Infrastructure Portfolio

LIVINGSTONE SHIRE TRANSPORT NETWORK

SIDRA BUSINESS RISK DOCUMENT
User Guidelines

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1.0 INTRODUCTION

Sidra Intersection is micro-analytical traffic evaluation software that is used as an aid for design and evaluation of signalised intersections, signalised pedestrian crossings, single point interchanges, roundabouts, roundabout metering and sign controlled intersections. This tool is used to model existing intersections and to test various scenarios for future intersection layouts and traffic conditions.

First released in 1984, Sidra has undergone a continuous development to introduce Sidra Intersection 6 in 2013. These guidelines are based on the data input and output functionalities Sidra Intersection 6 provides.

2.0 OBJECTIVE

The objectives of the guidelines are to guide users in:

- Developing models with acceptable parameter settings that are appropriate for the local conditions and requirements;
- Providing a basis for appropriate calibration process, comparison of performance measures and reporting structure;
- Providing a basis for intersections to be modelled consistently across the jurisdiction and by various internal departments and external agencies.

These guidelines provide guidance for modelling intersections within Livingstone for both internal staff as well as external consultants who submit intersection analysis reports to Livingstone Shire Council. The guideline provides flexibility in altering settings and parameters to test different conditions and requirements when dealing with unusual or specialised intersections. Any such deviation from the standard settings and parameter values shall be recorded with appropriate justification.

3.0 LIMITATIONS

Livingstone Shire Councils Sidra Guidelines are not recommended in modelling intersections that comprise of one or more legs controlled by Department of Transport and Main Roads (DTMR) unless appropriate prior consultation has been done.

These guidelines provide guidance to the users with basic experience in using Sidra Intersection 6 and with some basic knowledge in Transport and Traffic Engineering principles.

Scope of these guidelines does not include providing guidance in interpretation of model behaviour or the results. This part of the analysis has to be carried out by a competent person with adequate knowledge and experience in Sidra Intersection software and of Transport and Traffic Engineering expertise.

Objectives of these guidelines do not include providing guidance on each and every input or selections that a user has to provide in developing a Sidra Model. For the areas that are not covered adequately or at all these guidelines, or if it is referred to, Quick Guide to Sidra Intersection 6 shall be referred.

4.0 ANALYSIS

4.1 Analysing for Base Year and Design Year

Base Year

- If the intersection is at Detailed Design stage, use estimated year of construction completion as the Base Year.
- If the intersection under analysis forms a part of another development project, with known year of construction completion, use that as the Base Year.
- In all other cases, estimate year as the Base Year, unless the analysis is specifically required to determine traffic performance in a known future year.
- Other variations of Base Year can be used to suit varying traffic conditions as deemed by the assessment. For an example, if there will be an immediate development impacting traffic loadings of the intersection, two (or more) Base Year variations can be checked. These can be named, for instance, as 'Base Year – Current Conditions' and 'Base Year – With Development', for clarity.

Design Year

- Generally, a design life of 20 years is considered for traffic analysis purposes.
- If the analysis is undertaken for a different design year, clearly document the design year considerations and justification to use a different design life.

4.2 Input

4.2.1 Intersection Dialogue

The following is required as a minimum Intersection Dialogue:

Site Name to follow the syntax; [Road 1] / [Road 2] / [Road 3] [type of control (Priority / Signals / Roundabout)] [Year] [AM/PM] – [Any layout specifics (Current / With Development / etc.)]
Example 1 – Whitman / Vaughan Priority 2015 AM - Current
Example 2 – Appleton / Vaughan Signals 2015 PM - with Barry St connection

Site ID to be used an identification number within the context of the analysis undertaken as appropriate. If it is an ad-hoc site, just use 1 or the next available number to identify the particular site within the Sidra network file (in network analysis mode).

Site Title is used to correctly identify the site in Sidra reports. Provide the intersecting road (in non-abbreviated format) and the locality in two lines, as a minimum in this input field.
Example 1- Appleton Drive / Vaughan Street Intersection Yeppoon
Example 2 - Yeppoon Road / Cordingley Street Proposed Intersection Yeppoon

