SIDRA Intersection User Guideline

Version 1.0
July 2010

GLADSTONE
REGIONAL COUNCIL

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1 Introduction

SIDRA Intersection is a computer software package that models traffic intersections including light vehicles, heavy vehicles and pedestrians. The purpose of the software is to model various scenarios for both existing and future intersections to determine their performance under a range of conditions. The software allows many parameters to be inputted which make allowances for the varying conditions, including geometrical, vehicular and human characteristics applicable for each intersection.

This guideline has been prepared due the large quantity of parameters that can be altered and the large effects that sometimes only minor changes can make. The guideline sets out the acceptable parameters for input however it is designed to allow for flexibility in the analysis of unusual or specialised intersections.

2 Objectives of the Guideline

The objectives of the guideline are to:

- Provide guidance on what the acceptable solutions are for various parameters, performance measures, calibration requirements and reporting structure.
- Provide a basis for intersections to be modelled consistently across Council departments and external agencies.
- Ensure that all intersections are being modelled accurately.

The guideline is not an exhaustive list of requirements and Council reserves the right to require further assessment with different criteria. The guideline is based on the SIDRA Intersection Version 5.

3 Application of Guideline

This guideline is intended to provide guidance for modelling traffic intersections however it still provides flexibility in order to deal with unusual or specialised intersections. The guideline applies to all Gladstone Regional Council staff who use SIDRA Intersection and also to all external consultants who submit Intersection analysis reports to Gladstone Regional Council for approval.

This guideline should be used for modelling intersections that consist of only Council controlled roads. The guideline ***may not*** apply for intersections that consist of any leg which is under control of the Department of Transport and Main Roads and as they may have alternate guidelines/standards/requirements.

4 Getting Started

The following general items are required in order to model any intersection using SIDRA Intersection.

- The latest version/update of SIDRA Intersection should be used where possible.
- All projects created in SIDRA Intersection are required to be modelled as ***Standard Left***.

5 Analysis

SIDRA Intersection is a technical software package that requires a certain level of knowledge to input the correct data and interpret the results, which is proportional to the complexity of the intersection. It is considered that the analysis of any intersection in SIDRA Intersection should be completed by a person who has undertaken at least the Beginner Workshop Training for the software. The level of training required is dependant on the level of complexity of the intersection being analysed. This training should be conducted by Akcelik & Associates Pty Ltd or another accredited person/company.

SIDRA Intersection is a tool used to analyse only intersections therefore the Road Planning and Design Manual published by Department of Main Roads and other appropriate references should be referred to in order to incorporate all aspects of road design.

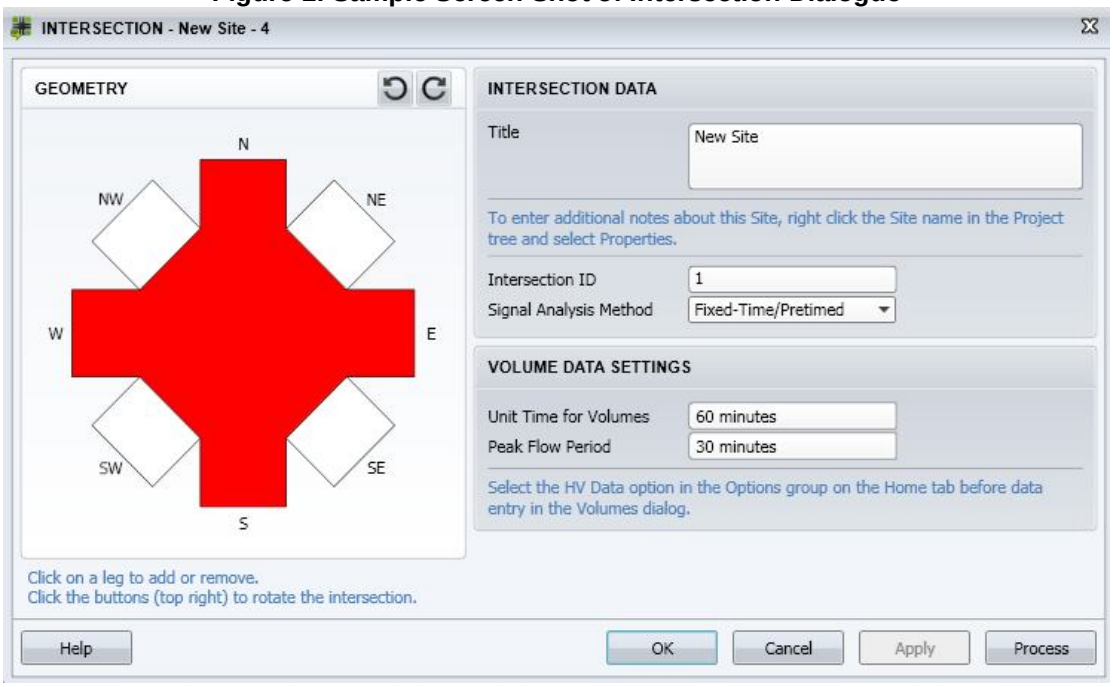
5.1 Input

5.1.1 Intersection Dialogue

The following is required as a minimum in the Intersection Dialogue:

- A descriptive Title of the intersection to be provided including location and purpose (but not limited to).
- The details of the user/developer/analyser of the model must also be included in the Title.
- Peak Flow Period and Unit Time for Volumes should be dependant on the data in the intersection counts where the:
  - Maximum Unit Time for Volumes is 60 minutes
    - Units used is dependant on actual flow data, and needs to be discussed.
  - Maximum Peak Flow Period is 60 minutes .
    - Peak flow factor (volume dialogue box) needs to be carefully assessed to replicate 'peak period'.
- Geometry should closely resemble actual alignment and orientation of the intersection.
- Signal Analysis Method should reflect the actual or proposed intersection operation (only applicable for signalised intersection).

Figure 1: Sample Screen Shot of Intersection Dialogue



5.1.2 Geometry Dialogue

The following is required as a minimum in the Approaches & Lanes Dialogue:

- Approach and exit lane data (Name, medians, lane width, lane length, grade, short lane, lane type, lane discipline, approach control) to be as per one or a combination of the following:
  - The existing geometry for constructed intersections
  - The Gladstone Regional Council Road Hierarchy for new intersections.
  - The 'For Construction Plans' for approved intersections.
- If slip or continuous lanes are present then the appropriate selection is required in this dialogue.
- The maximum Basic Saturation flow to be as per Table 1 for urban roads and Table 2 for rural roads. Higher values need to be supported by appropriate study data.
- 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 simulate the effects of extra bunching.
- Utilisation Ratio, Saturation Speed & Capacity Adjustment data should only be manually overwritten if the appropriate intersection data has been collected, provided or for calibration reasons (see Section 5.2.2).
- The turn designation should be as per the existing or proposed operation of the intersection.
- For signalised intersections, the parameters for Buses Stopping, Parking Manoeuvres, Short Lane Green Constraints and Free Queue should only be inputted if the appropriate intersection data has been collected/provided. If the parameter has a significant impact on the performance of the intersection then this data is required to be collected and included in the model.
- For Roundabouts, the Island Diameter, circulating width and number of circulating lanes should be as per the existing or proposed intersection geometry. This data must be specified for each approach. The calibration parameters in the Roundabout Data section must only be changed as part of the model calibration.

The Basic Saturation Flow parameter which appears in the Geometry Dialogue is required to be manually overwritten with a guide of the maximum values identified in Table 1 (urban roads) and Table 2 (rural roads) for Council Controlled Roads. These tables are based on Council's Road Hierarchy.

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

Figure 2: Sample Screen Shot of the Geometry Dialogue (Lanes & Movements Tab)

