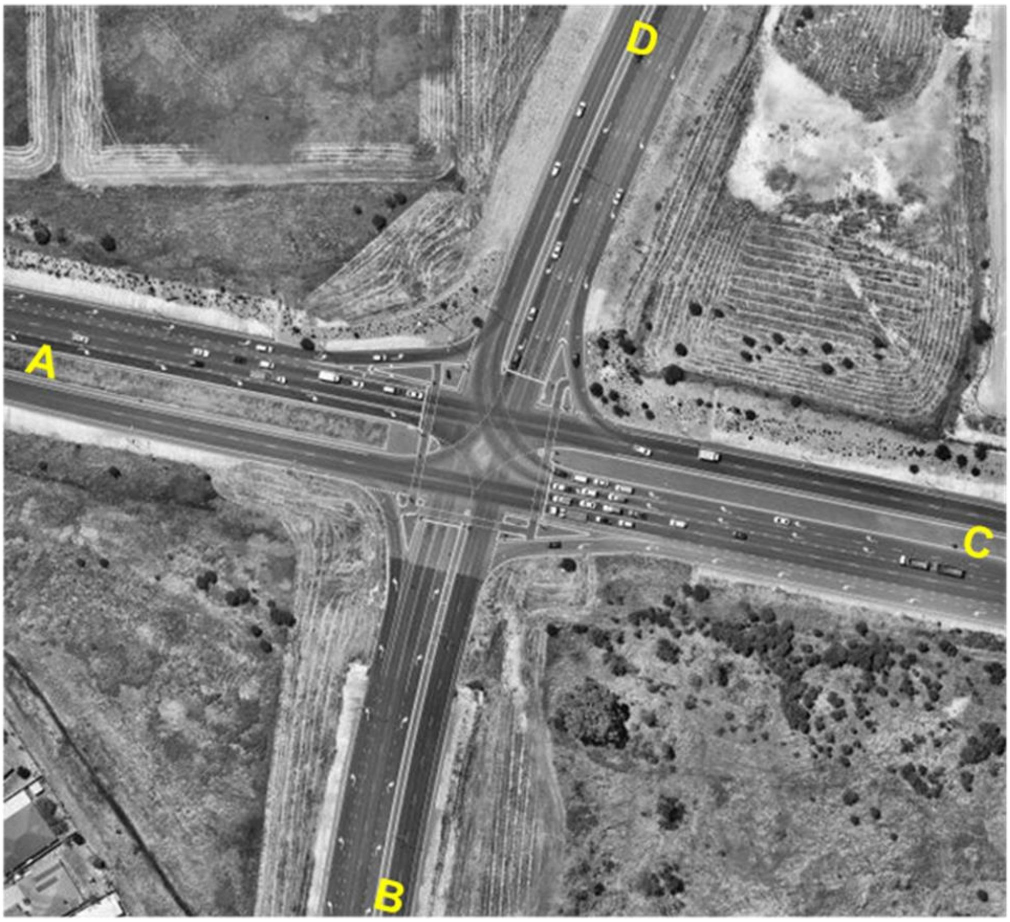
C.4.2 Obtaining Detailed Data

The first step in the general calibration process is to obtain all relevant data, including existing (actual) intersection turning movement counts for the relevant ‘existing’ base year, as well as modelled data from ROM24 for both the base year and future years (2021 / 2031).

C.4.2.1 Existing (Actual) Intersection Counts

Existing (actual) data for existing signalised intersections can be obtained from SCATS, using the process described in Attachment C.1 (using Reid Highway - Lord Street as an example).

Data should be obtained for the full 24-hour period of a typical weekday[2], as well as for the AM and PM peak hours, and should be converted into matrix form, using an identified label for each intersection approach leg, as follows:



(Source: Nearmaps - November, 2016)

[2] A typical weekday is a day that represents the general traffic behaviour through the intersections, hence weekends, school holidays, major event traffic etc. must not be considered as they represent modified traffic behaviour.

The available SCATS data for the Reid Highway - Lord Street example, for Wednesday 15 June 2016, is as follows:

Table 1: Daily Traffic Flows

	A	B	C	D	Total
A	0	628	8,246	5,742	**14,616**
B	744	0	192	1,642	**2,578**
C	8,706	233	0	4,253	**13,192**
D	4,621	1,959	4,370	0	**10,950**
Total	**14,071**	**2,820**	**12,808**	**11,637**	**41,336**

Table 2: AM Peak Hour Flows

	A	B	C	D	Total
A	0	15	664	244	**923**
B	72	0	18	86	**176**
C	758	16	0	248	**1,022**
D	544	187	400	0	**1,131**
Total	**1,374**	**218**	**1,082**	**578**	**3,252**

Table 3: PM Peak Hour Flows

	A	B	C	D	Total
A	0	68	772	624	**1,464**
B	51	0	15	190	**256**
C	844	25	0	418	**1,287**
D	233	136	306	0	**675**
Total	**1,128**	**229**	**1,093**	**1232**	**3,682**

It is important to note, however, that SCATS data at some intersections does not fully define all traffic movements, due to shared lanes and/or undetected lanes. In these situations it will be necessary to carry out additional surveys and/or analysis in order to establish a full set of existing data, as described in Attachment C.1.

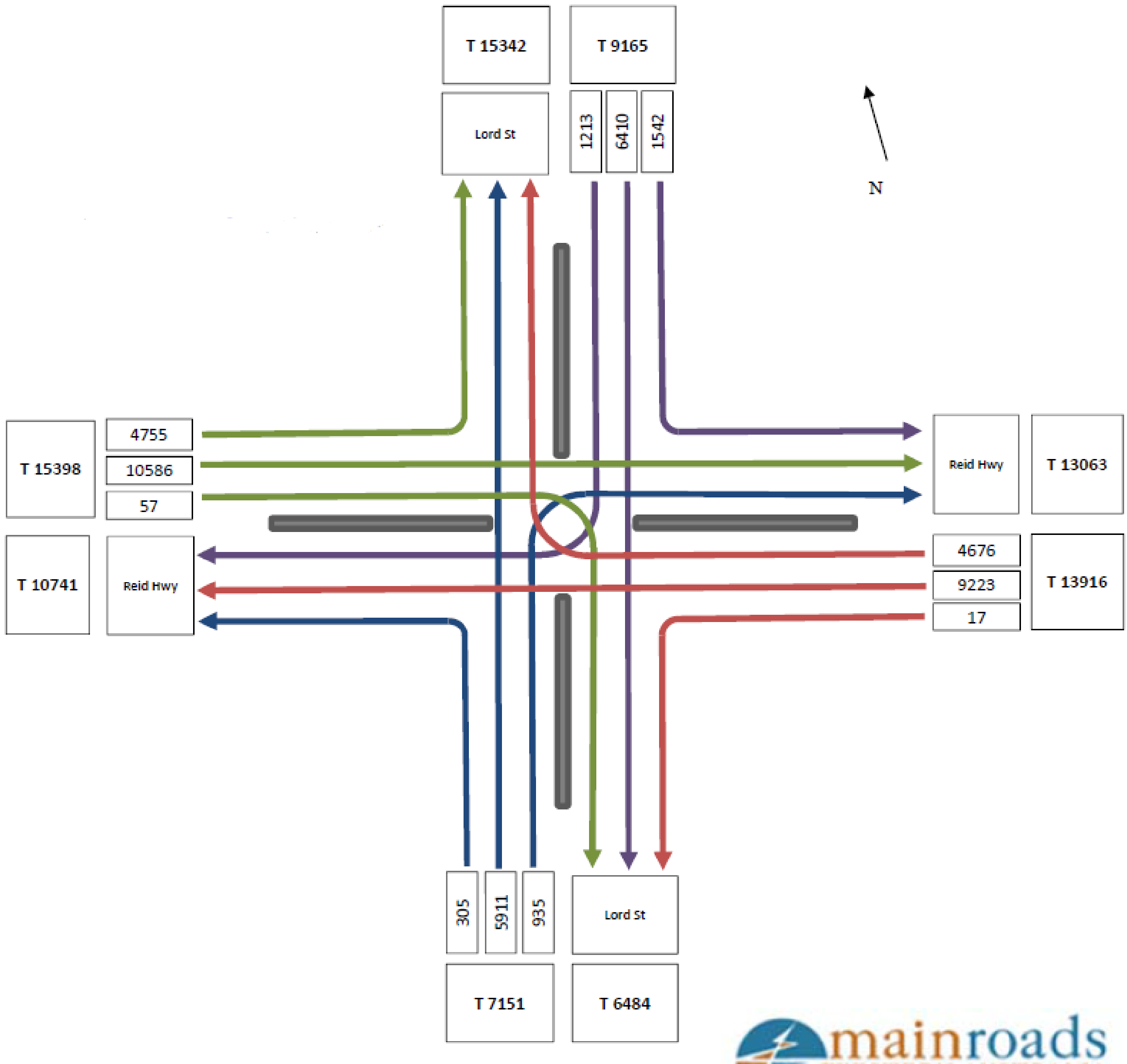
C.4.2.2 Base Year Data from ROM24

Modelled base year and forecast year volumes are requested from the Transport Modelling Section within PTS, as described in Section C.2.2.

For calibration purposes, it is recommended that the following base year (2016) ROM24 model outputs be obtained:

- Link volume plots – Modelled base-year daily volumes, showing the intersections to be analysed and the area surrounding. The extents of the surrounding area should be sufficient to assess the reliability of the modelled road network.
- Turning Movement diagram – Modelled base year daily turning volumes, for intersections to be analysed.

The obtained ROM24 daily turning movement diagram is given as follows:



The traffic volumes obtained for 2016 are converted into matrix format as follows:

Table 4: ROM24 Daily turning movement volumes - 2016

	A	B	C	D	Total
A	0	57	10,586	4,755	15,398
B	305	0	935	5,911	7,151
C	9,223	17	0	4,676	13,916
D	1,213	6,410	1,542	0	9,165
Total	10,741	6,484	13,063	15,342	45,630

For some situations (such as the alternative scenarios described in Section C.3), it may be necessary to also obtain the following additional model outputs:

- Select Link plots for specified model links;
- Sub-area matrices for a specified sub-area region in the model;

C.4.2.3 Future Data from ROM24

ROM24 model outputs should also be obtained for the forecast year to be analysed (in this case 2021), as follows:

- Link Volume plot – with modelled 2021 daily volumes, showing the intersections being analysed and the area surrounding. The Link Volume plot extents should be similar to the base year model plots.
- Turning Movement diagram - 2021 modelled daily turning volumes for intersections to be analysed.

The ROM24 daily turning movement volumes for 2021, represented in matrix format, are as follows:

Table 5: ROM24 Daily turning movement volumes – 2021

	A	B	C	D	Total
A	0	101	13,373	3,177	16,651
B	216	0	950	4,035	5,201
C	10,655	206	0	5,819	16,680
D	3,102	3,748	1,403	0	8,253
Total	13,973	4,055	15,726	13,031	46,785

Additional model outputs should also be obtained, if required, as noted above for the base year data.

C.4.2.4 Base Network vs Scenario Networks

There may be instances where it is required to model different scenarios to get a clear understanding on redistribution of traffic (ex: Mitchell Freeway extension). In these cases, with an agreement with Main Roads WA, ROM24 outputs for the specified scenario years can be requested.

C.4.3 Calibrate Future Daily Traffic

The general calibration and adjustment method for the use of ROM24 data for intersection operational analysis applies when the model is considered to be fit-for-purpose in its current form, after considering the various issues raised above in Section C.3.

The calibration process aims to produce modelled outputs that are sufficiently refined to provide reliable intersection turning movements suitable for detailed intersection analysis. The process involves comparison of modelled traffic volumes with actual traffic volumes (obtained as described in Section C.4.2), for a defined base year (currently 2016), to obtain a series of calibration adjustments. These adjustments are then applied to the modelled future volumes to determine the adjusted forecast daily volumes.

The resulting daily volumes are then checked to ensure the appropriateness of the directional split for each pair of movements, and corrections are applied if necessary.

C.4.3.1 Determine Relevant Calibration Adjustments for each Traffic Movement

The approach adopted to determine the relevant calibration adjustment for each individual turning movement is detailed below (Refer to Attachment C.3 for a detailed worked example):

Step A Calculate 'Absolute Difference' Calibration Adjustments:

The 'absolute difference' calibration method assumes that the difference between existing (actual) volumes and modelled volumes for the same year will remain consistent for future modelled years. Hence the absolute difference calibration adjustment is simply the difference between the existing (actual) volumes and the modelled volumes for the same base year.