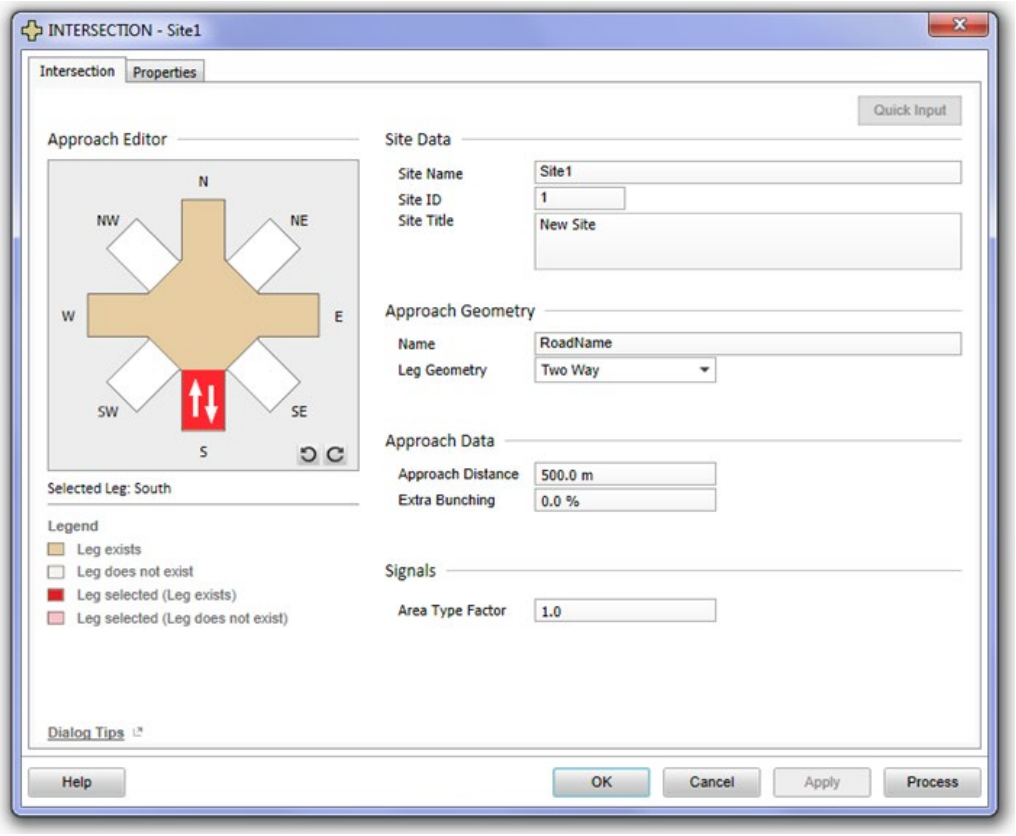

Figure 1- Intersection Tab (Intersection Dialog) Inputs

4.2.2 Lane Geometry Dialogue

The following is required as a minimum in the Lane Geometry Dialogue:

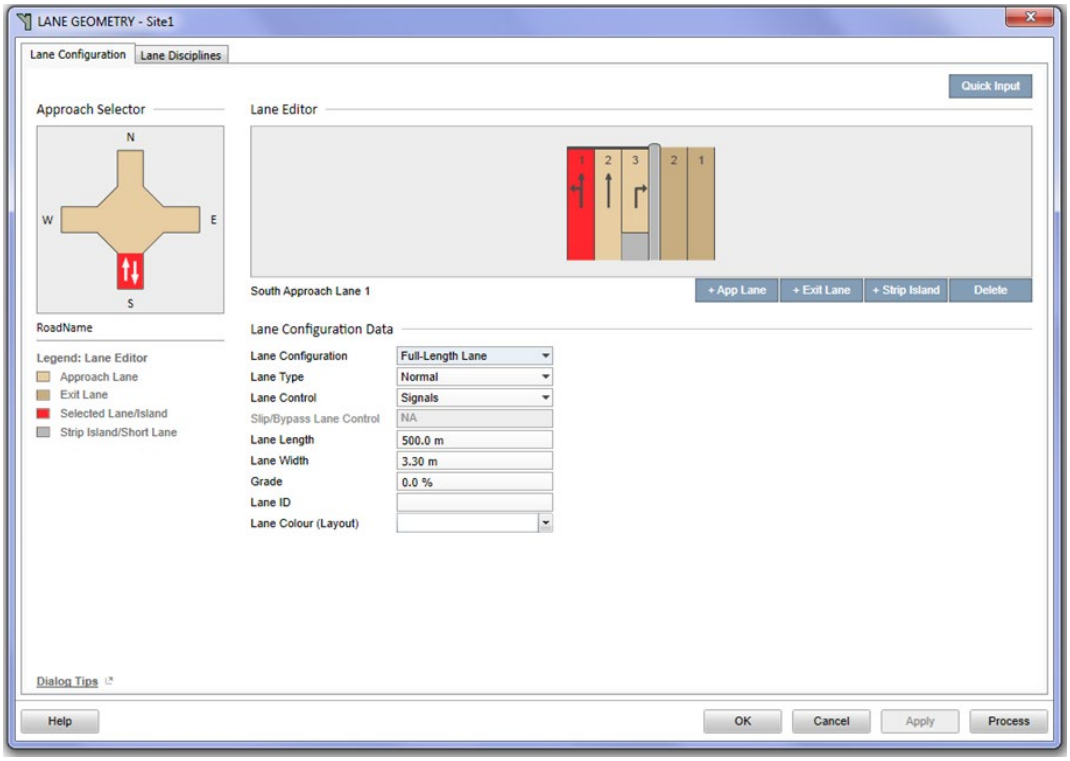

Figure 2- Lane Geometry Tab

Approach and exit lane data to contain street names, medians, lane widths, lane lengths, grade, lane configuration, lane type, lane control. Data pertaining to these inputs need to match existing geometry for constructed intersections. New intersections will need to be in accordance with CMDG Road Heirachy and standards.

Slip and short lane lengths are to be measured from the stop line to the farthest point along the particular lane that can accommodate a car without encroaching the adjacent lane and input in to Short Lane Length field. See Figure2 for details.

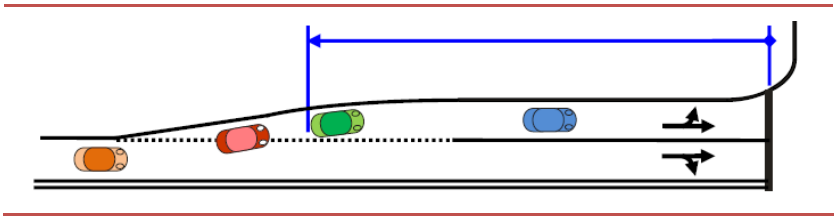

Figure 3- Measuring Short Lane length

4.2.3 Lane Data

The **maximum Basic Saturation** flow is to be in accordance with Table 1 for Urban Road and Table 2 for rural roads. Higher values will need to be supported. These tables are based on Councils Road Hierarchy and will need to be manually overwritten as required.

Values for **Extra Bunching** should be used if there are upstream signals in close proximity. Extra bunching should only be applied to sign-controlled and roundabout intersections. Table 3 outlines the maximum values to be used to stipulate the effects of extra bunching.