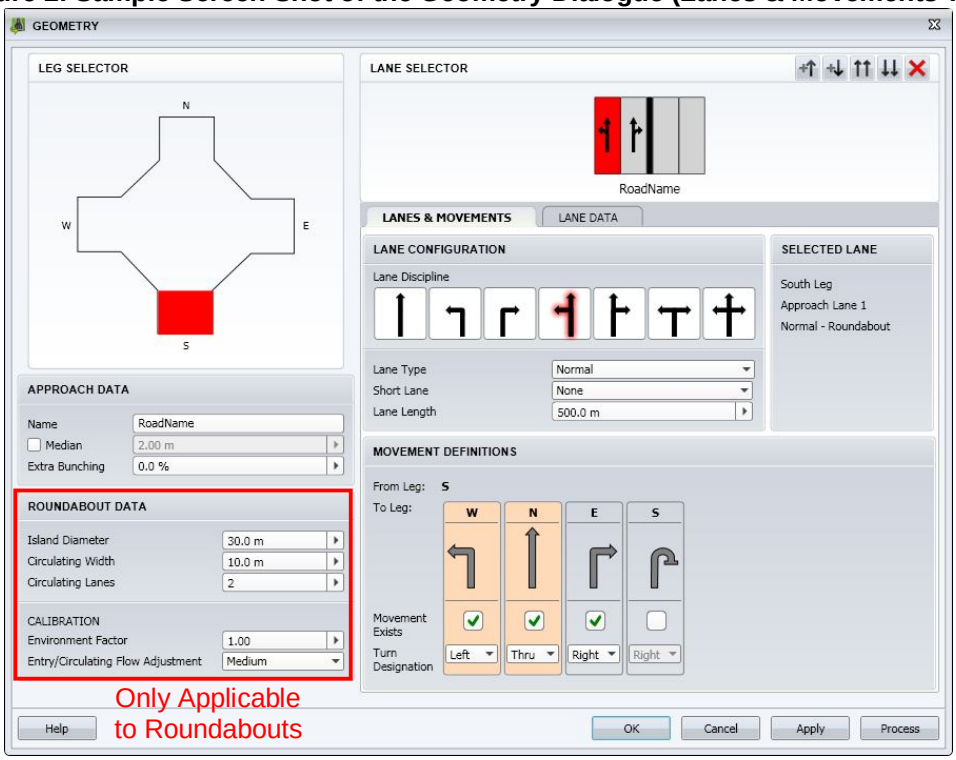
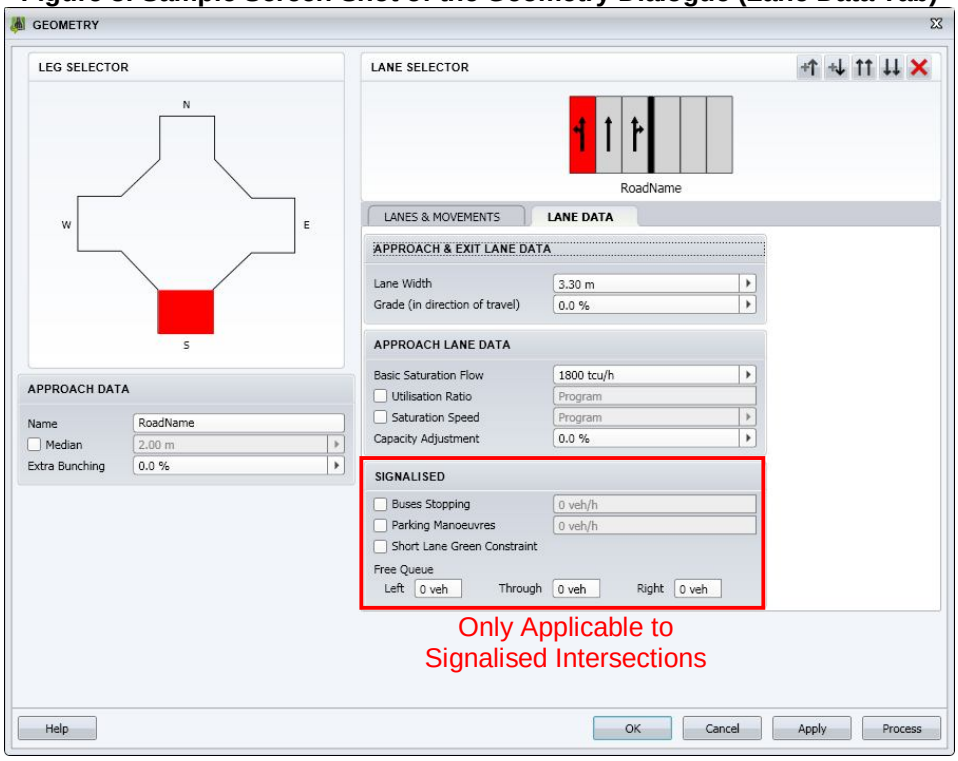


Figure 3: Sample Screen Shot of the Geometry Dialogue (Lane Data Tab)



5.1.3 Volumes Dialogue

Vehicle Volumes are to be based on the most current data collected from an intersection survey/count. The characteristics of the analysis of that data are to dictate the Peak Flow Factor used. Supporting discussion is to be provided justifying the factor used.

The growth rate parameter can be used if completing a design life analysis on the intersection.