Absolute difference calibration adjustment = Existing actual flow – Modelled flow for the same year.

The Absolute difference calibration adjustments should be calculated first and presented in a matrix form as shown:

Table 6: Absolute difference calibration adjustments

	A	B	C	D
A	0	+571	-2,340	+987
B	+439	0	-743	-4,269
C	-517	216	0	-423
D	+3,408	-4,451	+2,828	0

A positive result indicates that the model underestimates the traffic and the adjustment has to be added to the modelled volumes; a negative value indicates that the model overestimates the traffic and needs to be subtracted from the modelled volumes.

The absolute difference calibration method can be applied to most situations, except in the situation where the calculated adjustment is negative and the difference between the modelled base year flow and the modelled future year flow is also negative (since in this situation the calibrated future flow could also end up being negative) as discussed below. It is therefore necessary to calculate this difference before applying any adjustments to the modelled outputs.

Step B Calculate the difference between base year and future year modelled volumes:

In order to confirm the suitability of the absolute difference methodology, subtract the future year (2021) modelled flows from the base year (2016) modelled flows, and identify any traffic movements with negative values that also have a negative absolute difference calibration adjustment (from Step A), as follows:

Table 7: Difference between base year and future year modelled volumes

	A	B	C	D
A	0	44	2,787	-1,578
B	-89	0	15	-1,876
C	1,432	189	0	1,143
D	1,889	-2,662	-139	0

Cells with negative values calculated in both Step A and Step B

To review the worst case scenario, traffic movements with negative values in both Step A and Step B can be replaced with the existing observed daily traffic flows. However, it is recommended to investigate the causes of traffic flows reduction for those movements. For instance, reduction in the future traffic movement may be due to traffic flows using new or upgraded parallel routes in the future. If there is a logical reason for traffic flows reduction, then it is recommended to undertake Step C, the 'percentage difference calibration method' as described below.

Step C Optional: Calculate 'Percentage Difference' Calibration Adjustments for traffic movements identified in Step B:

The percentage difference calibration method is similar to the absolute difference methodology, except that the difference between the existing (actual) volume is expressed as a percentage of the modelled volume, as follows:

Percentage difference = (Existing flow – Existing Modelled flow) / Existing Modelled Flow %

By carrying out this calculation for each movement identified above in step b, the resulting overall calibration adjustments to be applied to the future year modelled volumes are as follows:

Table 8: Overall calibration adjustments

	A	B	C	D
A	0	+571	-2,340	+987
B	+439	0	-743	-72%
C	-517	+216	0	-423
D	+3,408	-69%	+2,828	0

C.4.3.2 Apply Calibration Adjustments to Obtain Initial Calibrated Volumes

Future year calibrated volumes can now be obtained by applying the resulting calibration adjustments for each individual traffic movement, as follows:

For 'absolute difference' calibration adjustments,

Calibrated future year volume = Modelled future year volume + calibration adjustment

For when traffic volume reduction for the movement is not acceptable'

Calibrated future year volume = Existing actual flows, or;

Otherwise, 'percentage difference' calibration adjustments,

Calibrated future year volume = Modelled future year volume x (1 + calibration adjustment)

The initial calibrated future volumes in the current example for both situations are therefore as follows:

Table 9: 2021 Initial Calibrated Volumes (Step a and b)

	A	B	C	D	Total
A	0	672	11,033	4,164	15,869
B	655	0	207	1,642	1,983
C	10,138	422	0	5,396	15,956
D	6,510	1,959	4,231	0	11,886
Total	17,303	2,239	15,471	10,681	45,694

Table 10: 2021 Initial Calibrated Volumes (all steps)

	A	B	C	D	Total
A	0	672	11,033	4,164	15,869
B	655	0	207	1,121	1,983
C	10,138	422	0	5,396	15,956
D	6,510	1,145	4,231	0	11,886
Total	17,303	2,239	15,471	10,681	45,694

C.4.3.3 Check Appropriateness of Directional Split

The initial calibrated volumes obtained above in Section C.4.3.2 should then be checked for appropriateness of the directional split for each OD pair in order to confirm that the results are not unreasonable or skewed. The directional split should be compared against the existing (actual) directional split, as detailed in Section C.4. If the current directional split of an OD pair is similar to the existing (actual) situation or if there is sufficient confidence that the changes are representative of expected future behaviour, then the current OD pair should be retained.

However, if the directional split for an OD pair varies significantly (i.e., for instance, > 10% or < 10%), and there is no reasonable justification, then a directional split correction should be applied such that it falls within reasonable limits.

For example, if the existing (actual) volumes show a 45/55 directional split (i.e. 45 percent of the combined traffic for an OD pair in one direction, and 55 percent in the other), then the directional split of the calibrated future year flows should be between 35/65 and 55/45.

C.4.3.4 Apply Directional Split Corrections

It should be noted that the 10% deviation limit suggested above is arbitrary and that the choice of observed directional split vs the directional split of the calibrated future year traffic volumes should be based on judgement.

If a correction is required, then the total traffic volume for the particular OD pair should be combined, and the closest limit of the acceptable range of variation should be applied.

For example, if the acceptable range of directional splits is between 35/65 and 55/45, but the current split is 61/39, then the correction to be applied should be to achieve a directional split of 55/45, as described in detail in Section C.4.

The resulting final calibrated 2021 future volumes in the current example (including Step C in Section C.4.3.1) are therefore as follows:

Table 11: 2021 Final Calibrated Volumes (all steps)

	A	B	C	D	Total
A	0	672	11,033	4,847	16,552
B	655	0	221	1,121	1,997
C	10,138	408	0	5,396	15,942
D	5,827	1,145	4,231	0	11,204
Total	16,620	2,225	15,485	11,364	45,694

C.4.4 Convert to Peak Hour Flows for Analysis

Once future daily volumes have been calibrated and finalised, it is now necessary to convert the daily flows to corresponding AM and PM peak hour flows for detailed intersection analysis.

Determination of peak hour flows from the daily flows should be based on the observed actual flows, as described below, with a detailed worked example presented in Section C.5.

C.4.4.1 Individual turning movement Peak Hour Percentage

The peak hour percentage for each individual turning movement should be determined from the Existing (Actual) intersection volumes for each required peak hour, as follows:

Peak hour percentage = (Peak hour volume / Daily Volume) %

C.4.4.2 Future Peak Hour Flow

The individual percentages are then applied to each individual turning movement of the future calibrated daily flow to determine the corresponding future peak hour flow.

The resulting peak hour traffic flows can then be input directly into traffic modelling for detailed intersection analysis.

Table 12: Resultant 2021 AM Peak hour flows (all steps)

	A	B	C	D	Total
A	0	16	888	206	1,110
B	63	0	21	59	143
C	883	28	0	315	1,225
D	686	109	387	0	1,183
Total	1,632	153	1,296	579	3,661

Table 13: Resultant 2021 PM Peak hour flows (all steps)

	A	B	C	D	Total
A	0	73	1,033	527	1,632
B	45	0	17	130	192
C	983	44	0	530	1,557
D	294	80	296	0	670
Total	1,322	196	1,346	1,187	4,051

C.5 Future Network Development Areas

In future development areas where there is insufficient existing data to carry out any required calibration, the ROM24 daily or AM and PM peak period output data can be used in consultation with Main Roads WA.

C.5.1 Turning Flows for an Intersection

ROM24 Daily Turning Volume Diagram can be utilised to forecast the peak hour turning flows, using peak hour percentage (e.g. 10% of daily flows). The peak hour percentage can be estimated by reviewing nearby locations (and it can be different for each approached). The assumptions should be confirmed with the Main Roads WA in advance. However, basic checks should still be carried out to ensure directional splits for OD pairs are realistic. Directional splits for the peak hour data should be checked against similar locations, and corrections should be identified and applied in a similar way to the process described above in Sections C.4.3.3 and C.4.3.4.

C.5.2 Peak Hour Traffic Volumes for a Link

In this situation both daily and peak period Link Volume Plots can be used to forecast the peak hour traffic flows for a link. Note that Main Roads Planning and Technical Services Directorate no longer provides one-hour Link Volume Plot. They only provide it for two-hour or more. The default AM and PM peak hours in ROM24 are 7am to 9am and 4pm to 6pm, respectively.

It is highly recommended to request ROM24 Calibration Plot for the sounding area of the future network development.

The methodology and its assumptions should be confirmed with the Main Roads WA in advance.

C.5.2.1 Using Daily Link Volume Plot

Similar to the method explained in Section C.5.1, peak hour percentage can be estimated by reviewing the nearby locations or parallel routes. This peak hour percentage can be then applied on the ROM24 daily traffic flows for the link to estimate the peak hour flows. The peak hour percentage can be different for each direction of the link.

C.5.2.2 Using Link Volume Plot Peak Period

ROM24 peak period data can also be used to estimate the peak hour flows. ROM24 Link Volume Plots can be provided for two-hour or more periods. For example 7am to 10am.

General Method: To forecast the one peak hour, divide the total peak period flows by the number of hours for each directions of the link. For example, to have AM peak traffic flow using 7-9am Link Volume plot, flows should be divided by two for each direction of the link.

Specific Method: To forecast the one peak hour, a pick hour proportion requires to be calculated for similar or nearby locations. This peak hour proportion can then be utilised to estimate future peak hour traffic flows.

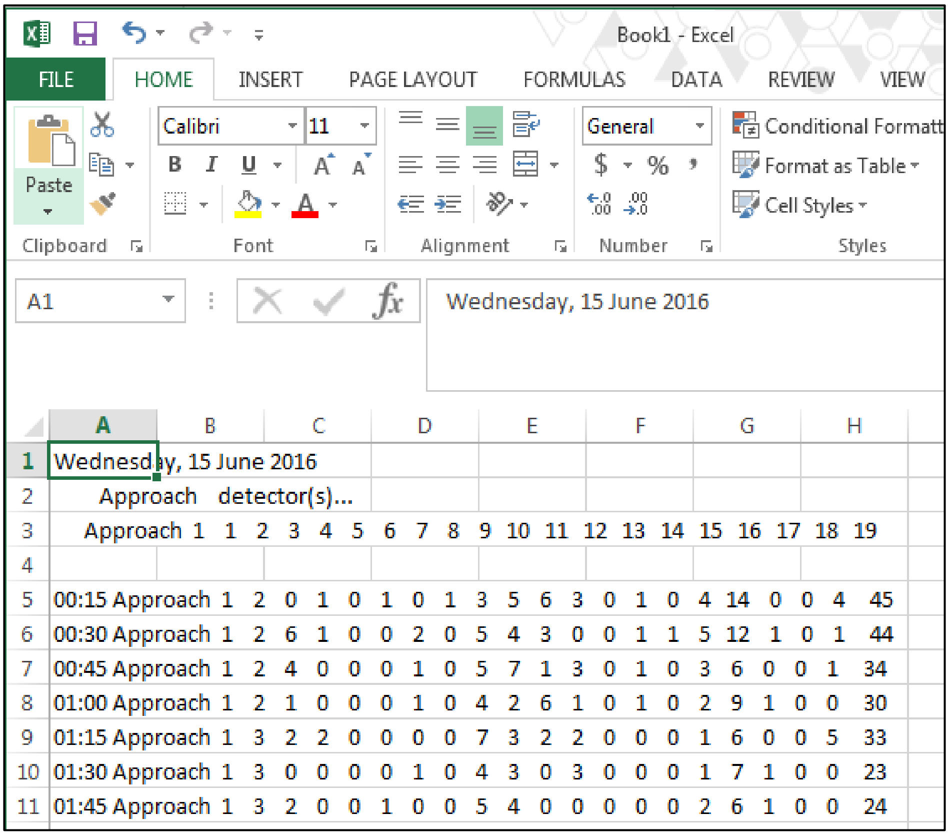
To estimate a practical peak hour proportion for an existing location, an analysis of traffic volume profile for the peak period is required. The length of analysed peak period must be similar to the number of peak hours as ROM24 plot. The one hour with the maximum total traffic volume of four continuous 15-minute intervals is the peak hour for that location. The peak hour proportion is the peak hour traffic volume divided by the total peak period traffic volume. The future peak hour traffic flow for a future link is equal to the peak hour proportion multiply by the peak hour period traffic flow for that link.