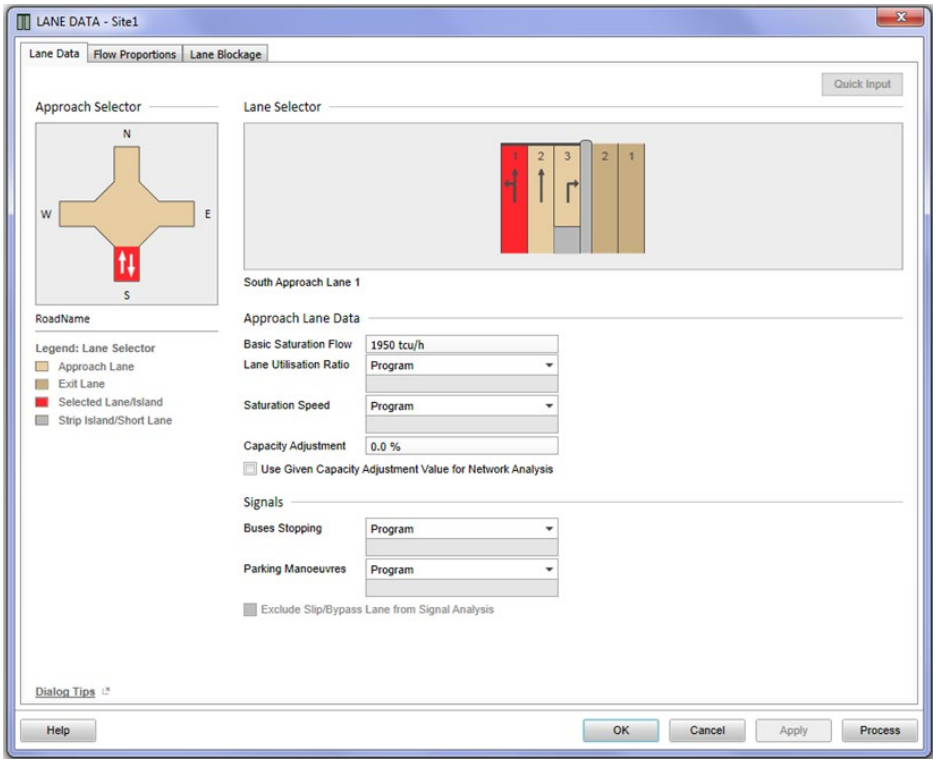

Figure 4- Lane Data Window

Table 1: Basic Saturation Flow Parameters for Urban Roads

Criterion	Road						Street			
	Arterial Road			Sub Arterial Road			Collector Street		Local Street	
	Highway	Arterial	Arterial Main Street	Traffic Distributor	Controlled Distributor	Sub Arterial Main Street	Major Collector[1]	Minor Collector[2]	Access Street	Access Place
Basic Saturation Flow (Veh/hr)	1800	1800	1500	1500	1500	900	450	300	120	30

[1] Major Collector is to be used as Industrial Collector
[2] Minor Collector to be used a Industrial Access

Table 2: Basic Saturation Flow Parameters for Rural Roads

Criterion	Arterial[1]	Traffic Dsitributor[2]	Minor Collector	Access Street
Basic Saturation Flow (Veh/hr)	1800	1200	150	30

[1] Where Road is State Controlled, Criteria must follow the State Road Authority Requirements
[2] Traffic Distributor is to be used as industrial Road

Table 3: Maximum values for Extra Bunching

Distance to Upstream Signals (m)	<100	100-200	200-400	400-600	600-800	>800
Extra Bunching (%)	25	20	15	10	5	0

4.2.4 Pedestrians Dialogue

Volume Data Settings for Site - Unit Time for Volumes and Peak Flow Period must be set at the same value, unless reasonable estimation of traffic distribution is available to apply a lesser peak flow period.

Please note that any changes to these values will change corresponding inputs in Volumes Dialog (see Section **Error! Reference source not found.**) and vice versa. If Peak Flow Period value is less than the value in Unit Time for Volumes, Peak Flow Factor field in Volume Data section will be enabled.

Volume Data – If pedestrian crossing option (either Full Crossing or Staged Crossing) is selected, Volume Data fields will appear with default values. These defaults to be changed to suit estimated or counted pedestrian demand figures and estimated pedestrian growth.

Pedestrian Movement Data - Generally, the default values in this tab are unchanged, with the following exceptions;

- If the lane geometry used in Sidra does not accurately replicate the actual crossing distance, Crossing Distance input to be altered to reflect actual distance pedestrians have to travel.

- In special conditions, where average walking speeds are estimated to be higher (or lower) than the default value (eg. high elderly pedestrian proportions), appropriate value to be entered in the Walking Speed (Average) field, with reasonable justification.

Note: Walking Speed is the average speed a pedestrian approaches the intersection and leaves after crossing completed. Crossing Speed parameter is different from Walking Speed parameter and to be

inputted only for signalised intersections.