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

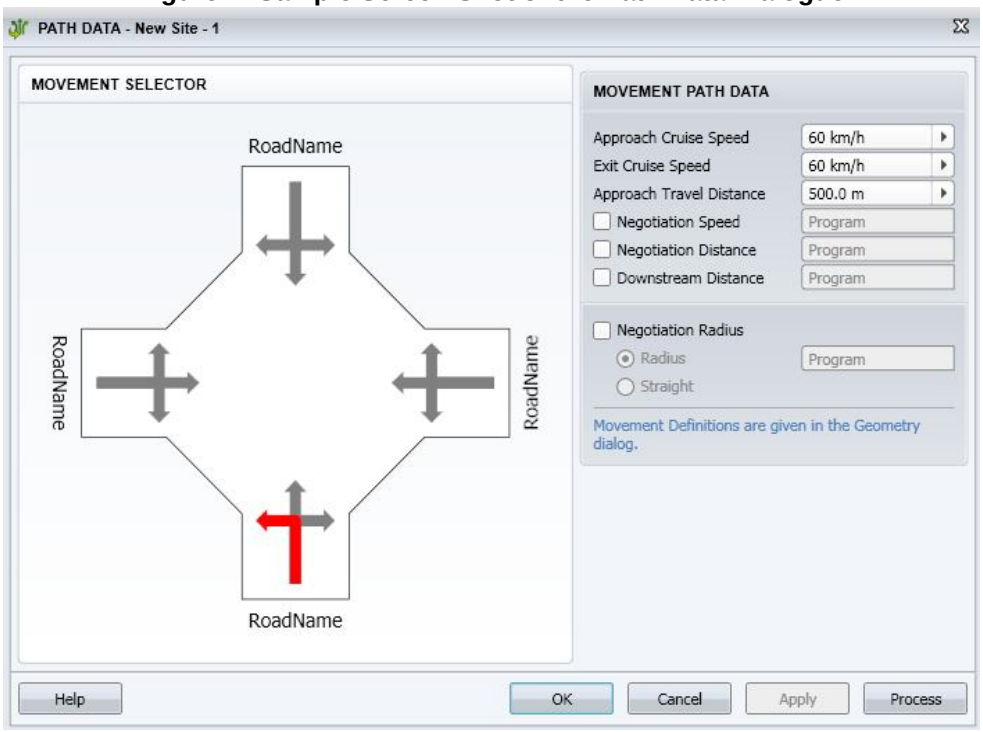
5.1.4 Path Data Dialogue

The Approach Cruise Speed and Exit Cruise Speed for existing intersections should reflect the present conditions (generally posted plus 10%). The Approach Cruise Speed and Exit Cruise Speed for designed or proposed intersections should reflect the hierarchy based design speed.

The Approach Travel Distance should be changed to reflect the existing/proposed operation of the intersection. The Negotiation Radius and Negotiation Distance can be manually overwritten to reflect the physical parameters for cases where an intersection has unusual geometry features.

Justification must be given for the values used due the intersection being of unusual nature. All other items in this dialogue should be as per the default values or calculation methods.

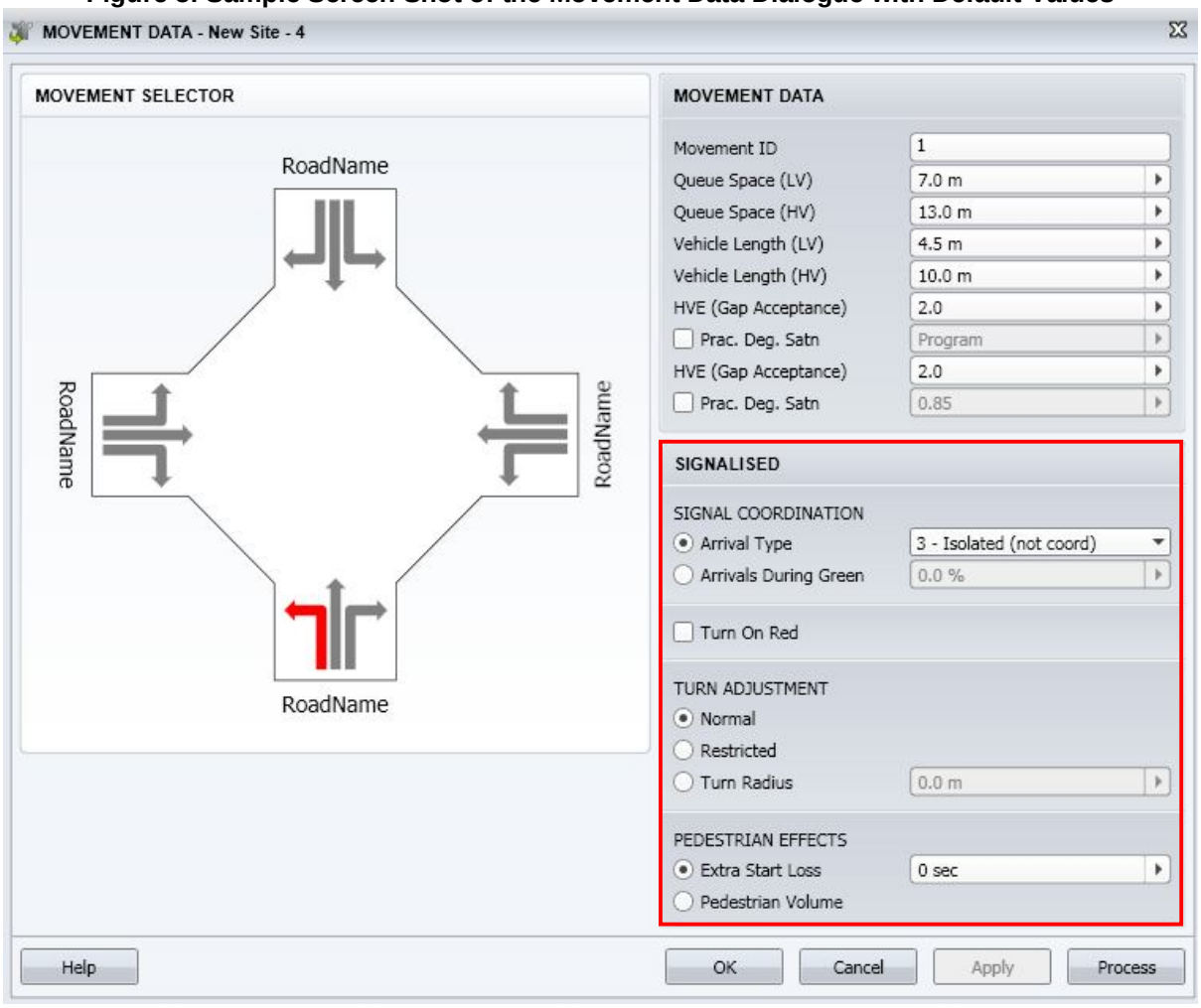
Figure 4: Sample Screen Shot of the Path Data Dialogue