Attachment C.1. Obtaining Data

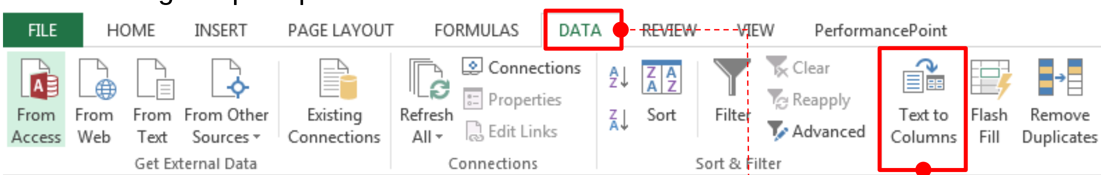
Existing (Actual) Traffic Flow Data from SCATS

SCATS detector volumes are recorded in the SCATS Traffic Reporter program. The procedure for determination of intersection traffic turning volumes is detailed in the following steps, noting that the four way signalised intersection of Reid Highway with Lord Street in Morley Region is used as an example to describe the process.

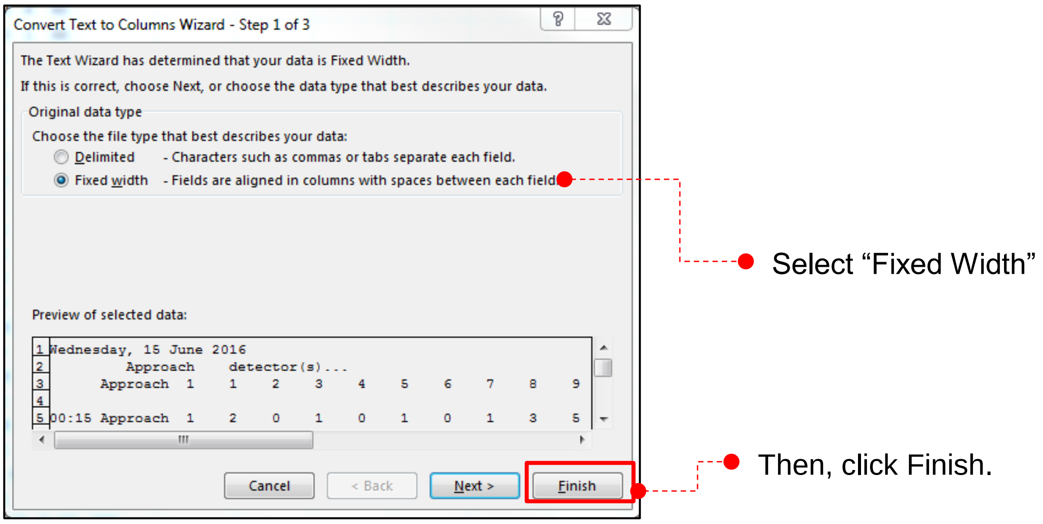
In order to be able to work with the data efficiently, it is recommended that the data be imported into MS Excel program. This can be achieved by simply opening the data in Microsoft Notepad and selecting the data (Left-click and hold down the mouse from the first line of data and drag to the bottom of the window), copying it (Ctrl + C) and pasting it (Ctrl + V) in a blank Excel sheet, shown as follows:



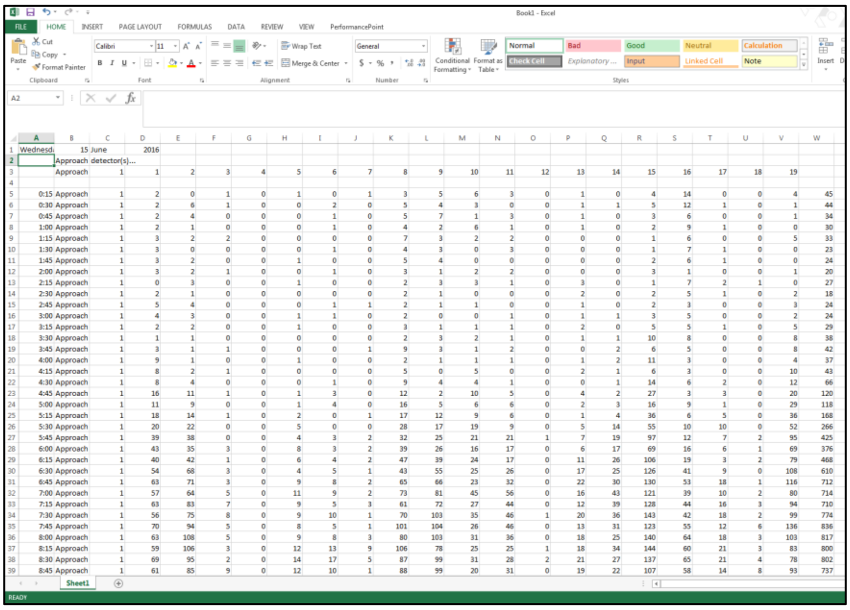
By default, data is pasted into the spreadsheet in “text” format in the selected column. In order to be able to perform calculations, the text has to be separated and placed into individual cells. This function can be achieved by selecting “Text to column” function in excel and following the prompts as shown below:



Select Data > Text to Columns and follow the prompts

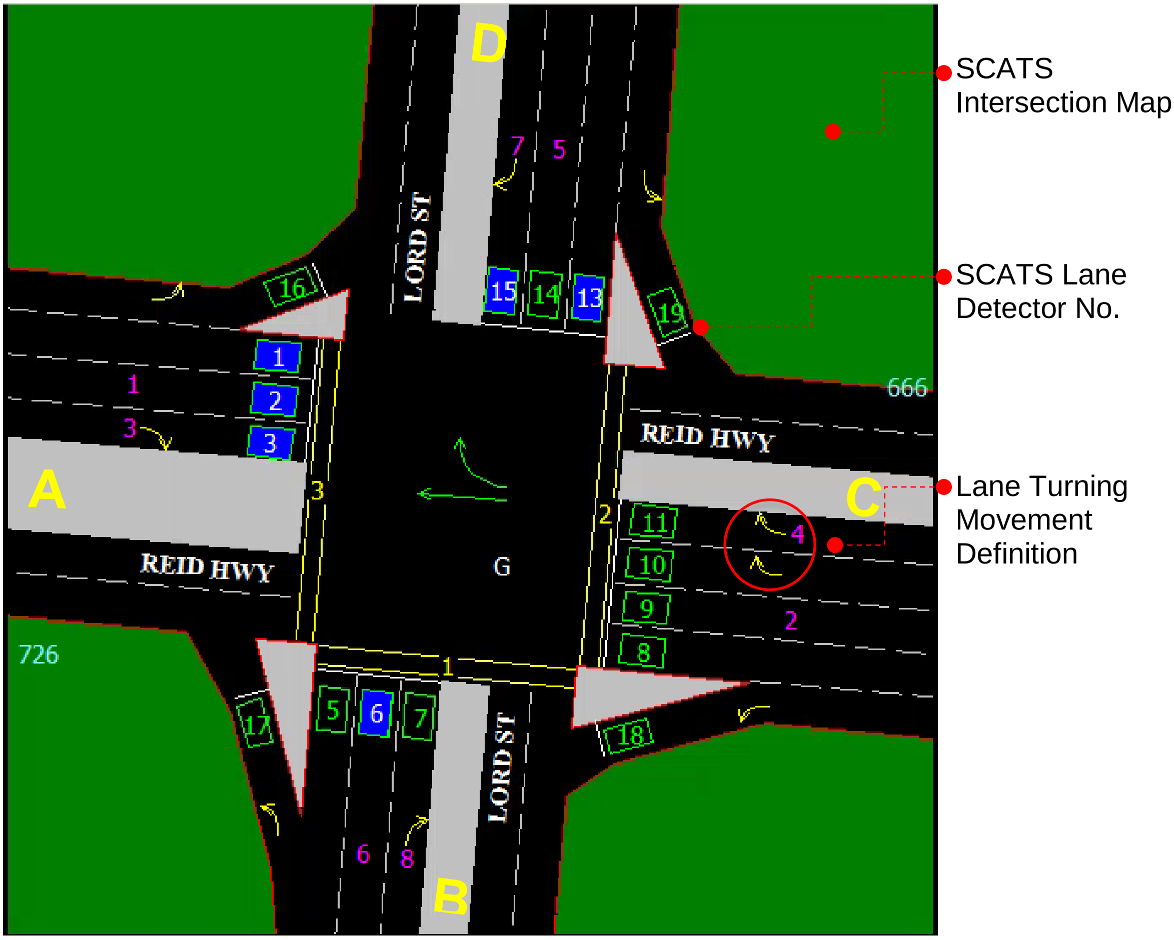


After the Data has been extracted, the Excel sheet should look similar to following:



Add up the total number of vehicles for each detector using the “Sum ()” function to obtain total Daily volumes as well as AM and PM Peak hour volumes for the identified peak hour times noted in step 4 above.

The SCATS intersection map (shown below) identifies the SCATS detector numbers for each lane, and also identifies the movement definition for all turn lanes.



Individual traffic movements can then be determined by combining the relevant detectors representing each movement as follows:

From – To	A	B	C	D
A		Detector 3	Detectors 1 and 2	Detector 16
B	Detector 17		Detector 7	Detectors 5 and 6
C	Detectors 8 and 9	Detector 18		Detectors 10 and 11
D	Detector 15	Detectors 13 and 14	Detector 19	

The calculated daily and peak hour flows can then be presented in a matrix format as follows:

Table 14: Daily Traffic Flows

	A	B	C	D	Total
A	0	628	8,246	5,742	14,616
B	744	0	192	1,642	2,578
C	8,706	233	0	4,253	13,192
D	4,621	1,959	4,370	0	10,950
Total	14,071	2,820	12,808	11,637	41,336

Table 15: AM Peak Hour Flows

	A	B	C	D	Total
A	0	15	664	244	923
B	72	0	18	86	176
C	758	16	0	248	1,022
D	544	187	400	0	1,131
Total	1,374	218	1,082	578	3,252

Table 16: PM Peak Hour Flows

	A	B	C	D	Total
A	0	68	772	624	1,464
B	51	0	15	190	256
C	844	25	0	418	1,287
D	233	136	306	0	675
Total	1,128	229	1,093	1,232	3,682

Undefined Traffic Movements in SCATS Data

SCATS detector volumes can be used to determine existing turning movements (and turning proportions) at intersections. However, it is important to note that at many intersections there are certain movements that are either undetected, such as slip lane turn movements; or are undefined due to shared lanes. In each of these cases, turning movement volumes will not be directly available from SCATS Traffic Reporter data.

Where individual movements are undefined, the proportion of the undefined movement can be determined relative to the other turning movements on the intersection approach. Alternatively, the turning proportion of an undefined movement can be obtained by an intersection count or by using other available flow data (e.g. metrocount data).

Intersection counts to determine the turning proportions of undefined movements can be obtained by a survey of the overall intersection, or by a short manual survey of the approach containing the undefined movement. The count of the intersection (or individual approach) should be taken during the peak hour and then extrapolated to daily flows.

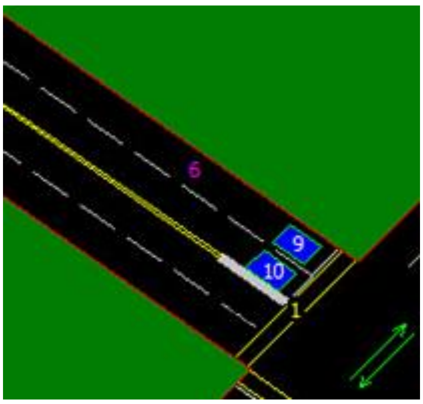
C.2.1 Manual Survey Counts

A short (i.e. 15 to 30 minute) count of an intersection approach during the peak hour can be used to determine turning proportions of each movement on the approach.