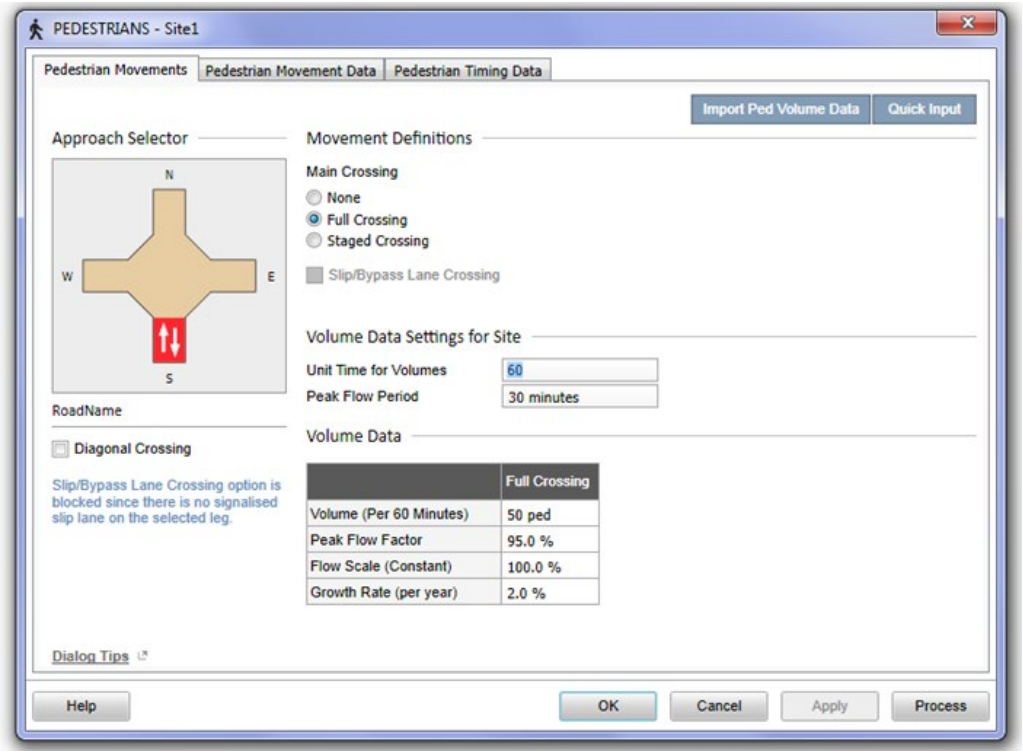

Figure 5- Pedestrian Movements Window

4.2.5 Volumes Dialogue

Volume Data Settings for Site - Volumes used must be based on the most current data collected for the intersection. This setting will be applied for both traffic and pedestrian volumes. Unit Time for Volumes and Peak Flow Period must be set at the same value, unless reasonable estimation of traffic distribution is available to apply a lesser peak flow period.

Please note that any changes to these values will change corresponding inputs in Pedestrians Dialog and vice versa. If Peak Flow Period value is less than the value in Unit Time for Volumes, Peak Flow Factor field in Volume Factors tab will be enabled

Growth rates used for future volume estimation or assumed new volumes will require justification of the method to determine values used. This should be included in the final report.

In the absence of site specific growth rate for traffic, it is recommended to use the following growth rates:

- Saturated catchments – 2%
- Average growth catchments – 3%
- High growth catchments – 4%

4.2.6 Priorities Dialogue

Default opposing movements are to be used unless the actual opposing movements are different to the Sidra defaults. This may be the case for intersections with an unusual geometry, turn designations or specialised treatments.

This dialog will not appear for roundabout and all-way stop controlled intersection models.

4.2.7 Gap Acceptance Dialogue

Table 4 and Table 5 are acceptable critical gap and follow-up headway parameters for all intersections.

Table 4: Gap Acceptance Parameters for Sign Controlled Intersections

Type of Movement	Less than 70km/hr [4]		71km/hr to 100km/hr [4]		Greater than 100km/hr [4]	
	Critical Gap (seconds)	Follow-up Headway (seconds)	Critical Gap (seconds)	Follow-up Headway (seconds)	Critical Gap (seconds)	Follow-up Headway (seconds)
Left turn [1]						
1-lane opposing	4.5	3.0	6.5	4.5	8.0	5.5
2-lane (or more) opposing	5.0	3.0	7.0	4.5	9.0	5.5
Through movement crossing one-way road						
1-lane one -way	4.0	2.0	6.0	3.0	7.5	3.5
2-lane one-way	4.5	2.5	6.5	3.5	8.0	4.5
3-lane one-way	6.0	3.0	8.5	4.5	11.0	5.5
Through movement crossing two-way road						
2-lane two-way	5.0	3.0	7.0	4.5	9.0	5.5
3-lane two-way	6.5	4.0	9.0	6.0	11.5	7.5
4-lane two-way	8.0	5.0	11.5	7.0	14.5	9.0
Right turn from major road [2]						
Across 1 lane	4.0	2.0	6.0	3.0	7.5	3.5
Across 2 lane	5.0	3.0	7.0	4.5	9.0	5.5
Right turn from minor road [3]						
One-way	4.5	3	6.5	4.5	8.0	5.5
2-lane (two-way)	5.5	3.5	8.0	5.0	10.0	6.5
3-lane (two-way)	6.5	4.0	9.0	6.0	11.5	7.5
4-lane (two-way)	8.0	5.0	11.5	7.0	14.5	9.0
Merge from acceleration lane	3.0	2.0	3.0	2.0	3.0	2.0

[1] This is considered to apply to left-turn movements from minor road, as well as slip-lane left-turn movements from minor road

[2] This case is relevant to two-way major road conditions with one direction of the major road opposing (1-lane, 2-lane or 3-lane).

[3] The conditions specified (one-way, 2-lane two-way, 4-lane two-way, 6-lane two-way) are relevant to the opposing movement lanes on the major road.

