REPORT

Tonkin+Taylor

Waipa Ngahinapouri Concept Plan: Transportation Assessment

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Version 6 Amendments

This is an updated report following further information from Waipa District Council with regards to recent intersection construction projects of a similar nature to those options proposed.

Please take note that section 1.6 High-level Indicative Costs has changed as a result of this information.

As the result of the Stakeholder Engagement Meeting the following changes have also been made:

- The 'Elongated Roundabout' option has been removed, and subsequent options renumbered, as it was considered this option didn't add anything of significant difference to the other roundabout options.
- Table 1.14 has been updated due to an inconsistency noted between it and Table 1.13.
- A new table (Table 1.15) and some explanatory text has been added to help clarify safety issues surrounding the intersection crash rates.
- A new option (Option 6 – Three Leg Roundabout) has been added following engagement with the community group and landowners.

1 Ngahinapouri: Concept Plan

1.1 Structure Plan Areas

Figure 1.1: Approximate extents of the Ngahinapouri Concept Plan (image sourced from Google Earth)

The Concept Plan covers the area of Ngahinapouri around Reid Road, to the west of State Highway 39 (SH39) and on the western extents of Ngahinapouri village; this area is currently rural but zoned for future large-lot residential development.

This concept plan covers three growth areas previously identified by Waipa District Council, being N1, N2 and N3 as labelled in Figure 1.1 above, with access points anticipated as shown.

1.2 Existing Situation

1.2.1 Existing Transport Environment

Reid Road runs through the middle of the concept plan area, being the only existing road adjoined to N1 and N2, with N3 also adjoining SH39 on its eastern extents.

Ngahinapouri Road forms the eastern side of the crossroads between Reid Road and State Highway 39 and is an important rural distributor from Ngahinapouri.

Reid and Ngahinapouri Roads are considered to be Local Roads by the Waipa District Plan, with SH39 being a Major Arterial.

Both roads are generally consistent with a rural environment, and as such there are currently no cycling and minimal pedestrian facilities.

Table 1.1: Road Details (Existing)

Road Name	Total Width (m)	Lanes	Shoulder	Cycle Facilities	Footpaths	Posted Speed (km/hr)
Reid Road	5.5	2	None	None	None	70 – 100
SH39 (north Reid Road intersection)	12.2	2 + median	2x 2.5 m wide	None	Narrow short length on eastern side opposite school, and along western side north of school	70
SH39 (south Reid Road intersection)	7.5 – 10.0	2 (+ median between speed threshold and intersection)	2x 0.5 m wide (rural area, widening to intersection)	None	None	70 – 100
Ngahinapouri Road (to Gillard Road)	6.0	2	None	None	None	100

Note: Measurements are approximate only using aerial imagery

1.2.2 Crash History

The NZTA Crash Analysis System (CAS) was interrogated for the period 2009 to 2018 (inclusive) to provide crash data for the intersection of Reid Road, Ngahinapouri Road and SH39, as well as the length of Reid Road in front of the concept plan area and Ngahinapouri Road to the intersection with Gillard Road. Full CAS outputs can be found in Appendix A.

Fundamentally there have been no recorded injury crashes at this intersection. However, considering the type of crash involved failure to give way and turning conflicts, there is still an element of increased risk at this intersection.

Table 1.2: 10-Year Crash History

Road Name	Number of Crashes	Non-injury	Minor Injury (M)	Death or Serious (DSI)	Crash Injury Rate	Years
Reid Road	0	0	0	0	0.0	n/a
SH39 (intersection associated)	4	4	0	0	0.0	1x 2011 1x 2012 2x 2018
Ngahinapouri Road (to intersection with Gillard Road)	0	0	0	0	0.0	n/a

Note: For SH39, one crash was removed as it was an out of control crash which happened 150 m south of the intersection with Reid Road and deemed not to be associated with the intersection, while one 100 m north of the intersection was counted as it was a nose-to-tail due to queuing traffic and so could have been related to the intersection.

1.2.3 Current Crash Prediction

A high-level Crash Prediction Model was put together for the existing situation on those roads assessed, using the methods and formulae found in NZTA's Crash Estimation Compendium (2016, Updated June 2018).

For this assessment, SH39 was assessed as an urban mid-block (70 km/hr or less) plus an urban cross-road intersection, as per section 2.1.1: Methodology by site and crash type, of the Crash Estimation Compendium.

Reid and Ngahinapouri Roads were assessed as rural mid-block (80 km/hr plus) not including the intersection as this is already accounted for with SH39.

Table 1.3: Crash Model Results (Existing Annual Rate)

Road Name	Predicted Injury Crash Rate (existing)	Recorded Injury Crash Rate	Differential: Predicted to Actual	Differential Rate
Reid Road	0.02	0.0	-0.02	-100%
SH39	0.17	0.0	-0.17	-100%
Ngahinapouri Road (to intersection with Gillard Road)	0.06	0.0	-0.06	-100%

Over the last ten years, all three intersections have experienced a lower injury crash rate than the calculated statistical norm for this type of intersection in this environment.

It is noted that SH39 intersection does not feature on NZTA's published high risk intersections listing, and is therefore not programmed for any investigations or works. However, there does appear to be a possible underlying issue with this intersection (predominantly failure to give way) which results in slightly elevated risk environment.

1.2.4 Current Road Safety

The existing road network is that of a rural village, with urbanised 70 km/h speed limits along its main road, in this case SH39, and open road speed limits taking over on side roads. There is a

footpath on the western side of SH39, north of the school behind kerb and channel, but open drains on the east (except directly opposite the school). There are no cycle facilities other than a sealed shoulder.

Outside the school there is one refuge island on the State Highway to connect to the section of footpath on the opposite side, which we understand is a dedicated link to the bus stop only. Given the relatively high speed environment, we consider this presents an elevated risk to pedestrians, especially during the hours of darkness as no dedicated crossing lighting is apparent.

However, the crash record (refer Appendix A) reveals there are no recorded accidents involving pedestrians or cyclists, and none that caused injury to any party.

This suggests that the level of risk for road users in Ngahinapouri appears to be no worse than any other rural community on a State Highway. This is likely to be because, to regular users, the level of perceived risk is greater than the actual risk, resulting in a more cautious approach to crossing. It does not account for changes in population or traffic volumes which will increase the level of exposure and therefore increase the risk of conflict.

1.2.5 Current Travel Patterns

No traffic survey has been undertaken, however using recognised industry practise and existing data from the Road Assessment and Maintenance Management database (RAMM) we can infer likely peak travel patterns.

This data was extracted from *"Mobileroad.org"*, which is populated using Road Controlling Authority (RCA) RAMM data. This data is maintained by the RCA (in this case NZTA for SH39, and Waipa District Council for Reid and Ngahinapouri Roads) for tracking and forecasting maintenance activities on their respective networks. It was noted that the traffic count numbers were all identified as estimates and so we cannot guarantee the accuracy of the data.

The key RAMM data used in this assessment is as follows:

Table 1.4: Assumed Traffic Volumes from RAMM Data

Road Name	Average Daily Traffic (ADT) (veh/day)	Date of Count / Estimate	Heavy Vehicles (%)
Reid Road	280	1/12/2016	0
SH39	7,472	25/12/2017	12
Ngahinapouri Road	870	1/12/2016	0

Note: All data obtained from "MobileRoad.org", 2-way traffic reported.

The attractors for determining travel patterns are considered to be as follows:

Table 1.5: Attractors and Type

Attractor Name	Approximate Distance from T6	Attractor Type	Attractions
Hamilton	15 km	Primary Attractor	· Largest population centre within 0.5 hrs travel · Large employment area · Nearest schools above primary · Large retail bases, including niche shops and large supermarkets · Recreational facilities
Pirongia	12 km	Secondary Attractor	· Nearest shops · Employment
Te Awamutu	18 km	Secondary Attractor	· Employment · Shopping · Schools
Local Rural Areas	1 km plus	Secondary Attractor	· Employment · Outdoor Recreation

From these assumptions we can reasonably assume that the majority of traffic will travel north and east (various routes to Hamilton and some rural areas), with the rest travelling south; and return from those same directions in similar proportions.

Westbound traffic moving away from this area (i.e. along Reid Road) is less likely as there are very few businesses in that direction, and the road network is local to Ngahinapouri, looping back around to connect again with SH39 both to the north and south of the village, which makes it more efficient to join the State Highway at the Reid Road intersection.

1.2.6 Public Transport

There are currently no bus routes, or other method of public transport servicing Ngahinapouri, with no immediate plans by Waikato Regional Council to fund such a service. Although a limited number of school buses operate services taking students from Ngahinapouri to Hamilton.

1.2.7 Other Modes

Currently for local trips to the school and sports facilities, it is possible that cycling and walking will be used by children, recreational users, and those with no access to, or choose not to use, a private vehicle.

However, we consider that the majority of trips are likely to be private vehicle-based regardless of the distance to travel, for example children being dropped off by parents on the way to work.

1.3 Proposed Situation

Figure 1.2: Proposed Ngahinapouri Concept Plan road network (source Boffa Miskell)

The proposed development area is intended to be a mixture of various lot sizes of essentially low density residential, ranging from 3,000 m^2 to 10,000 m^2.

At the time of writing, the current plan developed for Ngahinapouri results in an estimated lot yield for the new area of between 200 and 210 lots.

1.3.1 Proposed Road Network

1.3.1.1 Overview

The proposed road network is designed to provide good connectivity both to and within the land parcel, providing good traffic amenity as well as retaining the potential for future in-fill subdivision without the need for additional public road infrastructure.

The primary accesses from these growth areas occur at three points along Reid Road, the northern areas having two, and the southern area having one, despite accounting for the largest land area; this is not considered an issue, as the likely lot generation, and therefore traffic generation, is not high enough to cause an impediment to exiting onto Reid Road.

At the time of writing, there is a commercial area provided for on the south-western corner of the Reid Road / SH39 intersection; when developing this commercial area, it is key that no motorised vehicle inter-connectivity is allowed between the southern growth area (N3) and either Reid Road or SH39, as this would provide a means of egress for properties along the eastern side of this growth area and allow that area to be used in an unintended manner by through-traffic.

Reid Road provides primary access to SH39, and from there to the wider State Highway and local road networks, and it is anticipated the vast majority of vehicles will head in this direction due to the circular nature of travelling west along Reid Road.

1.3.1.2 Existing Road Upgrades

We consider the following improvements to the local roading network are necessary to provide continuous safe and efficient access. Especially those routes providing connectivity to new growth areas and the existing (and future) amenities. The proposal recommends appropriate upgrades which enhance the urban nature and slow vehicle speeds by providing positive calming measures.

Reid Road

Reid Road effectively becomes a Collector Road (according to the District Plan) however, considering the relatively modest volumes of traffic, the local road standard should be sufficient.

Currently Reid Road does not meet this standard and should be widened to a minimum of 7.0 m (two 3 m wide traffic lanes and 0.5 m shoulders) for its length from SH39 intersection to the intersection with new road N2. Consideration should be given to providing 1.5 m shoulders that will also serve as cycle ways, or some other cycle amenity.

Along the widened length of Reid Road, within the urbanised area, we recommend the provision of minimum 1.5 m wide footpaths on both sides of the road together with a 50 km/h speed limit, or 2.5 m shared paths if a wider shoulder is not to be provided.

Traffic calming in the form of gateway thresholds, vertical “visual narrowing’ and potentially localised physical narrowing (to 5.0 m) with raised platforms should also be considered to tie in with urban design elements and preferred pedestrian crossing positions.

New Roads

New roads N1 to 3 should be developed as residential local roads given the housing density and proposed “urbanised” look and feel of the area. According to the District Plan the minimum width should be 6.0 m, with 1.5 m shoulder on either side to allow for cycling, and 1.5 m wide footpaths.

Following consultation, and from comments within Waipa DC, it is evident the desired arrangement would be 7.0 m road area total with a 2.5 m minimum width shared path to enable safer travel for children to school, who are the expected primary cyclists in this area.

Intersections should be a traditional priority-controlled T (Give way).

SH39

SH39 will require improvements to footpaths between Reid Road and at least Holmwood Drive, to provide safe pedestrian access to the school and other amenities, with some consideration given to rationalisation of direct access to the State Highway. Improved lighting for the pedestrian crossing is also recommended.

SH39/Reid Road intersection will require some form of improvement in future years and this is discussed further in section 1.4.2.

1.3.2 Proposed Pedestrian and Cycling Links

The new growth areas are designed to encourage cycling and pedestrian facilities, with links alongside public roads as well as through existing and new recreational areas within Ngahinapouri.

As well as providing walking and cycling facilities along Reid Road and new development roads, consideration should be given to providing direct pedestrian and cyclist access to Duncan Road and Holmwood Drive if possible.

1.4 Modelling Assessments

1.4.1 Trip Distribution

Using the attractors as a guide (see section 1.2), the traffic flow has been proportionally split based on the most popular routes and likely destinations, this has been applied at each connection to the road network to develop a high level "model" of the predicted travel patterns at each intersection, compounding to the SH39 intersection.

This provides an assumed traffic pattern and turning flows to inform any high level intersection models which in turn give an indication on current performance and level of deterioration associated with the change in land use.

1.4.1.1 Modelling Basis

The following assumptions were used in calculating flows for intersection modelling:

- The ADT data was pro-rated to a Base Year of 2018 using a 2% per annum average.
- A Projected Year of 2035 using a 2% per annum average was also used; 2035 was chosen as this is the latest year this growth area is expected to be fully developed by.
- The average daily peaks will be 10% of the ADT.
- The flows on any one road are split 70/30 for direction based on the time of day and direction of attractors (i.e. 70% AM towards attractors, 70% PM away from attractors).
- Due to the lack of options for vehicles exiting the growth areas turning west, traffic out of these three access points are assumed to be 90% heading east (towards SH39) and 10% heading west.
- Where Heavy Traffic is 'Unknown' it is assumed to be 1%.

1.4.1.2 Model Limitations

It is important to note that, due to the high level of this assessment, no verification can be provided and results are determined from engineering judgement and available information.

1.4.1.3 Development Traffic Generation

Traffic growth within road networks is almost entirely due to land use changes and development growth. As this is a conceptual proposal, we have taken a more conservative approach and compounded the underlying traffic growth (2% per annum) with the predicted trip generation from the development.

Two development scenarios have been considered:

1 Low Development: A scenario whereby the lot yield as presented in the Concept Plan was used to determine additional traffic flow.

2 High Development: A scenario whereby the lot yield was doubled when compared to that in the Concept Plan, to account for a worst-case scenario of smaller lot types and future in-fill development.

The daily trip generation per lot was assumed to be 10 veh/day which is generally considered to be appropriate for housing.

Table 1.6: Trip Generation

Scenario	vpd	Peak Vph
Low Density	2,000	200
High Density	4,000	400

1.4.2 Intersection Modelling

Given the low increase in peak hour traffic on the Reid Road access roads N1, N2, and N3, it is not strictly necessary to carry out exhaustive modelling. For clarity a typical scenario has been calculated using the worst-case assumption (i.e. Road N3 where we have determined a flow range between 120 and 240 vehicles per hour). Even in the most conservative scenario a level of service of A is achieved therefore we consider that the proposed development can be accommodated within Reid road with no detriment to efficiency.

The Intersection with SH39 requires a higher degree of scrutiny with a potential peak traffic increase of almost 400 vehicles in future years. We have carried out limited modelling using Sidra software to provide an understanding of the current and proposed scenarios and to evaluate suggested improvement options. Further details of the modelling undertaken are in Appendix B.

1.4.2.1 SH39 Current Alignment (Option 1: Do Nothing (except local road upgrade))

This covers both the existing situation now and with appropriate growth to 2035 as baselines, and the Do Minimum situation for development (i.e. no change to intersection despite development).

The following tables summarise the LoS findings for each leg / lane by scenario for quick reference. Summaries of the modelling reports can be found in Appendix B.

Table 1.7: AM Peaks

Scenario	SH39 North		SH39 South		Reid Road	Ngahinapouri Road
	Through Lane	Right Turn Bay	Through Lane	Right Turn Bay		
2018 (no dev)	A	A	A	A	B	C
2018 + LD	A	A	A	A	C	D
2018 + HD	A	A	A	A	C	D
2035 (no dev)	A	A	A	A	C	E
2035 + LD	A	A	A	A	D	F
2035 + HD	A	A	A	A	F	F

Table 1.8: PM Peaks

Scenario	SH39 North		SH39 South		Reid Road	Ngahinapouri Road
	Through Lane	Right Turn Bay	Through Lane	Right Turn Bay		
2018 (no dev)	A	A	A	A	B	C
2018 + LD	A	A	A	A	B	C
2018 + HD	A	A	A	A	B	C
2035 (no dev)	A	A	A	A	C	D
2035 + LD	A	A	A	A	C	E
2035 + HD	A	A	A	A	C	E

These results indicate that, for both AM and PM peaks, the existing intersection is operating acceptably at current traffic levels, and the natural increase in traffic levels to 2035.

In future years there will be an erosion of performance and increased waiting times for drivers exiting Reid Road and Ngahinapouri Road, which will be exacerbated by the increase in traffic from development areas. This is likely to create peak hour frustration for drivers and increase the potential for drivers to take an inappropriate course of action.

On this basis, we recommend a material change to the alignment of the intersection to reduce side road delays as a result of the development. The following sections provide a high level evaluation of the options considered:

- Option 2 Staggered Intersection: Re-align Reid Road to the south to offset the minor roads from one another.
- Option 3 – Traffic Signals: Re-configure the existing cross-roads layout to provide traffic signal phasing for all directions.
- Option 4 and 5 – Standard and Offset Roundabout: Re-configure the existing cross-roads layout to provide a roundabout arrangement.
- Option 6 – Three Leg Roundabout: Provide a three leg roundabout arrangement at a new intersection at least 200m south of the current crossroads, and remove the Reid Road leg from the crossroads turning the State Highway into a T-intersection with Ngahinapouri Road.

Considering that the highest level of impact occurs during the morning peak, as drivers attempt to exit Reid Road/the proposed development area, we have only reported on the changes in LoS for that period for option assessment purposes.

1.4.2.2 Option 2 Staggered Intersection

Table 1.9: AM Peaks, Option 1 – Staggered Intersection

Scenario	SH39 North		SH39 South		Reid Road	Ngahinapouri Road
	Through Lane	Right Turn Bay	Through Lane	Right Turn Bay		
2018 + LD	A	A	A	A	B	C
2018 + HD	A	A	A	A	C	C
2035 + LD	A	B	A	A	C	E
2035 + HD	A	B	A	A	D	E

These results indicate that this intersection operates more efficiently than the existing cross-roads. However, there are still long delays for vehicles on Ngahinapouri Road.

1.4.2.3 Option 3 – Traffic Signals

Table 1.10: AM Peaks, Option 2 – Traffic Signals

Scenario	SH39 North		SH39 South		Reid Road	Ngahinapouri Road
	Through Lane	Right Turn Bay	Through Lane	Right Turn Bay		
2018 + LD	A	B	B	B	B	B
2018 + HD	A	B	B	B	C	B
2035 + LD	A	B	B	B	C	C
2035 + HD	A	B	B	B	C	C

These results indicate that this intersection operates more efficiently than the existing cross-roads for side roads although, as expected, there is a slight deterioration in performance for SH39. Whilst traffic signals would provide a significant enhancement for pedestrian safety, fundamentally the installation of an isolated controlled intersection in a rural high-speed environment is more likely to create problems with failure to stop and rear end crashes.

1.4.2.4 Options 4 and 5 – Standard and Offset Roundabouts

From a traffic flow perspective, all four leg roundabout options operate in the same manner and the choices between the two depend on other comparative advantages and disadvantages such as land purchasing costs.

Table 1.11: AM Peaks, Options 3 to 5 – Standard and Offset Roundabouts

Scenario	SH39 North	SH39 South	Reid Road	Ngahinapouri Road
2018 + LD	A	A	A	A
2018 + HD	A	A	A	A
2035 + LD	A	A	B	B
2035 + HD	A	A	B	B

The results indicate that the intersection operates more efficiently than the existing cross-roads, and maintains acceptable levels of service beyond 2035. There is little or no detriment to the efficiency of SH39 and significant benefits to both Ngahinapouri Road and Reid Road. Whilst there are potential risks associated with a rural roundabout, the traffic calming effect would be a benefit to the township.

1.4.2.5 Option 6 – Three Leg Roundabout

From a traffic flow perspective, all roundabout options operate in the same manner and the choices between the three depend on other comparative advantages and disadvantages such as land purchasing costs. In the case of the three leg roundabout, it also inherits some of the effects of the Option 2: Staggered Intersection arrangement.

Table 1.12: AM Peaks, Option 6 – Three Leg Roundabout

Scenario	SH39 North		SH39 South	Development Road	Ngahinapouri Road
	Through Lane	Right Turn Bay			
2018 + LD	A	A	A	A	C
2018 + HD	A	A	A	A	C
2035 + LD	A	A	A	A	E
2035 + HD	A	A	A	A	E

The results indicate that this modified staggered intersection with a three leg roundabout on the southern approach combines some of the efficiencies found in each of the staggered intersection and roundabout options, which is to say operating more efficiently than the existing cross-roads, and maintaining acceptable levels of service beyond 2035. There is little or no detriment to the efficiency of SH39, increased serviceability for the development, and some benefit to Ngahinapouri Road (though not as great as a roundabout at this location).

Note that the LoS E issues on Ngahinapouri Road could be mitigated by having the option to turn left and then U-turn around the roundabout at peak times; this possibility has not been modelled at this time, as it is unclear what the uptake is likely to be.

1.4.3 Crash Prediction Modelling

The crash prediction model (see section 1.2.3) has been updated using the predicted trip generation as follows:

Table 1.13: Crash Model Results (Combined Annual Rates)

Road Name	Predicted Injury Crash Rate (current)	Predicted Injury Crash Rate (existing + LD)	Predicted Injury Crash Rate (2035 only)	Predicted Injury Crash Rate (2035 + HD)
Reid Road	0.02	0.13	0.02	0.25
SH39	0.17	0.18	0.21	0.37
Ngahinapouri Road (to intersection with Gillard Road)	0.06	0.07	0.08	0.09

This indicates that, predicted injury crash rate will increase with the increase in traffic volumes, with the exception of Ngahinapouri Road where traffic growth remains relatively minor.

It also shows an increase in expected injury crashes as development increases, which is expected given the additional volume of traffic on each road in addition to the new flows from the development.

Noting that these results assume no change to the existing road or intersection arrangements, further assessment was undertaken for the option types and is presented below:

Table 1.14: Crash Model Results (SH39 Intersection Changes)

Scenario	Predicted Injury Crash Rate (2035)	Predicted Injury Crash Rate (2035 + development)
Do Nothing	0.21	0.37
Staggered Intersection		0.59
Traffic Signals		0.61
Standard and Offset Roundabouts		0.36
Three Leg Roundabout		0.34

This comparison indicates that, of the options under consideration, a roundabout is likely to have the lowest injury crash rates (based on NZTA's prediction formula).

These results suggest the difference between a crossroads style intersection (the existing 'Do Nothing' situation) and a roundabout is similar in injury crash rates. Experience suggests that this may be true, however severity of those injury crashes is likely to be much lower; this is supported by statistical results on severity from the High-risk Intersection Guide (NZTA, 2013) summarised below:

Table 1.15: Typical rural intersection crash severity rates

Intersection Type	Severity Rate
Do Nothing (Crossroads)	0.39
Staggered Intersection	0.37
Traffic Signals	0.22
Roundabout	0.16

1.5 Impact Assessment

The development potential, as presented in this plan, is expected to generate approximately 2,000 veh/day, with a conservative future vehicle generation of 4,000 veh/day (should future subdivision be permitted).

This will increase the traffic movements on the local roads and SH39, especially during peak travel times. However, modelling indicates that the existing road network is largely unaffected by this. The SH39 intersection will remain largely unaffected until 2035 when some form of intervention will be necessary to counter the increased delays from side road turning traffic.

The assessment of traffic growth shows that the risks of an injury crash also increase with this elevated level of exposure, with the SH39 intersection being the worst effected with a potential doubling of risk from its current levels.

On this basis we recommend a future improvement to the intersection which effectively deals with the safety and efficiency risks.

1.5.1 SH39 Intersection Options

As indicated in the previous section, at some point before 2035 the intersection of Reid Road, SH39 and Ngahinapouri Road will require upgrading to cater for traffic volumes and improve safety.

The options being considered were identified in detail in modelling section 1.4.2, and are as follows:

- Option 1 – Do nothing
- Option 2 – Staggered Intersection
- Option 3 – Traffic Signals
- Option 4 – Traditional Roundabout
- Option 5 – Offset Roundabout
- Option 6 – Three Leg Roundabout

The following table summarises the findings from the assessment and high level modelling:

Table 1.16: SH39 Combined Assessment Results for 2035 (with development)

Road Name	Predicted Injury Crash Rate HD)	Worst LoS for Intersection Type
Do Nothing	0.37	F
Staggered Intersection	0.59	E
Traffic Signals	0.61	C
4-leg Roundabout	0.36	B
Three Leg Roundabout	0.34	E

This comparison shows that, in a worst-case scenario of normal traffic growth of 2% per annum to 2035 added to a higher density development scenario, the best performing intersection option overall would be one of the four leg roundabout options, though a three leg roundabout arrangement has slightly lower crash risk, and as noted later there are possibilities the LoS for this option may be better in reality than indicated.

A more detailed option assessment of each option is presented in Table 1.17 below:

Table 1.17: Intersection Option Considerations

Option	Advantages	Disadvantages
Option 1 Do Nothing	· Familiar layout for users · Forces a stop at the intersection for side-road users · No cost implications	· Run-through risks for side-roads, resulting impacts at high speeds · Four movements (Right and Ahead for each side-road) must find gaps in two lanes of relatively fast moving traffic (70 km/hr) against one another · Carry-through speed on SH39 expected to be higher than posted limit · Increased crash risk in the future
Option 2 Staggered Intersection	· Familiar layout for users · Forces a stop at the intersection for side-road users · Increases traffic flow efficiency of intersection as a whole · Run-through less likely as no road directly opposite · Traffic on Reid Road slowed by corners on re-alignment · Two conflicting movements removed (Ahead for each side-road)	· While less likely, any run-through still occurs at high speed · Two movements (Right for each side-road) must find gaps in two lanes of relatively fast moving traffic (70 km/hr) · Two Ahead movements are added to those needing to turn right off the State Highway (SH), increasing SH queue lengths · Right turning queues are back-to-back, which could cause queuing in the SH through-lanes at peak times · Carry-through speed on SH39 expected to be higher than posted limit · Predicted injury-crash frequency much higher than some other options · Requires land and considerable road realignment of Reid Road
Option 3 Traffic Signals	· Should cause traffic to slow down from all directions, anticipating lights changing · Increases traffic flow efficiency of side-roads · Conflicting movements managed (reduced human error) · Pedestrian crossing of roads is significantly improved	· Not a typical rural intersection control, likely to be “unexpected” for most road users · Run-through risks for side-roads, resulting impacts at high speeds · Out of context for environment, and difficult to effectively sign for, so will be unexpected for SH users · Possible lack of compliance during quiet periods · Reduces traffic flow efficiency of SH traffic flows · Predicted injury-crash frequency much higher than all other options · High cost option with ongoing maintenance liability

Option	Advantages	Disadvantages
Option 4 Traditional Roundabout	· Familiar layout for users · Traffic forced to give-way from all directions · Increases traffic flow efficiency of intersection as a whole · Run-through less likely as roundabout blocks line of sight · Impact speeds much lower · Predicted injury-crash frequency lower than all other options · Six conflicting movements removed (Ahead for each side-road, Right for all approaches) as every movement is effectively a left-turn · Splitter islands on lead ins can be used as pedestrian refuges	· Run-through still a potential risk, but reduced · In order to allow truck movements common on SH39, roundabout will need to have wide circulating lanes and/or be a reasonably large diameter · No obligation to come to a complete stop · Reduces through traffic efficiency, side road peak traffic demand could take precedence over SH through traffic in certain circumstances · Higher risk for on-road cyclists due to having to merge with the live traffic stream on approach · Land required due to large footprint
Option 5 Offset Roundabout	· Effectively the same as Option 4 · Offset roundabout will improve deflection and visibility of intersection · Possible advantages in land acquisition	· As Option 4
Option 6 Three Leg Roundabout	· The roundabout leg will have many of the same advantages as Option 4 · The Ngahinapouri Road intersection will share the following advantages with the Staggered Intersection: o Forces a stop at the intersection for side-road users o Increases traffic flow efficiency of intersection as a whole o Run-through less likely as no road directly opposite · Advantages of the combined arrangement include: o Reduce speed on southern approach to Ngahinapouri Road intersection due to the slowing effect of the roundabout o Some land and road realignment issues may be mitigated my landowner buy-in o Right turning issues from Ngahinapouri Road onto SH39 could be mitigated by having the option to left turn and then U-turn at the roundabout	· As Option 4, and in addition the following from the Staggered Intersection: o Queues from right turning could back up to the roundabout at peak times o Right turning from Ngahinapouri Road is still problematic o Requires land and considerable road realignment

These considerations are predominantly related to efficiency and safety and are to offer a high-level differentiation between options.