For example, an intersection count on an approach may obtain the following data:

Observed Traffic Flow	Left Turn	Through	Right Turn	Total
	115	242	65	422
% Split	27.25%	57.35%	15.40%	100
rounded	27	57	16	100
Example A	204.3839	430.0948	115.5213	750
rounded	204	430	116	750
Example B	27.25%	72.75%		100
calculated	412.0521	1100		1512.052

Example A



Detector 9 (shared through/left turn lane) – 400 veh

Detector 10 (shared through/right turn lane) – 350 veh

Total detected – 750 veh

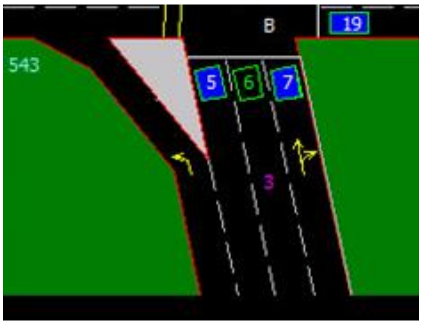
Using the turning proportions from the survey count:

Left turn – 27% = 204 veh

Through – 57% = 430 veh

Right turn – 15% = 116 veh

Example B



Detector 5 (through lane) – 500 veh

Detector 6 (through lane) – 450 veh

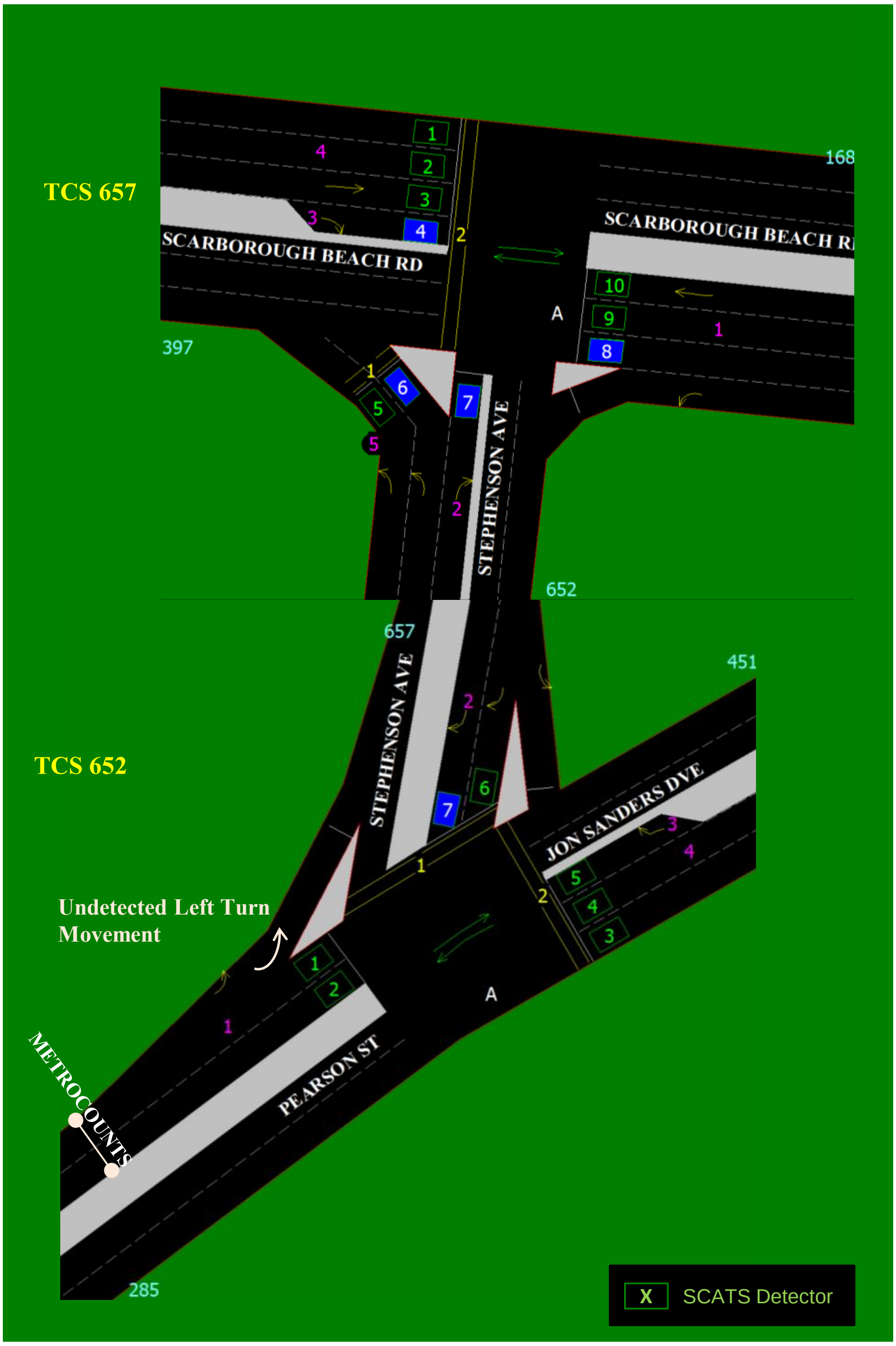
Detector 7 (shared through/right turn lane) – 150 veh

Total detected – 1100 veh

Based on the turning proportions from the survey count, the detected traffic makes up 72.75% of the overall approach traffic when rounded (57.35%+15.40%). Therefore, the total approach traffic is 1100 ÷ 0.7275 = 1512 vehicles. The left turning traffic is therefore 27.25% of 1512 = 412 vehicles.

C.2.2 Count Data for Estimating Undetected Turning Flows

Where only one turning movement is undefined for a particular approach, recent data (from either manual surveys, metrocount data, or SCATS data from adjoining intersections) for the approach leading to an intersection can be used in conjunction with the available SCATS data for the detected turning movements to determine the undefined flow. The following SCATS diagrams of the Stephenson Avenue, Pearson Street and Jon Sanders Drive intersection (TCS 652) shows an example where this method may be used.



Method 1: this method can be used when the downstream flows are available. In this example, the undetected left turn slip lane traffic flows on Pearson Street eastbound can be estimated by firstly obtaining the daily traffic flows approaching the intersection on Pearson Street eastbound, using metrocount data. In this case, daily left turn slip lane turning flows can be estimated by subtracting daily SCATS traffic flows detected by detectors 1 and 2 on Site 652 from Daily metrocount traffic on Pearson Street eastbound.

It is important to note that there will be uncertainties in using metrocount data due to differences in day and time of year between the metrocount and SCATS counts. Therefore, it is recommended that SCATS data be extracted for the same day as the survey or the available Metro counts.

Method 2: This method can be used if upstream flows are available. In this example, the total departure flows on the Stephenson Avenue northbound from Pearson Street and Jon Sanders Drive can be estimated using SCATS traffic flow data for detectors 5, 6 and 7 on the northern adjacent intersection, Stephenson Avenue and Scarborough Beach Road (TCS 657). In this case, daily slip lane turning flows can be estimated by subtracting daily SCATS traffic flows detected by detector 5 on Site 652 from daily SCATS traffic flows detected by detectors 5, 6 and 7 on Site 657.

This method is also applicable for estimation turning flow for a shared lane.

Note: A sense check of the left turn slip lane flows from Person Street onto Stephenson Avenue i.e in the AM Peak hour, may be compared with the right turn flows from Stephenson Avenue southbound (detector 7 on site 652) in the PM Peak hour to determine whether the estimated flows are reasonable (assuming that the flows are tidal).

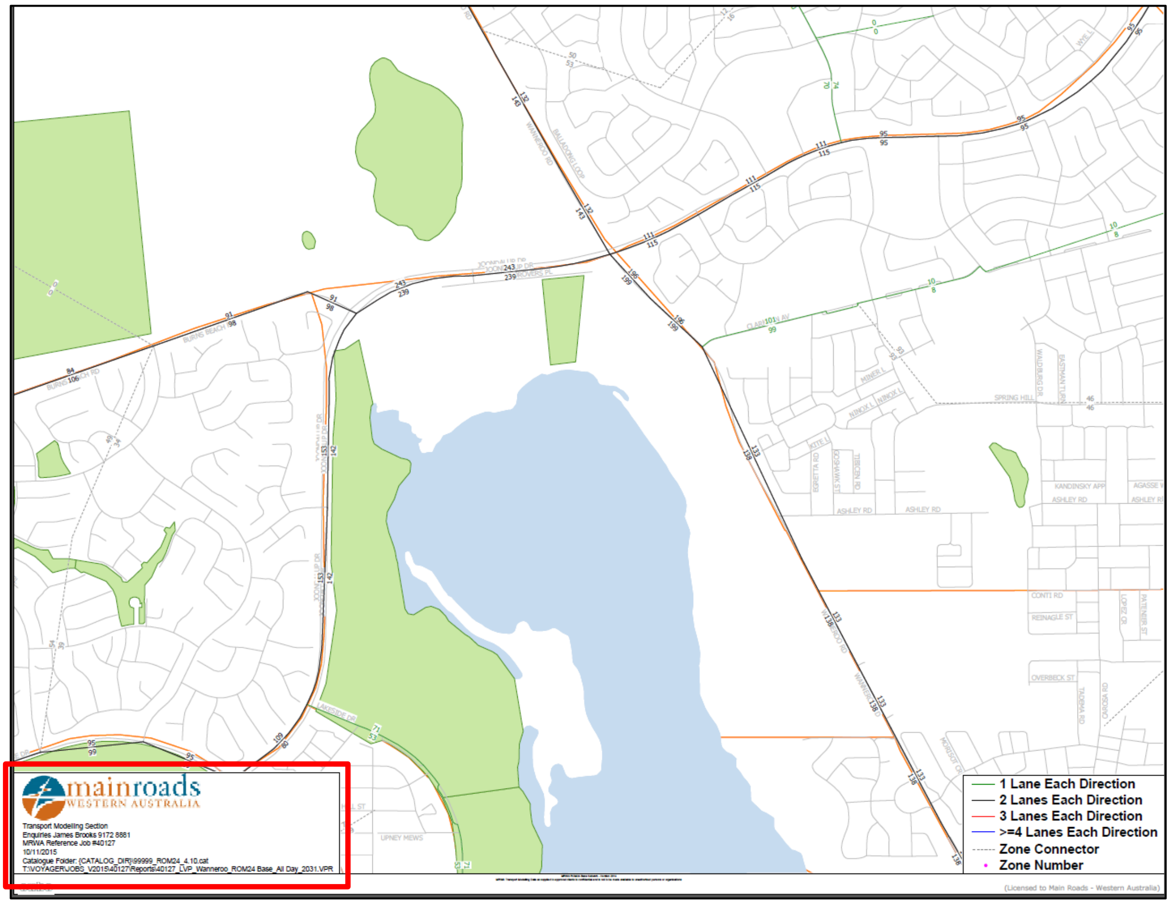
Attachment C.2. Model Data from ROM24

Base year volumes and forecast volumes are requested from the Transport Modelling Section within PTS. As discussed in Section C.1.2, the data produced from the ROM24 model is typically supplied as Link Volume Plots and Turning Volume Diagrams. Select link plots and sub area matrices may also be requested.

Examples of ROM24 Model output data is presented in the following sections:

Link Volume Plot

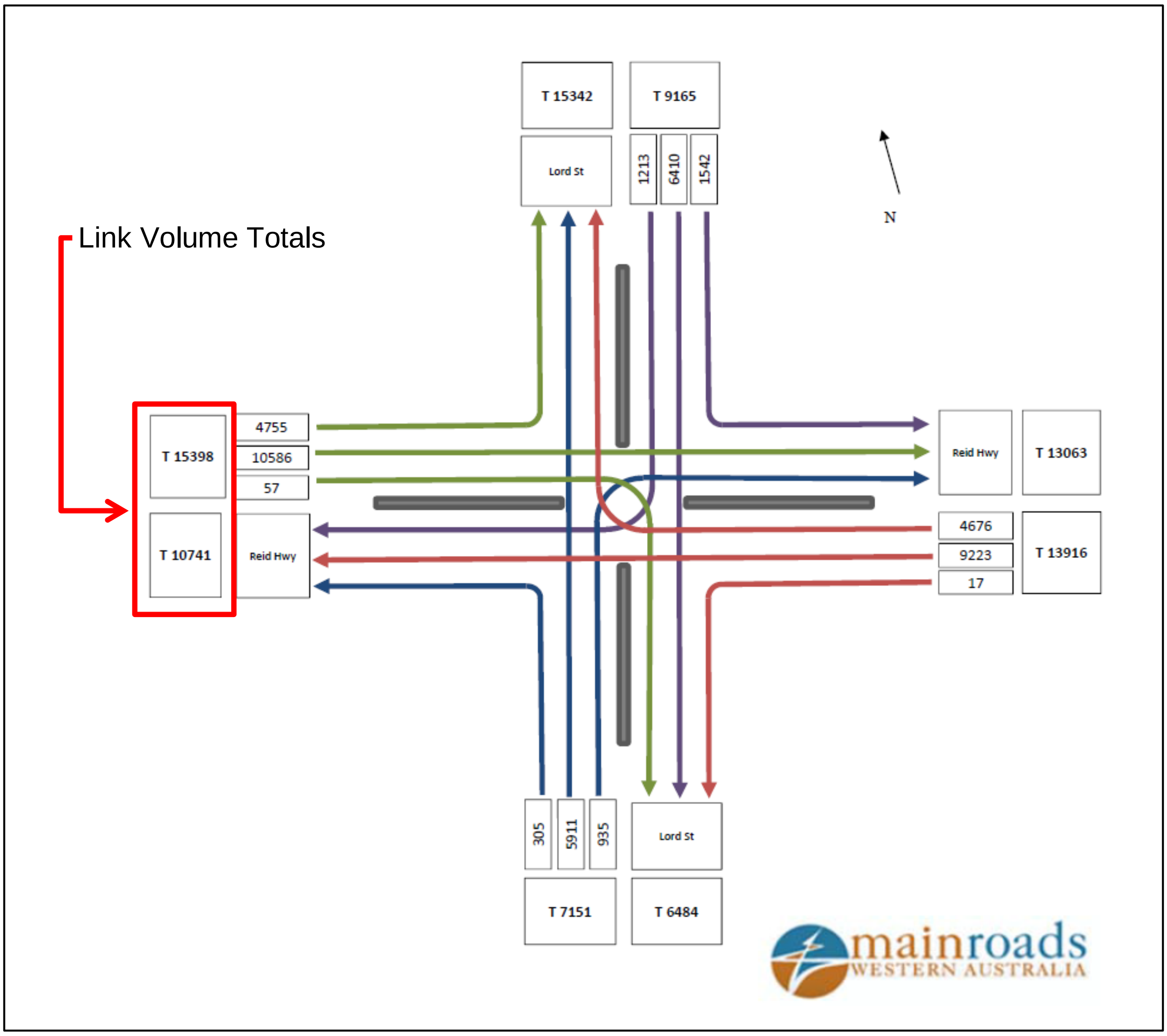
Link Volume Plots show estimated daily traffic volumes on the modelled road network. The volumes on each road link are forecast for each direction.