[4] The speeds are relevant to the sign posted speed on the major road unless the only opposing traffic is on the minor road then the speeds are relevant to the minor road.

Table 5: Gap Acceptance Parameters for Roundabout and Signalised Intersections

Type of Movement	Signals		Roundabouts	
	Critical Gap (seconds)	Follow-up Headway (seconds)	Critical Gap (seconds)	Follow-up Headway (seconds)
Left turn [1]				
1-lane opposing	4.5	3.0	Estimated by SIDRA	
2-lane (or more) opposing	5.0	3.0	Estimated by SIDRA	
Through movement crossing one-way road				
1-lane one -way	4.0	2.0	Estimated by SIDRA	
2-lane one-way	4.5	2.5	Estimated by SIDRA	
3-lane one-way	6.0	3.0	Estimated by SIDRA	
Through movement crossing two-way road				
2-lane one-way	5.0	3.0	Estimated by SIDRA	
3-lane one-way	6.5	4.0	Estimated by SIDRA	
4-lane one-way	8.0	5.0	Estimated by SIDRA	
Right turn from major road [2]				
Across 1 lane	4.0	2.0	Estimated by SIDRA	
Across 2 lane	5.0	3.0	Estimated by SIDRA	
Right turn from minor road [3]				
One-way	4.5	3.0	Estimated by SIDRA	
2-lane (two-way)	5.5	3.5	Estimated by SIDRA	
3-lane (two-way)	6.5	4.0	Estimated by SIDRA	
4-lane (two-way)	8.0	5.0	Estimated by SIDRA	
Merge from acceleration lane	3.0	2.0	Estimated by SIDRA	

[1] This is considered to apply to left-turn movements from minor road, as well as slip-lane left-turn movements from minor road

[2] This case is relevant to two-way major road conditions with one direction of the major road opposing (1-lane or 2-lane).

[3] The conditions specified (one-way, 2-lane two-way, 3-lane two-way or 4-lane two-way) are relevant to the opposing movement lanes on the major road.

4.2.8 Gap Acceptance Dialogue

Path Data - Input posted speed limits on immediate sections of the legs for Approach Cruise Speed and Exit Cruise Speed parameters. Rest of the parameters in this window is recommended to be kept unchanged at default (Program) unless specific local characteristics are known.

Calibration - This window lets the user to input values to represent specific vehicle and manoeuvring characteristics only if Movement Class is changed to Light Vehicles of Heavy Vehicles in left pane. It is recommended to edit these inputs only during fine tuning or calibration process of a Sidra model.

Signals - Default values to remain unchanged unless fine tuning of the model is required with known local or site conditions.

4.2.9 Phasing and Timing Dialogue

This dialog appears only for signalised intersections.

For new intersections, this dialog is used to determine the most appropriate signal phasing. In

modelling existing signalised intersections, actual phase timing shall be adopted for modelling base conditions. If it is required to investigate on alternative signal phase timing for existing signalised intersections, different phase time data can be inputted, however, additional hardware requirements to be documented and reported, if required for alternative phasing arrangements.

4.2.10 Phase & Sequence Data

Options and functions included in the Phase & Sequence Data tab are shown in **Error! Reference source not found.**.

Following to be considered in providing inputs in this tab:

- Variable Phase: If one or more phases are required to be considered variable, check this box. A reference phase cannot be a variable phase.
- Reference Phase: This is used for signal coordination purposes. If the site is analysed as an isolated site, use any phase (or the default A phase) as the reference phase. In the network mode, a reference phase can be used with relevant phase timing inputs and network settings. A reference phase cannot be a variable phase.
- Phase Time: This is an optional input and can be used in specific conditions such as provide a fixed green belt in a coordinated signal series.
- Yellow Time and All-Red Time: Use default Yellow Time and All-Red Time settings of 4 seconds and 2 seconds respectively, unless different values are justified.
- Dummy Movement Data: One or more dummy movement phase can be used to determine signal timing while no actual movement occurs. This may be necessary in paired intersection analysis. For stand-alone intersection analysis, always leave Dummy Movement Exists check box unchecked.
- Effective Detection Zone Length: Leave this input at default value unless satisfactory local conditions exist to change the default.

4.2.11 Timing Options

This tab has a few options to select for various scenarios. For a new intersection analysis, select Practical Cycle Time with a Maximum Cycle Time setting at 120s. Other options are only to be selected with appropriate engineering judgement and/or as required by different settings such as actuated / coordinated signal settings or to apply a minimum cycle time limit. For more details, see Sidra Intersection 6.0 Manual.