1.6 High-level Indicative Costs

Note: This section has been updated following further information from Waipa District Council with regards to recent intersection construction projects of a similar nature to those options proposed.

Given that the majority of road construction costs will be borne by developers, only a high-level cost estimate has been produced for the concept area, specifically targeting the SH39 intersection and the upgrade of Reid Road. The high-level cost estimate will need to be refined at concept and detailed design stage, and will need to also consider aspects around services and/or service relocation.

Table 1.18: High-level Cost Summary by Option

	Option 1: Do Nothing	Option 2	Option 3	Option 4	Option 5	Option 6*
Option construction estimate	$0	$1.50M	$1.50M	$2.50M	$3.15M	$2.50M
Reid Road upgrade construction costs	$1.85M	$1.30M	$1.85M	$1.85M	$1.55M	$1.60M
Preliminary and General estimate (15% of construction)	$0.30M	$0.40M	$0.50M	$0.65M	$0.70M	$0.60M
Design Fee estimate (10% of contract)	$0.20M	$0.30M	$0.35M	$0.45M	$0.50M	$0.40M
Land Purchase estimate	$0	$0.35M	$0.00M	$0.15m	$0.65M	$0.35M
Subtotal:	$2.35M	$3.85M	$4.20M	$5.60M	$6.55M	$5.45M
Contingency (60% of subtotal)	$1.40M	$2.30M	$2.50M	$3.35M	$3.90M	$3.30M
Budget Provision	$3.75M	$6.15M	$6.70M	$8.95M	$10.45M	$8.75M

**Note: It has been assumed council will not be financially responsible for the development connecting roads between Reid Road and the Three Leg Roundabout*

This high-level cost estimate is on the following basis:

- Construction estimates are based on figures obtained for similar projects from Waipa District Council.
- No escalation has been allowed for, these figures are based on 2019 prices.
- No design has been undertaken prior to this estimate, figures are derived from a comparative analysis of other similar works.
- The typical cross section used for Reid Road was based on a "Rural and Large Lot Zone" Collector type road from the Waipa District Plan, with an allowance for a separate pedestrian and cycle shared path.
- Reid Road is upgraded for the full length of the development frontage (approx. 1.1 km), except where a realignment is happening (assumed re-alignment will be built to the same standard and included intersection upgrade costs).
- A nominal earthworks quantity was assumed based on the road upgrade following the existing vertical alignment with no undercutting for poor ground conditions considered.
- No landscaping, beautification or other enhancement has been assumed (i.e.: grassed berms only).
- No minor roads are included for upgrade or construction.
- Preliminary and General is assumed at 15%.
- Professional fees associated with the design, consenting and construction observation have been included at 10% of the overall physical works costs, based on previous similar projects on the State Highway and Waipa local road networks.

- We have allowed a 60% contingency due to the level of uncertainty around ground conditions and services.

Land costs are based on concept design land take areas only, supplied by Boffa Miskell, and derived using the valuations given on Waipa District Council's online rates database for 2016 (3 years old), as shown in Table 1.19. We strongly suggest that a qualified land valuer is engaged to assess the market value of the land parcels to provide an appropriate budget provision.

Table 1.19: Land cost workings

Property	Land Area (m2)	Land value (last RV)	Date of last RV
29 Reid Road (south-west corner)	5,978	$275,000	1/08/2016
1189 Kakaramea Road (school - north-west corner)	2,000	$180,000	1/08/2016
1182 Kakaramea Road (north-east, tiny corner property)	1,162	$138,000	1/08/2016
1146 Kakaramea Road (south-east corner)	676,860	$3,070,000	1/08/2016

2 Conclusion

The traffic generated through the proposal can be accommodated within the existing road network in the short term with only minimal impact on the operation of SH39, Reid Road and Ngahinapouri Road. (i.e.: increase in delays by approximately 5 seconds and increasing the risk of injury crashes rom approximately one every 4 years to approximately one every 3 years).

In a worst-case scenario the expected traffic generation can also be accommodated by the road network with some improvements to the SH39 intersection (over a minute in additional delay in 2035, and a doubling of injury crash risk from approximately one every 3 years to 2 every 3 years).

Within 15 years or so we anticipate that SH39 intersection will require improvement to accommodate the predicted underlying (normal) traffic growth, this is further impacted by the additional traffic anticipated from development of the structure plan areas. Based on this high-level assessment, we consider that a roundabout in some form is likely to provide the most appropriate solution both in the immediate future and in the long term.

With that in mind the three leg roundabout option is more cost efficient whilst being comparable in safety terms, and seems likely to be approved by the community. It is recommended this option be carefully considered in terms of efficiency at Ngahinapouri Road, and if the results are acceptable to council adopted as the preferred option.

It should be noted that, if the three leg roundabout option is chosen, the roundabout construction may have to be brought forward to coincide with development plans to avoid having a period of time with a de-facto Option 2: Staggered Intersection scenario, being the worst of the options for both efficiency and safety.

With any of the above options, Reid Road will require widening to accommodate the increase in local traffic, with associated traffic calming and improvements to walking and cycling facilities.

3 Recommendations

Based on our analysis, we recommend the following actions for further consideration:

1 Reid Road widening to 7.0 m and include cycle and pedestrian facilities (ideally a shared path rather than on-road) to enable connectivity with existing and future village amenities.

2 Any paths should also be extended along SH39 to connect the village and the existing path on the western side to the north of the school.

3 Consideration should be given to relocation of the school bus-stop on the eastern side of SH39 to a position off the State Highway, to eliminate the risk to students crossing the high-speed road. In lieu of moving the bus stop, a better facility for crossing the State Highway should be provided, and appropriately lit.

4 Inter-connectivity between the main roads (SH39 and Reid Road) and the residential roads should be avoided when the proposed commercial area is developed.

5 More detailed modelling and assessment, including survey of traffic volumes and turning count data, should be conducted to inform and verify the preferred design option.

4 Applicability

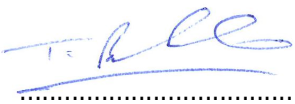
This report has been prepared by Tonkin & Taylor Limited (T+T) for Boffa Miskell Ltd pursuant to the terms of engagement (Contract) between T+T and Boffa Miskell Ltd in relation to the Ngahinapouri Village Concept Plan project.

T+T agrees this report may also be used by Waipa District Council (WDC) for the purposes set out in, or able to be reasonably inferred from, the Contract, on the basis that the aggregate liability of T+T to Boffa Miskell Ltd and WDC in respect of any such use or reliance is subject to the limitations and exclusions of liability set out in the Contract.

This report may not be relied upon in other contexts or for any other purpose, or by any person other than Boffa Miskell Ltd and WDC, without T+T's prior written agreement.

Tonkin & Taylor Ltd

Report prepared by:



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Timothy Broadhead

Transportation Engineer

Authorised for Tonkin & Taylor Ltd by:

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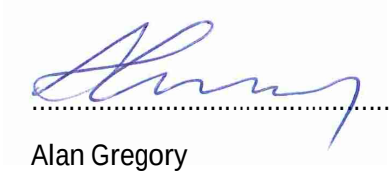
Glen Nicholson

Project Director

Reviewed by:



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Alan Gregory

Principal Transport Planner

TIBR
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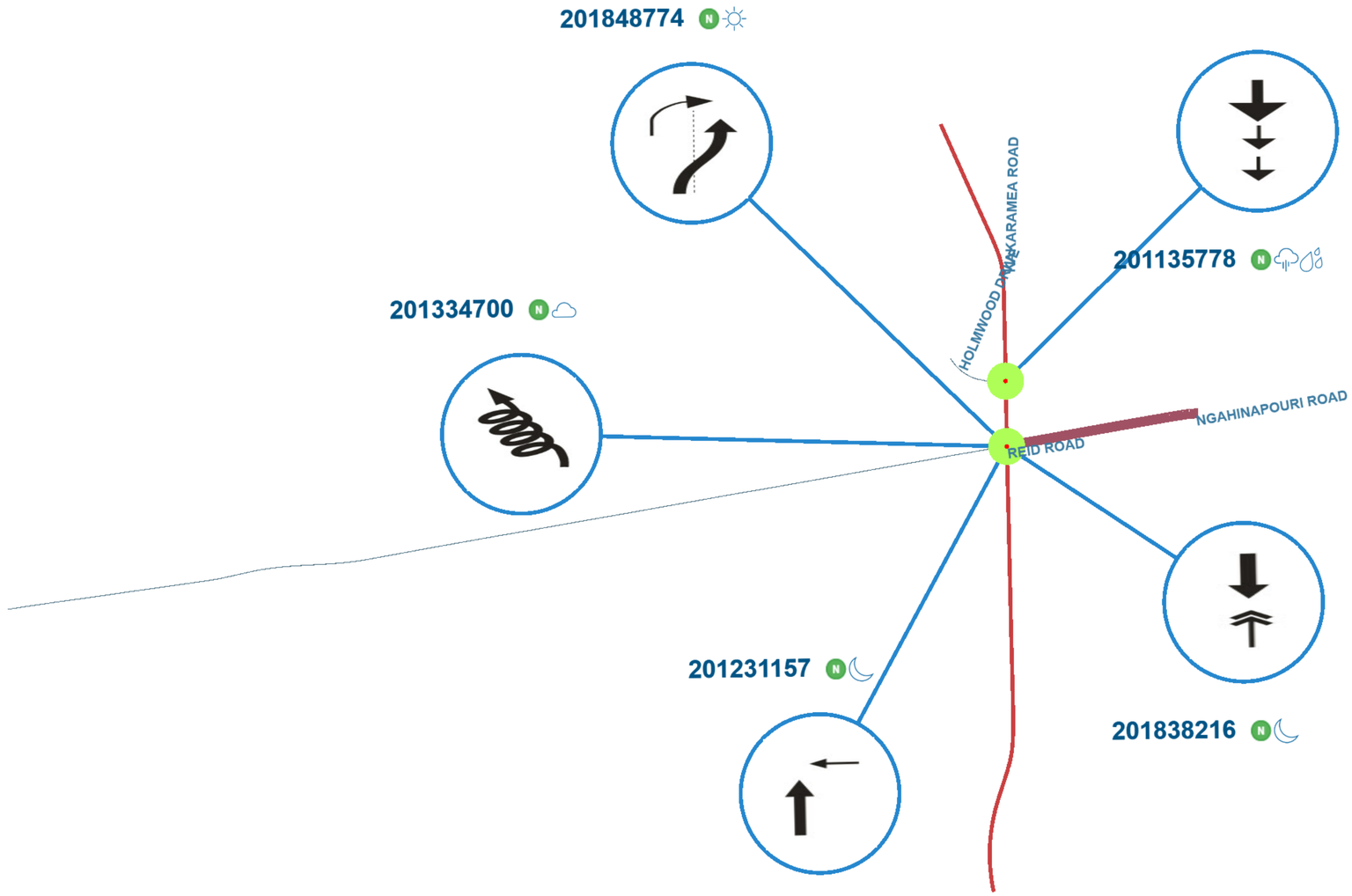
Appendix A: CAS Outputs



Untitled query

Saved sites

Reid-SH3

Crash year

2009 — 2019

Plain English report

5 results from your query.

1-5 of 5

Crash road	Distance	Direction	Side road	ID	Date	Day of week	Time	Description of events	Crash factors	Surface condition	Natural light	Weather	Junction	Control	Crash count fatal	Crash count severe	Crash count minor
SH 39		I	NGAHINAPOURI ROAD	201848774	21/09/2018	Fri	08:05	Car/Wagon1 NDB on Kakaramea Road overtaking hit Car/Wagon2 NDB on Kakaramea Road turning right	CAR/WAGON2, alcohol test below limit	Dry	Bright sun	Fine	Crossroads	Stop	0	0	0
SH 39		I	NGAHINAPOURI ROAD	201231157	02/05/2012	Wed	19:37	Car/Wagon1 NDB on SH 39 hit Car/Wagon2 crossing at right angle from right	CAR/WAGON1, alcohol suspected CAR/WAGON2, did not check/notice another party from other dirn, failed to give way at priority traffic control	Dry	Dark	Fine	Crossroads	Stop	0	0	0
SH 39		I	NGAHINAPOURI ROAD	201838216	15/02/2018	Thu	03:09	Car/Wagon1 SDB on Kakaramea road hit Car/Wagon2 reversing along road	CAR/WAGON2, alcohol test below limit, evading enforcement, intentional collision	Dry	Dark	Fine	T Junction	Stop	0	0	0
SH 39	100m	N	NGAHINAPOURI ROAD	201135778	24/06/2011	Fri	16:15	Car/Wagon1 SDB on SH 39 hit rear end of Car/Wagon2 stop/slow for queue	CAR/WAGON1, following too closely, ENV: slippery road due to rain	Wet	Twilight	Light rain	Nil (Default)	Unknown	0	0	0
SH 39	150m	S	REID ROAD	201334700	05/06/2013	Wed	16:34	Car/Wagon1 NDB on SH 39 lost control; went off road to left, Car/Wagon1 hit ditches	CAR/WAGON1, other lost control, overseas/migrant driver fail to adjust to nz roads, suddenly braked	Dry	Overcast	Fine	Nil (Default)	Unknown	0	0	0

1-5 of 5

Appendix B: Intersection Modelling Outputs

INTERSECTION SUMMARY

Site: 101 [2018_Existing_AM]

New Site
Site Category: (None)
Stop (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	64.0	km/h	64.0	km/h
Travel Distance (Total)	915.7	veh-km/h	1098.9	pers-km/h
Travel Time (Total)	14.3	veh-h/h	17.2	pers-h/h
Demand Flows (Total)	905	veh/h	1086	pers/h
Percent Heavy Vehicles (Demand)	7.6	%		
Degree of Saturation	0.255			
Practical Spare Capacity	233.8	%		
Effective Intersection Capacity	3549	veh/h		
Control Delay (Total)	0.94	veh-h/h	1.13	pers-h/h
Control Delay (Average)	3.7	sec	3.7	sec
Control Delay (Worst Lane)	21.2	sec		
Control Delay (Worst Movement)	24.3	sec	24.3	sec
Geometric Delay (Average)	2.5	sec		
Stop-Line Delay (Average)	1.3	sec		
Idling Time (Average)	0.9	sec		
Intersection Level of Service (LOS)	NA			
95% Back of Queue - Vehicles (Worst Lane)	0.9	veh		
95% Back of Queue - Distance (Worst Lane)	6.3	m		
Queue Storage Ratio (Worst Lane)	0.01			
Total Effective Stops	237	veh/h	284	pers/h
Effective Stop Rate	0.26		0.26	
Proportion Queued	0.12		0.12	
Performance Index	16.8		16.8	
Cost (Total)	385.76	$/h	385.76	$/h
Fuel Consumption (Total)	80.2	L/h		
Carbon Dioxide (Total)	192.1	kg/h		
Hydrocarbons (Total)	0.017	kg/h		
Carbon Monoxide (Total)	0.275	kg/h		
NOx (Total)	0.366	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 1.6 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 2.8% 1.4% 0.7%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	434,526	veh/y	521,432	pers/y
Delay	450	veh-h/y	540	pers-h/y
Effective Stops	113,668	veh/y	136,401	pers/y
Travel Distance	439,541	veh-km/y	527,449	pers-km/y
Travel Time	6,863	veh-h/y	8,235	pers-h/y
Cost	185,167	$/y	185,167	$/y
Fuel Consumption	38,499	L/y		
Carbon Dioxide	92,230	kg/y		
Hydrocarbons	8	kg/y		
Carbon Monoxide	132	kg/y		
NOx	176	kg/y		

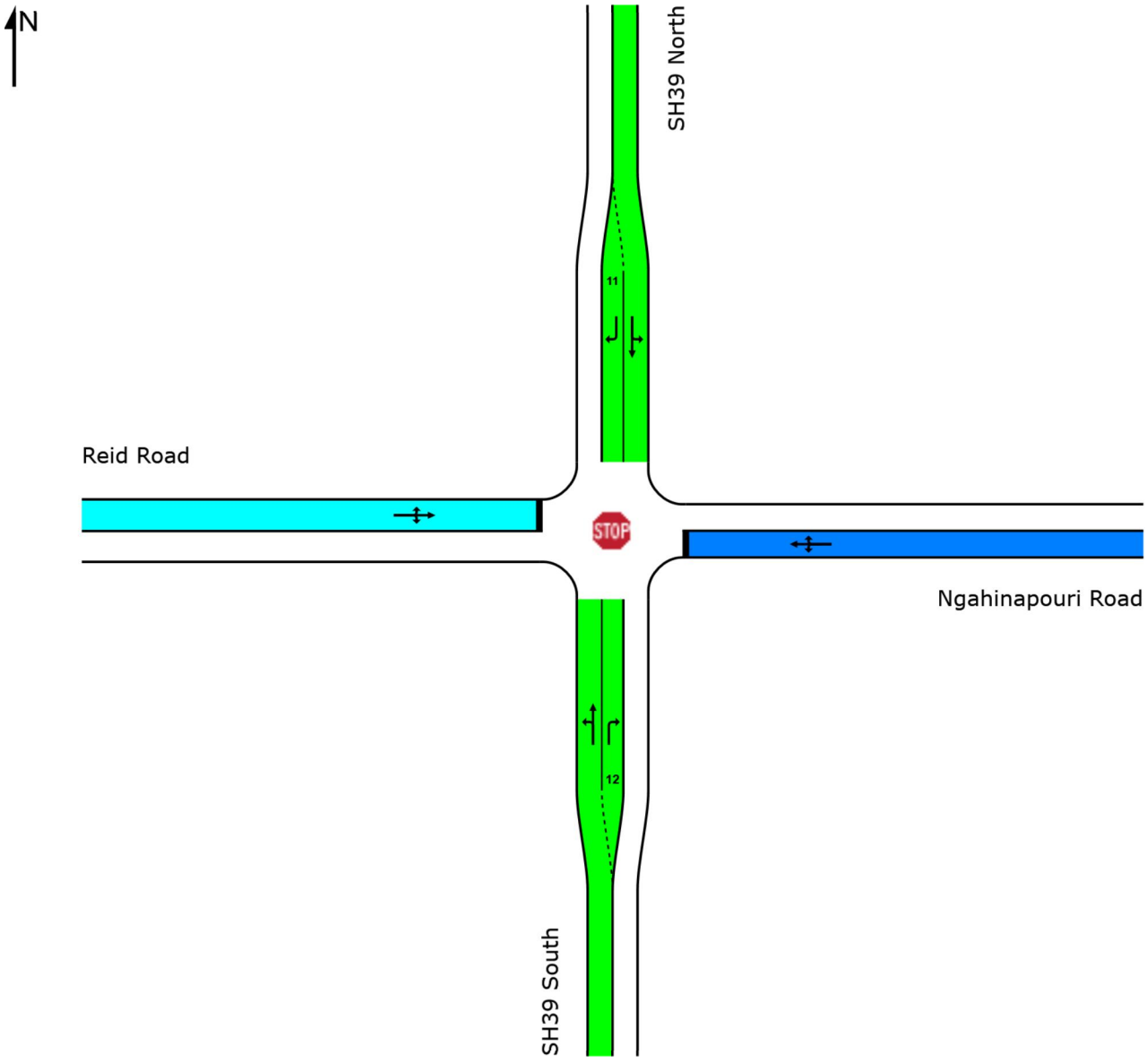
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101 [2018_Existing_AM]

New Site
Site Category: (None)
Stop (Two-Way)

	Approaches				Intersection
	South	East	North	West	
LOS	NA	C	NA	B	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

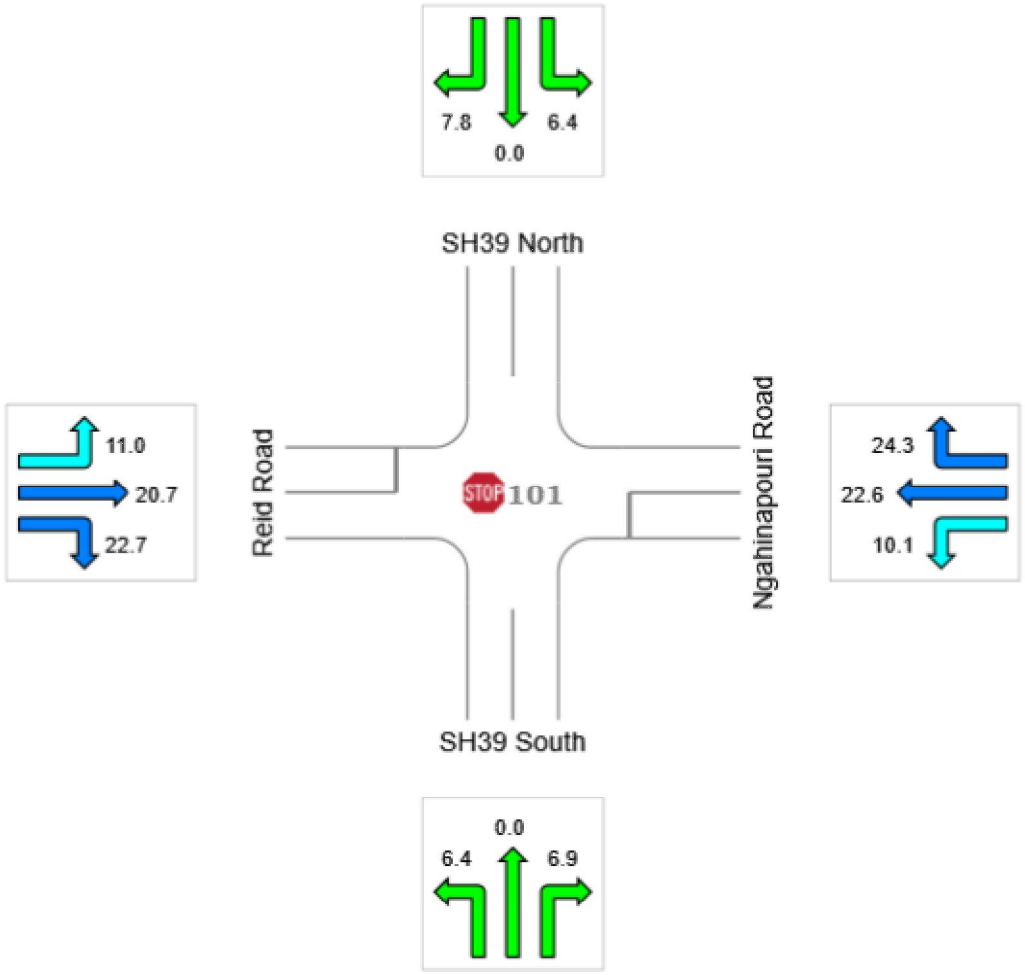
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101 [2018_Existing_AM]

New Site
Site Category: (None)
Stop (Two-Way)

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	2.0	21.2	2.1	14.3	3.7
LOS	NA	C	NA	B	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101 [2018_Existing_PM]

New Site
Site Category: (None)
Stop (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	65.2	km/h	65.2	km/h
Travel Distance (Total)	865.8	veh-km/h	1039.0	pers-km/h
Travel Time (Total)	13.3	veh-h/h	15.9	pers-h/h
Demand Flows (Total)	856	veh/h	1027	pers/h
Percent Heavy Vehicles (Demand)	8.0	%		
Degree of Saturation	0.291			
Practical Spare Capacity	236.5	%		
Effective Intersection Capacity	2939	veh/h		
Control Delay (Total)	0.67	veh-h/h	0.80	pers-h/h
Control Delay (Average)	2.8	sec	2.8	sec
Control Delay (Worst Lane)	20.0	sec		
Control Delay (Worst Movement)	22.8	sec	22.8	sec
Geometric Delay (Average)	2.2	sec		
Stop-Line Delay (Average)	0.7	sec		
Idling Time (Average)	0.4	sec		
Intersection Level of Service (LOS)	NA			
95% Back of Queue - Vehicles (Worst Lane)	0.4	veh		
95% Back of Queue - Distance (Worst Lane)	2.5	m		
Queue Storage Ratio (Worst Lane)	0.00			
Total Effective Stops	193	veh/h	231	pers/h
Effective Stop Rate	0.23		0.23	
Proportion Queued	0.08		0.08	
Performance Index	14.8		14.8	
Cost (Total)	353.20	$/h	353.20	$/h
Fuel Consumption (Total)	75.3	L/h		
Carbon Dioxide (Total)	180.7	kg/h		
Hydrocarbons (Total)	0.016	kg/h		
Carbon Monoxide (Total)	0.257	kg/h		
NOx (Total)	0.362	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 3.6 %
Number of Iterations: 6 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 3.7% 1.8% 0.9%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	410,779	veh/y	492,935	pers/y
Delay	320	veh-h/y	385	pers-h/y
Effective Stops	92,483	veh/y	110,979	pers/y
Travel Distance	415,604	veh-km/y	498,725	pers-km/y
Travel Time	6,377	veh-h/y	7,653	pers-h/y
Cost	169,538	$/y	169,538	$/y
Fuel Consumption	36,159	L/y		
Carbon Dioxide	86,739	kg/y		
Hydrocarbons	7	kg/y		
Carbon Monoxide	123	kg/y		
NOx	174	kg/y		

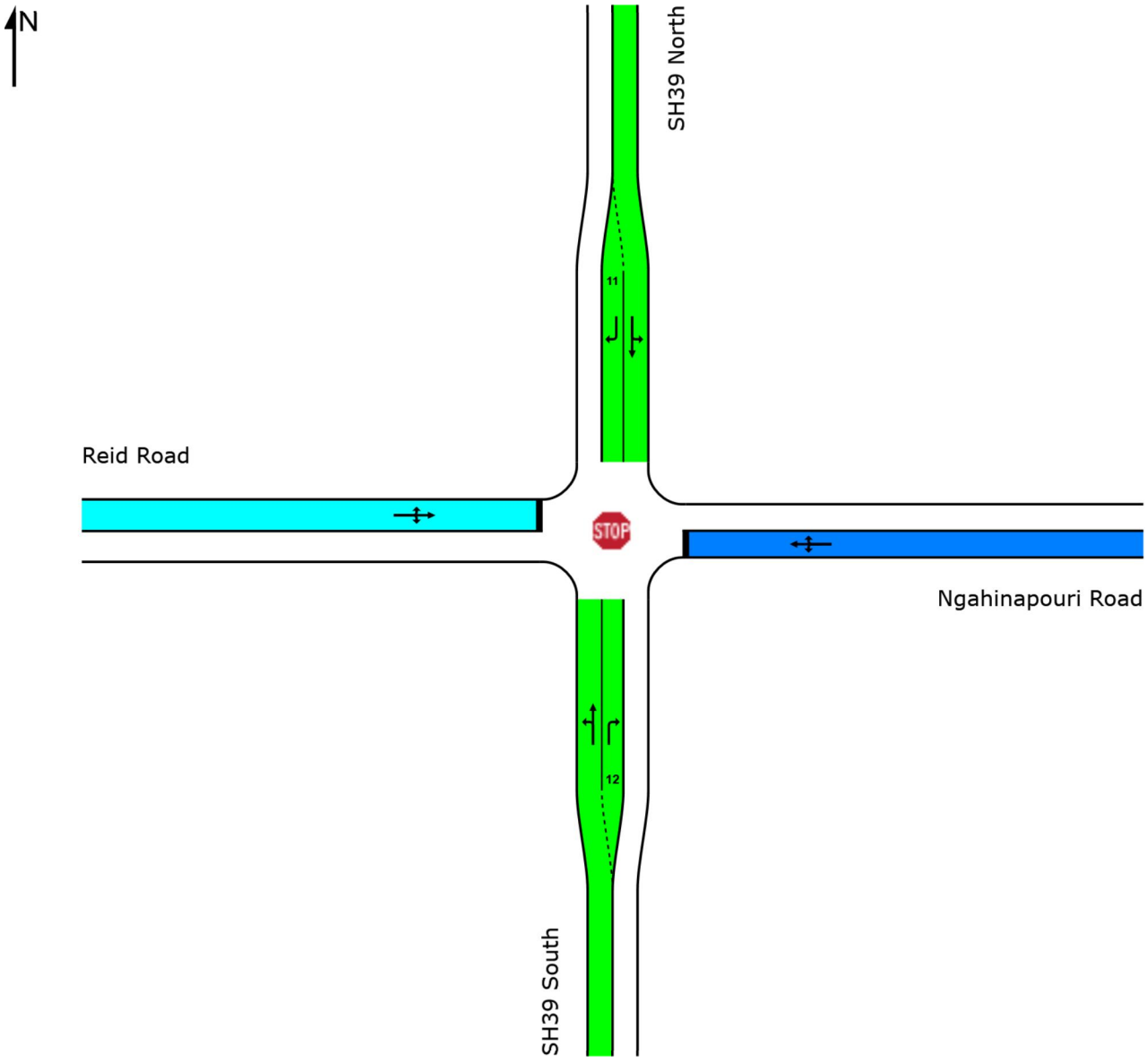
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101 [2018_Existing_PM]

New Site
Site Category: (None)
Stop (Two-Way)

	Approaches				Intersection
	South	East	North	West	
LOS	NA	C	NA	B	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