5.1.5 Movement Data Dialogue

All default values in the Movement Data Dialogue shall be used unless evidence can be provided which indicates a different level is appropriate. Defaults are as per the screen shot shown in Figure 5. The red box in this figure outlines the data that is only applicable for signals. The effects of pedestrians may be included in the 'Pedestrian Effects' section of this dialogue however justification is necessary.

Figure 5: Sample Screen Shot of the Movement Data Dialogue with Default Values



5.1.6 Priorities Dialogue

Default opposing movements to be used unless evidence can be provided to show the actual opposing movements are different. This may be the case for intersections with unusual geometry, turn designations or specialised treatments.

5.1.7 Gap-Acceptance Data Dialogue

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

Table 6 outlines the acceptable Exiting Flow Effects. These parameters represent the give-way/yield behaviour of opposed traffic.

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.

Table 6: Exiting Flow Effects

Type of Movement	Existing Flow Effects (%)
Sign-Controlled Intersection	
Minor Road - Left Turn	50
Minor Road - Through	50
Minor Road - Right Turn	50
Turn from Major Road	0
Slip Lane on Minor Road	50
Slip lane on Major Road	0
Signals	
All Movements	0
Roundabouts	
All Movements	0

5.1.8 Model Settings Dialogue

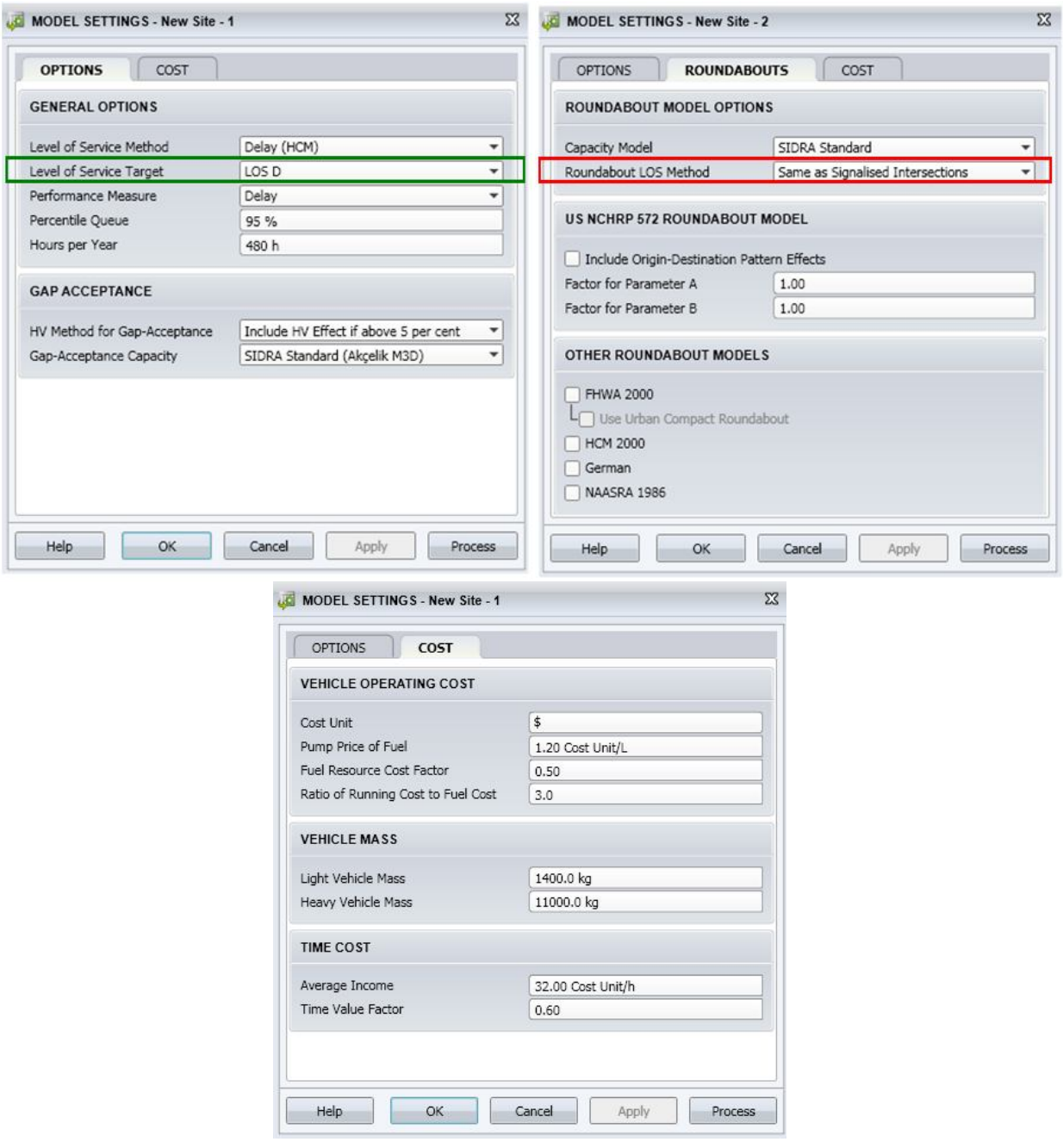
Software default parameters are to be used for the Model Settings Dialogue as per Figure 6, ***except*** for:

- The Roundabout LOS Method (in the Roundabout Models section)
- The Level of Service Target.

The Roundabout LOS Method is to be set to '***SIDRA Roundabout LOS***' as per the red box in Figure 6.

The Level of Service Target (green box in Figure 6) is dependent on the hierarchy of the intersecting roads. The road with the highest LOS standard as identified in Table 8 (urban roads) and Table 9 (rural roads) in Section 5.2.3 is to be used as the overall Level of Service Target.

Figure 6: Sample Screen Shot of Model Settings Dialogue (Options, Roundabouts & Cost Tabs)



5.1.9 Demand & Sensitivity Dialogue

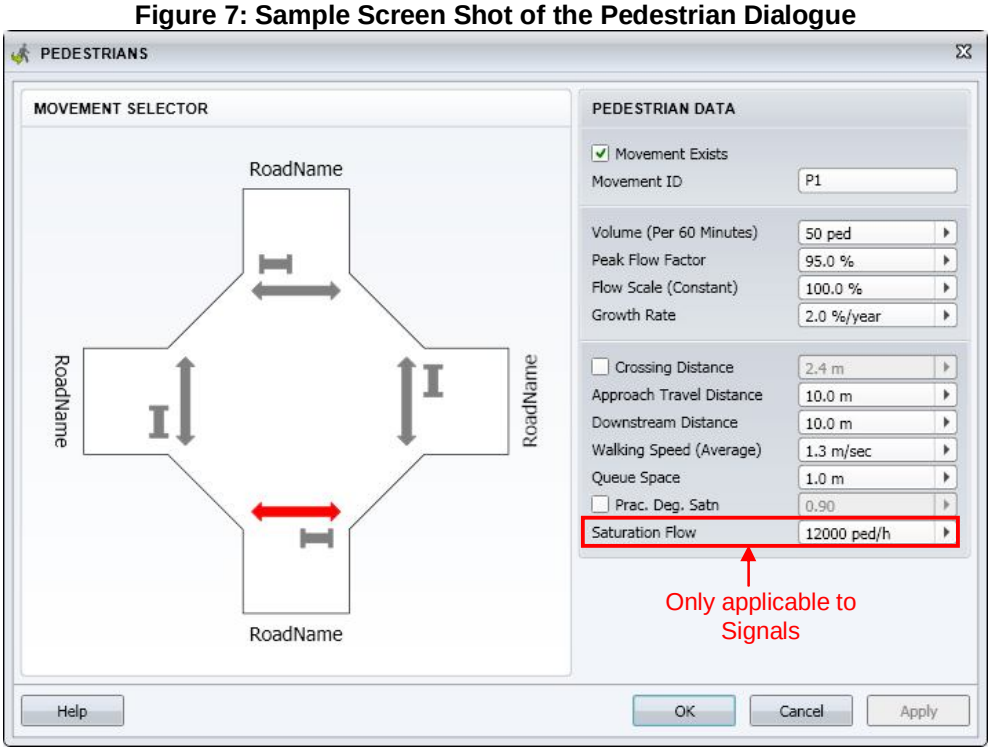
All methods in the Demand and Sensitivity can be used as required for analysis purposes of the intersection. For each method used (if any) the related scenarios are required to be included in the SIDRA Intersection file (.sip).