Note: For any follow-up enquiries, the job number and/or job references will usually be required. The job number and references are usually located in the bottom left corner of the network plot (as shown in the red box). The references will indicate the Date and Voyager Catalogue file path and Viper project file path.

Turning Volume Diagrams

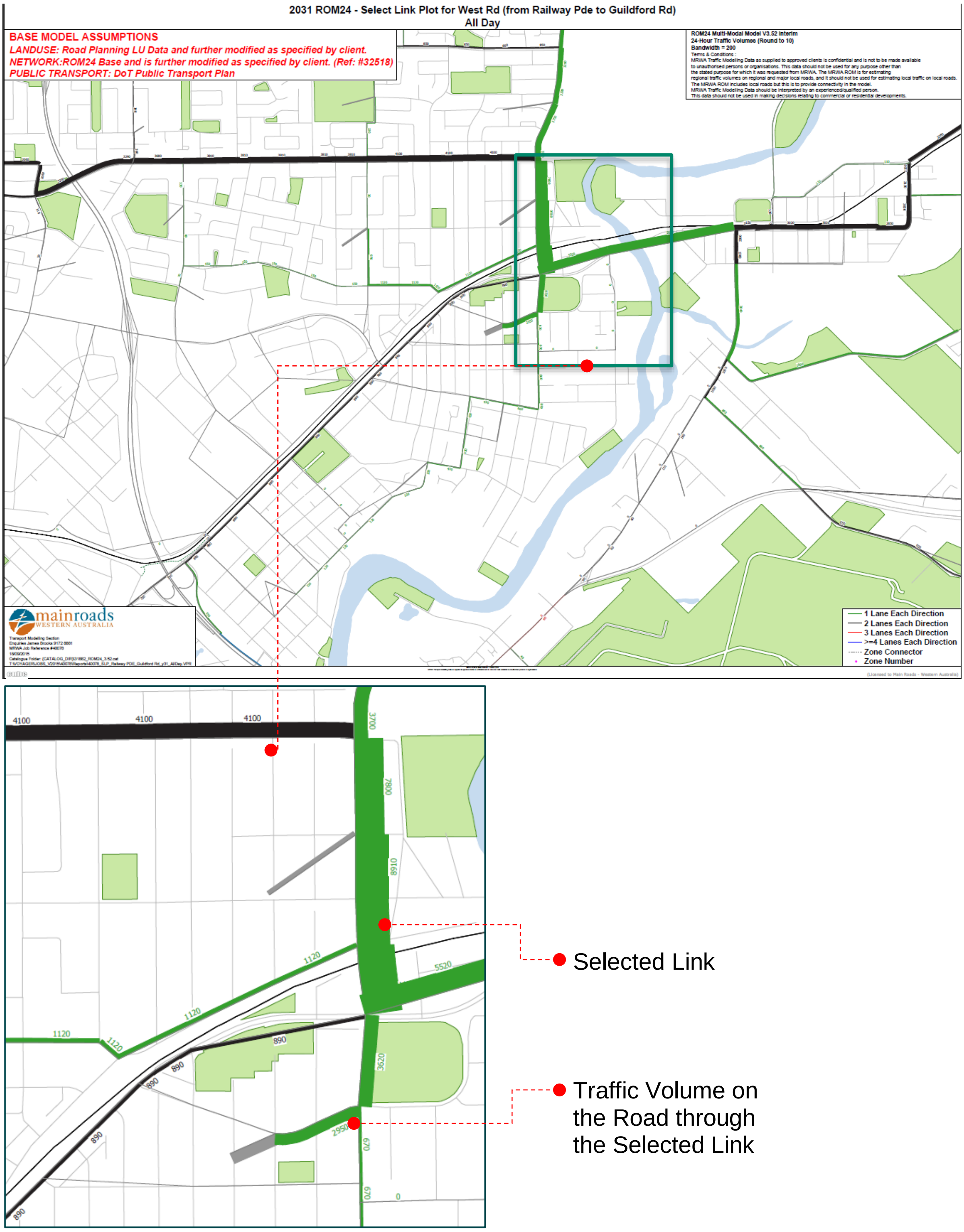
Turning Volume Diagrams show the estimated daily traffic volumes at intersections that are part of the modelled network. They can be provided for the 24 hour period and/or peak hour periods. Note that the peak hour period provided by the Transport Modelling Section will be a minimum of two hours.



Select Link Plots

Select Link Analysis is a method of analysing traffic movements by only showing trips that pass through a nominated link (or links). Select link plots can be used to explore the origin and destination of traffic demand through the link and therefore would be able to determine traffic re-distribution through the network. Select link plots are especially useful in scenarios where ROM24 turning flow data cannot be readily used and where initial adjustments are necessary as described in Section C.3.

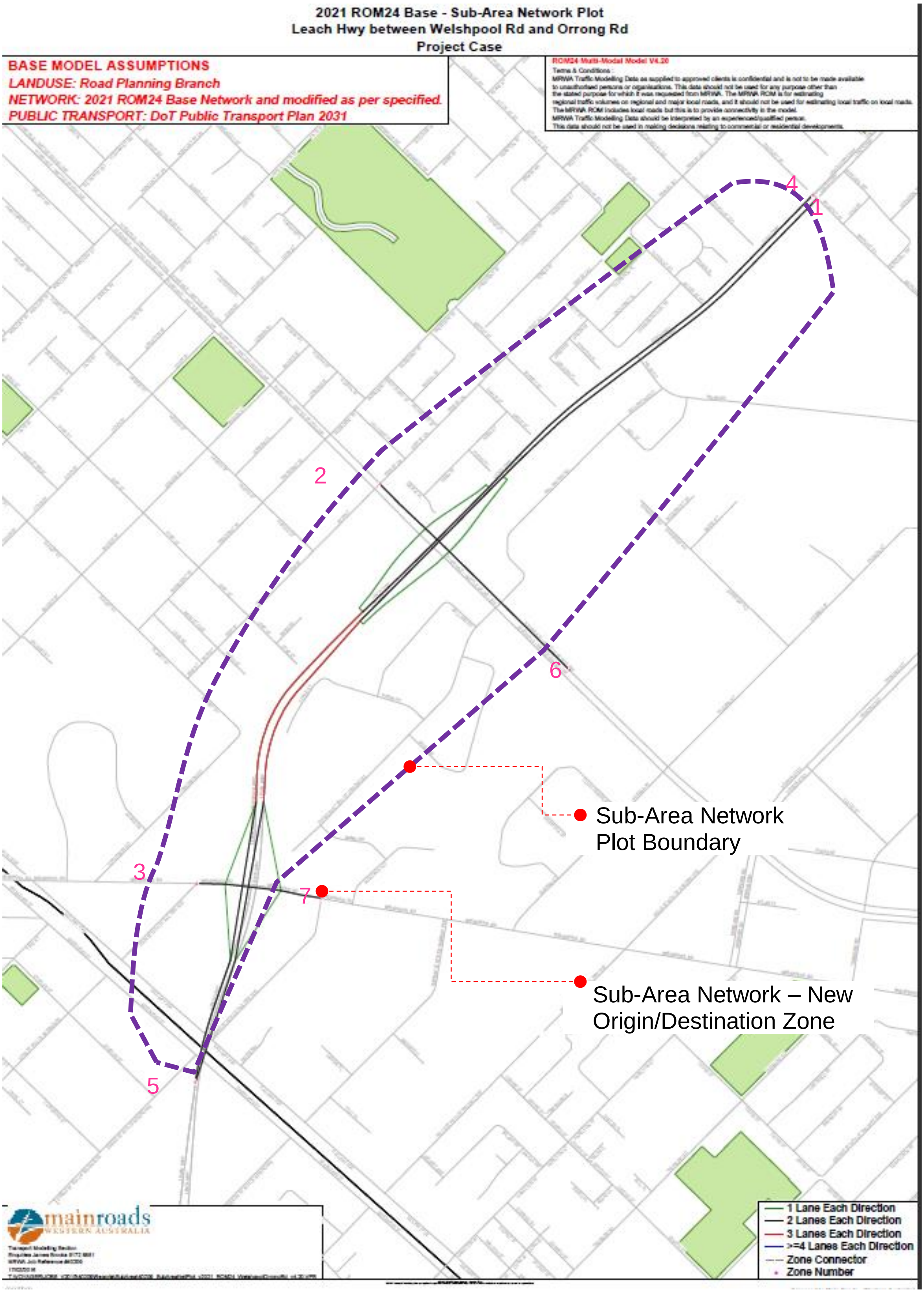
An example for a Select Link Analysis Plot that can be requested from ROM24 is presented as follows:


2031 ROM24 - Select Link Plot for West Rd (from Railway Pde to Guildford Rd)
All Day
BASE MODEL ASSUMPTIONS
LANDUSE: Road Planning LU Data and further modified as specified by client.
NETWORK:ROM24 Base and is further modified as specified by client. (Ref: #32518)
PUBLIC TRANSPORT: DoT Public Transport Plan
ROM24 Multi-Modal Model V3.52 Interim
24-Hour Traffic Volumes (Round to 10)
Bandwidth = 200
Terms & Conditions :
MRWA Traffic Modelling Data as supplied to approved clients is confidential and is not to be made available to unauthorised persons or organisations. This data should not be used for any purpose other than the stated purpose for which it was requested from MRWA. The MRWA ROM is for estimating regional traffic volumes on regional and major local roads, and it should not be used for estimating local traffic on local roads.
The MRWA ROM includes local roads but this is to provide connectivity in the model.
MRWA Traffic Modelling Data should be interpreted by an experienced/qualified person.
This data should not be used in making decisions relating to commercial or residential developments.
mainroads
WESTERN AUSTRALIA
Transport Modelling Section
Enquiries James Brooks 9172 8881
MRWA Job Reference #40078
18/09/2015
1 Lane Each Direction
2 Lanes Each Direction
3 Lanes Each Direction
>=4 Lanes Each Direction
Zone Connector
Zone Number
4100
4100
4100
3700
7800
8910
5520
1120
1120
1120
1120
890
890
890
890
890
3620
2950
670
670
0
Selected Link
Traffic Volume on the Road through the Selected Link

Sub-Area Matrix (with sub-area zones)

A Sub-Area Matrix provides a matrix of traffic flows within a specifically requested sub-area of the overall model. Sub area matrices are useful in determining trip distribution or for calculating the overall growth rate/s for the specified sub-area within the model.