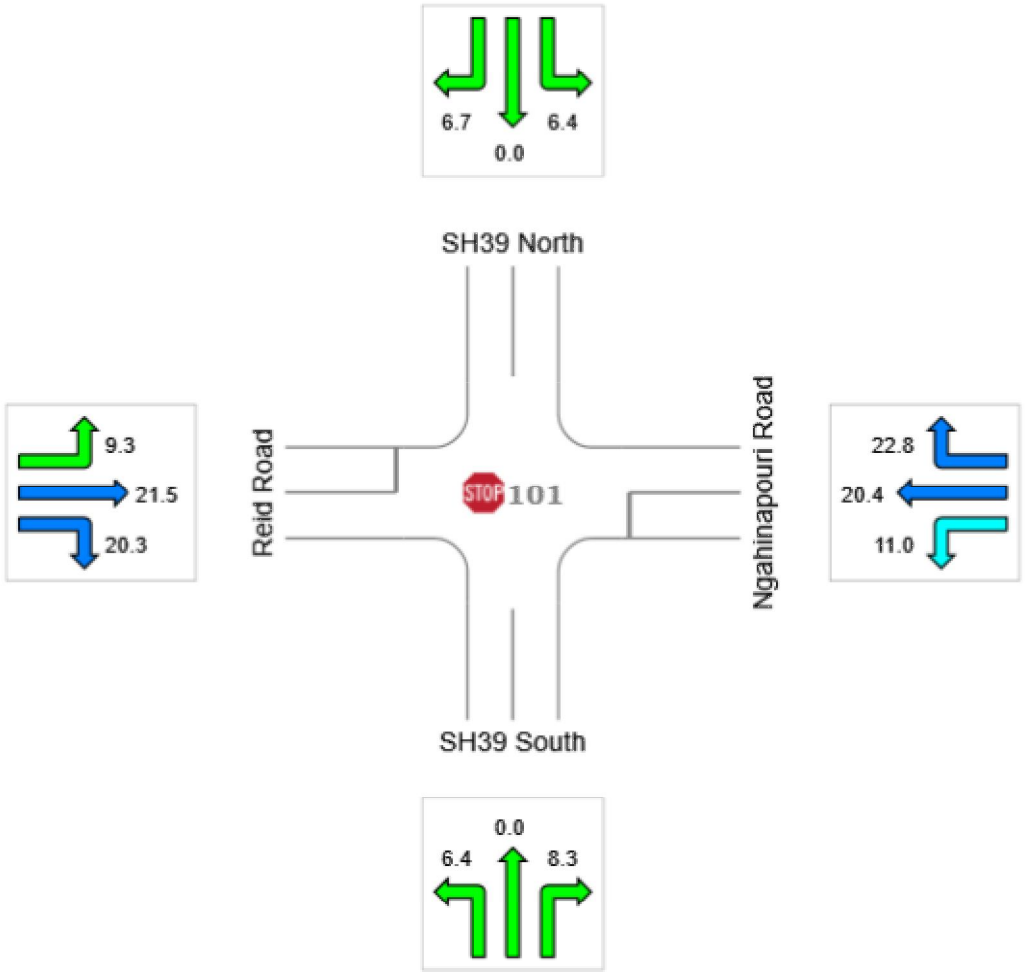
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101 [2018_Existing_PM]

New Site
Site Category: (None)
Stop (Two-Way)

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	2.3	20.0	2.0	14.5	2.8
LOS	NA	C	NA	B	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101 [2018_Low Dev_AM]

New Site
Site Category: (None)
Stop (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	62.0	km/h	62.0	km/h
Travel Distance (Total)	1043.9	veh-km/h	1252.7	pers-km/h
Travel Time (Total)	16.8	veh-h/h	20.2	pers-h/h
Demand Flows (Total)	1032	veh/h	1238	pers/h
Percent Heavy Vehicles (Demand)	6.7	%		
Degree of Saturation	0.328			
Practical Spare Capacity	143.5	%		
Effective Intersection Capacity	3140	veh/h		
Control Delay (Total)	1.61	veh-h/h	1.93	pers-h/h
Control Delay (Average)	5.6	sec	5.6	sec
Control Delay (Worst Lane)	25.5	sec		
Control Delay (Worst Movement)	30.0	sec	30.0	sec
Geometric Delay (Average)	3.2	sec		
Stop-Line Delay (Average)	2.4	sec		
Idling Time (Average)	1.8	sec		
Intersection Level of Service (LOS)	NA			
95% Back of Queue - Vehicles (Worst Lane)	1.4	veh		
95% Back of Queue - Distance (Worst Lane)	10.1	m		
Queue Storage Ratio (Worst Lane)	0.01			
Total Effective Stops	370	veh/h	444	pers/h
Effective Stop Rate	0.36		0.36	
Proportion Queued	0.19		0.19	
Performance Index	21.8		21.8	
Cost (Total)	466.98	$/h	466.98	$/h
Fuel Consumption (Total)	92.5	L/h		
Carbon Dioxide (Total)	221.0	kg/h		
Hydrocarbons (Total)	0.020	kg/h		
Carbon Monoxide (Total)	0.319	kg/h		
NOx (Total)	0.377	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 1.6 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 2.8% 1.4% 0.7%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	495,158	veh/y	594,190	pers/y
Delay	771	veh-h/y	925	pers-h/y
Effective Stops	177,729	veh/y	213,275	pers/y
Travel Distance	501,065	veh-km/y	601,278	pers-km/y
Travel Time	8,085	veh-h/y	9,702	pers-h/y
Cost	224,151	$/y	224,151	$/y
Fuel Consumption	44,401	L/y		
Carbon Dioxide	106,100	kg/y		
Hydrocarbons	9	kg/y		
Carbon Monoxide	153	kg/y		
NOx	181	kg/y		

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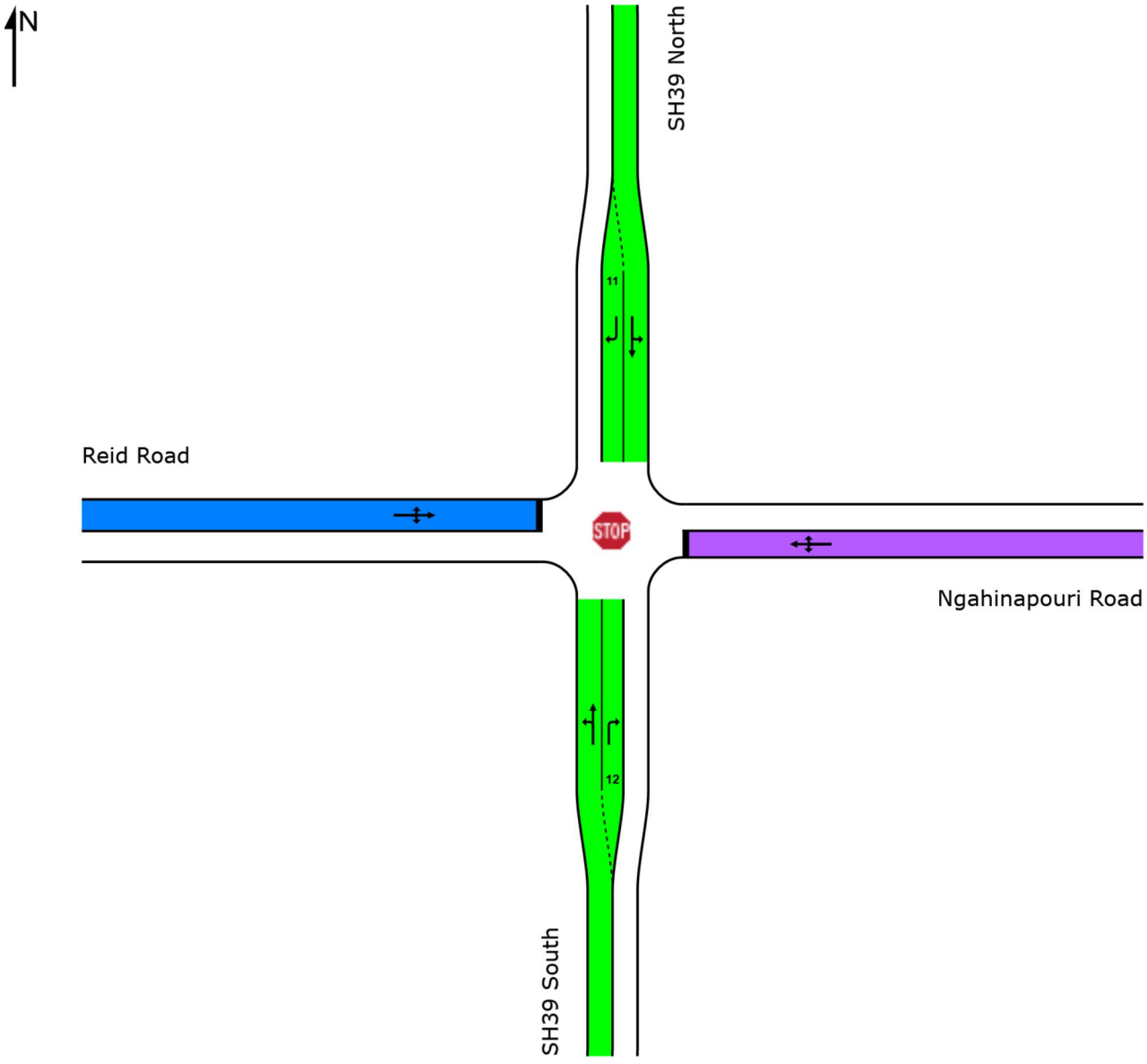
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101 [2018_Low Dev_AM]

New Site
Site Category: (None)
Stop (Two-Way)

	Approaches				Intersection
	South	East	North	West	
LOS	NA	D	NA	C	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

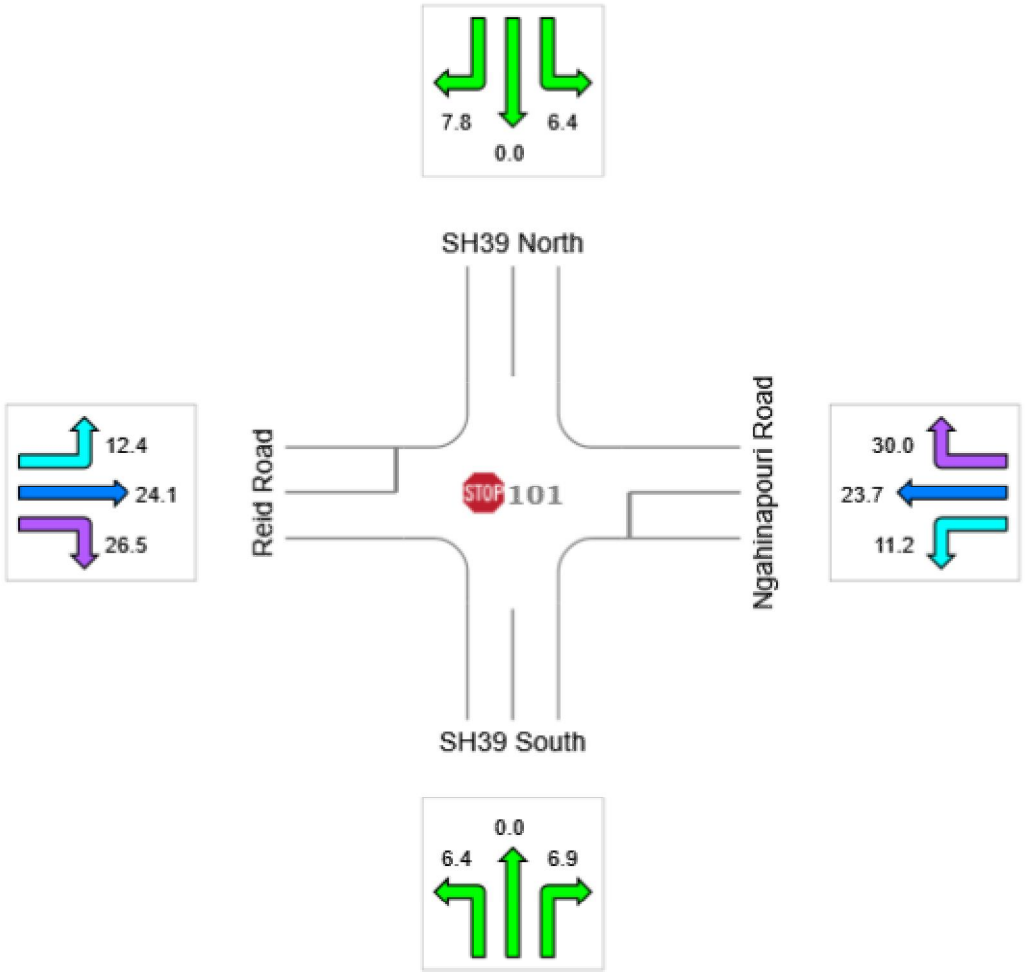
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101 [2018_Low Dev_AM]

New Site
Site Category: (None)
Stop (Two-Way)

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	2.0	25.5	2.1	16.4	5.6
LOS	NA	D	NA	C	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101 [2018_Low Dev_PM]

New Site
Site Category: (None)
Stop (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	64.5	km/h	64.5	km/h
Travel Distance (Total)	911.8	veh-km/h	1094.1	pers-km/h
Travel Time (Total)	14.1	veh-h/h	17.0	pers-h/h
Demand Flows (Total)	901	veh/h	1081	pers/h
Percent Heavy Vehicles (Demand)	7.6	%		
Degree of Saturation	0.291			
Practical Spare Capacity	236.5	%		
Effective Intersection Capacity	3094	veh/h		
Control Delay (Total)	0.84	veh-h/h	1.01	pers-h/h
Control Delay (Average)	3.3	sec	3.3	sec
Control Delay (Worst Lane)	21.0	sec		
Control Delay (Worst Movement)	24.3	sec	24.3	sec
Geometric Delay (Average)	2.5	sec		
Stop-Line Delay (Average)	0.9	sec		
Idling Time (Average)	0.6	sec		
Intersection Level of Service (LOS)	NA			
95% Back of Queue - Vehicles (Worst Lane)	0.4	veh		
95% Back of Queue - Distance (Worst Lane)	2.6	m		
Queue Storage Ratio (Worst Lane)	0.00			
Total Effective Stops	233	veh/h	280	pers/h
Effective Stop Rate	0.26		0.26	
Proportion Queued	0.10		0.10	
Performance Index	16.2		16.2	
Cost (Total)	379.99	$/h	379.99	$/h
Fuel Consumption (Total)	79.6	L/h		
Carbon Dioxide (Total)	190.8	kg/h		
Hydrocarbons (Total)	0.017	kg/h		
Carbon Monoxide (Total)	0.273	kg/h		
NOx (Total)	0.366	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 3.6 %
Number of Iterations: 6 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 3.7% 1.8% 0.9%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	432,505	veh/y	519,006	pers/y
Delay	402	veh-h/y	483	pers-h/y
Effective Stops	111,875	veh/y	134,251	pers/y
Travel Distance	437,652	veh-km/y	525,182	pers-km/y
Travel Time	6,785	veh-h/y	8,142	pers-h/y
Cost	182,394	$/y	182,394	$/y
Fuel Consumption	38,227	L/y		
Carbon Dioxide	91,599	kg/y		
Hydrocarbons	8	kg/y		
Carbon Monoxide	131	kg/y		
NOx	176	kg/y		

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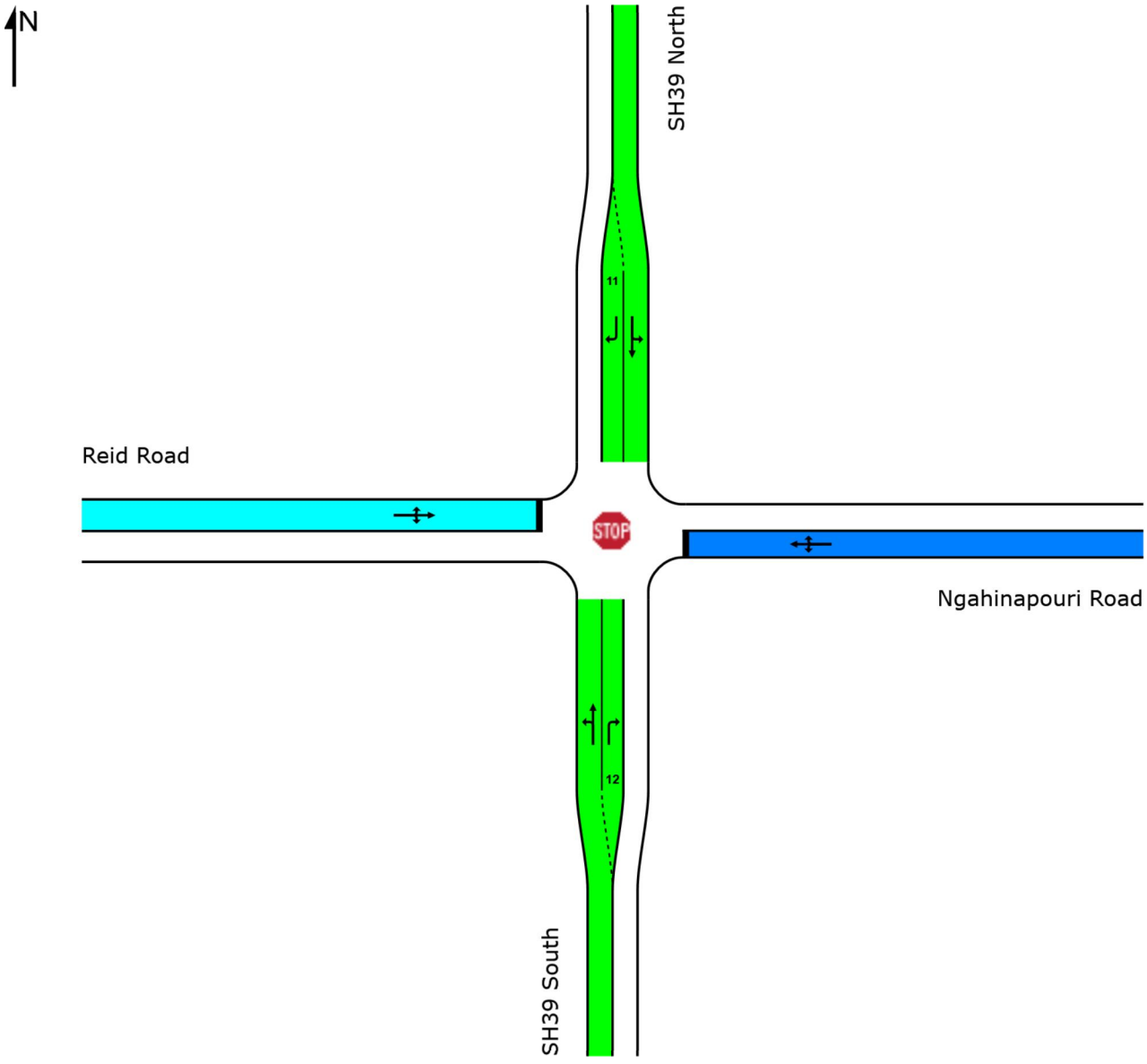
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101 [2018_Low Dev_PM]

New Site
Site Category: (None)
Stop (Two-Way)

	Approaches				Intersection
	South	East	North	West	
LOS	NA	C	NA	B	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

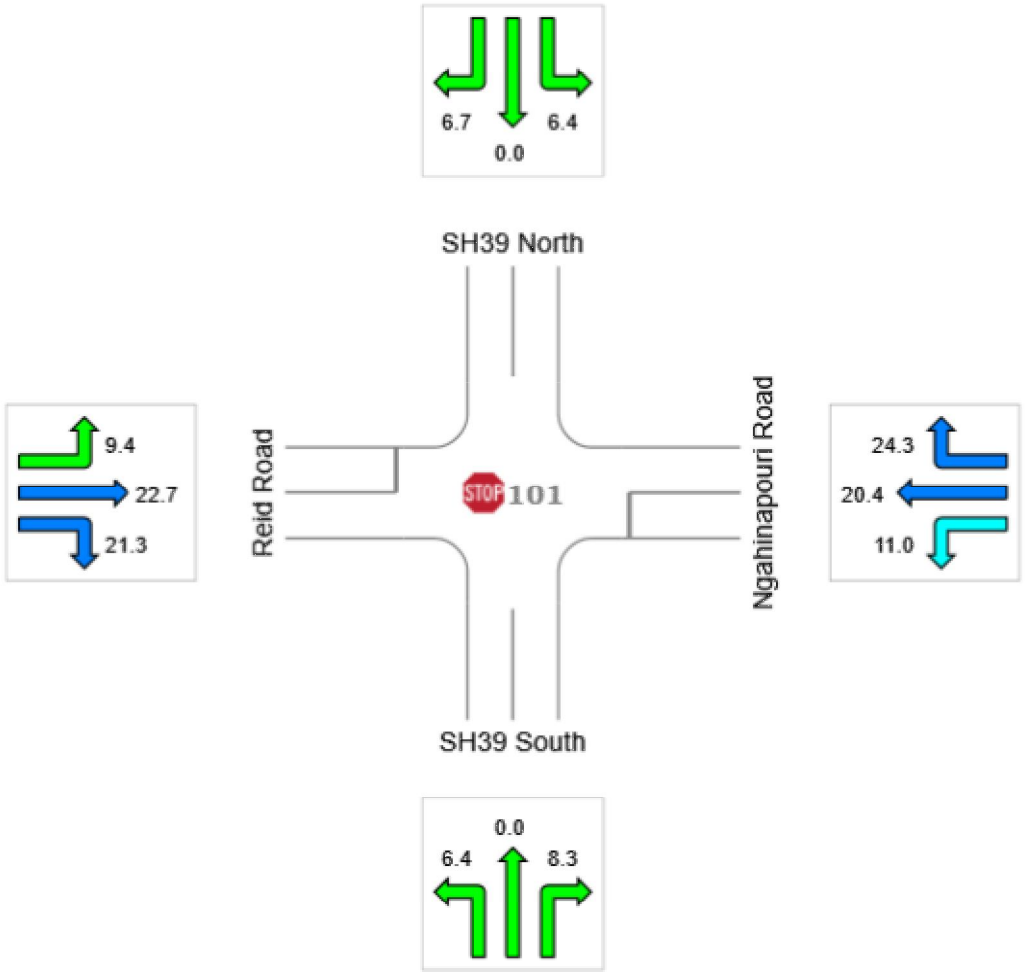
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101 [2018_Low Dev_PM]

New Site
Site Category: (None)
Stop (Two-Way)

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	2.3	21.0	2.0	13.2	3.3
LOS	NA	C	NA	B	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101 [2018_Hi Dev_AM]

New Site
Site Category: (None)
Stop (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	59.5	km/h	59.5	km/h
Travel Distance (Total)	1167.8	veh-km/h	1401.3	pers-km/h
Travel Time (Total)	19.6	veh-h/h	23.6	pers-h/h
Demand Flows (Total)	1154	veh/h	1384	pers/h
Percent Heavy Vehicles (Demand)	6.0	%		
Degree of Saturation	0.599			
Practical Spare Capacity	33.5	%		
Effective Intersection Capacity	1925	veh/h		
Control Delay (Total)	2.59	veh-h/h	3.10	pers-h/h
Control Delay (Average)	8.1	sec	8.1	sec
Control Delay (Worst Lane)	30.0	sec		
Control Delay (Worst Movement)	35.9	sec	35.9	sec
Geometric Delay (Average)	3.7	sec		
Stop-Line Delay (Average)	4.3	sec		
Idling Time (Average)	2.9	sec		
Intersection Level of Service (LOS)	NA			
95% Back of Queue - Vehicles (Worst Lane)	4.0	veh		
95% Back of Queue - Distance (Worst Lane)	28.2	m		
Queue Storage Ratio (Worst Lane)	0.02			
Total Effective Stops	537	veh/h	645	pers/h
Effective Stop Rate	0.47		0.47	
Proportion Queued	0.25		0.25	
Performance Index	28.9		28.9	
Cost (Total)	557.44	$/h	557.44	$/h
Fuel Consumption (Total)	105.0	L/h		
Carbon Dioxide (Total)	250.3	kg/h		
Hydrocarbons (Total)	0.023	kg/h		
Carbon Monoxide (Total)	0.362	kg/h		
NOx (Total)	0.387	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 1.6 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 2.8% 1.4% 0.7%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	553,769	veh/y	664,522	pers/y
Delay	1,241	veh-h/y	1,489	pers-h/y
Effective Stops	257,835	veh/y	309,403	pers/y
Travel Distance	560,539	veh-km/y	672,647	pers-km/y
Travel Time	9,421	veh-h/y	11,305	pers-h/y
Cost	267,573	$/y	267,573	$/y
Fuel Consumption	50,376	L/y		
Carbon Dioxide	120,141	kg/y		
Hydrocarbons	11	kg/y		
Carbon Monoxide	174	kg/y		
NOx	186	kg/y		

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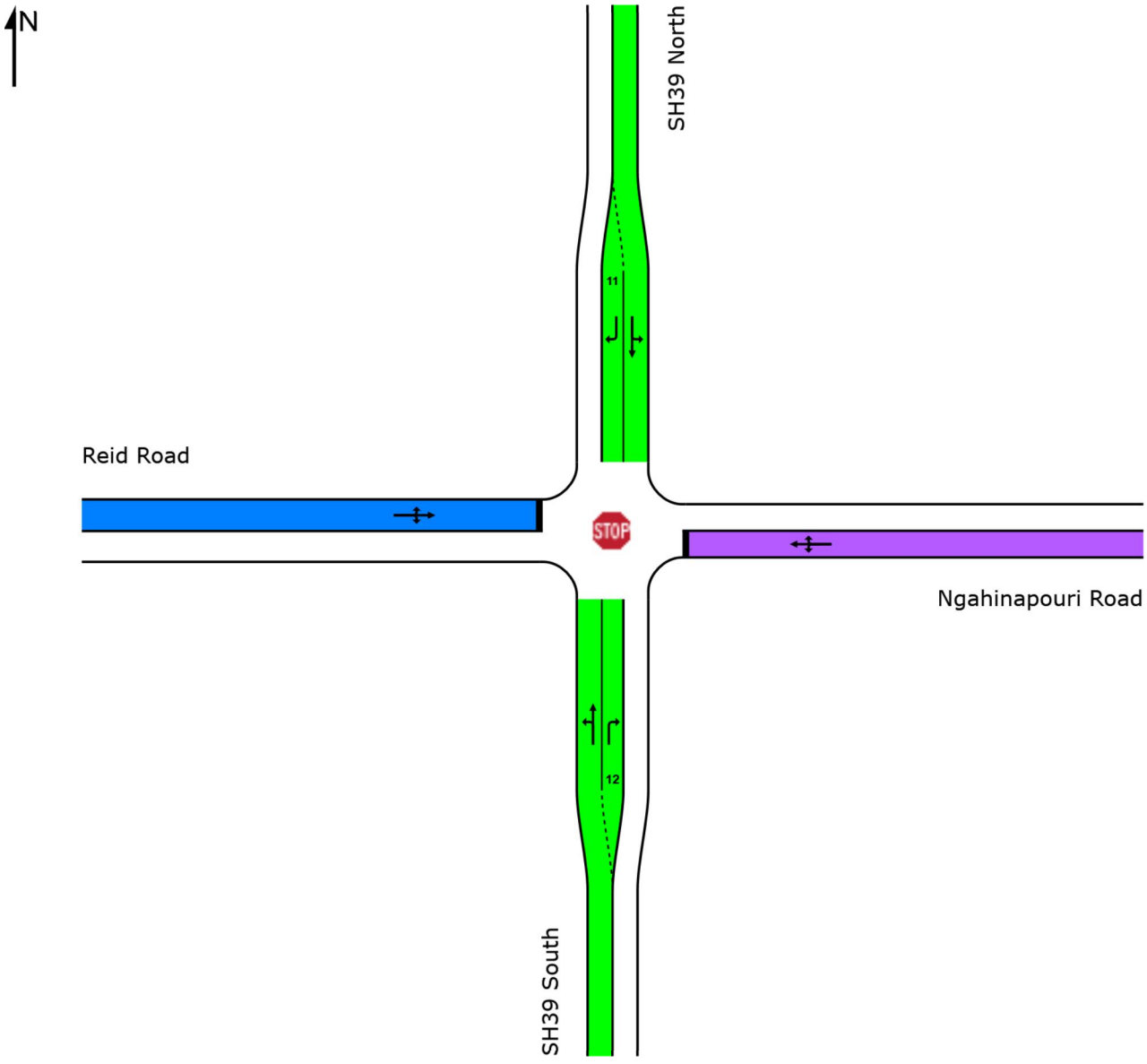
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101 [2018_Hi Dev_AM]

New Site
Site Category: (None)
Stop (Two-Way)

	Approaches				Intersection
	South	East	North	West	
LOS	NA	D	NA	C	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