4.2.12 Advanced

Undetected movements and phase transition can be specified in this tab. For a basic intersection analysis project, it is recommended to start with default inputs (i.e. Undetected and Phase Transition check boxes unchecked and All Movement Classes selected). Changes to these settings are to be undertaken only when required and with appropriate justification of selections.

Notes:

- When some turning movements stop and start between phases, Phase Transition shall be checked.
- If Slip / Bypass lane movements are to be excluded from timing analysis, it should be done in the Lane Data tab in Lane Data dialog.

4.3 Calibration and Validation

According to Austroads Guide, intersection models are commonly used for analysis of isolated sites, such as an intersection. Because they are based on predetermined equations, their accuracy is limited to the assumptions used in the formulation of the equations. Model calibration involves adjusting specific parameters to the model or model inputs to replicate the conditions and/or behaviour of the subject site.

When a base model is used to derive conclusions and to test scenarios (eg. future model or modified layouts), the base model being accepted as reasonably replicating site observations of the subject site or calibration (or re-calibration) should be undertaken.

Calibration process should be based on various traffic surveys and siye observations. All changes required in order to calibrate the model should be fully documented with an explanation and justifications of the change.

SIDRA User Guidelines should be referred to for possible calibration methods. In order to properly identify the effects of future network and/or demand changes on the existing operation of intersections then the timings obtained from a calibrated model of existing conditions (based on observed signal phases and timings) should be compared with those observed from the SIDRA optimised timings. In this way differences can be compared, and an explanation provided as to why they may exist.

This comparison is useful in identifying:

- Incorrect model assumptions in respect of traffic behaviour
- Incorrect model assumptions in respect to signal operation assumptions
- Incorrect STREAMS setup.

Consideration should be given, but not limited, to the following, as applicable:

- Accurate road geometry
- Classified turning movement / OD data
- Observed saturation flow values
- Observed lane utilisation
- Observed weaving patterns
- STREAMS signal timings
- Observed non-blocking storage and storage in front of the stop line
- Observed delays to turning traffic
- Accurate routing for general and public transport vehicles

4.4 Output

4.4.1 Demand and Sensitivity

There are four main Analysis Options in the Demand and Sensitivity dialogue which can be used as required analysis of intersections. ‘Design Life’ and ‘None’ are the two most commonly used options. These options are explained below:

'None' - Select this option if the intersection is analysed using Method 1 as described in Section 4.1. There will be no input parameters in this dialog for this option.

'Design Life' - Inputs for the Design Life option in the Demand & Sensitivity dialog is shown in **Error! Reference source not found.**.

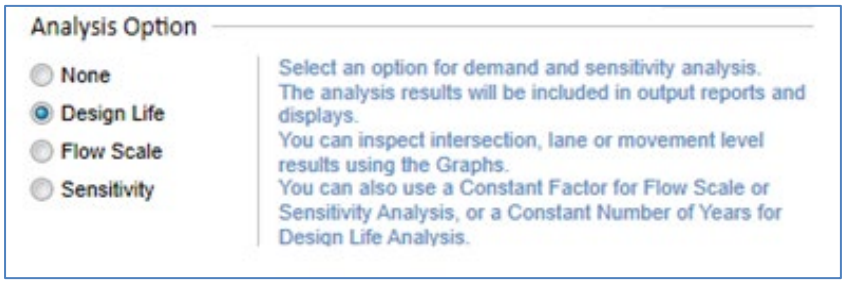

Figure 6- Analysis Options

The Design Life analysis has four inputs which are explained below:

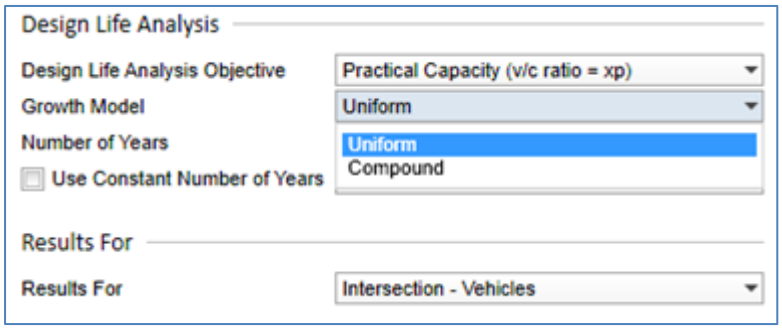

Figure 7- Design Life Options

Design Life Analysis Objective – Use default value, Practical Capacity (v/c ratio = xp) for this input.