A screenshot of a Sub-Area Network Plot as an output from ROM24 along with the associated matrix is shown below:



Corresponding Sub-Area Network Matrix with new sub-area zones:

Table 17: Subarea Network Matrix

Zone	1	2	3	4	5	6	7	Total
1	0	7,586	3,788	0	25,394	2,525	992	40,285
2	0	0	8	9,680	3,443	16,035	8	29,173
3	0	302	0	5,495	1,769	495	7,961	16,022
4	0	0	0	0	0	0	0	0
5	0	5,502	2,628	24,563	0	1,831	4,745	39,268
6	0	16,260	257	2,233	1,685	0	0	20,436
7	0	0	8,172	11	7,608	0	0	15,791
Total	0	29,650	14,852	41,983	39,900	20,885	13,706	

Attachment C.3. General Calibration Example

The following section presents a worked example to illustrate the steps involved to achieve future year calibrated model traffic volumes as described in Sections C.4.2 to C.4.4 in Section C.4 in the report.

Obtain Relevant Data

As described in Section C.4.2, the following data should be obtained for the intersection to be analysed and be put into a matrix format:

- **Matrix A** – 2016 daily traffic volumes

Table 18: 2016 Daily Traffic Volumes

	A	B	C	D	Total
A	0	628	8,246	5,742	14,616
B	744	0	192	1,642	2,578
C	8,706	233	0	4,253	13,192
D	4,621	1,959	4,370	0	10,950
Total	14,071	2,820	12,808	11,637	41,336

- **Matrix B** – 2016 ROM24 modelled daily traffic volumes

Table 19: 2016 ROM24 Modelled Traffic Volumes

	A	B	C	D	Total
A	0	57	10,586	4,755	15,398
B	305	0	935	5,911	7,151
C	9,223	17	0	4,676	13,916
D	1,213	6,410	1,542	0	9,165
Total	10,741	6,484	13,063	15,342	45,630

- **Matrix C** – 2021 ROM24 modelled daily traffic volumes

Table 20: 2021 ROM24 Modelled Daily Traffic Volumes

	A	B	C	D	Total
A	0	101	13,373	3,177	16,651
B	216	0	950	4,035	5,201
C	10,655	206	0	5,819	16,680
D	3,102	3,748	1,403	0	8,253
Total	13,973	4,055	15,726	13,031	46,785

- **Matrix D** – 2016 AM peak hour traffic volumes

Table 21: 2016 AM peak hour traffic volumes

	A	B	C	D	Total
A	0	15	664	244	923
B	72	0	18	86	176
C	758	16	0	248	1,022
D	544	187	400	0	1,131
Total	1,374	218	1,082	578	3,252

- **Matrix E** – 2016 PM peak hour traffic volumes

Table 22: 2016 PM peak hour traffic volumes

	A	B	C	D	Total
A	0	68	772	624	1,464
B	51	0	15	190	256
C	844	25	0	418	1,287
D	233	136	306	0	675
Total	1,128	229	1,093	1,232	3,682

Determine calibration factors for each traffic movement

To determine the relevant calibration factor for each of the individual intersection turning movements, the following approach should be adopted:

1. Calculate absolute difference calibration factor (Matrix F = Matrix A- Matrix B) and identify negative values.

- **Matrix F** – Absolute Difference Calibration Factors – for all the turn movements

Table 23: Absolute Difference Calibration Factors – for all the turn movements

	A	B	C	D
A	0	571	-2,340	987
B	439	0	-743	-4,269
C	-517	216	0	-423
D	3,408	-4,451	2,828	0

Identify negative values as shown (highlighted in orange)

2. Calculate the difference between the 2021 and 2016 Modelled Traffic (Matrix G = Matrix C – Matrix B) and identify negative values.

- **Matrix G** – Difference between 2021 and 2016 ROM24 Model Traffic volumes

Table 24: Difference between 2021 and 2016 ROM24 Model Traffic volumes

	A	B	C	D
A	0	44	2,787	-1,578
B	-89	0	15	-1,876
C	1,432	189	0	1,143
D	1,889	-2,662	-139	0

Identify negative values as shown (highlighted in orange)

3. Identify cells that have negative values both in Matrix F and Matrix G and eliminate them.

- **Matrix H** – Absolute Difference Calibration Factors – applicable for the analysis

Table 25: Absolute Difference Calibration Factors

	A	B	C	D
A	0	571	-2,340	987
B	439	0	-743	
C	-517	216	0	-423
D	3,408		-2,828	0

Negative values identified both in Matrix F and G are eliminated.

4. Calculate Percentage Difference Calibration Factor for the highlighted turning movements in step 3 (Matrix I = (Matrix A- Matrix B)/Matrix B %)

- **Matrix I** – Percentage Difference Calibration Factors – for the highlighted cells in Matrix H

	A	B	C	D
A				
B				-72%
C				
D		-69%		

Calculate Percentage difference calibration factor (highlighted in orange)

Apply calibration factors to obtain future calibrated volumes

5. Apply Absolute Difference Calibration Factor (Matrix H) to 2021 ROM24 Modelled daily Volumes (Matrix C) : Matrix J = Matrix C + Matrix F

- **Matrix J** – 2021 Calibrated Daily Traffic Volumes by applying absolute difference calibration factor

Table 26: 2021 Calibrated Daily Traffic Volumes by applying absolute difference calibration factor

	A	B	C	D	Total
A	0	672	11,033	4164	15,869
B	655	0	207		862
C	10,138	422	0	5396	15,956
D	6,510		4,231	0	10,741
Total	17,303	1,094	15,471	9560	43,428

6. Apply Percentage Difference Calibration Factors (Matrix I) to 2021 ROM24 Modelled Daily Volumes (Matrix C) (optional step): Matrix K = Matrix C x (1+Matrix I)

- **Matrix K** – 2021 Calibrated Daily Traffic Volumes by applying percentage difference calibration factor

Table 27: 2021 Calibrated Daily Traffic Volumes by applying percentage difference calibration factor

	A	B	C	D
A				
B				1,121
C				
D		1,145		

7. Combine Matrices J and K to obtain Matrix L which is the calibrated 2021 daily traffic volumes.

- **Matrix L** – Final 2021 Calibrated Daily Traffic Volumes

Table 28: Final 2021 Calibrated Daily Traffic Volumes

	A	B	C	D	Total
A	0	672	11,033	4,164	15,869
B	655	0	207	1,121	1,983
C	10,138	422	0	5,396	15,956
D	6,510	1,145	4,231	0	11,886
Total	17,303	2,239	15,471	10,681	45,694

Check appropriateness of directional split

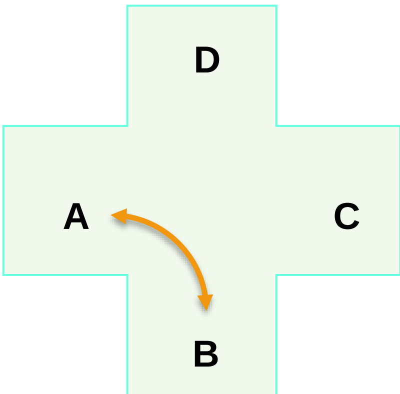
8. Obtain the directional split from the 2016 existing traffic volumes (Matrix A)

- **Matrix M** – 2016 OD pair Directional Split

Table 29: 2016 OD pair Directional Split

	A	B	C	D
A	0%	46%	49%	55%
B	54%	0%	45%	46%
C	51%	55%	0%	49%
D	45%	54%	51%	0%

Note that cells belonging to an OD pair are represented in a single colour here. For instance, for the OD pair A and B, the colour of the cells is orange and they represent the movement from A to B and from B to A, which is illustrated diagrammatically as shown:



9. Obtain the directional split from the calibrated 2021 daily traffic volumes

- **Matrix N** – Calibrated 2021 OD pair Directional Split

Table 30: Calibrated 2021 OD pair Directional Split

	A	B	C	D
A	0%	51%	52%	39%
B	49%	0%	33%	49%
C	48%	67%	0%	56%
D	61%	51%	44%	0%

10. If directional split for an OD pair is sufficiently close to the actual directional split, then it should be retained. However, if there is a variation, the following steps must be followed to correct the splits:

In this case, we have assumed a variability limit of 10%

	A	B	C	D
A	0%	51%	52%	39%
B	49%	0%	33%	49%
C	48%	67%	0%	56%
D	61%	51%	44%	0%

Observed Existing Directional Split is: (Matrix M)
C-B: 55%; B-C: 45%
The calibrated future volumes directional splits is (Matrix N):
C-B: 67%; B-C: 33%
In this case, there is no reversing in directional splits but the proportion of a single direction increases beyond a 10% variability limit. Judgement should be made on whether to retain this split or to adjust to fall within the variability limit.

Observed Existing Directional Split is: (Matrix M)
A-D: 55%; D-A: 45%
However, the calibrated future volumes show a significant reverse in directional flows (Matrix N):
A-D: 39%; D-A: 61%
This directional change can be attributed to any future developments in the area/ network changes. If so, this split can be retained as is. However, if this is inconsistent with the expected future traffic behaviour, apply corrections as shown in next steps.

For the purpose of calculations, a 10% variability limit correction will be applied to both the identified OD pairs.

Therefore, 2021 Calibrated Daily Volumes for the turning movements which do not require further corrections is presented as follows:

Table 31: 2021 Calibrated Daily Volumes for the turning movements

	A	B	C	D
A	0	672	11,033	
B	655	0		1,121
C	10,138		0	5,396
D		1,145	4,231	0

Blank cells need directional split corrections.

Apply directional split corrections, if necessary

Apply Directional split corrections for the identified turning movement in step 10.

- **Matrix O** – Adjusted directional splits for the identified OD pairs

Table 32: Adjusted directional splits for the identified OD pairs

	A	B	C	D
A				45%
B			35%	
C		65%		
D	55%			

Existing Directional Split is for A-D: 55%; 10% variability range of 55% is 45% to 65%. However, the calibrated future A-D directional split is A-D: 39%; Therefore, it is adjusted to 45% which is the lower limit of the required variability range.

- **Matrix P** – Adjusted 2021 Volumes with the adjusted directional splits in Matrix O

Table 33: Adjusted 2021 Volumes with the adjusted directional splits in Matrix O

	A	B	C	D
A				4,847
B			221	
C		408		
D	5,827			

Obtained by adding directional flows from A to D and D to A from the 2021 calibrated flows (Matrix L) and then applying the corresponding directional splits identified in Matrix O.

- **Matrix Q** – Final Calibrated 2021 Volumes with the adjusted directional splits

Table 34: Final Calibrated 2021 Volumes with the adjusted directional splits

	A	B	C	D	Total
A	0	672	11,033	4,847	16,552
B	655	0	221	1,121	1,997
C	10,138	408	0	5,396	15,942
D	5,827	1,145	4,231	0	11,204
Total	16,620	2,225	15,485	11,364	45,694

It should be noted that the process can be applied as it is to the modelled peak 2-hour volumes in place of daily volumes if there is sufficient confidence that the peak 2-hour models are representative.

Convert to Peak Hour Flows for Analysis

11. Calculate Individual turning movement Peak Hour Percentages from Existing (Actual) intersection turning movement volumes.

- **Matrix R** – AM Peak Hour Percentage for Individual Turning Movements

Table 35: AM Peak Hour Percentage for Individual Turning Movements

	A	B	C	D	Overall
A		2%	8%	4%	
B	10%		9%	5%	
C	9%	7%		6%	
D	12%	10%	9%		
Overall					8%

AM Peak hour percentage = AM Peak hour volume (Matrix D)/ Daily Volume (Matrix A) %

12. Apply individual percentages to each individual turning movement of the future calibrated daily flow to determine the corresponding future peak hour flow.

- **Matrix S** – 2021 Calculated AM Peak Hour Flows

Table 36: 2021 Calculated AM Peak Hour Flows

	A	B	C	D	Total
A	0	16	888	206	1,110
B	63	0	21	59	143
C	883	28	0	315	1,225
D	686	109	387	0	1,183
Total	1,632	153	1,296	579	3,661

Peak hour flow = Peak hour percentage (Matrix R) x 2021 calibrated Daily Flow (Matrix Q)

The resulting peak hour traffic flows can then be input directly into traffic modelling for detailed intersection analysis.

It is recommended that link volumes and flows in the surrounding network/ intersections be examined while determining the peak hour percentages.