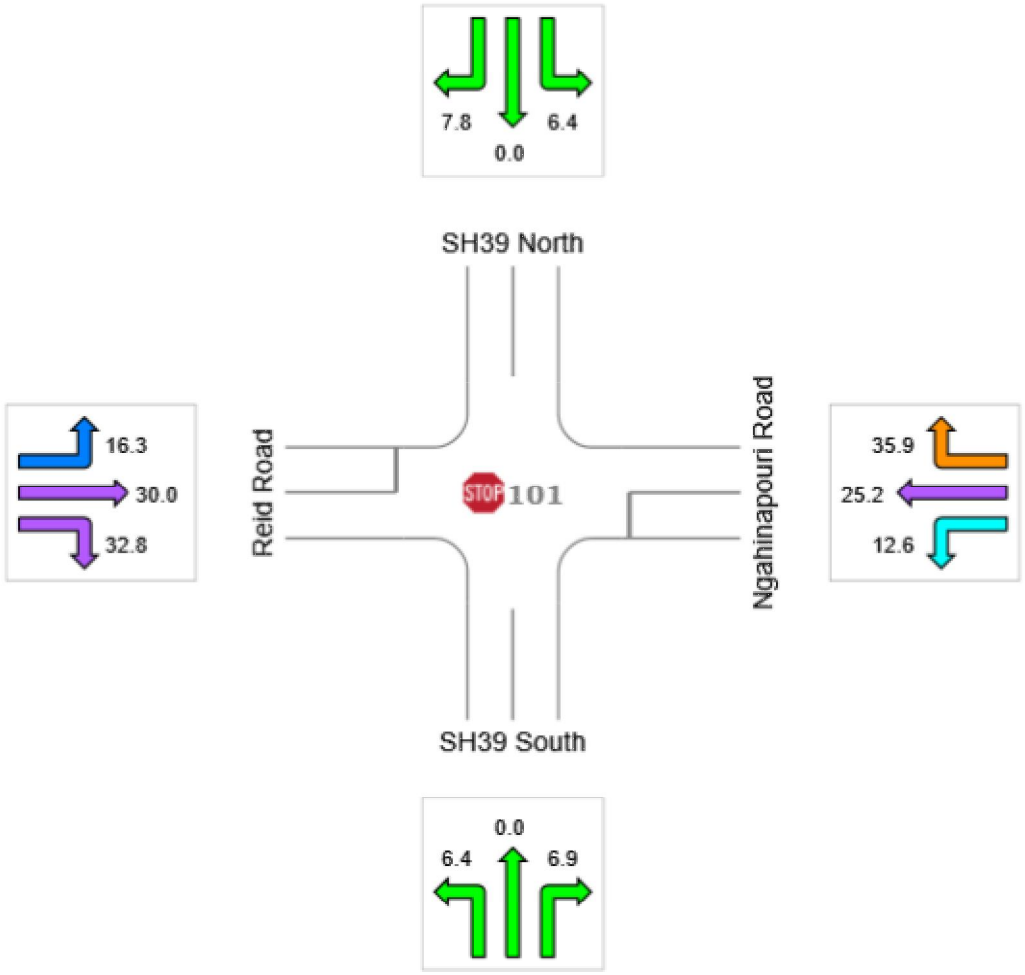
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101 [2018_Hi Dev_AM]

New Site
Site Category: (None)
Stop (Two-Way)

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	2.0	30.0	2.1	21.0	8.1
LOS	NA	D	NA	C	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101 [2018_Hi Dev_PM]

New Site
Site Category: (None)
Stop (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	63.9	km/h	63.9	km/h
Travel Distance (Total)	954.5	veh-km/h	1145.4	pers-km/h
Travel Time (Total)	14.9	veh-h/h	17.9	pers-h/h
Demand Flows (Total)	943	veh/h	1132	pers/h
Percent Heavy Vehicles (Demand)	7.3	%		
Degree of Saturation	0.291			
Practical Spare Capacity	236.5	%		
Effective Intersection Capacity	3239	veh/h		
Control Delay (Total)	1.01	veh-h/h	1.21	pers-h/h
Control Delay (Average)	3.8	sec	3.8	sec
Control Delay (Worst Lane)	21.9	sec		
Control Delay (Worst Movement)	25.5	sec	25.5	sec
Geometric Delay (Average)	2.7	sec		
Stop-Line Delay (Average)	1.1	sec		
Idling Time (Average)	0.8	sec		
Intersection Level of Service (LOS)	NA			
95% Back of Queue - Vehicles (Worst Lane)	0.7	veh		
95% Back of Queue - Distance (Worst Lane)	4.8	m		
Queue Storage Ratio (Worst Lane)	0.00			
Total Effective Stops	271	veh/h	325	pers/h
Effective Stop Rate	0.29		0.29	
Proportion Queued	0.11		0.11	
Performance Index	17.6		17.6	
Cost (Total)	405.18	$/h	405.18	$/h
Fuel Consumption (Total)	83.7	L/h		
Carbon Dioxide (Total)	200.3	kg/h		
Hydrocarbons (Total)	0.017	kg/h		
Carbon Monoxide (Total)	0.287	kg/h		
NOx (Total)	0.369	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 3.6 %
Number of Iterations: 6 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 3.7% 1.8% 0.9%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	452,716	veh/y	543,259	pers/y
Delay	483	veh-h/y	579	pers-h/y
Effective Stops	130,144	veh/y	156,173	pers/y
Travel Distance	458,160	veh-km/y	549,792	pers-km/y
Travel Time	7,168	veh-h/y	8,602	pers-h/y
Cost	194,487	$/y	194,487	$/y
Fuel Consumption	40,156	L/y		
Carbon Dioxide	96,132	kg/y		
Hydrocarbons	8	kg/y		
Carbon Monoxide	138	kg/y		
NOx	177	kg/y		

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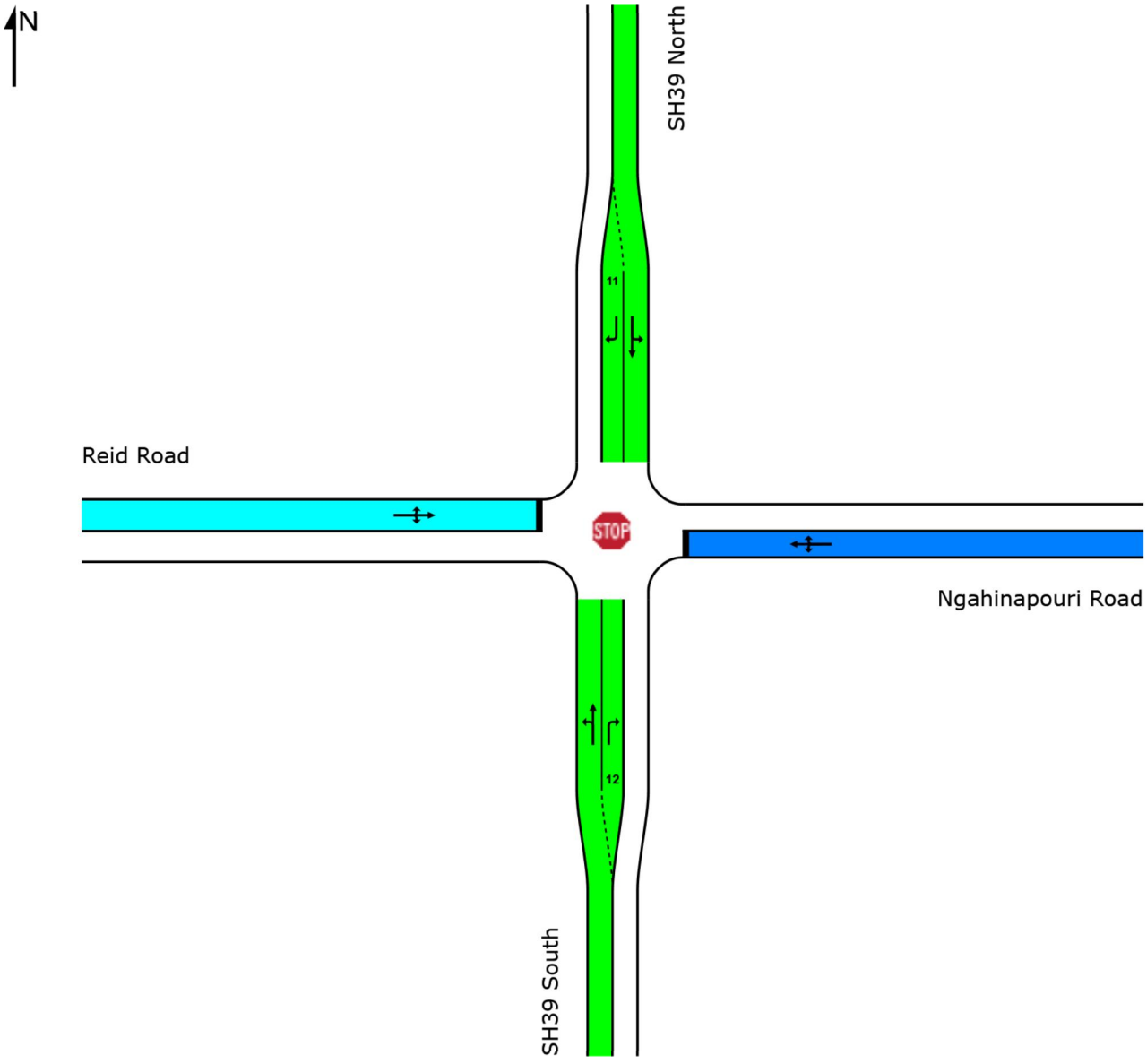
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101 [2018_Hi Dev_PM]

New Site
Site Category: (None)
Stop (Two-Way)

	Approaches				Intersection
	South	East	North	West	
LOS	NA	C	NA	B	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

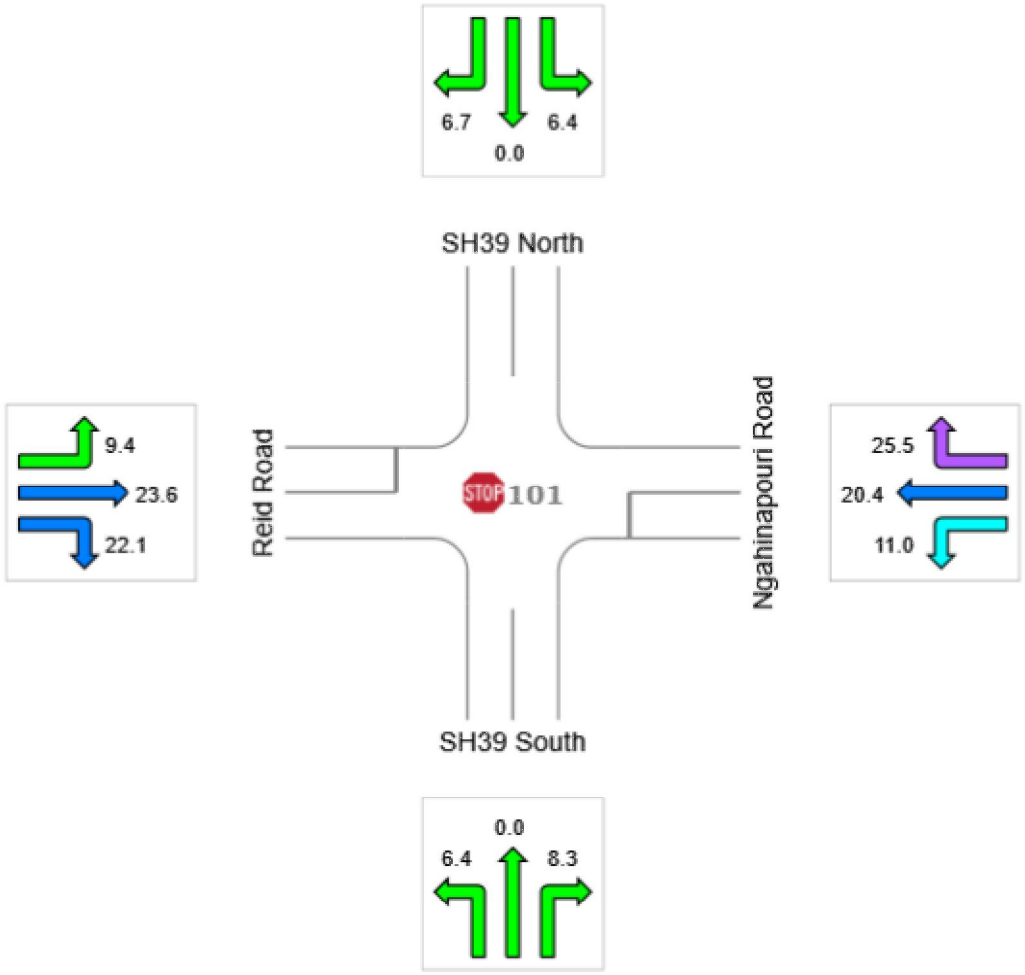
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101 [2018_Hi Dev_PM]

New Site
Site Category: (None)
Stop (Two-Way)

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	2.3	21.9	2.0	13.4	3.8
LOS	NA	C	NA	B	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101 [2035_No Dev_AM]

New Site
Site Category: (None)
Stop (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	61.8	km/h	61.8	km/h
Travel Distance (Total)	1228.8	veh-km/h	1474.5	pers-km/h
Travel Time (Total)	19.9	veh-h/h	23.9	pers-h/h
Demand Flows (Total)	1215	veh/h	1458	pers/h
Percent Heavy Vehicles (Demand)	7.6	%		
Degree of Saturation	0.577			
Practical Spare Capacity	38.6	%		
Effective Intersection Capacity	2104	veh/h		
Control Delay (Total)	1.97	veh-h/h	2.36	pers-h/h
Control Delay (Average)	5.8	sec	5.8	sec
Control Delay (Worst Lane)	46.4	sec		
Control Delay (Worst Movement)	53.1	sec	53.1	sec
Geometric Delay (Average)	2.5	sec		
Stop-Line Delay (Average)	3.3	sec		
Idling Time (Average)	2.8	sec		
Intersection Level of Service (LOS)	NA			
95% Back of Queue - Vehicles (Worst Lane)	2.6	veh		
95% Back of Queue - Distance (Worst Lane)	18.0	m		
Queue Storage Ratio (Worst Lane)	0.01			
Total Effective Stops	340	veh/h	408	pers/h
Effective Stop Rate	0.28		0.28	
Proportion Queued	0.15		0.15	
Performance Index	25.2		25.2	
Cost (Total)	542.10	$/h	542.10	$/h
Fuel Consumption (Total)	108.5	L/h		
Carbon Dioxide (Total)	260.0	kg/h		
Hydrocarbons (Total)	0.023	kg/h		
Carbon Monoxide (Total)	0.370	kg/h		
NOx (Total)	0.491	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 2.4 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 4.2% 2.0% 1.0%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	583,074	veh/y	699,688	pers/y
Delay	945	veh-h/y	1,134	pers-h/y
Effective Stops	163,372	veh/y	196,047	pers/y
Travel Distance	589,807	veh-km/y	707,768	pers-km/y
Travel Time	9,543	veh-h/y	11,452	pers-h/y
Cost	260,206	$/y	260,206	$/y
Fuel Consumption	52,097	L/y		
Carbon Dioxide	124,778	kg/y		
Hydrocarbons	11	kg/y		
Carbon Monoxide	177	kg/y		
NOx	236	kg/y		

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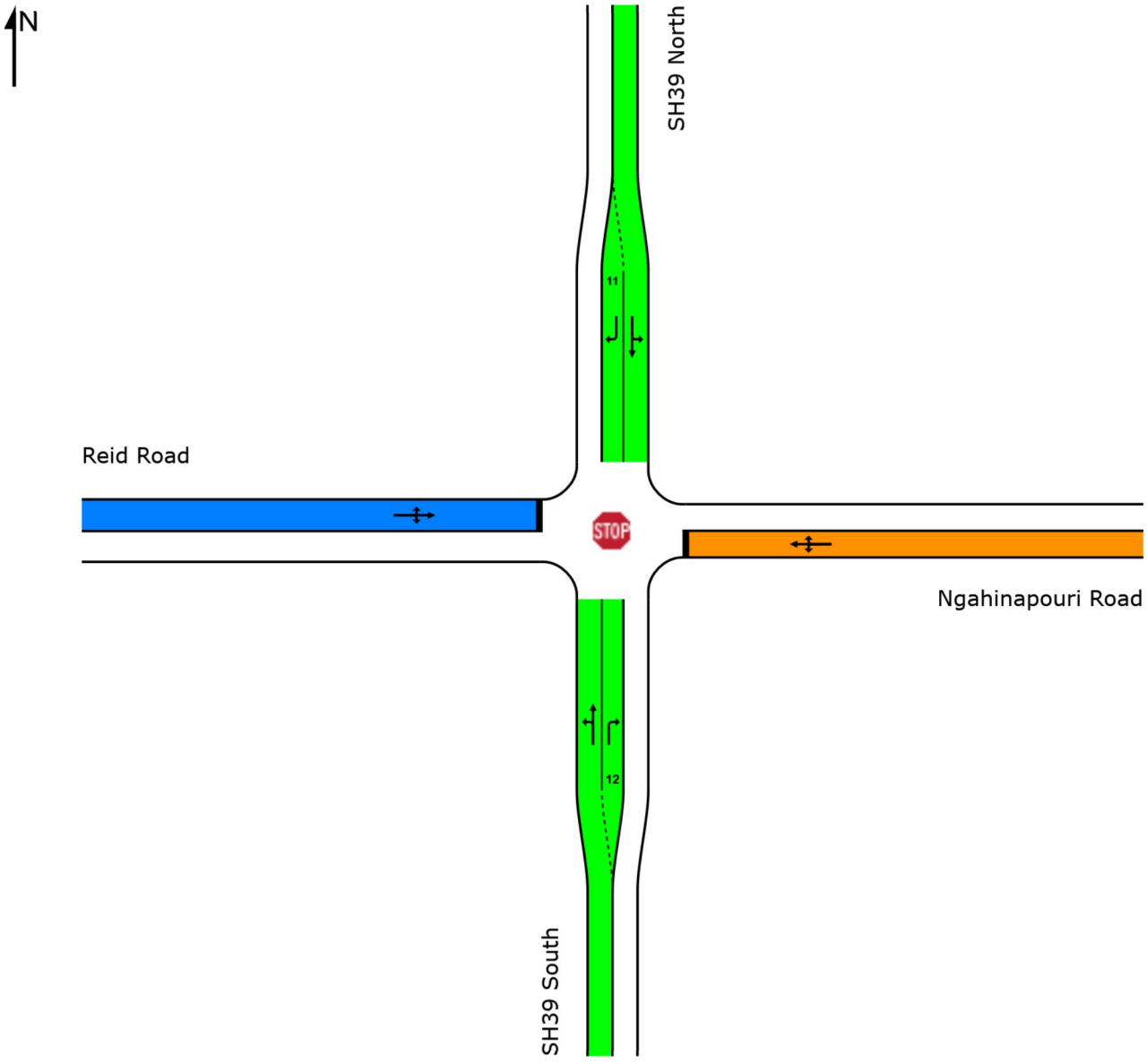
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101 [2035_No Dev_AM]

New Site
Site Category: (None)
Stop (Two-Way)

	Approaches				Intersection
	South	East	North	West	
LOS	NA	E	NA	C	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

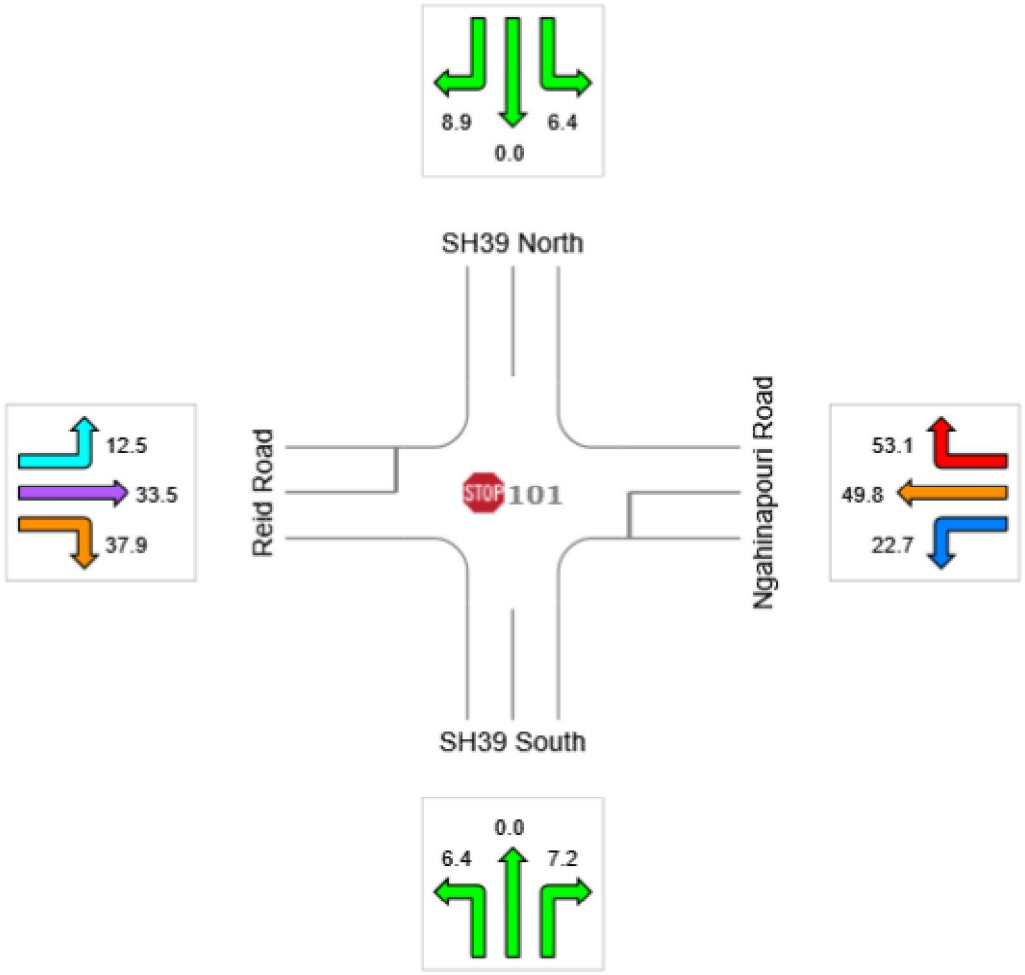
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101 [2035_No Dev_AM]

New Site
Site Category: (None)
Stop (Two-Way)

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	2.1	46.4	2.2	20.2	5.8
LOS	NA	E	NA	C	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101 [2035_No Dev_PM]

New Site
Site Category: (None)
Stop (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	64.4	km/h	64.4	km/h
Travel Distance (Total)	1159.8	veh-km/h	1391.7	pers-km/h
Travel Time (Total)	18.0	veh-h/h	21.6	pers-h/h
Demand Flows (Total)	1146	veh/h	1376	pers/h
Percent Heavy Vehicles (Demand)	8.0	%		
Degree of Saturation	0.390			
Practical Spare Capacity	151.3	%		
Effective Intersection Capacity	2940	veh/h		
Control Delay (Total)	1.10	veh-h/h	1.32	pers-h/h
Control Delay (Average)	3.4	sec	3.4	sec
Control Delay (Worst Lane)	34.6	sec		
Control Delay (Worst Movement)	40.9	sec	40.9	sec
Geometric Delay (Average)	2.2	sec		
Stop-Line Delay (Average)	1.3	sec		
Idling Time (Average)	1.0	sec		
Intersection Level of Service (LOS)	NA			
95% Back of Queue - Vehicles (Worst Lane)	0.9	veh		
95% Back of Queue - Distance (Worst Lane)	6.0	m		
Queue Storage Ratio (Worst Lane)	0.00			
Total Effective Stops	269	veh/h	323	pers/h
Effective Stop Rate	0.23		0.23	
Proportion Queued	0.09		0.09	
Performance Index	20.6		20.6	
Cost (Total)	480.13	$/h	480.13	$/h
Fuel Consumption (Total)	101.2	L/h		
Carbon Dioxide (Total)	242.6	kg/h		
Hydrocarbons (Total)	0.021	kg/h		
Carbon Monoxide (Total)	0.345	kg/h		
NOx (Total)	0.485	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 4.6 %
Number of Iterations: 7 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 2.7% 1.3% 0.6%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	550,232	veh/y	660,278	pers/y
Delay	527	veh-h/y	633	pers-h/y
Effective Stops	129,134	veh/y	154,961	pers/y
Travel Distance	556,697	veh-km/y	668,036	pers-km/y
Travel Time	8,640	veh-h/y	10,368	pers-h/y
Cost	230,461	$/y	230,461	$/y
Fuel Consumption	48,553	L/y		
Carbon Dioxide	116,462	kg/y		
Hydrocarbons	10	kg/y		
Carbon Monoxide	165	kg/y		
NOx	233	kg/y		

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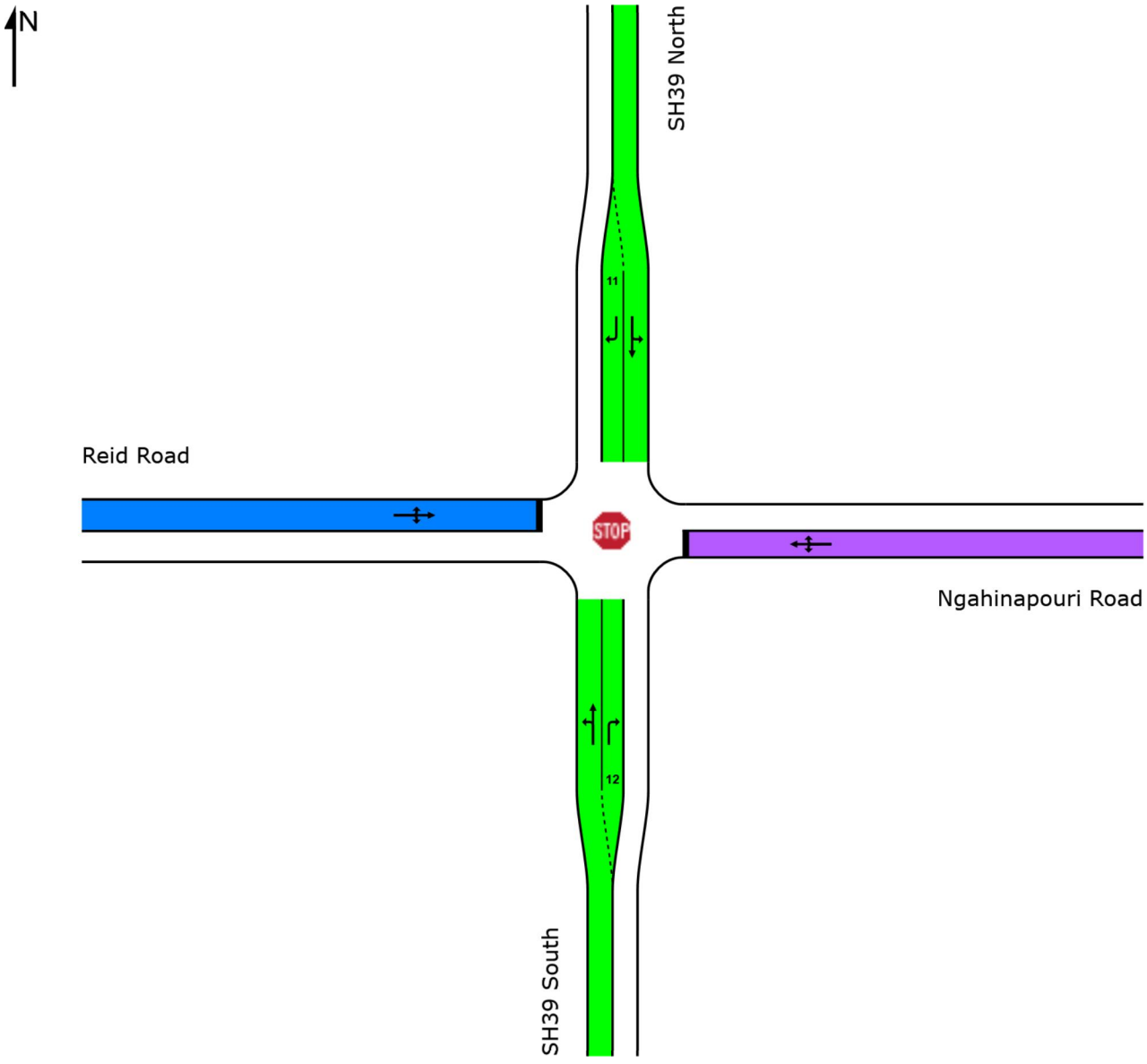
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101 [2035_No Dev_PM]

New Site
Site Category: (None)
Stop (Two-Way)

	Approaches				Intersection
	South	East	North	West	
LOS	NA	D	NA	C	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