5.1.10 Pedestrians Dialogue

This dialogue only applies to Roundabouts (all types) and Signals (including signalised Pedestrian Crossings).

The volume of pedestrians and Peak Flow Factor are to be altered to suit the intersection counts obtained. The growth rate used is required to be justified and explained. The geometry of the intersection with regards to crossing distance, Approach travel distance and downstream distance can be altered to represent the geometry of the intersection if measurements are available. Default values are to be used for all other parameters in this dialogue as shown in Figure 7.

Figure 7: Sample Screen Shot of the Pedestrian Dialogue



5.1.11 Phasing and Timing Dialogue

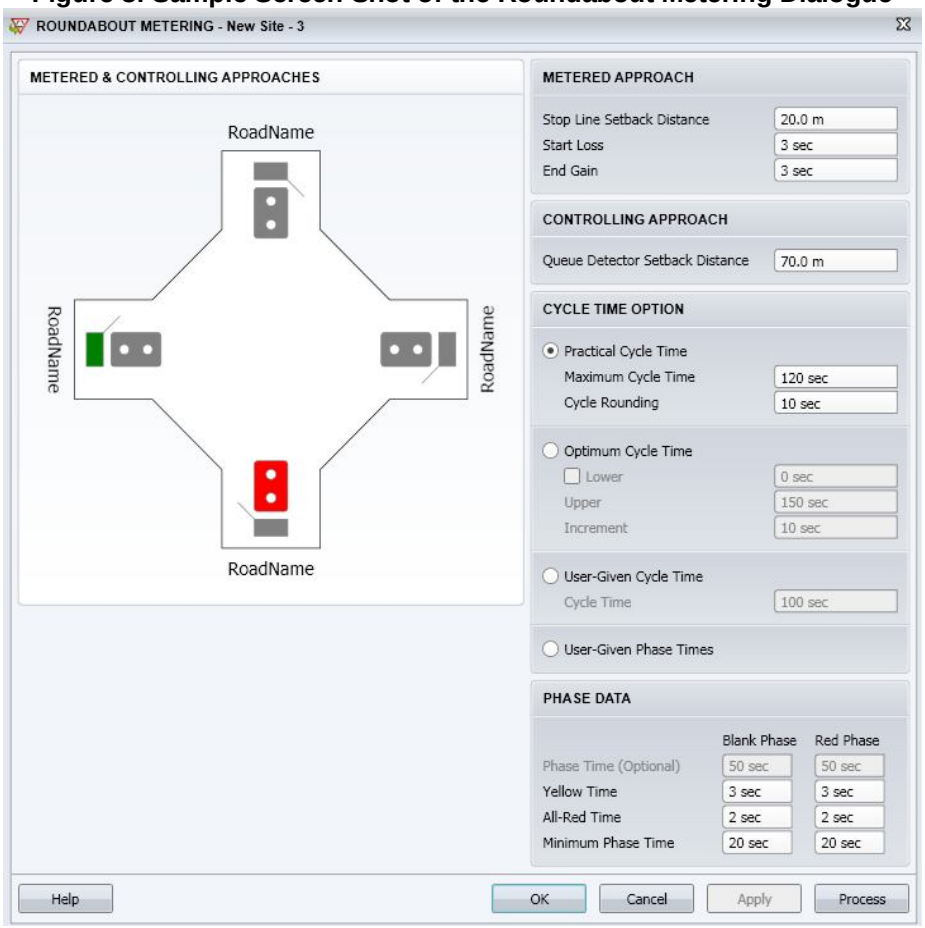
The phasing and Timing on signalised intersections can be altered to determine the most appropriate solution however if modelling the current condition of an existing intersection then the phasing and timing should be representative of that intersection (intersection surveys may be necessary if the appropriate data isn't available).

Default Yellow time of 4 sec and Red time of 2 sec applies if measured data is not available or applicable.

5.1.12 Roundabout Metering Dialogue

The roundabout metering dialogue can be altered to determine the most appropriate solution, however if modelling the current condition of an existing intersection the data used should be representative of that intersection (intersection surveys may be necessary if the appropriate data isn't available).

Figure 8: Sample Screen Shot of the Roundabout Metering Dialogue



5.2 Output

This section outlines the minimum performance levels and calibration requirements needed in order to achieve an acceptable solution.

5.2.1 Definitions

The following section clarifies the definition of particular output performance criteria.

- **95% Back of Queue Distance** – This value represents the storage length of a lane. This length forms part of the overall lane length.

5.2.2 Calibration

For existing intersections, a calibrated scenario is required to be set up before any future scenarios are explored. The calibration process is to be based on various traffic surveys and observations.