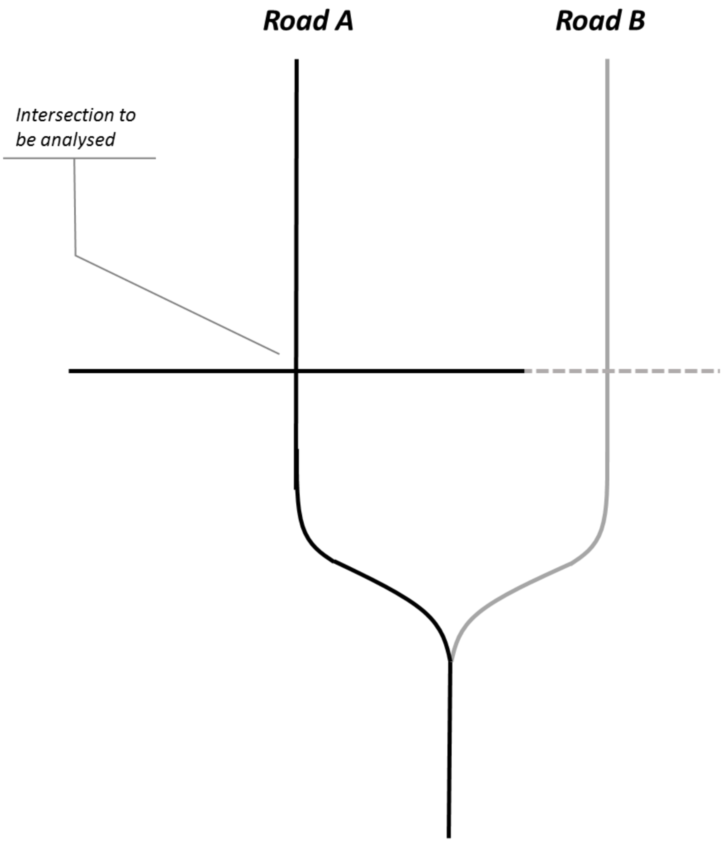
Attachment C.4. Examples of alternative Scenarios

The process discussed in Section C.4 details the calibration procedure when there is sufficient confidence that the model representation of the intersection in the network is acceptable. However, there may be situations where adjustments are required to interpret the model outputs and apply corrections to the raw data outputs.

Some alternative scenarios where this adjustment process is required were identified in Section C.3 and further details are provided here to illustrate the steps that may need to be carried out in specific possible situations.

Scenario 1: Two or More Parallel Roads

As an example, consider the case of two parallel routes A and B in the illustration below:



In such instances, there is a possibility that the parallel traffic movement (in this case, the north-south through traffic) could be assigned to Road A in the base year forecast, but then shifted over to Road B in the future year model. When there is not enough confidence in the model's assigned flows through parallel roads, it is recommended the subsequent process be undertaken to estimate the future turning volumes through the intersection for analysis:

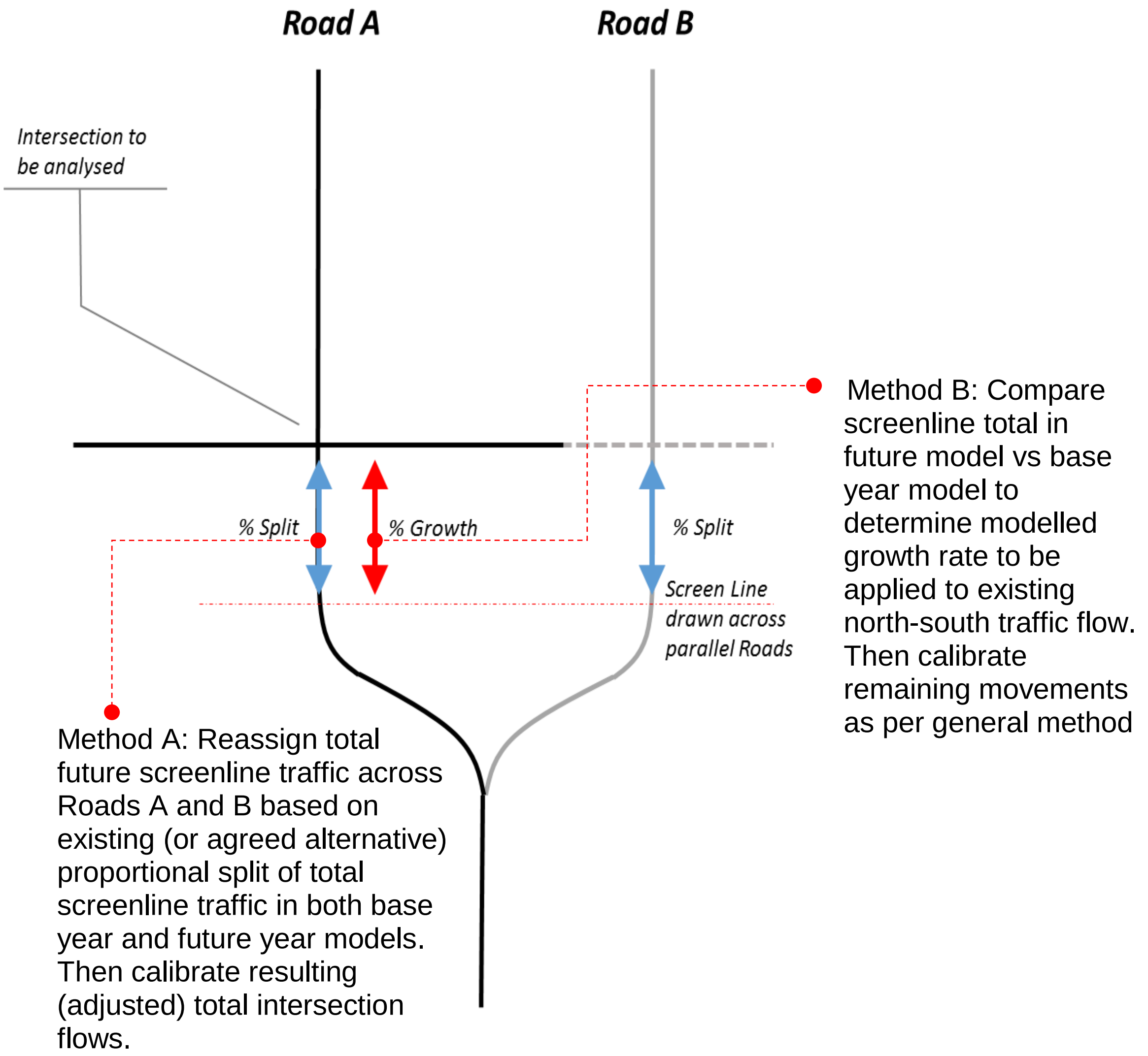
1. Identify a screenline through the two parallel roads;
2. Obtain the existing traffic count data at a screenline across the roads either from SCATS or pneumatic counts or manual counts.
3. Apply one of two correction methods, as follows:

Method A: Adjust ROM24 outputs and proceed

- Calculate the total existing north-south flow through the screen line ;
- Calculate existing proportional traffic flow split across the parallel roads;
- Calculate modelled ROM24 proportional split across the parallel roads similarly;
- If the proportional split (or another agreed proportional split) is highly skewed, adjust ROM24 flows according to the existing proportional split to adjust the north-south modelled traffic flows in both the base year and future year models;
- Proceed with the general calibration process for the adjusted ROM24 flows in accordance with the procedure described in Section C.4.3.

Method B: Determine traffic growth rate to predict future traffic

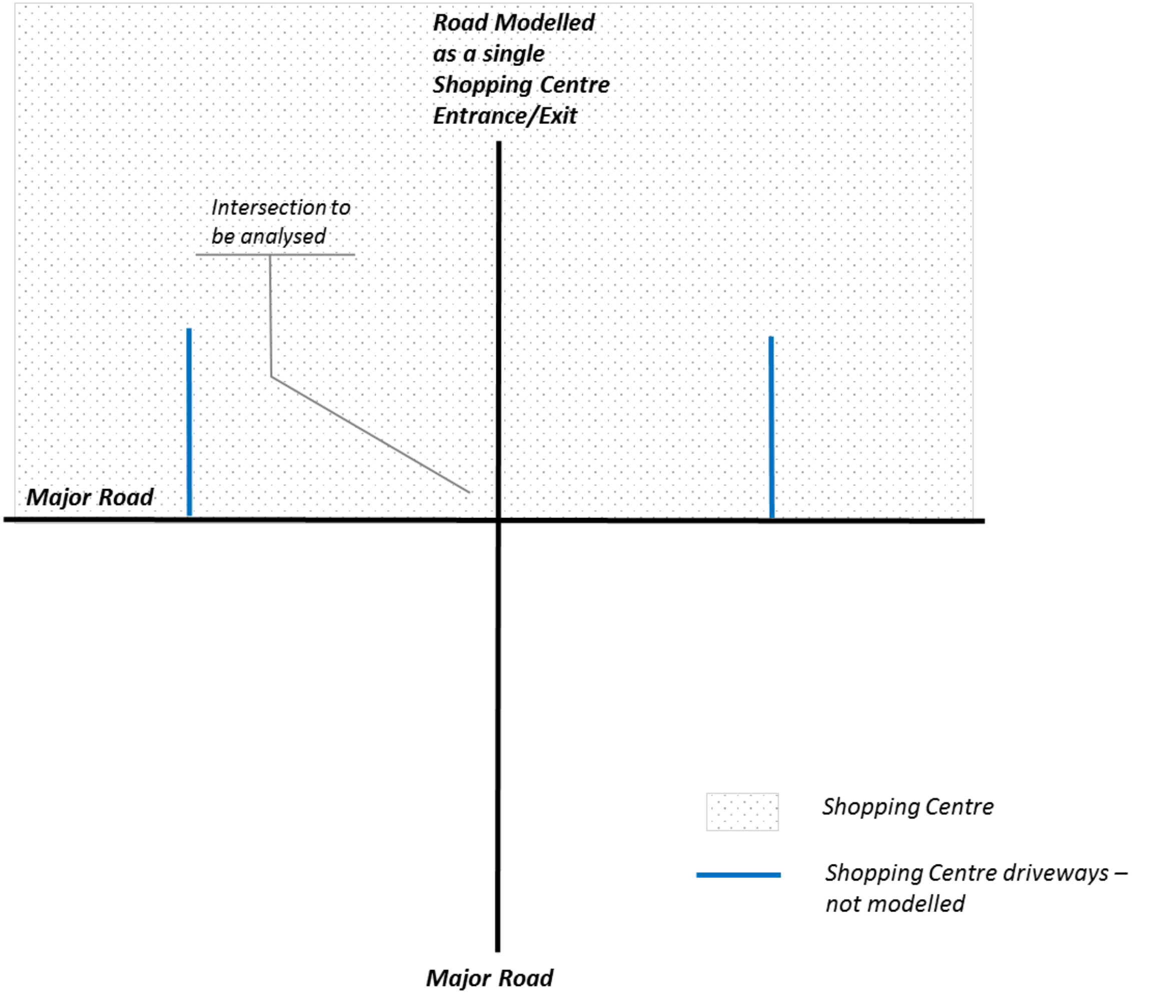
- Determine the modelled overall growth rate across the screenline between the base year and future year model;
- Apply the growth rate to the existing north-south flows to determine future flows for the north-south movement at the intersection to be analysed;
- Proceed with the general calibration process for all the remaining intersection movements as described in Section C.4.3.