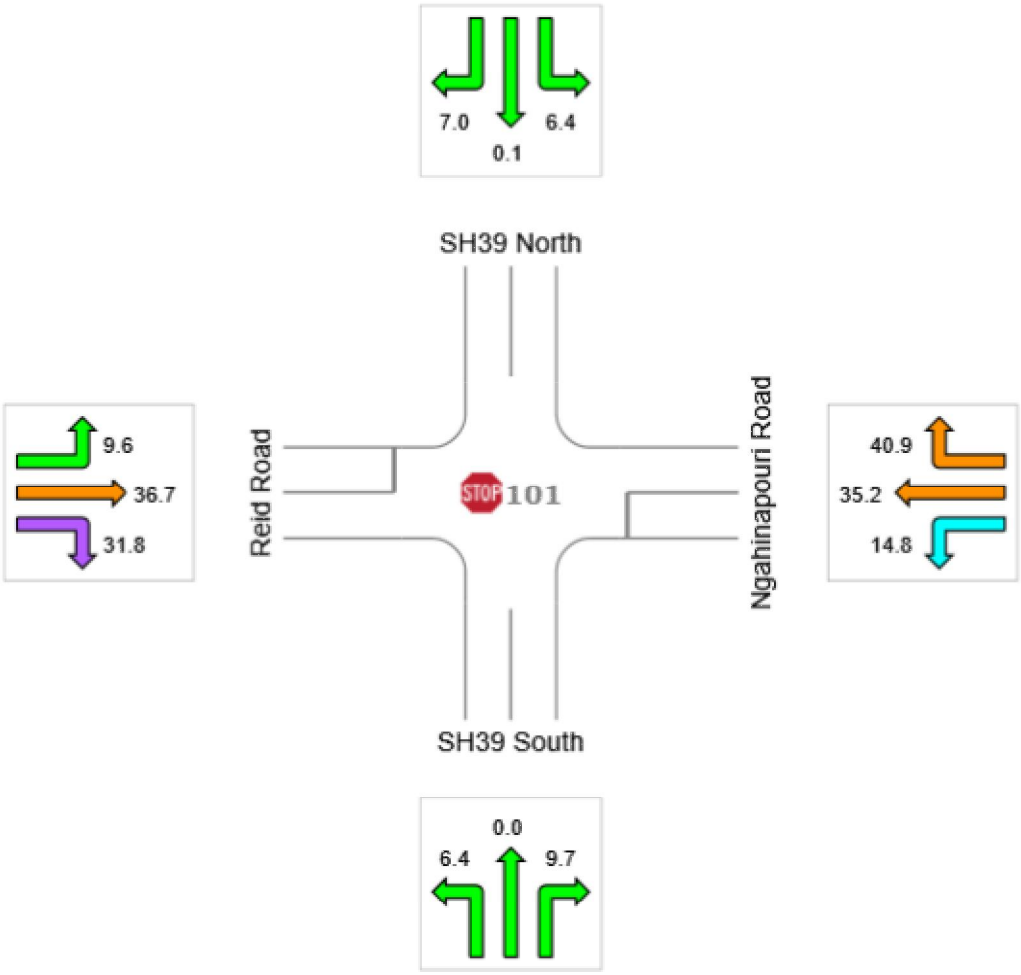
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101 [2035_No Dev_PM]

New Site
Site Category: (None)
Stop (Two-Way)

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	2.6	34.6	2.0	17.9	3.4
LOS	NA	D	NA	C	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101vv [Do Min - 2035_Low Dev_AM]

New Site
Site Category: (None)
Stop (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	58.2	km/h	58.2	km/h
Travel Distance (Total)	1355.9	veh-km/h	1627.0	pers-km/h
Travel Time (Total)	23.3	veh-h/h	28.0	pers-h/h
Demand Flows (Total)	1340	veh/h	1608	pers/h
Percent Heavy Vehicles (Demand)	6.9	%		
Degree of Saturation	0.718			
Practical Spare Capacity	11.4	%		
Effective Intersection Capacity	1866	veh/h		
Control Delay (Total)	3.55	veh-h/h	4.26	pers-h/h
Control Delay (Average)	9.5	sec	9.5	sec
Control Delay (Worst Lane)	68.7	sec		
Control Delay (Worst Movement)	78.1	sec	78.1	sec
Geometric Delay (Average)	3.0	sec		
Stop-Line Delay (Average)	6.5	sec		
Idling Time (Average)	5.4	sec		
Intersection Level of Service (LOS)	NA			
95% Back of Queue - Vehicles (Worst Lane)	3.5	veh		
95% Back of Queue - Distance (Worst Lane)	24.4	m		
Queue Storage Ratio (Worst Lane)	0.02			
Total Effective Stops	494	veh/h	592	pers/h
Effective Stop Rate	0.37		0.37	
Proportion Queued	0.21		0.21	
Performance Index	33.4		33.4	
Cost (Total)	654.17	$/h	654.17	$/h
Fuel Consumption (Total)	121.9	L/h		
Carbon Dioxide (Total)	291.4	kg/h		
Hydrocarbons (Total)	0.026	kg/h		
Carbon Monoxide (Total)	0.415	kg/h		
NOx (Total)	0.502	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 2.4 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 4.2% 2.0% 1.0%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	643,200	veh/y	771,840	pers/y
Delay	1,705	veh-h/y	2,046	pers-h/y
Effective Stops	236,938	veh/y	284,326	pers/y
Travel Distance	650,819	veh-km/y	780,983	pers-km/y
Travel Time	11,191	veh-h/y	13,429	pers-h/y
Cost	314,001	$/y	314,001	$/y
Fuel Consumption	58,518	L/y		
Carbon Dioxide	139,867	kg/y		
Hydrocarbons	12	kg/y		
Carbon Monoxide	199	kg/y		
NOx	241	kg/y		

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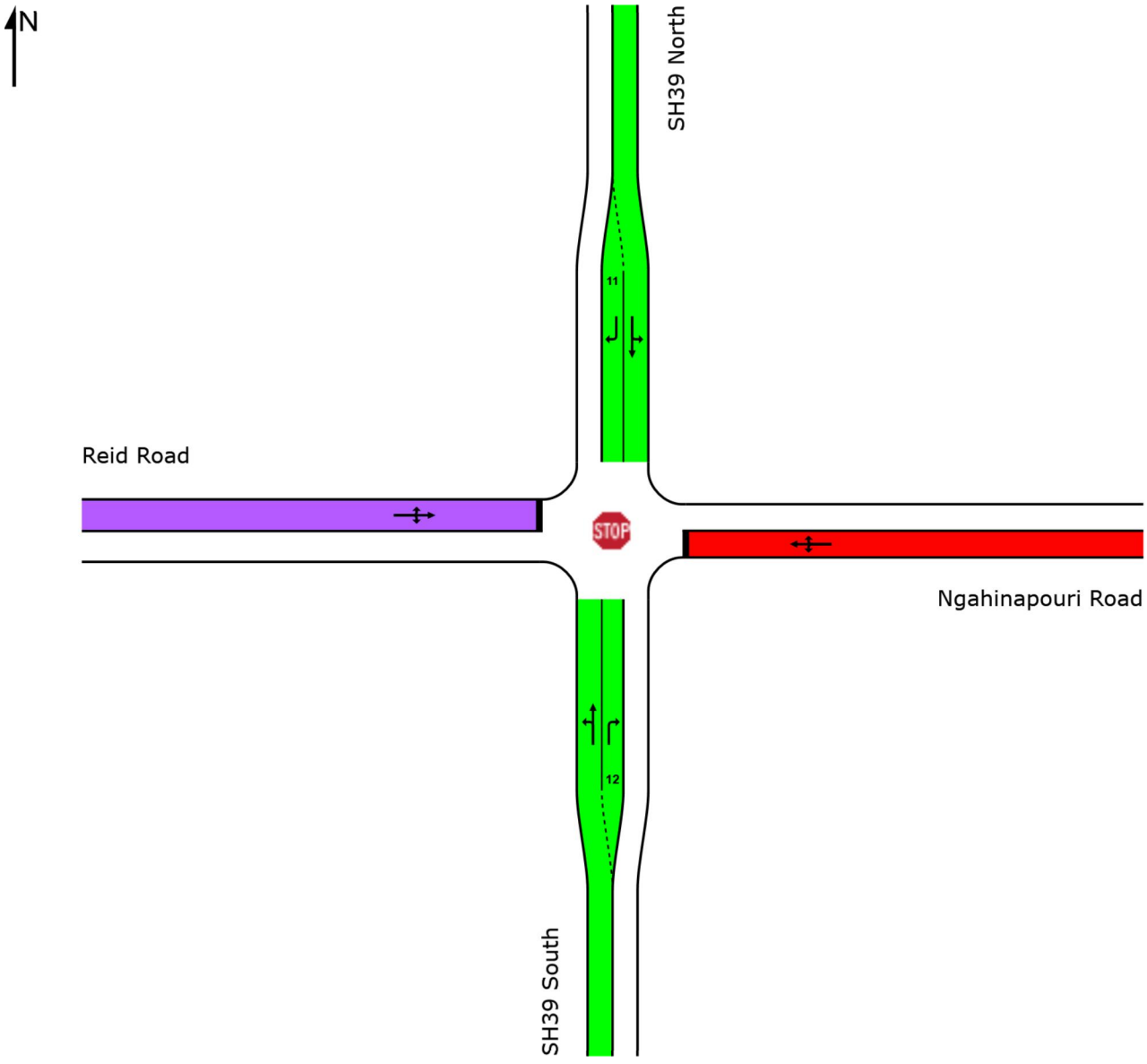
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101vv [Do Min - 2035_Low Dev_AM]

New Site
Site Category: (None)
Stop (Two-Way)

	Approaches				Intersection
	South	East	North	West	
LOS	NA	F	NA	D	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

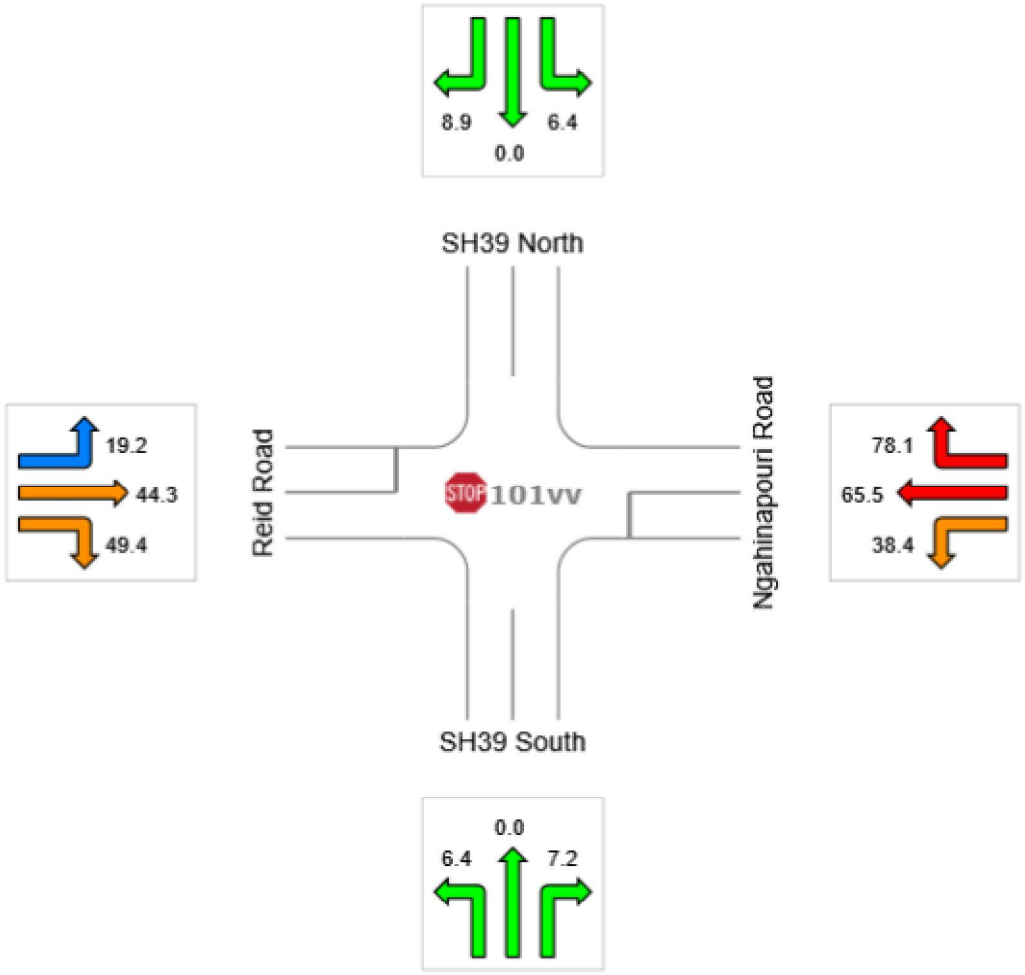
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101vv [Do Min - 2035_Low Dev_AM]

New Site
Site Category: (None)
Stop (Two-Way)

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	2.1	68.7	2.2	27.8	9.5
LOS	NA	F	NA	D	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101vv [Do Min - 2035_Low Dev_PM]

New Site
Site Category: (None)
Stop (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	63.7	km/h	63.7	km/h
Travel Distance (Total)	1206.8	veh-km/h	1448.1	pers-km/h
Travel Time (Total)	18.9	veh-h/h	22.7	pers-h/h
Demand Flows (Total)	1193	veh/h	1431	pers/h
Percent Heavy Vehicles (Demand)	7.7	%		
Degree of Saturation	0.390			
Practical Spare Capacity	151.3	%		
Effective Intersection Capacity	3059	veh/h		
Control Delay (Total)	1.35	veh-h/h	1.63	pers-h/h
Control Delay (Average)	4.1	sec	4.1	sec
Control Delay (Worst Lane)	37.6	sec		
Control Delay (Worst Movement)	44.9	sec	44.9	sec
Geometric Delay (Average)	2.4	sec		
Stop-Line Delay (Average)	1.7	sec		
Idling Time (Average)	1.3	sec		
Intersection Level of Service (LOS)	NA			
95% Back of Queue - Vehicles (Worst Lane)	0.9	veh		
95% Back of Queue - Distance (Worst Lane)	6.5	m		
Queue Storage Ratio (Worst Lane)	0.01			
Total Effective Stops	311	veh/h	373	pers/h
Effective Stop Rate	0.26		0.26	
Proportion Queued	0.11		0.11	
Performance Index	22.4		22.4	
Cost (Total)	510.26	$/h	510.26	$/h
Fuel Consumption (Total)	105.7	L/h		
Carbon Dioxide (Total)	253.2	kg/h		
Hydrocarbons (Total)	0.022	kg/h		
Carbon Monoxide (Total)	0.361	kg/h		
NOx (Total)	0.489	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 4.6 %
Number of Iterations: 7 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 2.7% 1.3% 0.6%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	572,463	veh/y	686,956	pers/y
Delay	650	veh-h/y	780	pers-h/y
Effective Stops	149,281	veh/y	179,138	pers/y
Travel Distance	579,256	veh-km/y	695,108	pers-km/y
Travel Time	9,095	veh-h/y	10,914	pers-h/y
Cost	244,925	$/y	244,925	$/y
Fuel Consumption	50,718	L/y		
Carbon Dioxide	121,549	kg/y		
Hydrocarbons	11	kg/y		
Carbon Monoxide	173	kg/y		
NOx	235	kg/y		

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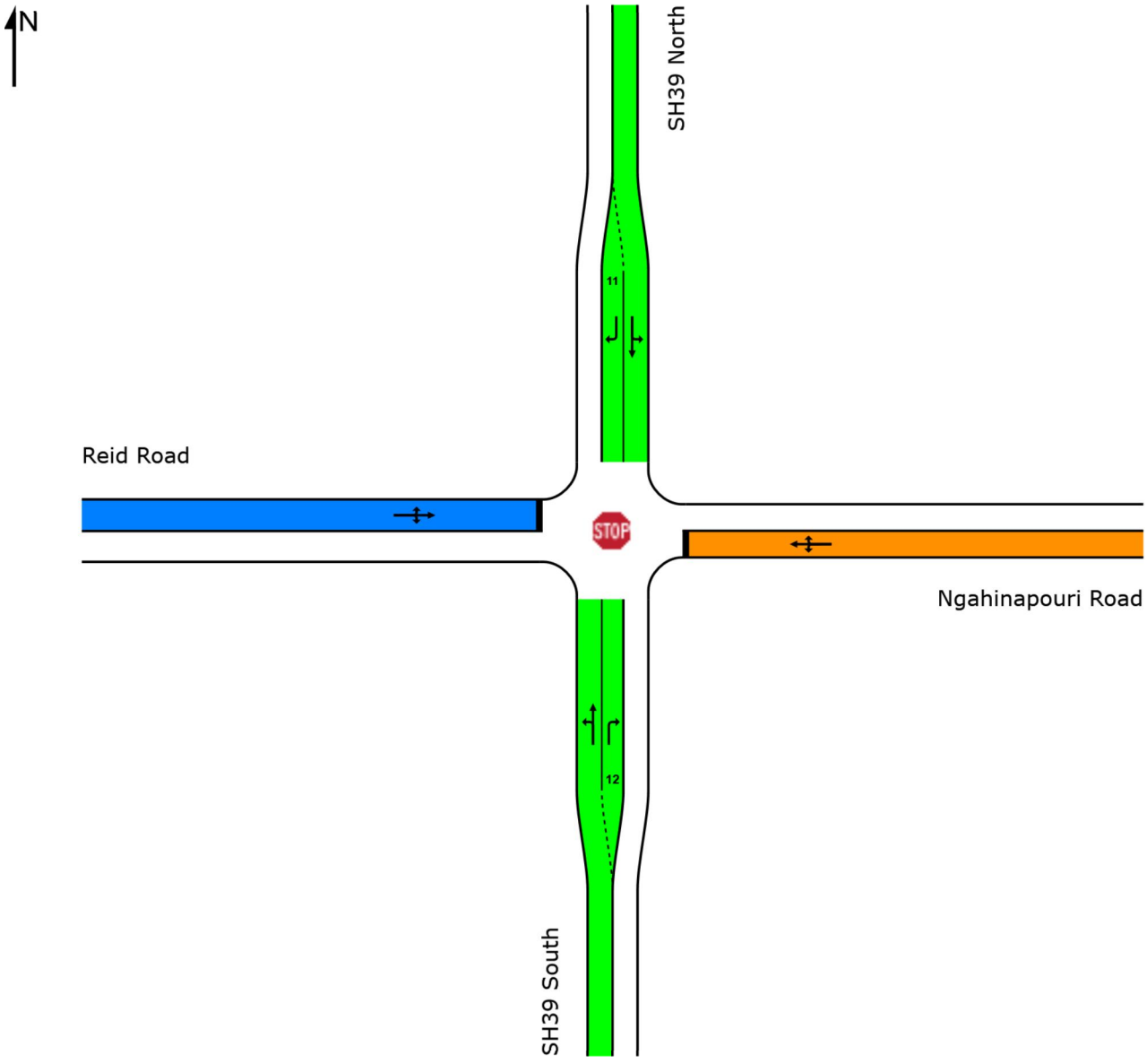
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101vv [Do Min - 2035_Low Dev_PM]

New Site
Site Category: (None)
Stop (Two-Way)

	Approaches				Intersection
	South	East	North	West	
LOS	NA	E	NA	C	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

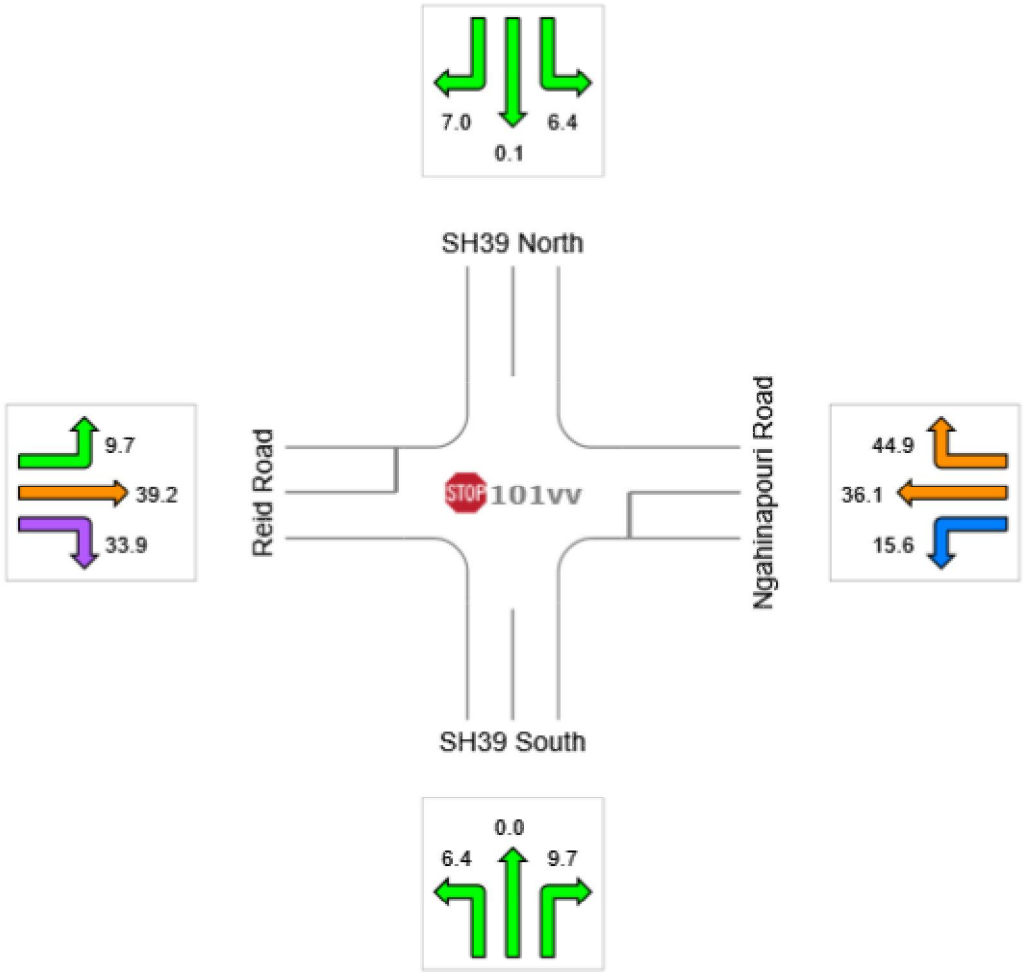
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101vv [Do Min - 2035_Low Dev_PM]

New Site
Site Category: (None)
Stop (Two-Way)

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	2.6	37.6	2.0	17.5	4.1
LOS	NA	E	NA	C	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101 [Do Min - 2035_Hi Dev_AM]

New Site
Site Category: (None)
Stop (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	47.3	km/h	47.3	km/h
Travel Distance (Total)	1479.8	veh-km/h	1775.7	pers-km/h
Travel Time (Total)	31.3	veh-h/h	37.5	pers-h/h
Demand Flows (Total)	1462	veh/h	1755	pers/h
Percent Heavy Vehicles (Demand)	6.3	%		
Degree of Saturation	0.981			
Practical Spare Capacity	-18.5	%		
Effective Intersection Capacity	1490	veh/h		
Control Delay (Total)	9.72	veh-h/h	11.67	pers-h/h
Control Delay (Average)	23.9	sec	23.9	sec
Control Delay (Worst Lane)	113.2	sec		
Control Delay (Worst Movement)	125.6	sec	125.6	sec
Geometric Delay (Average)	3.5	sec		
Stop-Line Delay (Average)	20.5	sec		
Idling Time (Average)	15.5	sec		
Intersection Level of Service (LOS)	NA			
95% Back of Queue - Vehicles (Worst Lane)	15.4	veh		
95% Back of Queue - Distance (Worst Lane)	107.5	m		
Queue Storage Ratio (Worst Lane)	0.09			
Total Effective Stops	889	veh/h	1067	pers/h
Effective Stop Rate	0.61		0.61	
Proportion Queued	0.29		0.29	
Performance Index	60.9		60.9	
Cost (Total)	925.27	$/h	925.27	$/h
Fuel Consumption (Total)	141.4	L/h		
Carbon Dioxide (Total)	337.2	kg/h		
Hydrocarbons (Total)	0.031	kg/h		
Carbon Monoxide (Total)	0.466	kg/h		
NOx (Total)	0.515	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 2.4 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 4.2% 2.0% 1.0%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	701,811	veh/y	842,173	pers/y
Delay	4,668	veh-h/y	5,601	pers-h/y
Effective Stops	426,831	veh/y	512,197	pers/y
Travel Distance	710,292	veh-km/y	852,350	pers-km/y
Travel Time	15,010	veh-h/y	18,013	pers-h/y
Cost	444,129	$/y	444,129	$/y
Fuel Consumption	67,878	L/y		
Carbon Dioxide	161,864	kg/y		
Hydrocarbons	15	kg/y		
Carbon Monoxide	224	kg/y		
NOx	247	kg/y		

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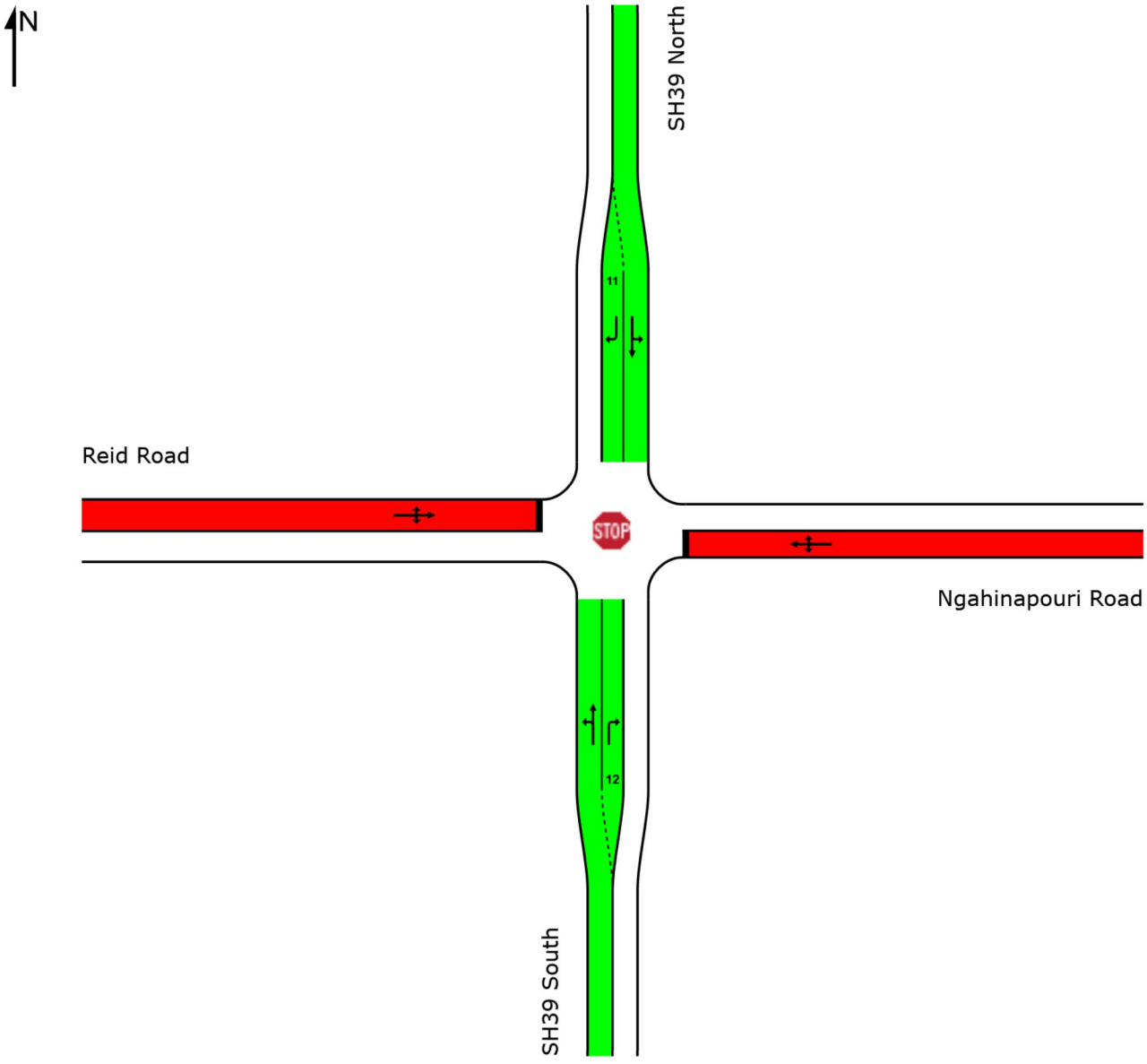
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101 [Do Min - 2035_Hi Dev_AM]

New Site
Site Category: (None)
Stop (Two-Way)

	Approaches				Intersection
	South	East	North	West	
LOS	NA	F	NA	F	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