Growth Model – Select appropriate growth rate model in this field. Generally, it is recommended to use Compound growth model.

Number of Years – Input appropriate number of years in this field, that is determined as described in Section 4.1. If a value is inserted in to this field, outputs are generated for the last year the intersection is forecasted to perform satisfactorily, before it fails next year. If the intersection is to be tested for the performance levels at the end of the Design Life regardless of the year of failure, check Use Constant Number of Years and input the relevant number of years in the field next to the check box caption. Note: There will be limitations in the graphs and reports produced in using constant number of years. See Sidra Intersection 6.0 Manual for details.

Results For – An appropriate selection is to be made from the drop-down menu. The default value i.e. Intersection – Vehicles, is used in most cases of analysis. Note: This facility exists for single intersection analysis only. In a network analysis, the selected options will be disregarded.

4.4.2 Model Settings

4.4.2.1 Options tab

Level of Service Method – Use default value of "Delay (HCM 2000)" for this parameter setting.

Level of Service Target – For existing intersections, this parameter has to be set to "LOS D". It is recommended to use "LOS C" for new intersections; however, "LOS D" can be used with reasonable justification of such use. Note: Absolute minimum setting for this parameter is "LOS D" for any intersection.

Performance Measure – Use default value of "Delay" for this parameter setting.

Percentile Queue – Use default value of "95%" for this parameter setting.

Hours of Year – Use default value of "480 h" for this parameter setting. Note: Hours of Year parameter has to be changed if the analysis is undertaken to peak times other than Morning Peak or Afternoon Peak times. Refer to Table 5.14.1 of Sidra Intersection 6.0 Manual for more details.

4.4.2.2 Model Parameters

Default parameter settings should be used in this tab. These may be altered if extended analysis or calibration is required. Justification and documentations explaining changes will be required.

4.4.2.3 Cost and Fuel & Emissions

The parameter settings are generally left unchanged using defaults. Modifying these parameter settings are only required if the relevant outputs in the reports are used during analysis or for reporting purposes.

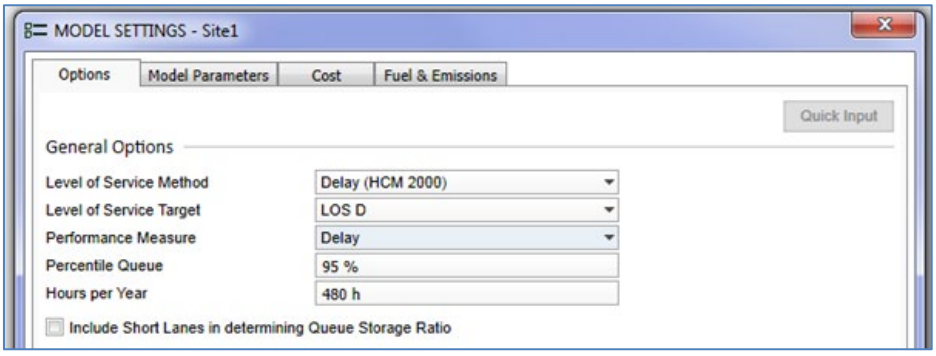

Figure 8- Model Settings Window

5.0 REPORTING REQUIREMENTS

All SIDRA Intersection analysis reports are required to be completed or at least reviewed by a RPEQ member with the name, RPEQ number and signature included on the front cover of the report.

The report must justify and explain the reasons for using or accepting input and output values of those that differ to the guideline. The following is a guide of the files, tables, diagrams that should be included in the report:-

Full SIDRA Intersection project file (.sip) which includes;

- All scenarios used (named appropriately)
- Output files for each scenario

Data Summary required only for the existing intersection once calibrated and the proposed/recommended future intersections:

- Intersections Layout from SIDRA
- Volume Summary from an excel spread sheet used for SIDRA
- Traffic Counts used
- Input Report

Outputs required for existing and the proposed/recommended future intersections:

- Intersection Summary
- Movement Summary
- Lane Summary
- Phasing Summary (Signalised Intersections)
- Roundabout Metering (Roundabouts)
- Tables and Figures from detailed output as required for evidence/justification

6.0 REFRENCES

Quick Guide to Sidra Intersection 6.0 - Sidra Solutions

Sidra Intersection User Guideline – Gladstone Regional Council

Sidra Intersection Analysis User Input Guideline – Rockhampton