Scenario 2: Simplified Road Network

Case 1: Shopping Centre represented as a single point of entrance

As an example, consider a case of a shopping centre represented as a single point of entrance into the network for simplicity as illustrated below:

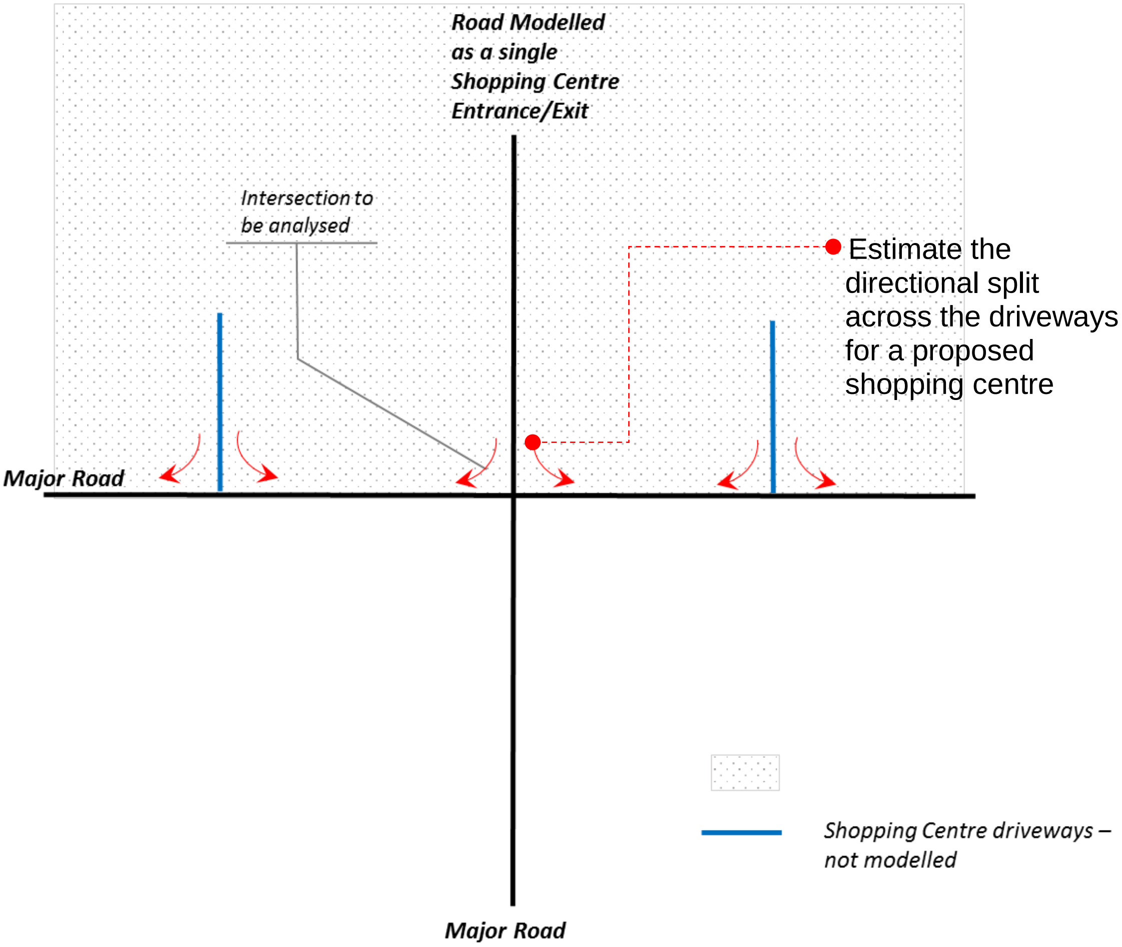


If this is an existing shopping centre with the similar configuration of driveways in the future, then the following procedure must be adopted to estimate the future turning movements through the intersection:

- Obtain the existing daily traffic count data for the intersection to be analysed.
- From ROM24 daily traffic flows, obtain the traffic growth rate for all the turning movements through the intersection.
- Apply the growth rates calculated to the existing daily volume turning movements across the intersection to obtain future traffic flows.

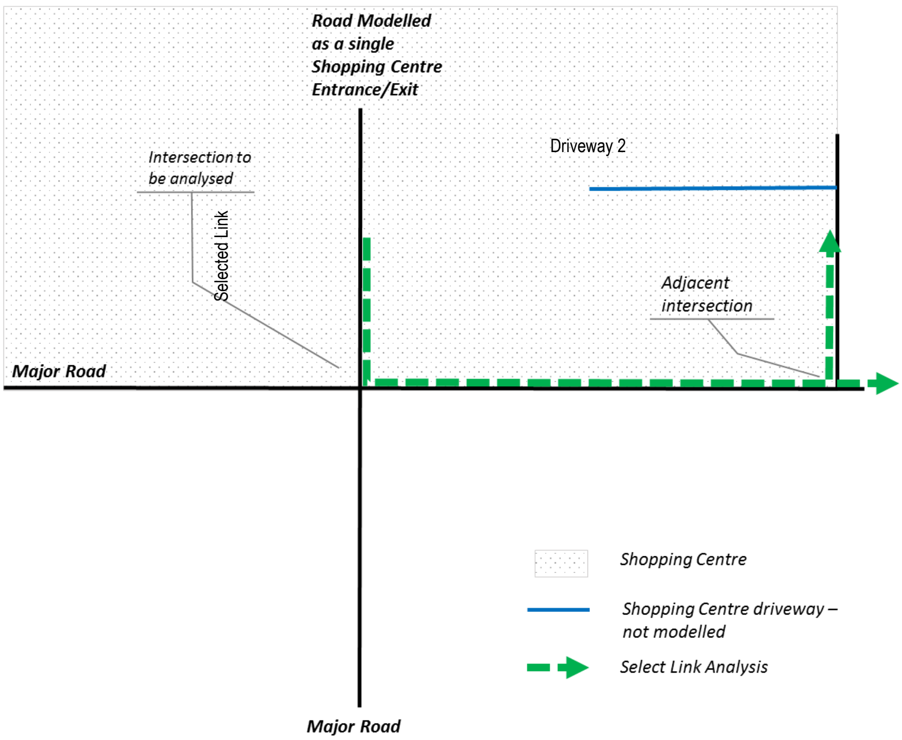
Sub-case 1: Proposed Shopping Centre

In the case where this is a proposed shopping centre, coded as a single entry point into the network with the drive-way configuration as shown above, it is recommended that manual traffic assignment (to and from the shopping centre) be performed to both the proposed driveways, to identify the proportion of traffic through the intersection to be analysed. For the other turning movements, the growth factor method could be applied similarly as described above. The proportion of traffic using the driveways may take into consideration the proposed parking within the shopping centre site and accessibility.



Sub Case 2: Proposed Shopping centre with access on an adjacent road

In the case where, a shopping centre has one of its accesses on an adjacent major road but is represented as illustrated in the model, then manual assignment of traffic should be made using the select link analysis procedure:

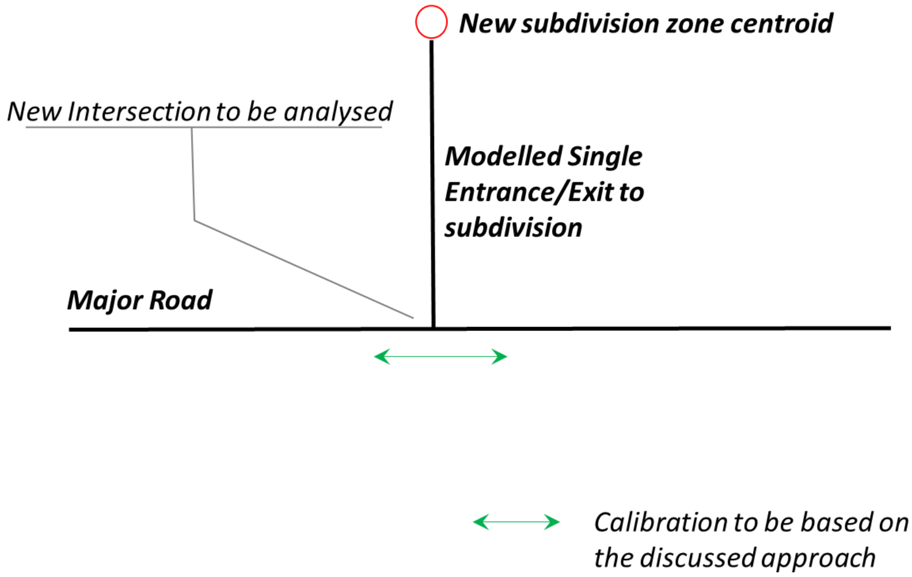


Select link analysis on the proposed shopping centre link can be used to determine the proportion of traffic heading north and east from the shopping centre. In this example, it is reasonable to assume that a higher proportion of shopping centre traffic heading north or east would use the Driveway 2 rather than the modelled drive way link. Hence, the traffic could be proportionally allocated to the both driveways to arrive at flows at the intersection to be analysed.

For all other turning movements, it is recommended that either the calibration procedure described in Section C.4.3 or a growth factor method be used.

Case 2: Sub-Division

Consider the case of a new proposed sub-division represented in the future year model as a single zone with one access onto a major road.



In this case, it is recommended that the calibration process for the major road be carried out as discussed in Sections C.4 and C.5 while for the subdivision entrance leg, judgement should be based on factors as follows:

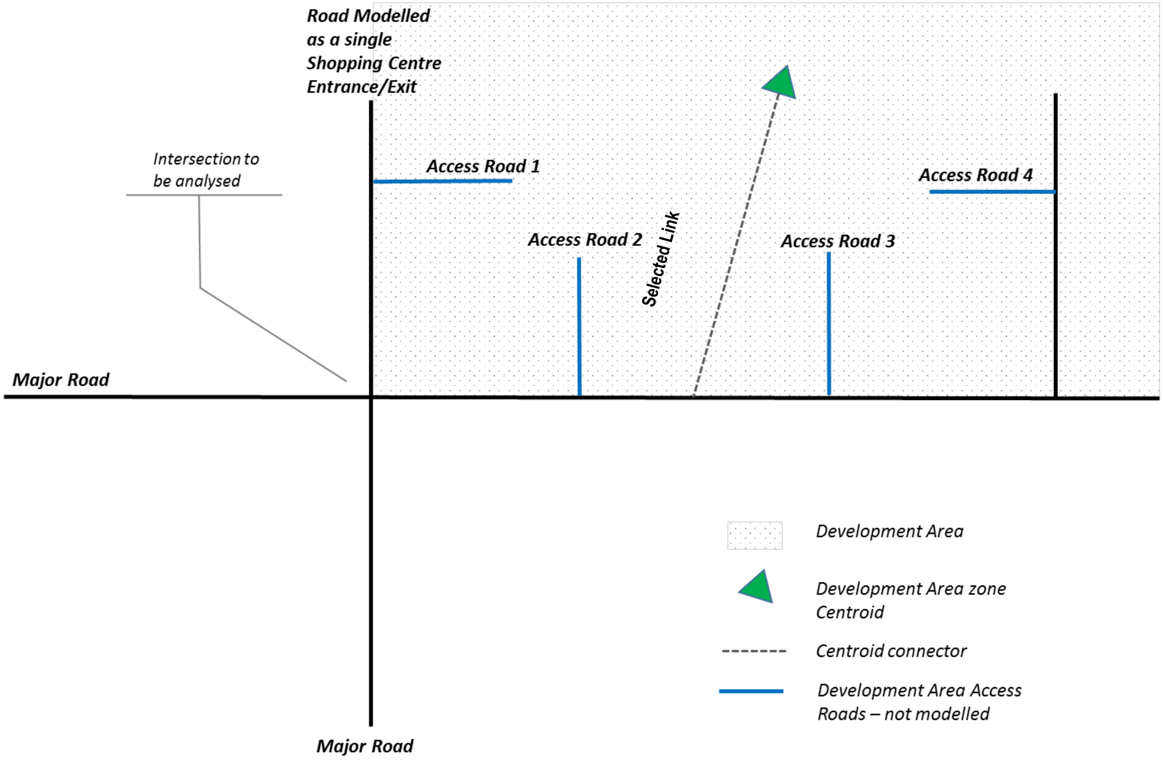
- Number of entry/exit points to the proposed sub-division
- Directional traffic distribution from the centre based on the location of the access point (use Select Link Analysis)
- Subdivision land use and trip distribution peaks (to estimate peak hour distribution).

It is important to note, however, that the growth rate method must be applied carefully, since the road to be analysed could be the first of several roads to be constructed, and all of the subsequent growth could be taken up by the additional roads, with little or no growth at all on the initial road.

Scenario 3: Links Adjoining Centroid Connectors

Where large areas of development are combined together and represented as a single centroid, the traffic volumes on the road links adjoining the centroid connector will be distorted. If the intersection to be analysed is adjacent to a centroid connector of this type, it may be necessary to adjust the traffic flow on the affected road link, especially if the centroid in question shows significant traffic growth between the existing and future modelled years.

Consider the example in the following illustration:



The development area adjacent to the intersection to be analysed is represented as a single point of traffic load in the network. If there is a significant growth in the area in the future, the additional growth would distort the turning movements at the intersection to be analysed, thereby making the model outputs un-usable.

In such instances it is recommended that any of the following processes be adopted:

Method A: Overall area growth rate

- Obtain the existing flows for the intersection to be analysed;
- Identify a suitable sub area around the intersection and the surrounding development for both the base year and future year ROM24 models;
- Determine overall subarea growth rate;
- Apply the growth rate to the existing intersection flows to obtain the future volumes.

Method B: Select Link Analysis and Manual adjustments:

In the case where the location of access roads of the development area are known, Select Link Analysis could be used to determine the proportional distribution of development traffic and then adjust the traffic manually to various access roads, based on proximity. The Calibration procedure described in Section C.4.3 must be carried out for the intersection at first, without the development traffic. The calculated traffic through the intersection can then be added to the intersection to obtain future flows.