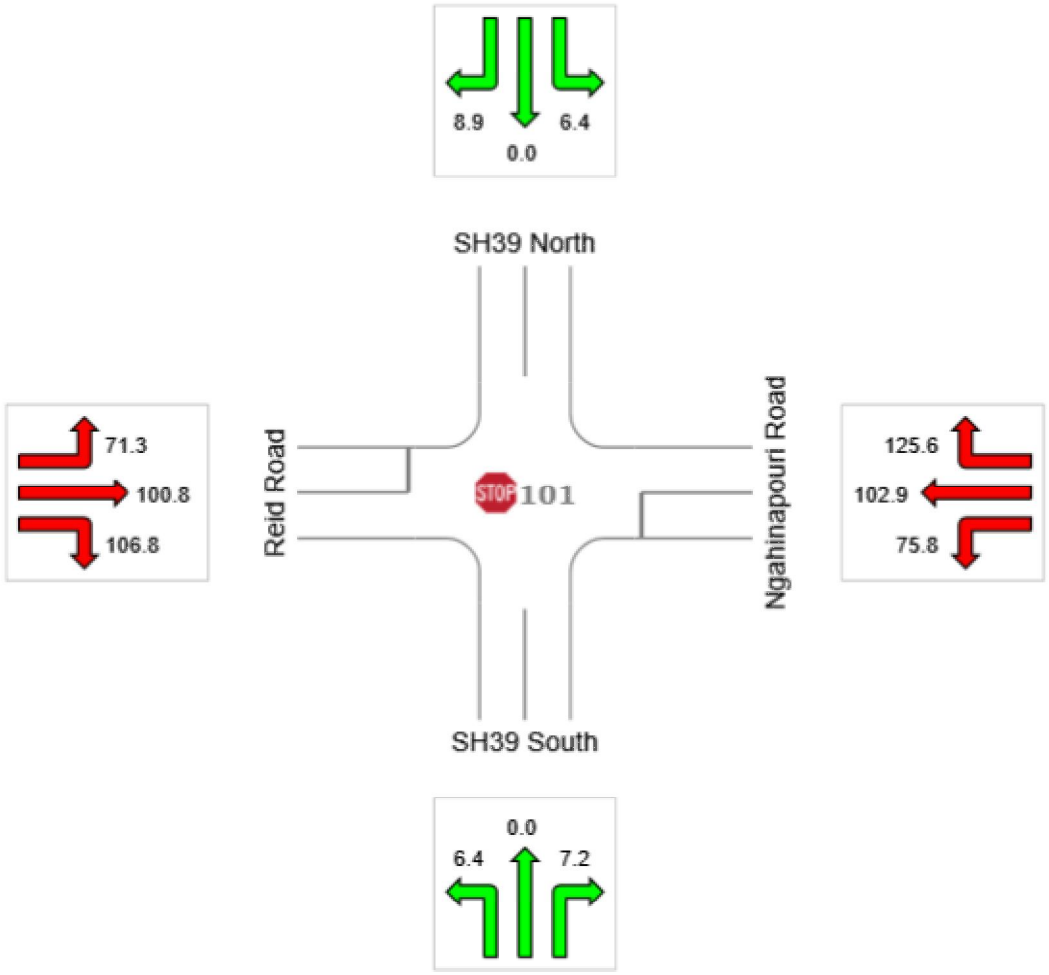
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101 [Do Min - 2035_Hi Dev_AM]

New Site
Site Category: (None)
Stop (Two-Way)

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	2.1	113.2	2.2	81.4	23.9
LOS	NA	F	NA	F	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101 [Do Min - 2035_Hi Dev_PM]

New Site
Site Category: (None)
Stop (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	63.0	km/h	63.0	km/h
Travel Distance (Total)	1248.4	veh-km/h	1498.1	pers-km/h
Travel Time (Total)	19.8	veh-h/h	23.8	pers-h/h
Demand Flows (Total)	1234	veh/h	1480	pers/h
Percent Heavy Vehicles (Demand)	7.5	%		
Degree of Saturation	0.390			
Practical Spare Capacity	151.3	%		
Effective Intersection Capacity	3164	veh/h		
Control Delay (Total)	1.62	veh-h/h	1.94	pers-h/h
Control Delay (Average)	4.7	sec	4.7	sec
Control Delay (Worst Lane)	40.6	sec		
Control Delay (Worst Movement)	48.7	sec	48.7	sec
Geometric Delay (Average)	2.6	sec		
Stop-Line Delay (Average)	2.1	sec		
Idling Time (Average)	1.7	sec		
Intersection Level of Service (LOS)	NA			
95% Back of Queue - Vehicles (Worst Lane)	1.1	veh		
95% Back of Queue - Distance (Worst Lane)	7.8	m		
Queue Storage Ratio (Worst Lane)	0.01			
Total Effective Stops	351	veh/h	422	pers/h
Effective Stop Rate	0.28		0.28	
Proportion Queued	0.13		0.13	
Performance Index	24.2		24.2	
Cost (Total)	538.28	$/h	538.28	$/h
Fuel Consumption (Total)	109.7	L/h		
Carbon Dioxide (Total)	262.8	kg/h		
Hydrocarbons (Total)	0.023	kg/h		
Carbon Monoxide (Total)	0.375	kg/h		
NOx (Total)	0.492	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 4.6 %
Number of Iterations: 7 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 2.7% 1.3% 0.6%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	592,168	veh/y	710,602	pers/y
Delay	776	veh-h/y	931	pers-h/y
Effective Stops	168,613	veh/y	202,336	pers/y
Travel Distance	599,253	veh-km/y	719,103	pers-km/y
Travel Time	9,514	veh-h/y	11,417	pers-h/y
Cost	258,376	$/y	258,376	$/y
Fuel Consumption	52,664	L/y		
Carbon Dioxide	126,121	kg/y		
Hydrocarbons	11	kg/y		
Carbon Monoxide	180	kg/y		
NOx	236	kg/y		

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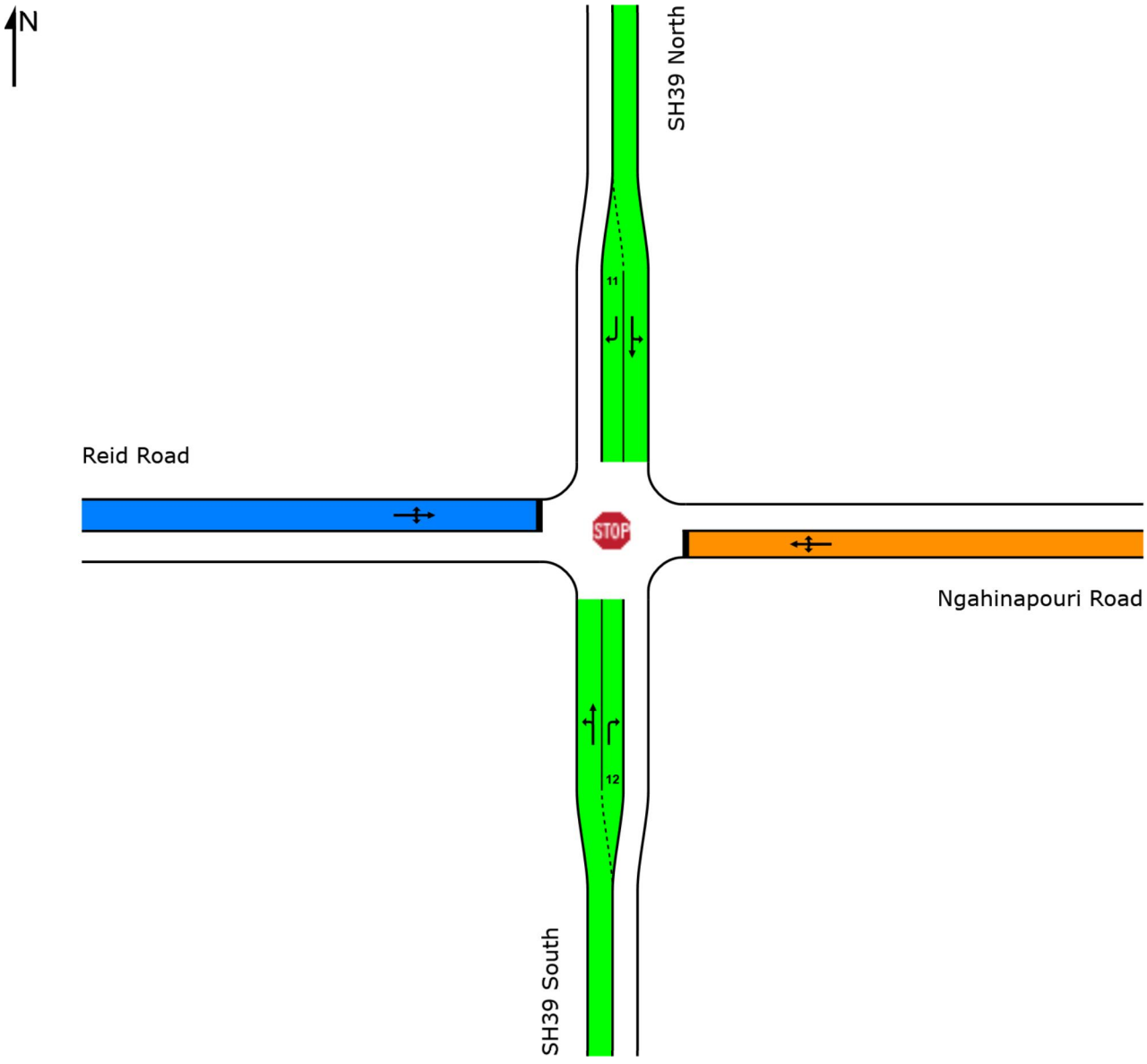
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101 [Do Min - 2035_Hi Dev_PM]

New Site
Site Category: (None)
Stop (Two-Way)

	Approaches				Intersection
	South	East	North	West	
LOS	NA	E	NA	C	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

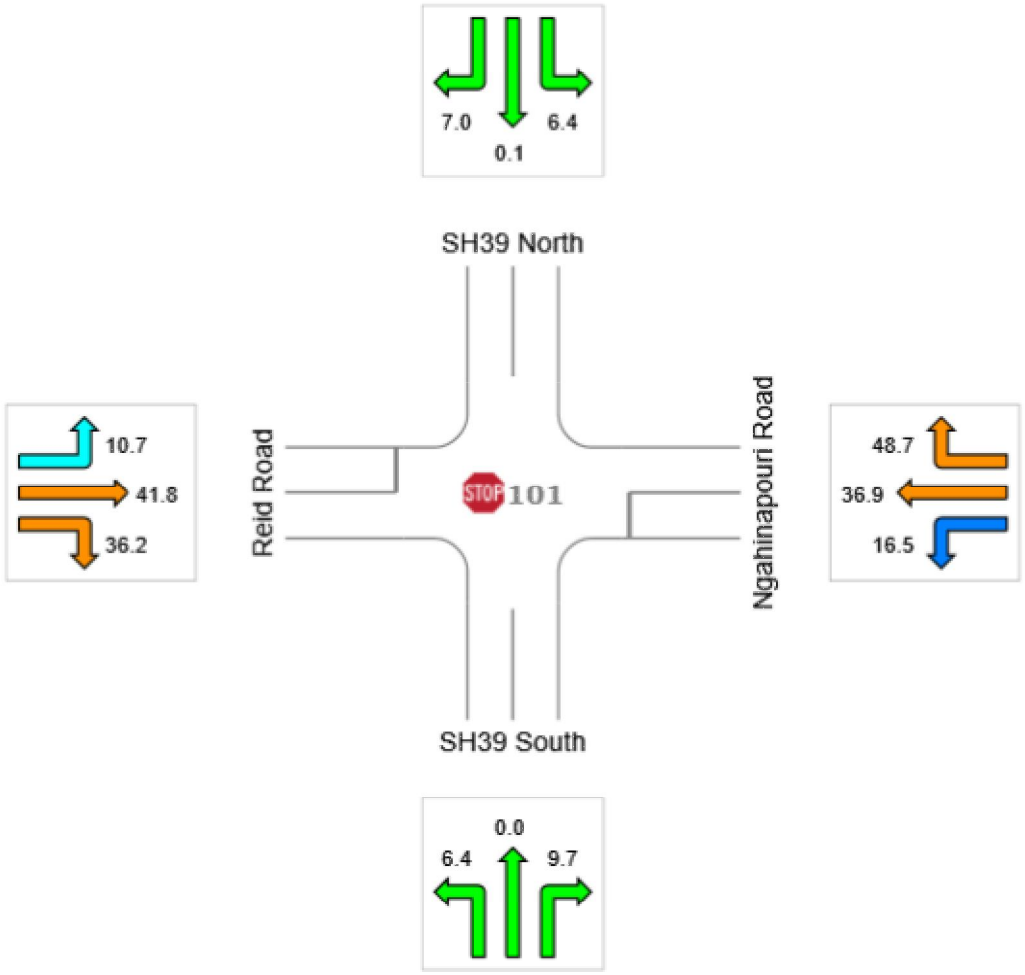
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101 [Do Min - 2035_Hi Dev_PM]

New Site
Site Category: (None)
Stop (Two-Way)

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	2.6	40.6	2.0	18.7	4.7
LOS	NA	E	NA	C	NA



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

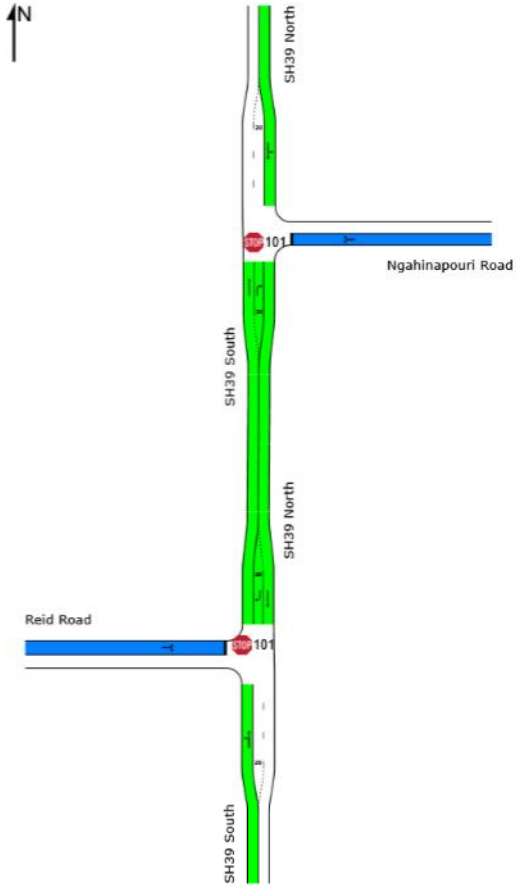
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

LANE LEVEL OF SERVICE

Lane Level of Service for Network Sites

Network: N101 [2018_Hi Dev_Staggered T_AM]

New Network
Network Category: (None)



Colour code based on Level of Service

LOS A	LOS B	LOS C	LOS D	LOS E	LOS F

Delay model settings are specified for individual Sites forming the Network.

Organisation: TONKIN & TAYLOR | Processed: Wednesday, 12 June 2019 10:43:02 AM
Project: \\ttgroup.local\corporate\Hamilton\Projects\1008305\1008305.1000\WorkingMaterial\Traffic\Modelling\SIDRA\Ngahinapouri\N_Reid SH39 Int.sip8

NETWORK SUMMARY

Network: N101 [2018_Hi Dev_Staggered T_PM]

New Network
Network Category: (None)

Network Performance - Hourly Values						
Performance Measure	**Vehicles**		**Per Unit Distance**		**Persons**	
Network Level of Service (LOS)	LOS A[3]					
Travel Time Index	13.32					
Speed Efficiency	1.30					
Congestion Coefficient	0.77					
Travel Speed (Average)	64.9	km/h			64.9	km/h
Travel Distance (Total)	1053.3	veh-km/h			1264.0	pers-km/h
Travel Time (Total)	16.2	veh-h/h			19.5	pers-h/h
Desired Speed	50.0	km/h				
Demand Flows (Total for all Sites)	1703	veh/h			2044	pers/h
Arrival Flows (Total for all Sites)	1703	veh/h			2044	pers/h
Demand Flows (Entry Total)	943	veh/h				
Midblock Inflows (Total)	7	veh/h				
Midblock Outflows (Total)	-7	veh/h				
Percent Heavy Vehicles (Demand)	9.3	%				
Percent Heavy Vehicles (Arrival)	9.3	%				
Degree of Saturation	0.320					
Control Delay (Total)	0.93	veh-h/h			1.11	pers-h/h
Control Delay (Average)	2.0	sec			2.0	sec
Control Delay (Worst Lane)	16.0	sec				
Control Delay (Worst Movement)	18.1	sec			18.1	sec
Geometric Delay (Average)	1.5	sec				
Stop-Line Delay (Average)	0.4	sec				
Queue Storage Ratio (Worst Lane)	0.00					
Total Effective Stops	280	veh/h			336	pers/h
Effective Stop Rate	0.16		0.27	per km	0.16	
Proportion Queued	0.06				0.06	
Performance Index	18.3				18.3	
Cost (Total)	470.51	$/h	0.45	$/km	470.51	$/h
Fuel Consumption (Total)	95.1	L/h	90.3	mL/km		
Fuel Economy	9.0	L/100km				
Carbon Dioxide (Total)	228.0	kg/h	216.5	g/km		
Hydrocarbons (Total)	0.020	kg/h	0.019	g/km		
Carbon Monoxide (Total)	0.318	kg/h	0.302	g/km		
NOx (Total)	0.483	kg/h	0.458	g/km		

Network Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation or Queue Storage Ratios for the last three Network Iterations: 0.0% 0.0% 0.0%
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Software Setup used: New Zealand.

3 Calculated Average Speed exceeds the specified Desired Speed.

Network Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total for all Sites)	817,516	veh/y	981,019	pers/y
Delay	445	veh-h/y	534	pers-h/y
Effective Stops	134,413	veh/y	161,295	pers/y
Travel Distance	505,593	veh-km/y	606,712	pers-km/y
Travel Time	7,786	veh-h/y	9,343	pers-h/y
Cost	225,847	$/y	225,847	$/y
Fuel Consumption	45,670	L/y		
Carbon Dioxide	109,464	kg/y		
Hydrocarbons	9	kg/y		
Carbon Monoxide	152	kg/y		

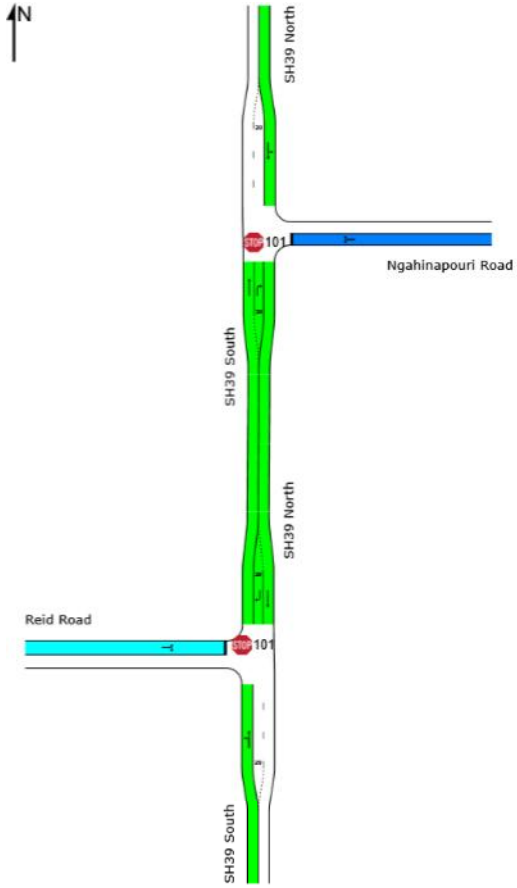
NOx	232 kg/y

LANE LEVEL OF SERVICE

Lane Level of Service for Network Sites

Network: N101 [2018_Hi Dev_Staggered T_PM]

New Network
Network Category: (None)



Colour code based on Level of Service

LOS A	LOS B	LOS C	LOS D	LOS E	LOS F

Delay model settings are specified for individual Sites forming the Network.

Organisation: TONKIN & TAYLOR | Processed: Wednesday, 12 June 2019 10:43:04 AM
Project: \\ttgroup.local\corporate\Hamilton\Projects\1008305\1008305.1000\WorkingMaterial\Traffic\Modelling\SIDRA\Ngahinapouri\N_Reid SH39 Int.sip8

NETWORK SUMMARY

Network: N101 [2035_Low Dev_Staggered T_AM]

New Network
Network Category: (None)

Network Performance - Hourly Values						
Performance Measure	**Vehicles**		**Per Unit Distance**		**Persons**	
Network Level of Service (LOS)	LOS A[3]					
Travel Time Index	12.71					
Speed Efficiency	1.24					
Congestion Coefficient	0.80					
Travel Speed (Average)	62.2	km/h			62.2	km/h
Travel Distance (Total)	1553.3	veh-km/h			1864.0	pers-km/h
Travel Time (Total)	25.0	veh-h/h			30.0	pers-h/h
Desired Speed	50.0	km/h				
Demand Flows (Total for all Sites)	2531	veh/h			3037	pers/h
Arrival Flows (Total for all Sites)	2531	veh/h			3037	pers/h
Demand Flows (Entry Total)	1340	veh/h				
Midblock Inflows (Total)	87	veh/h				
Midblock Outflows (Total)	-1	veh/h				
Percent Heavy Vehicles (Demand)	9.2	%				
Percent Heavy Vehicles (Arrival)	9.2	%				
Degree of Saturation	0.481					
Control Delay (Total)	2.46	veh-h/h			2.95	pers-h/h
Control Delay (Average)	3.5	sec			3.5	sec
Control Delay (Worst Lane)	36.3	sec				
Control Delay (Worst Movement)	44.1	sec			44.1	sec
Geometric Delay (Average)	1.7	sec				
Stop-Line Delay (Average)	1.8	sec				
Queue Storage Ratio (Worst Lane)	0.01					
Total Effective Stops	492	veh/h			590	pers/h
Effective Stop Rate	0.19		0.32	per km	0.19	
Proportion Queued	0.12				0.12	
Performance Index	30.7				30.7	
Cost (Total)	726.86	$/h	0.47	$/km	726.86	$/h
Fuel Consumption (Total)	142.8	L/h	91.9	mL/km		
Fuel Economy	9.2	L/100km				
Carbon Dioxide (Total)	342.2	kg/h	220.3	g/km		
Hydrocarbons (Total)	0.030	kg/h	0.019	g/km		
Carbon Monoxide (Total)	0.473	kg/h	0.304	g/km		
NOx (Total)	0.713	kg/h	0.459	g/km		

Network Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation or Queue Storage Ratios for the last three Network Iterations: 0.0% 0.0% 0.0%
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Software Setup used: New Zealand.

3 Calculated Average Speed exceeds the specified Desired Speed.

Network Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total for all Sites)	1,214,653	veh/y	1,457,583	pers/y
Delay	1,178	veh-h/y	1,414	pers-h/y
Effective Stops	236,093	veh/y	283,312	pers/y
Travel Distance	745,596	veh-km/y	894,715	pers-km/y
Travel Time	11,984	veh-h/y	14,381	pers-h/y
Cost	348,891	$/y	348,891	$/y
Fuel Consumption	68,544	L/y		
Carbon Dioxide	164,254	kg/y		
Hydrocarbons	14	kg/y		
Carbon Monoxide	227	kg/y		

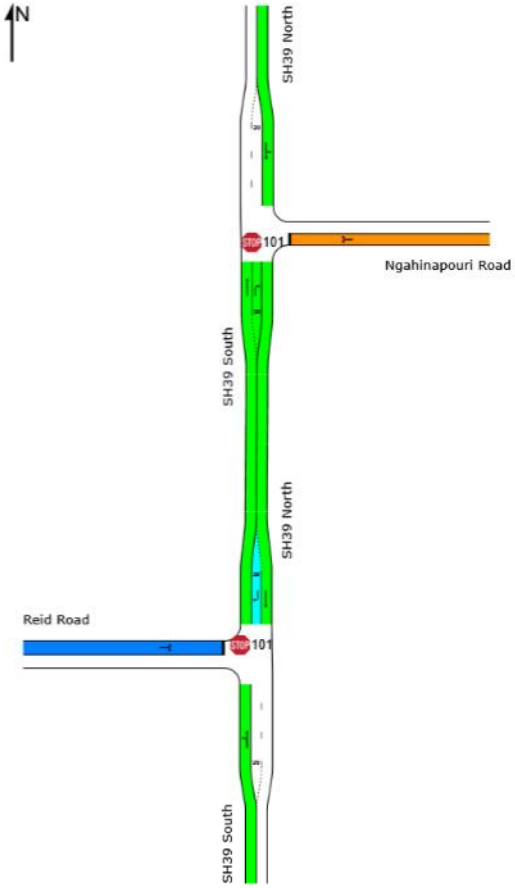
NOx	342 kg/y

LANE LEVEL OF SERVICE

Lane Level of Service for Network Sites

Network: N101 [2035_Low Dev_Staggered T_AM]

New Network
Network Category: (None)



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Delay model settings are specified for individual Sites forming the Network.

Organisation: TONKIN & TAYLOR | Processed: Wednesday, 12 June 2019 10:43:07 AM
Project: \\ttgroup.local\corporate\Hamilton\Projects\1008305\1008305.1000\WorkingMaterial\Traffic\Modelling\SIDRA\Ngahinapouri\N_Reid SH39 Int.sip8

NETWORK SUMMARY

Network: N101 [2035_Low Dev_Staggered T_PM]

New Network
Network Category: (None)

Network Performance - Hourly Values						
Performance Measure	**Vehicles**		**Per Unit Distance**		**Persons**	
Network Level of Service (LOS)	LOS A[3]					
Travel Time Index	13.33					
Speed Efficiency	1.30					
Congestion Coefficient	0.77					
Travel Speed (Average)	65.0	km/h			65.0	km/h
Travel Distance (Total)	1350.6	veh-km/h			1620.7	pers-km/h
Travel Time (Total)	20.8	veh-h/h			24.9	pers-h/h
Desired Speed	50.0	km/h				
Demand Flows (Total for all Sites)	2185	veh/h			2622	pers/h
Arrival Flows (Total for all Sites)	2185	veh/h			2622	pers/h
Demand Flows (Entry Total)	1193	veh/h				
Midblock Inflows (Total)	37	veh/h				
Midblock Outflows (Total)	-7	veh/h				
Percent Heavy Vehicles (Demand)	9.6	%				
Percent Heavy Vehicles (Arrival)	9.6	%				
Degree of Saturation	0.429					
Control Delay (Total)	1.16	veh-h/h			1.40	pers-h/h
Control Delay (Average)	1.9	sec			1.9	sec
Control Delay (Worst Lane)	22.9	sec				
Control Delay (Worst Movement)	27.5	sec			27.5	sec
Geometric Delay (Average)	1.3	sec				
Stop-Line Delay (Average)	0.6	sec				
Queue Storage Ratio (Worst Lane)	0.00					
Total Effective Stops	322	veh/h			386	pers/h
Effective Stop Rate	0.15		0.24	per km	0.15	
Proportion Queued	0.06				0.06	
Performance Index	23.2				23.2	
Cost (Total)	592.61	$/h	0.44	$/km	592.61	$/h
Fuel Consumption (Total)	121.1	L/h	89.6	mL/km		
Fuel Economy	9.0	L/100km				
Carbon Dioxide (Total)	290.4	kg/h	215.0	g/km		
Hydrocarbons (Total)	0.025	kg/h	0.018	g/km		
Carbon Monoxide (Total)	0.403	kg/h	0.299	g/km		
NOx (Total)	0.634	kg/h	0.469	g/km		

Network Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation or Queue Storage Ratios for the last three Network Iterations: 0.0% 0.0% 0.0%
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Software Setup used: New Zealand.

3 Calculated Average Speed exceeds the specified Desired Speed.

Network Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total for all Sites)	1,048,927	veh/y	1,258,712	pers/y
Delay	559	veh-h/y	671	pers-h/y
Effective Stops	154,344	veh/y	185,213	pers/y
Travel Distance	648,288	veh-km/y	777,946	pers-km/y
Travel Time	9,975	veh-h/y	11,970	pers-h/y
Cost	284,452	$/y	284,452	$/y
Fuel Consumption	58,113	L/y		
Carbon Dioxide	139,378	kg/y		
Hydrocarbons	12	kg/y		
Carbon Monoxide	194	kg/y		

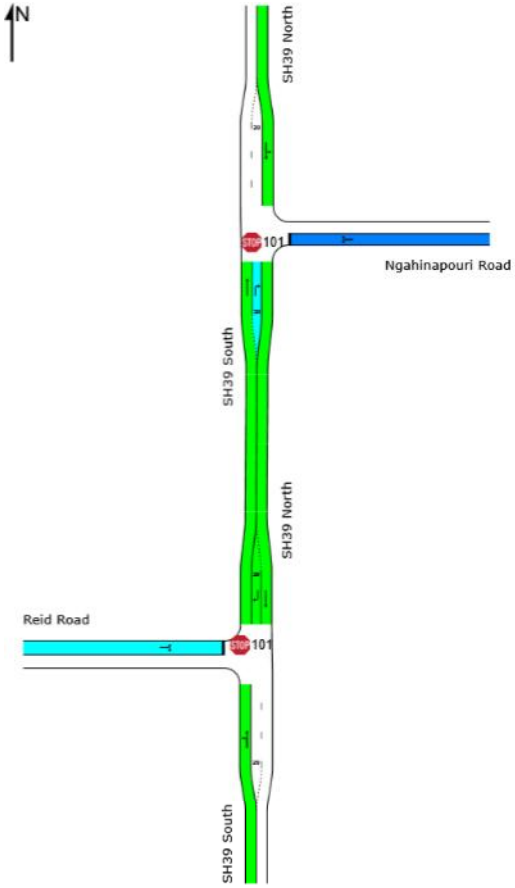
NOx	304 kg/y

LANE LEVEL OF SERVICE

Lane Level of Service for Network Sites

Network: N101 [2035_Low Dev_Staggered T_PM]

New Network
Network Category: (None)



Colour code based on Level of Service

LOS A	LOS B	LOS C	LOS D	LOS E	LOS F

Delay model settings are specified for individual Sites forming the Network.