All changes required in order to calibrate the model are to be fully documented with an explanation and justification of the change. SIDRA User Guides should be referred to for possible calibration methods.

5.2.3 Acceptable Performance Criteria

The core performance elements that should be used to assess any intersection in SIDRA Intersection are the Practical Degree of Saturation and the Level of Service (LOS) (based on Delay). It should be noted that all other performance elements need to be assessed as they supplement the core criteria.

5.2.3.1 Degree of Saturation (DOS)

The Practical Degree of Saturation is a pass/fail performance indicator; therefore if the value is greater than the corresponding values provided in Table 7 for any lane, then the intersection is ***not*** acceptable (unless evidence can be provided of why the values should be changed).

Table 7: Practical Degree of Saturation Limits

Intersection Type	Maximum Practical Degree of Saturation
Signals	0.9
Roundabouts	0.85
Sign-Controlled	0.8
Continuous Lanes	0.98

5.2.3.2 Level of Service (LOS)

- The acceptable minimum LOS for each individual leg/lane is to be assessed as per the limits identified in Table 8 for Urban Roads and Table 9 for Rural Roads.
- The LOS will depend on the hierarchy of the intersecting roads.
- The delay criteria for each LOS has been identified in Table 10 (for vehicles) and Table 11 (for pedestrians).

- The leg with the highest LOS standard as identified in Table 8 (urban roads) and Table 9 (rural roads) is to be used as the overall intersection minimum acceptable Level of Service Target.

Table 8: Allowable Minimum LOS for each Leg based on the Road Hierarchy (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	Minor Collector	Access Street	Access Place
Minimum LOS per Leg	C	C	C	C	C	D	D	D	D	D

Table 9: Allowable Minimum LOS for each Leg based on the Road Hierarchy (Rural Roads)

Criterion	Arterial	Traffic Dsitributor	Minor Collector	Access Street
Minimum LOS per Leg	B	B	C	D

Table 10: Delay LOS Criteria

Level of Service	Control Delay per vehicle (s)		
	Signals	Roundabouts	Stop and Giveway/Yield signs
A	d ≤ 10	d ≤ 10	d ≤ 10
B	10 < d ≤ 20	10 < d ≤ 20	10 < d ≤ 15
C	20 < d ≤ 35	20 < d ≤ 35	15 < d ≤ 25
D	35 < d ≤ **55**	35 < d ≤ **50**	25 < d ≤ **35**
E	**55** < d ≤ 80	**50** < d ≤ 70	**35** < d ≤ 50
F	80 < d	70 < d	50 < d

Table 11: Pedestrian LOS Criteria

Level of Service	Average delay per pedestrian in seconds (d)		Likelihood of risk-taking behaviour
	Signals	Unsignalised Intersections	
A	d ≤ 10	d ≤ 5	Low
B	10 < d ≤ 20	5 < d ≤ 10	-
C	20 < d ≤ 30	10 < d ≤ 20	Moderate
D	30 < d ≤ **40**	20 < d ≤ **30**	-
E	**40** < d ≤ 60	**30** < d ≤ 45	High
F	60 < d	45 < d	Very High

6 Reporting Requirements

All SIDRA Intersection analysis reports are required to be completed or at least reviewed by a RPEQ member. The name, RPEQ number, signature of that member and an accompanying statement (example statement shown below) must be included in the final report.

The report must justify and explain the reasons for using or accepting any input or output values that differ from those identified in guideline.

The following list is a guide of the files, tables, diagrams required (at a minimum but not limited to) that should be reported for the analysis of an intersection in SIDRA Intersection.

- 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 (calibrated) and the proposed/ recommended future intersections:
  - Intersection Layout from SIDRA
  - Volume Summary from SIDRA

  - Input Report
- Outputs required only for the existing intersection (calibrated) and the proposed/recommended future intersections:
  - Intersection Summary
  - Movement Summary
  - Lane Summary
  - Phasing Summary (signalised intersection only)
  - Roundabout Metering (metered roundabouts only)
  - Other tables and figures from the Detailed Output as required for supporting evidence
- Draft design of all future intersections which shows the extent of alterations and the physical constraints present.
- All traffic counts and ancillary data used in the intersection assessment.

Example Accompanying Statement

I, Tom Smith, confirm that Matthew Jones has completed the modelling of intersections in this report. He has completed the Beginner and Intermediated SIDRA Intersection workshop in May 2010 by Akcelik and Associates Pty Ltd. The intersection analysed was of medium complexity, therefore in my opinion he was capable of completing the model build and analysis. I have also reviewed the analysis process and the contents of this report and authorise the release of this report to the intended audience.

Tom J Smith

Tom Smith
RPEQ# 99999