Organisation: TONKIN & TAYLOR | Processed: Wednesday, 12 June 2019 10:43:09 AM
Project: \\ttgroup.local\corporate\Hamilton\Projects\1008305\1008305.1000\WorkingMaterial\Traffic\Modelling\SIDRA\Ngahinapouri\N_Reid SH39 Int.sip8

NETWORK SUMMARY

Network: N101 [2035_Hi Dev_Staggered T_AM]

New Network
Network Category: (None)

Network Performance - Hourly Values						
Performance Measure	**Vehicles**		**Per Unit Distance**		**Persons**	
Network Level of Service (LOS)	LOS A[3]					
Travel Time Index	12.21					
Speed Efficiency	1.20					
Congestion Coefficient	0.83					
Travel Speed (Average)	59.9	km/h			59.9	km/h
Travel Distance (Total)	1636.1	veh-km/h			1963.3	pers-km/h
Travel Time (Total)	27.3	veh-h/h			32.8	pers-h/h
Desired Speed	50.0	km/h				
Demand Flows (Total for all Sites)	2664	veh/h			3197	pers/h
Arrival Flows (Total for all Sites)	2664	veh/h			3197	pers/h
Demand Flows (Entry Total)	1462	veh/h				
Midblock Inflows (Total)	5	veh/h				
Midblock Outflows (Total)	-5	veh/h				
Percent Heavy Vehicles (Demand)	8.7	%				
Percent Heavy Vehicles (Arrival)	8.7	%				
Degree of Saturation	0.693					
Control Delay (Total)	3.64	veh-h/h			4.37	pers-h/h
Control Delay (Average)	4.9	sec			4.9	sec
Control Delay (Worst Lane)	37.2	sec				
Control Delay (Worst Movement)	45.2	sec			45.2	sec
Geometric Delay (Average)	2.0	sec				
Stop-Line Delay (Average)	2.9	sec				
Queue Storage Ratio (Worst Lane)	0.03					
Total Effective Stops	677	veh/h			812	pers/h
Effective Stop Rate	0.25		0.41	per km	0.25	
Proportion Queued	0.16				0.16	
Performance Index	36.3				36.3	
Cost (Total)	824.58	$/h	0.50	$/km	824.58	$/h
Fuel Consumption (Total)	153.5	L/h	93.8	mL/km		
Fuel Economy	9.4	L/100km				
Carbon Dioxide (Total)	367.3	kg/h	224.5	g/km		
Hydrocarbons (Total)	0.032	kg/h	0.020	g/km		
Carbon Monoxide (Total)	0.506	kg/h	0.309	g/km		
NOx (Total)	0.722	kg/h	0.442	g/km		

Network Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation or Queue Storage Ratios for the last three Network Iterations: 0.0% 0.0% 0.0%
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Software Setup used: New Zealand.

3 Calculated Average Speed exceeds the specified Desired Speed.

Network Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total for all Sites)	1,278,821	veh/y	1,534,585	pers/y
Delay	1,747	veh-h/y	2,097	pers-h/y
Effective Stops	324,922	veh/y	389,906	pers/y
Travel Distance	785,324	veh-km/y	942,389	pers-km/y
Travel Time	13,104	veh-h/y	15,724	pers-h/y
Cost	395,797	$/y	395,797	$/y
Fuel Consumption	73,675	L/y		
Carbon Dioxide	176,313	kg/y		
Hydrocarbons	15	kg/y		
Carbon Monoxide	243	kg/y		

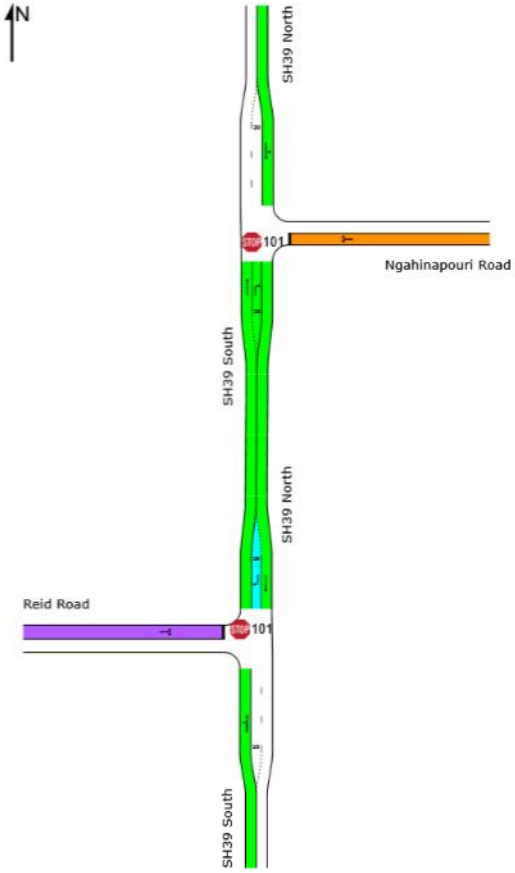
NOx	347 kg/y

LANE LEVEL OF SERVICE

Lane Level of Service for Network Sites

Network: N101 [2035_Hi Dev_Staggered T_AM]

New Network
Network Category: (None)



Colour code based on Level of Service

LOS A LOS B LOS C LOS D LOS E LOS F

Delay model settings are specified for individual Sites forming the Network.

Organisation: TONKIN & TAYLOR | Processed: Wednesday, 12 June 2019 10:43:12 AM
Project: \\ttgroup.local\corporate\Hamilton\Projects\1008305\1008305.1000\WorkingMaterial\Traffic\Modelling\SIDRA\Ngahinapouri\N_Reid SH39 Int.sip8

NETWORK SUMMARY

Network: N101 [2035_Hi Dev_Staggered T_PM]

New Network
Network Category: (None)

Network Performance - Hourly Values						
Performance Measure	**Vehicles**		**Per Unit Distance**		**Persons**	
Network Level of Service (LOS)	LOS A[3]					
Travel Time Index	13.25					
Speed Efficiency	1.29					
Congestion Coefficient	0.77					
Travel Speed (Average)	64.6	km/h			64.6	km/h
Travel Distance (Total)	1377.9	veh-km/h			1653.5	pers-km/h
Travel Time (Total)	21.3	veh-h/h			25.6	pers-h/h
Desired Speed	50.0	km/h				
Demand Flows (Total for all Sites)	2229	veh/h			2675	pers/h
Arrival Flows (Total for all Sites)	2229	veh/h			2675	pers/h
Demand Flows (Entry Total)	1234	veh/h				
Midblock Inflows (Total)	7	veh/h				
Midblock Outflows (Total)	-7	veh/h				
Percent Heavy Vehicles (Demand)	9.4	%				
Percent Heavy Vehicles (Arrival)	9.4	%				
Degree of Saturation	0.429					
Control Delay (Total)	1.32	veh-h/h			1.59	pers-h/h
Control Delay (Average)	2.1	sec			2.1	sec
Control Delay (Worst Lane)	22.9	sec				
Control Delay (Worst Movement)	27.6	sec			27.6	sec
Geometric Delay (Average)	1.5	sec				
Stop-Line Delay (Average)	0.7	sec				
Queue Storage Ratio (Worst Lane)	0.00					
Total Effective Stops	362	veh/h			435	pers/h
Effective Stop Rate	0.16		0.26	per km	0.16	
Proportion Queued	0.07				0.07	
Performance Index	24.2				24.2	
Cost (Total)	616.85	$/h	0.45	$/km	616.85	$/h
Fuel Consumption (Total)	124.2	L/h	90.2	mL/km		
Fuel Economy	9.0	L/100km				
Carbon Dioxide (Total)	297.8	kg/h	216.2	g/km		
Hydrocarbons (Total)	0.025	kg/h	0.018	g/km		
Carbon Monoxide (Total)	0.414	kg/h	0.301	g/km		
NOx (Total)	0.637	kg/h	0.462	g/km		

Network Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation or Queue Storage Ratios for the last three Network Iterations: 0.0% 0.0% 0.0%
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Software Setup used: New Zealand.

3 Calculated Average Speed exceeds the specified Desired Speed.

Network Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total for all Sites)	1,070,148	veh/y	1,284,177	pers/y
Delay	635	veh-h/y	761	pers-h/y
Effective Stops	173,847	veh/y	208,616	pers/y
Travel Distance	661,406	veh-km/y	793,687	pers-km/y
Travel Time	10,236	veh-h/y	12,284	pers-h/y
Cost	296,087	$/y	296,087	$/y
Fuel Consumption	59,639	L/y		
Carbon Dioxide	142,965	kg/y		
Hydrocarbons	12	kg/y		
Carbon Monoxide	199	kg/y		

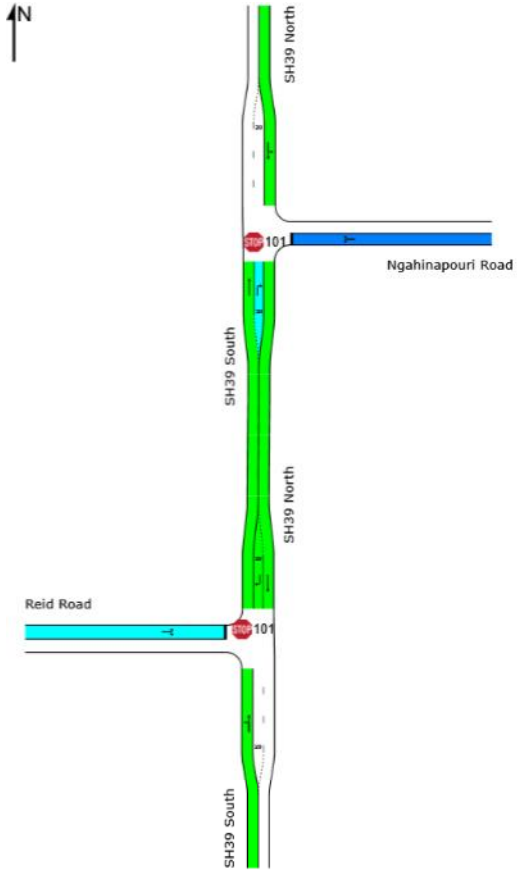
NOx	306 kg/y

LANE LEVEL OF SERVICE

Lane Level of Service for Network Sites

Network: N101 [2035_Hi Dev_Staggered T_PM]

New Network
Network Category: (None)



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Delay model settings are specified for individual Sites forming the Network.

Organisation: TONKIN & TAYLOR | Processed: Wednesday, 12 June 2019 10:43:14 AM
Project: \\ttgroup.local\corporate\Hamilton\Projects\1008305\1008305.1000\WorkingMaterial\Traffic\Modelling\SIDRA\Ngahinapouri\N_Reid SH39 Int.sip8

NETWORK SUMMARY

Network: N101 [2018_Low Dev_Staggered T_AM]

New Network
Network Category: (None)

Network Performance - Hourly Values						
Performance Measure	**Vehicles**		**Per Unit Distance**		**Persons**	
Network Level of Service (LOS)	LOS A[3]					
Travel Time Index	13.04					
Speed Efficiency	1.27					
Congestion Coefficient	0.78					
Travel Speed (Average)	63.7	km/h			63.7	km/h
Travel Distance (Total)	1170.8	veh-km/h			1404.9	pers-km/h
Travel Time (Total)	18.4	veh-h/h			22.1	pers-h/h
Desired Speed	50.0	km/h				
Demand Flows (Total for all Sites)	1915	veh/h			2298	pers/h
Arrival Flows (Total for all Sites)	1915	veh/h			2298	pers/h
Demand Flows (Entry Total)	1063	veh/h				
Midblock Inflows (Total)	1	veh/h				
Midblock Outflows (Total)	-33	veh/h				
Percent Heavy Vehicles (Demand)	9.0	%				
Percent Heavy Vehicles (Arrival)	9.0	%				
Degree of Saturation	0.339					
Control Delay (Total)	1.40	veh-h/h			1.68	pers-h/h
Control Delay (Average)	2.6	sec			2.6	sec
Control Delay (Worst Lane)	16.6	sec				
Control Delay (Worst Movement)	20.0	sec			20.0	sec
Geometric Delay (Average)	1.8	sec				
Stop-Line Delay (Average)	0.9	sec				
Queue Storage Ratio (Worst Lane)	0.01					
Total Effective Stops	381	veh/h			457	pers/h
Effective Stop Rate	0.20		0.33	per km	0.20	
Proportion Queued	0.10				0.10	
Performance Index	21.8				21.8	
Cost (Total)	547.79	$/h	0.47	$/km	547.79	$/h
Fuel Consumption (Total)	107.5	L/h	91.8	mL/km		
Fuel Economy	9.2	L/100km				
Carbon Dioxide (Total)	257.4	kg/h	219.8	g/km		
Hydrocarbons (Total)	0.022	kg/h	0.019	g/km		
Carbon Monoxide (Total)	0.358	kg/h	0.305	g/km		
NOx (Total)	0.528	kg/h	0.451	g/km		

Network Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation or Queue Storage Ratios for the last three Network Iterations: 0.0% 0.0% 0.0%
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Software Setup used: New Zealand.

3 Calculated Average Speed exceeds the specified Desired Speed.

Network Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total for all Sites)	919,074	veh/y	1,102,889	pers/y
Delay	672	veh-h/y	807	pers-h/y
Effective Stops	182,844	veh/y	219,412	pers/y
Travel Distance	561,967	veh-km/y	674,360	pers-km/y
Travel Time	8,823	veh-h/y	10,587	pers-h/y
Cost	262,939	$/y	262,939	$/y
Fuel Consumption	51,597	L/y		
Carbon Dioxide	123,541	kg/y		
Hydrocarbons	11	kg/y		
Carbon Monoxide	172	kg/y		

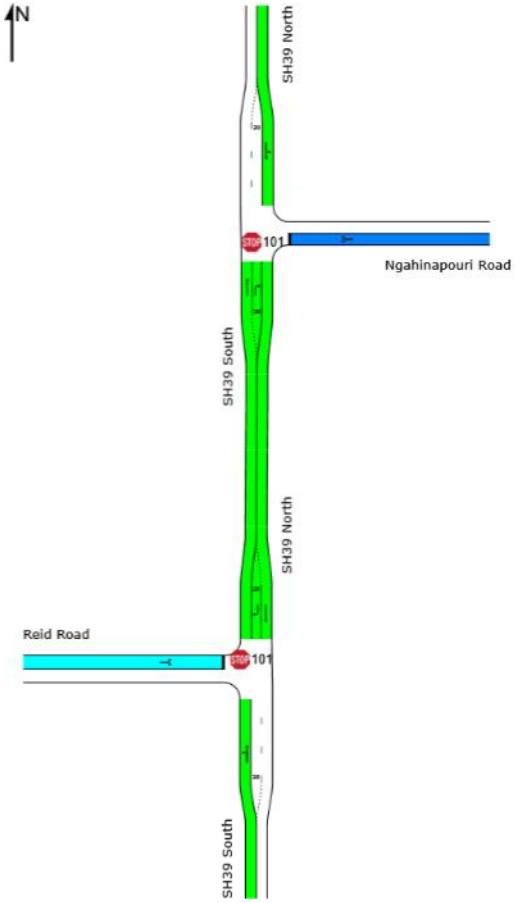
NOx	253 kg/y

LANE LEVEL OF SERVICE

Lane Level of Service for Network Sites

Network: N101 [2018_Low Dev_Staggered T_AM]

New Network
Network Category: (None)



Colour code based on Level of Service

LOS A LOS B LOS C LOS D LOS E LOS F

Delay model settings are specified for individual Sites forming the Network.

Organisation: TONKIN & TAYLOR | Processed: Wednesday, 12 June 2019 10:42:57 AM
Project: \\ttgroup.local\corporate\Hamilton\Projects\1008305\1008305.1000\WorkingMaterial\Traffic\Modelling\SIDRA\Ngahinapouri\N_Reid SH39 Int.sip8

NETWORK SUMMARY

Network: N101 [2018_Low Dev_Staggered T_PM]

New Network
Network Category: (None)

Network Performance - Hourly Values						
Performance Measure	**Vehicles**		**Per Unit Distance**		**Persons**	
Network Level of Service (LOS)	LOS A[3]					
Travel Time Index	13.40					
Speed Efficiency	1.31					
Congestion Coefficient	0.77					
Travel Speed (Average)	65.3	km/h			65.3	km/h
Travel Distance (Total)	1006.4	veh-km/h			1207.6	pers-km/h
Travel Time (Total)	15.4	veh-h/h			18.5	pers-h/h
Desired Speed	50.0	km/h				
Demand Flows (Total for all Sites)	1628	veh/h			1954	pers/h
Arrival Flows (Total for all Sites)	1628	veh/h			1954	pers/h
Demand Flows (Entry Total)	901	veh/h				
Midblock Inflows (Total)	7	veh/h				
Midblock Outflows (Total)	-7	veh/h				
Percent Heavy Vehicles (Demand)	9.5	%				
Percent Heavy Vehicles (Arrival)	9.5	%				
Degree of Saturation	0.320					
Control Delay (Total)	0.79	veh-h/h			0.94	pers-h/h
Control Delay (Average)	1.7	sec			1.7	sec
Control Delay (Worst Lane)	15.5	sec				
Control Delay (Worst Movement)	17.4	sec			17.4	sec
Geometric Delay (Average)	1.4	sec				
Stop-Line Delay (Average)	0.3	sec				
Queue Storage Ratio (Worst Lane)	0.00					
Total Effective Stops	240	veh/h			288	pers/h
Effective Stop Rate	0.15		0.24	per km	0.15	
Proportion Queued	0.06				0.06	
Performance Index	17.1				17.1	
Cost (Total)	442.85	$/h	0.44	$/km	442.85	$/h
Fuel Consumption (Total)	90.3	L/h	89.7	mL/km		
Fuel Economy	9.0	L/100km				
Carbon Dioxide (Total)	216.4	kg/h	215.1	g/km		
Hydrocarbons (Total)	0.018	kg/h	0.018	g/km		
Carbon Monoxide (Total)	0.301	kg/h	0.300	g/km		
NOx (Total)	0.468	kg/h	0.465	g/km		

Network Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation or Queue Storage Ratios for the last three Network Iterations: 0.0% 0.0% 0.0%
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Software Setup used: New Zealand.

3 Calculated Average Speed exceeds the specified Desired Speed.

Network Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total for all Sites)	781,642	veh/y	937,971	pers/y
Delay	377	veh-h/y	452	pers-h/y
Effective Stops	115,036	veh/y	138,043	pers/y
Travel Distance	483,052	veh-km/y	579,663	pers-km/y
Travel Time	7,395	veh-h/y	8,874	pers-h/y
Cost	212,570	$/y	212,570	$/y
Fuel Consumption	43,332	L/y		
Carbon Dioxide	103,895	kg/y		
Hydrocarbons	9	kg/y		
Carbon Monoxide	145	kg/y		

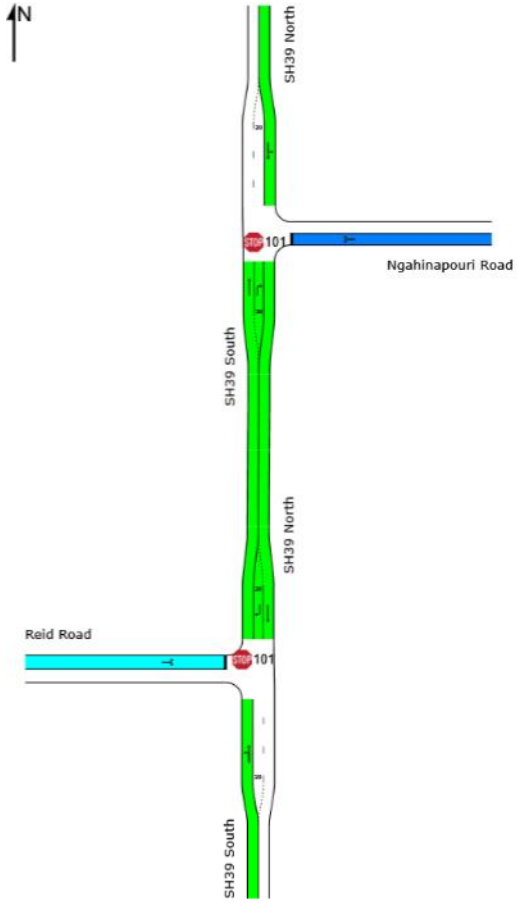
NOx	225 kg/y

LANE LEVEL OF SERVICE

Lane Level of Service for Network Sites

Network: N101 [2018_Low Dev_Staggered T_PM]

New Network
Network Category: (None)



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Delay model settings are specified for individual Sites forming the Network.

Organisation: TONKIN & TAYLOR | Processed: Wednesday, 12 June 2019 10:42:59 AM
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NETWORK SUMMARY

Network: N101 [2018_Hi Dev_Staggered T_AM]

New Network
Network Category: (None)

Network Performance - Hourly Values						
Performance Measure	**Vehicles**		**Per Unit Distance**		**Persons**	
Network Level of Service (LOS)	LOS A[3]					
Travel Time Index	12.71					
Speed Efficiency	1.24					
Congestion Coefficient	0.80					
Travel Speed (Average)	62.2	km/h			62.2	km/h
Travel Distance (Total)	1307.1	veh-km/h			1568.5	pers-km/h
Travel Time (Total)	21.0	veh-h/h			25.2	pers-h/h
Desired Speed	50.0	km/h				
Demand Flows (Total for all Sites)	2133	veh/h			2559	pers/h
Arrival Flows (Total for all Sites)	2133	veh/h			2559	pers/h
Demand Flows (Entry Total)	1185	veh/h				
Midblock Inflows (Total)	6	veh/h				
Midblock Outflows (Total)	-37	veh/h				
Percent Heavy Vehicles (Demand)	8.6	%				
Percent Heavy Vehicles (Arrival)	8.6	%				
Degree of Saturation	0.476					
Control Delay (Total)	2.12	veh-h/h			2.54	pers-h/h
Control Delay (Average)	3.6	sec			3.6	sec
Control Delay (Worst Lane)	19.1	sec				
Control Delay (Worst Movement)	23.3	sec			23.3	sec
Geometric Delay (Average)	2.1	sec				
Stop-Line Delay (Average)	1.5	sec				
Queue Storage Ratio (Worst Lane)	0.01					
Total Effective Stops	534	veh/h			641	pers/h
Effective Stop Rate	0.25		0.41	per km	0.25	
Proportion Queued	0.14				0.14	
Performance Index	26.7				26.7	
Cost (Total)	638.71	$/h	0.49	$/km	638.71	$/h
Fuel Consumption (Total)	122.1	L/h	93.4	mL/km		
Fuel Economy	9.3	L/100km				
Carbon Dioxide (Total)	292.2	kg/h	223.6	g/km		
Hydrocarbons (Total)	0.026	kg/h	0.020	g/km		
Carbon Monoxide (Total)	0.405	kg/h	0.310	g/km		
NOx (Total)	0.571	kg/h	0.437	g/km		

Network Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation or Queue Storage Ratios for the last three Network Iterations: 0.0% 0.0% 0.0%
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Software Setup used: New Zealand.

3 Calculated Average Speed exceeds the specified Desired Speed.

Network Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total for all Sites)	1,023,663	veh/y	1,228,396	pers/y
Delay	1,015	veh-h/y	1,219	pers-h/y
Effective Stops	256,271	veh/y	307,525	pers/y
Travel Distance	627,411	veh-km/y	752,893	pers-km/y
Travel Time	10,091	veh-h/y	12,109	pers-h/y
Cost	306,581	$/y	306,581	$/y
Fuel Consumption	58,623	L/y		
Carbon Dioxide	140,271	kg/y		
Hydrocarbons	12	kg/y		
Carbon Monoxide	194	kg/y		

NOx	274 kg/y

DELAY (CONTROL)

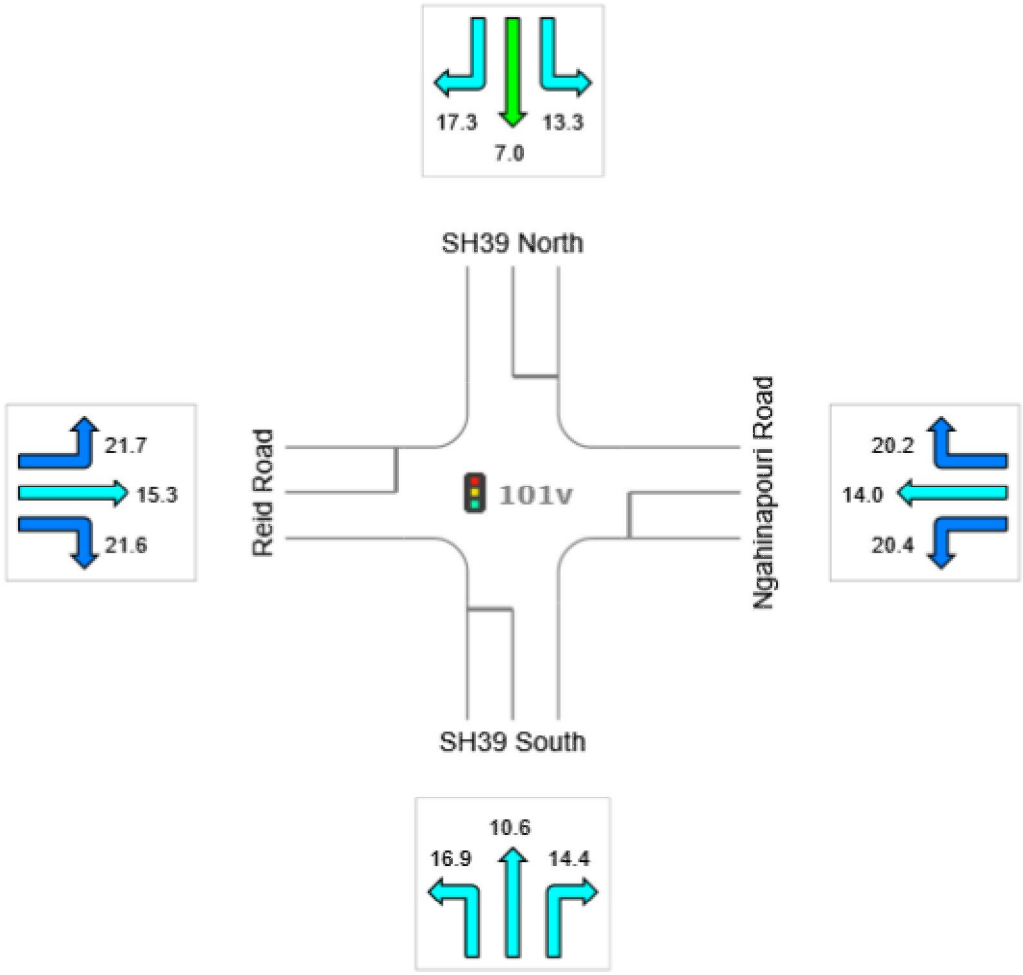
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101v [Opt2 - 2018_Hi Dev_AM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 30 seconds (Site Practical Cycle Time)

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	12.0	19.6	9.3	21.1	14.0
LOS	B	B	A	C	B



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101v [Opt2 - 2018_Hi Dev_PM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 30 seconds (Site Practical Cycle Time)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	55.0	km/h	55.0	km/h
Travel Distance (Total)	954.5	veh-km/h	1145.4	pers-km/h
Travel Time (Total)	17.4	veh-h/h	20.8	pers-h/h
Demand Flows (Total)	943	veh/h	1132	pers/h
Percent Heavy Vehicles (Demand)	7.3	%		
Degree of Saturation	0.779			
Practical Spare Capacity	15.5	%		
Effective Intersection Capacity	1210	veh/h		
Control Delay (Total)	3.42	veh-h/h	4.11	pers-h/h
Control Delay (Average)	13.1	sec	13.1	sec
Control Delay (Worst Lane)	18.7	sec		
Control Delay (Worst Movement)	18.7	sec	18.7	sec
Geometric Delay (Average)	2.4	sec		
Stop-Line Delay (Average)	10.7	sec		
Idling Time (Average)	5.7	sec		
Intersection Level of Service (LOS)	LOS B			
95% Back of Queue - Vehicles (Worst Lane)	8.1	veh		
95% Back of Queue - Distance (Worst Lane)	61.3	m		
Queue Storage Ratio (Worst Lane)	0.08			
Total Effective Stops	762	veh/h	915	pers/h
Effective Stop Rate	0.81		0.81	
Proportion Queued	0.85		0.85	
Performance Index	43.7		43.7	
Cost (Total)	625.49	$/h	625.49	$/h
Fuel Consumption (Total)	119.8	L/h		
Carbon Dioxide (Total)	286.2	kg/h		
Hydrocarbons (Total)	0.025	kg/h		
Carbon Monoxide (Total)	0.356	kg/h		
NOx (Total)	0.808	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 2 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Main (Timing-Capacity) Iterations: 0.0% 0.0% 0.0%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	452,716	veh/y	543,259	pers/y
Delay	1,644	veh-h/y	1,973	pers-h/y
Effective Stops	365,946	veh/y	439,135	pers/y
Travel Distance	458,160	veh-km/y	549,792	pers-km/y
Travel Time	8,336	veh-h/y	10,004	pers-h/y
Cost	300,235	$/y	300,235	$/y
Fuel Consumption	57,519	L/y		
Carbon Dioxide	137,398	kg/y		
Hydrocarbons	12	kg/y		
Carbon Monoxide	171	kg/y		
NOx	388	kg/y		

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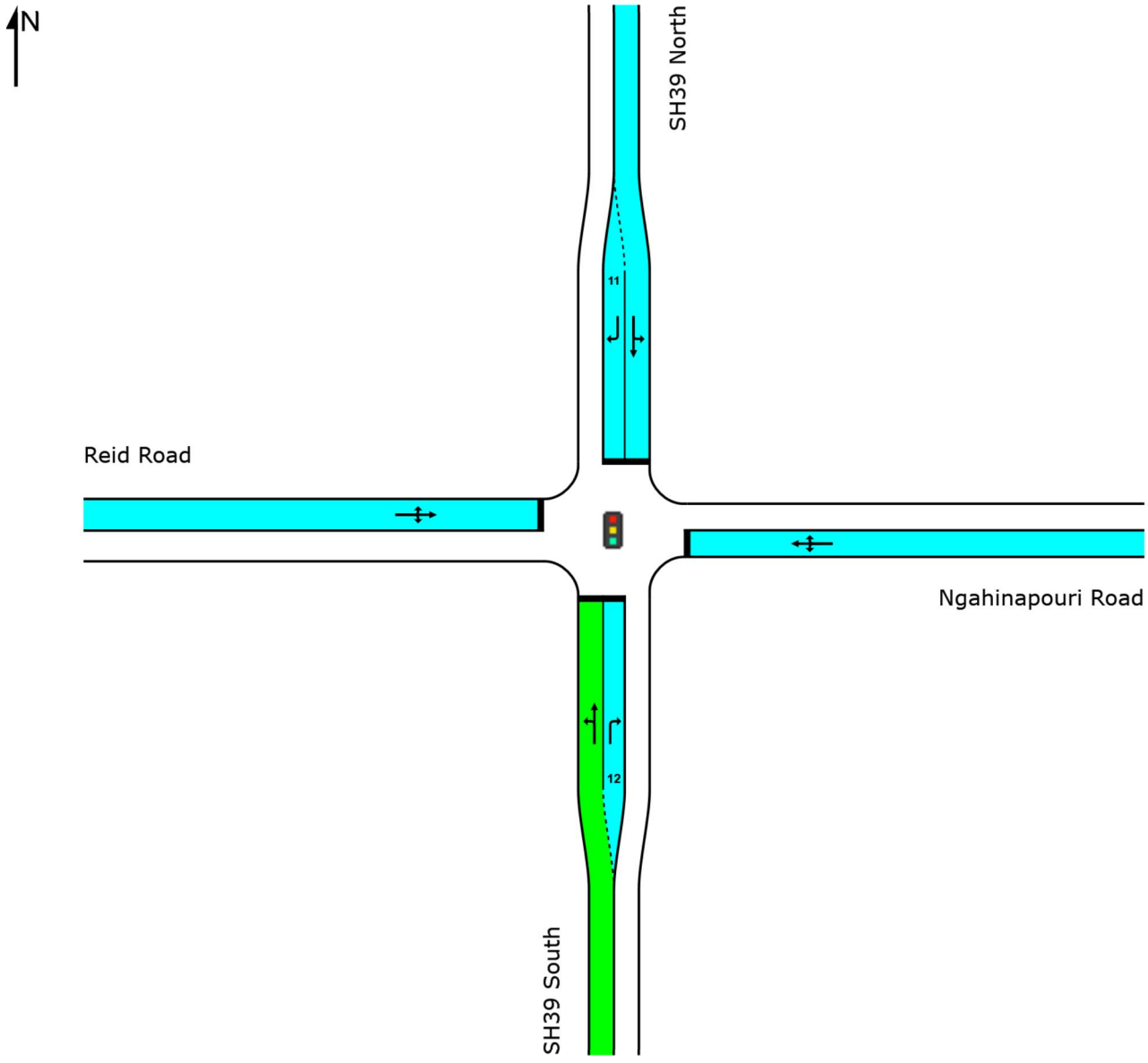
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101v [Opt2 - 2018_Hi Dev_PM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 30 seconds (Site Practical Cycle Time)

	Approaches				Intersection
	South	East	North	West	
LOS	A	B	B	B	B



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

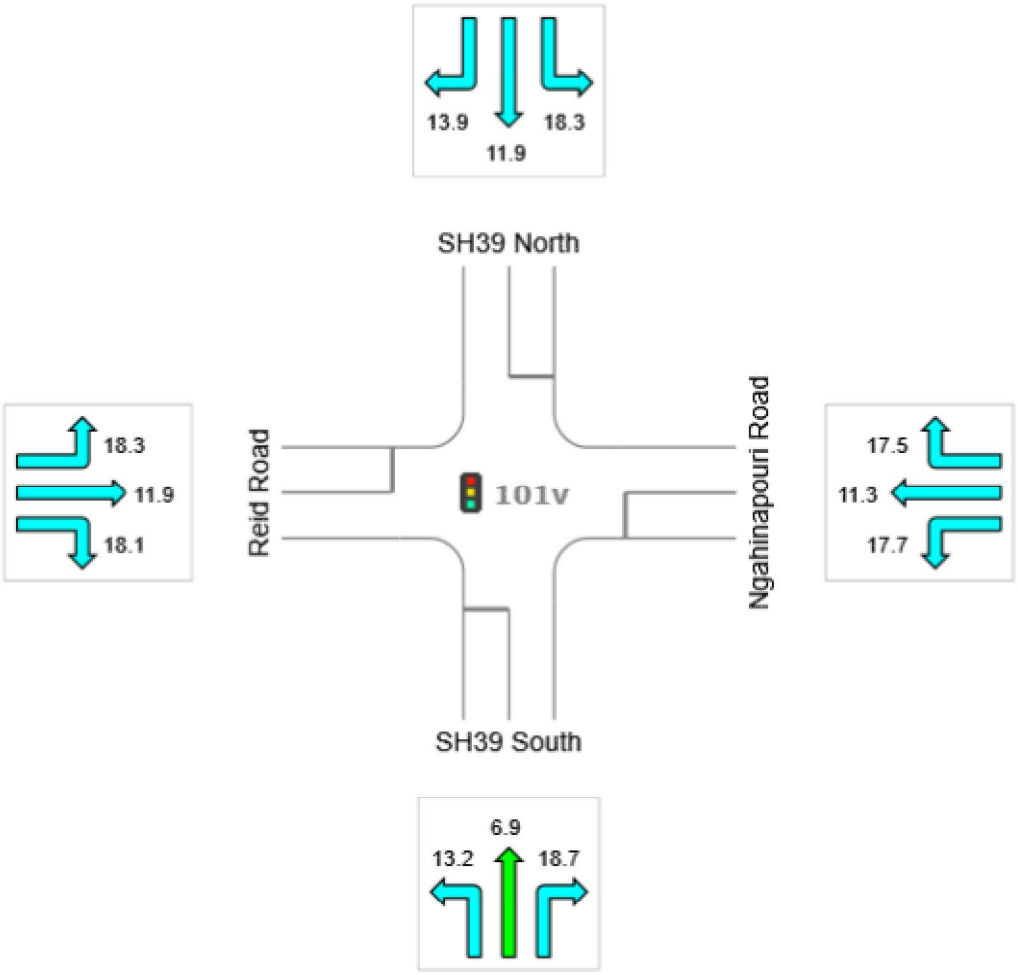
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101v [Opt2 - 2018_Hi Dev_PM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 30 seconds (Site Practical Cycle Time)

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	9.9	17.1	13.4	17.7	13.1
LOS	A	B	B	B	B



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101v [Opt2 - 2035_Low Dev_AM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 40 seconds (Site Practical Cycle Time)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	54.6	km/h	54.6	km/h
Travel Distance (Total)	1355.9	veh-km/h	1627.0	pers-km/h
Travel Time (Total)	24.8	veh-h/h	29.8	pers-h/h
Demand Flows (Total)	1340	veh/h	1608	pers/h
Percent Heavy Vehicles (Demand)	6.9	%		
Degree of Saturation	0.788			
Practical Spare Capacity	14.2	%		
Effective Intersection Capacity	1701	veh/h		
Control Delay (Total)	5.00	veh-h/h	6.00	pers-h/h
Control Delay (Average)	13.4	sec	13.4	sec
Control Delay (Worst Lane)	25.0	sec		
Control Delay (Worst Movement)	25.7	sec	25.7	sec
Geometric Delay (Average)	2.6	sec		
Stop-Line Delay (Average)	10.9	sec		
Idling Time (Average)	6.8	sec		
Intersection Level of Service (LOS)	LOS B			
95% Back of Queue - Vehicles (Worst Lane)	10.4	veh		
95% Back of Queue - Distance (Worst Lane)	79.7	m		
Queue Storage Ratio (Worst Lane)	0.10			
Total Effective Stops	971	veh/h	1166	pers/h
Effective Stop Rate	0.72		0.72	
Proportion Queued	0.73		0.73	
Performance Index	65.4		65.4	
Cost (Total)	854.03	$/h	854.03	$/h
Fuel Consumption (Total)	159.8	L/h		
Carbon Dioxide (Total)	381.5	kg/h		
Hydrocarbons (Total)	0.034	kg/h		
Carbon Monoxide (Total)	0.488	kg/h		
NOx (Total)	0.982	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 2 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Main (Timing-Capacity) Iterations: 0.0% 24.5% 0.2%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	643,200	veh/y	771,840	pers/y
Delay	2,402	veh-h/y	2,882	pers-h/y
Effective Stops	466,274	veh/y	559,528	pers/y
Travel Distance	650,819	veh-km/y	780,983	pers-km/y
Travel Time	11,924	veh-h/y	14,309	pers-h/y
Cost	409,933	$/y	409,933	$/y
Fuel Consumption	76,687	L/y		
Carbon Dioxide	183,108	kg/y		
Hydrocarbons	16	kg/y		
Carbon Monoxide	234	kg/y		
NOx	471	kg/y		

Organisation: TONKIN & TAYLOR | Processed: Wednesday, 12 June 2019 10:42:44 AM
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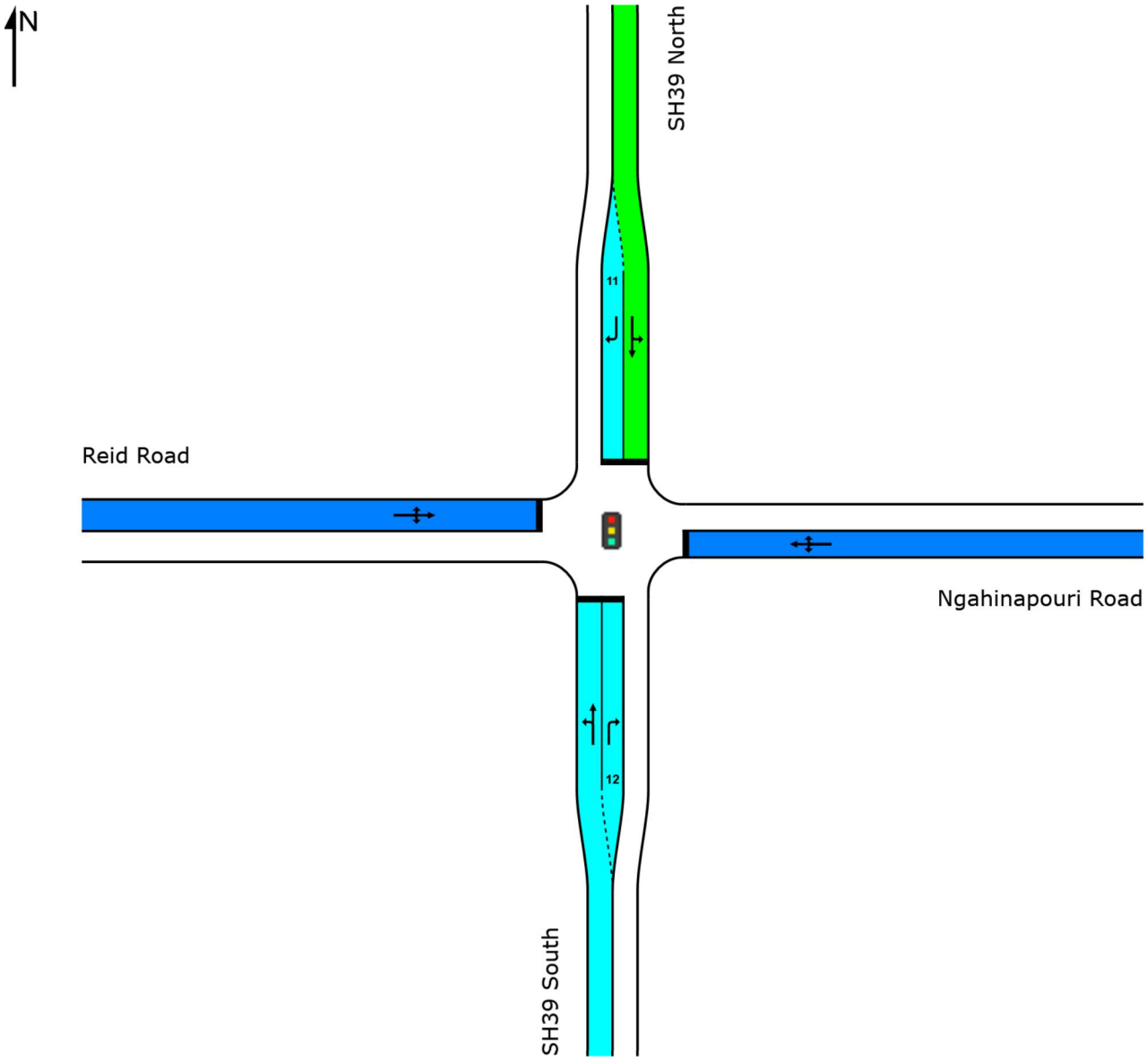
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101v [Opt2 - 2035_Low Dev_AM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 40 seconds (Site Practical Cycle Time)

	Approaches				Intersection
	South	East	North	West	
LOS	B	C	A	C	B



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

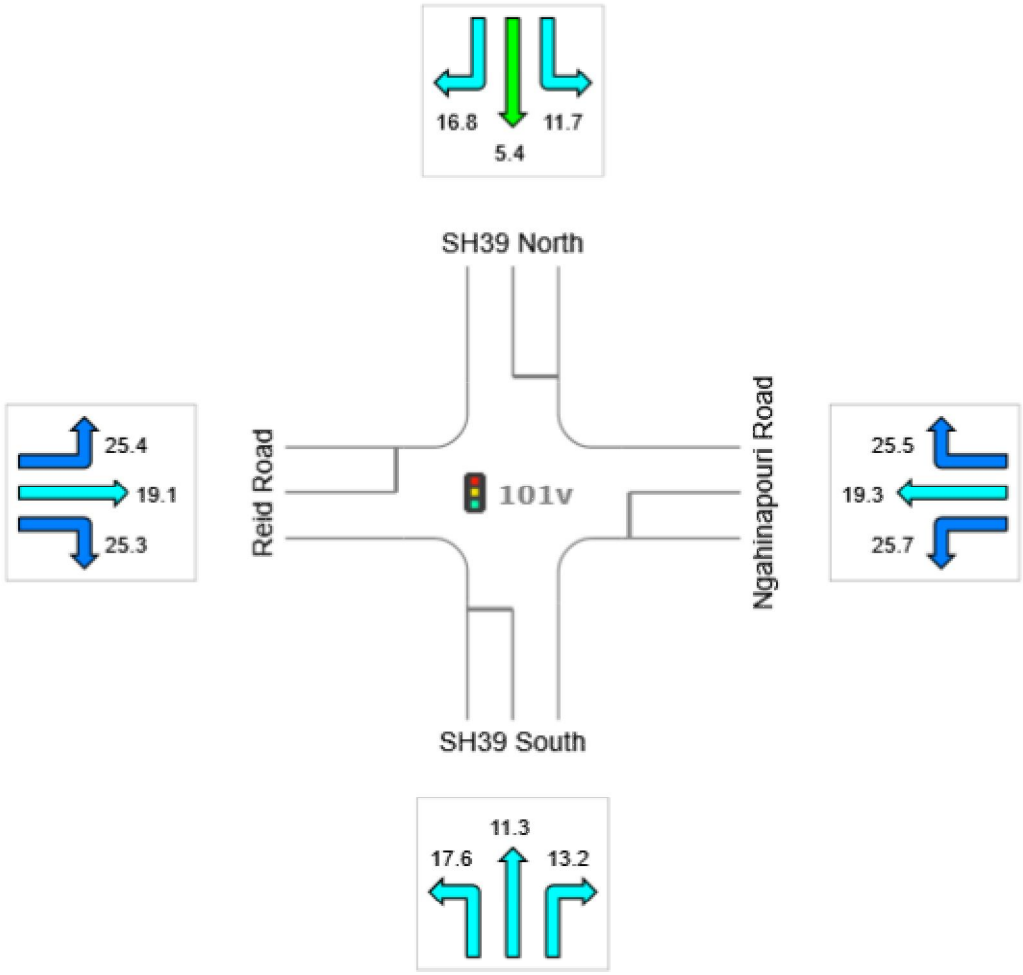
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101v [Opt2 - 2035_Low Dev_AM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 40 seconds (Site Practical Cycle Time)

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	12.2	25.0	7.7	24.8	13.4
LOS	B	C	A	C	B



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101v [Opt2 - 2035_Low Dev_PM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 40 seconds (Site Practical Cycle Time)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	55.7	km/h	55.7	km/h
Travel Distance (Total)	1206.8	veh-km/h	1448.1	pers-km/h
Travel Time (Total)	21.7	veh-h/h	26.0	pers-h/h
Demand Flows (Total)	1193	veh/h	1431	pers/h
Percent Heavy Vehicles (Demand)	7.7	%		
Degree of Saturation	0.783			
Practical Spare Capacity	14.9	%		
Effective Intersection Capacity	1523	veh/h		
Control Delay (Total)	4.08	veh-h/h	4.89	pers-h/h
Control Delay (Average)	12.3	sec	12.3	sec
Control Delay (Worst Lane)	23.2	sec		
Control Delay (Worst Movement)	23.8	sec	23.8	sec
Geometric Delay (Average)	2.2	sec		
Stop-Line Delay (Average)	10.1	sec		
Idling Time (Average)	6.0	sec		
Intersection Level of Service (LOS)	LOS B			
95% Back of Queue - Vehicles (Worst Lane)	12.4	veh		
95% Back of Queue - Distance (Worst Lane)	93.8	m		
Queue Storage Ratio (Worst Lane)	0.11			
Total Effective Stops	883	veh/h	1059	pers/h
Effective Stop Rate	0.74		0.74	
Proportion Queued	0.74		0.74	
Performance Index	58.5		58.5	
Cost (Total)	761.17	$/h	761.17	$/h
Fuel Consumption (Total)	147.3	L/h		
Carbon Dioxide (Total)	352.1	kg/h		
Hydrocarbons (Total)	0.031	kg/h		
Carbon Monoxide (Total)	0.440	kg/h		
NOx (Total)	0.995	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 2 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Main (Timing-Capacity) Iterations: 0.6% 0.0% 0.0%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	572,463	veh/y	686,956	pers/y
Delay	1,957	veh-h/y	2,349	pers-h/y
Effective Stops	423,716	veh/y	508,459	pers/y
Travel Distance	579,256	veh-km/y	695,108	pers-km/y
Travel Time	10,407	veh-h/y	12,488	pers-h/y
Cost	365,360	$/y	365,360	$/y
Fuel Consumption	70,689	L/y		
Carbon Dioxide	169,014	kg/y		
Hydrocarbons	15	kg/y		
Carbon Monoxide	211	kg/y		
NOx	477	kg/y		

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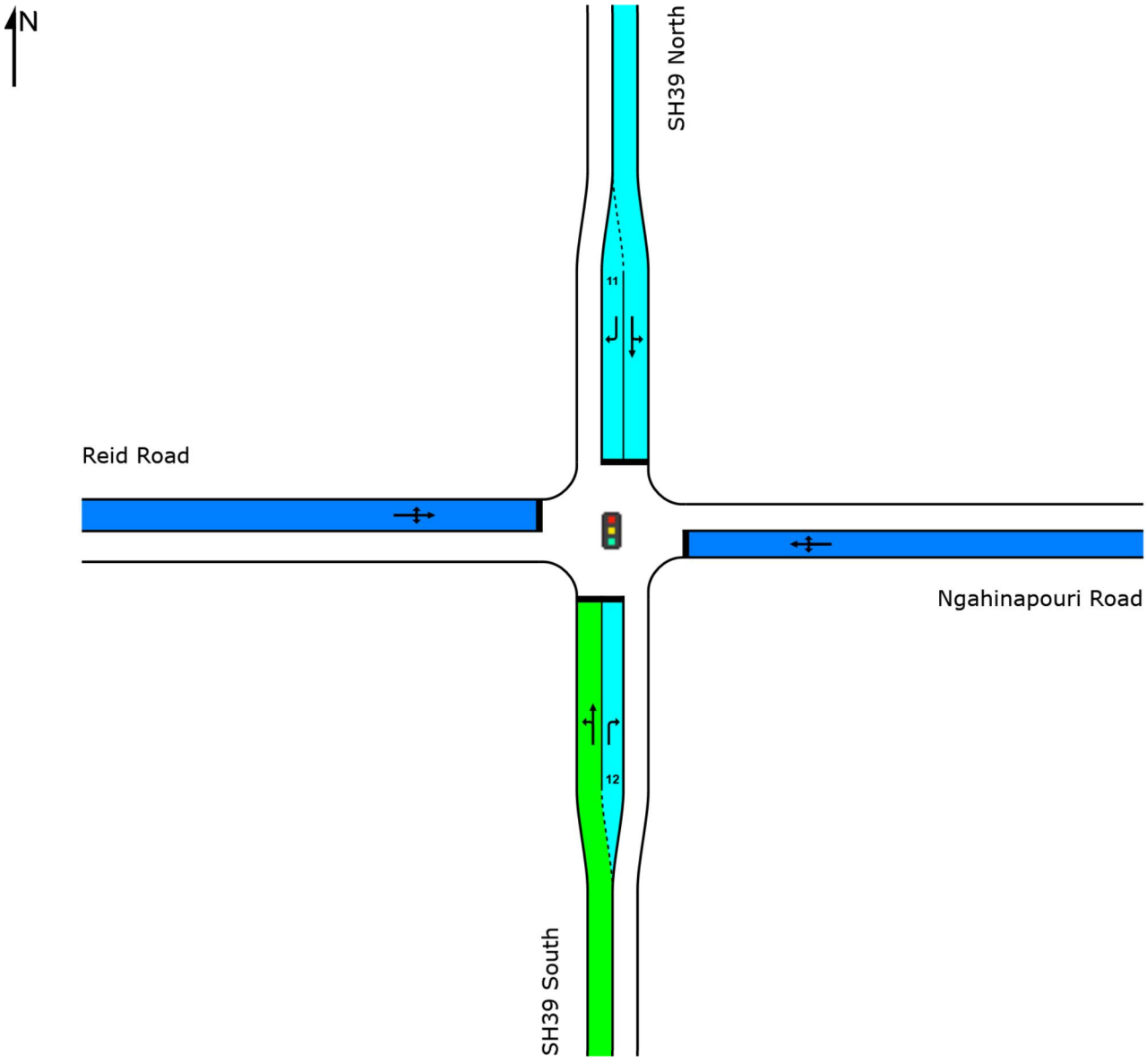
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101v [Opt2 - 2035_Low Dev_PM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 40 seconds (Site Practical Cycle Time)

	Approaches				Intersection
	South	East	North	West	
LOS	A	C	B	C	B



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

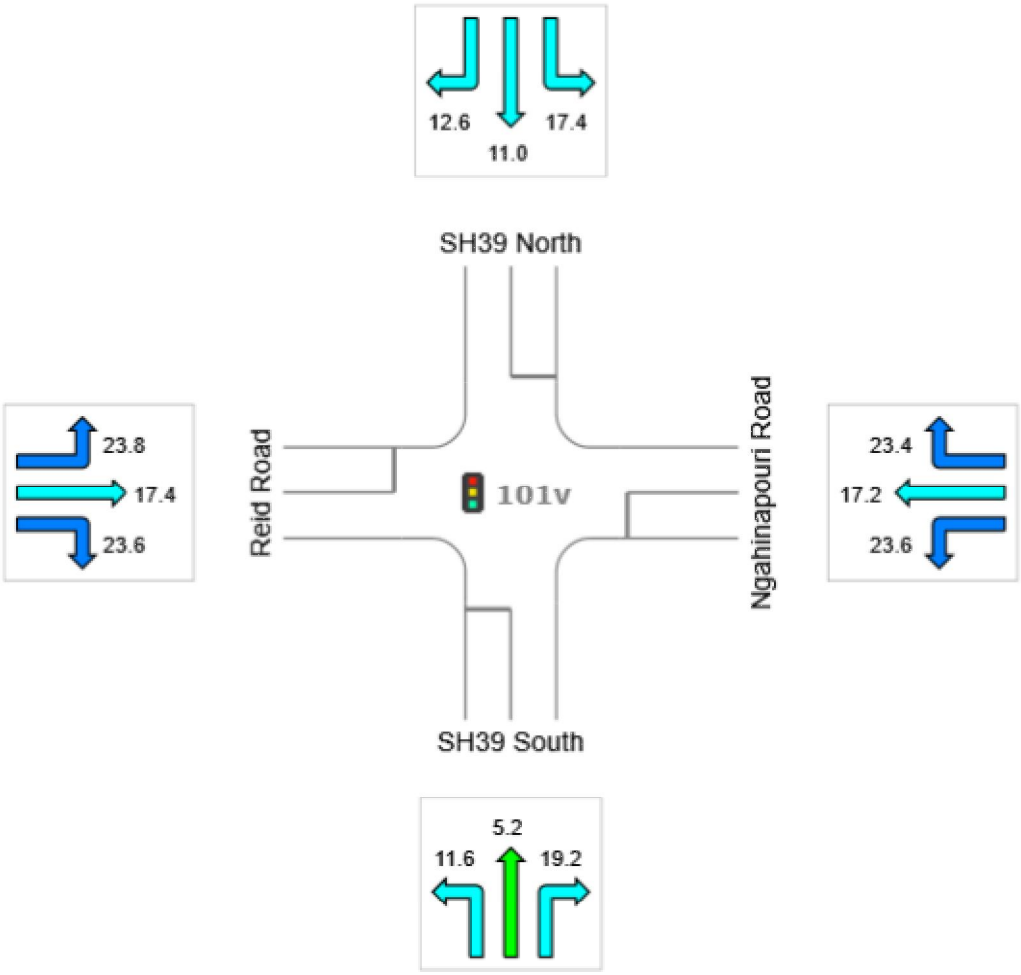
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101v [Opt2 - 2035_Low Dev_PM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 40 seconds (Site Practical Cycle Time)

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	8.7	22.9	12.5	23.2	12.3
LOS	A	C	B	C	B



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101v [Opt2 - 2035_Hi Dev_AM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 40 seconds (Site Practical Cycle Time)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	50.9	km/h	50.9	km/h
Travel Distance (Total)	1479.8	veh-km/h	1775.7	pers-km/h
Travel Time (Total)	29.1	veh-h/h	34.9	pers-h/h
Demand Flows (Total)	1462	veh/h	1755	pers/h
Percent Heavy Vehicles (Demand)	6.3	%		
Degree of Saturation	0.865			
Practical Spare Capacity	4.1	%		
Effective Intersection Capacity	1691	veh/h		
Control Delay (Total)	7.39	veh-h/h	8.87	pers-h/h
Control Delay (Average)	18.2	sec	18.2	sec
Control Delay (Worst Lane)	26.0	sec		
Control Delay (Worst Movement)	26.6	sec	26.6	sec
Geometric Delay (Average)	2.8	sec		
Stop-Line Delay (Average)	15.4	sec		
Idling Time (Average)	9.9	sec		
Intersection Level of Service (LOS)	LOS B			
95% Back of Queue - Vehicles (Worst Lane)	13.6	veh		
95% Back of Queue - Distance (Worst Lane)	103.6	m		
Queue Storage Ratio (Worst Lane)	0.13			
Total Effective Stops	1226	veh/h	1472	pers/h
Effective Stop Rate	0.84		0.84	
Proportion Queued	0.81		0.81	
Performance Index	83.0		83.0	
Cost (Total)	1013.99	$/h	1013.99	$/h
Fuel Consumption (Total)	178.9	L/h		
Carbon Dioxide (Total)	426.7	kg/h		
Hydrocarbons (Total)	0.038	kg/h		
Carbon Monoxide (Total)	0.545	kg/h		
NOx (Total)	1.063	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 2 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Main (Timing-Capacity) Iterations: 0.0% 16.8% 0.4%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	701,811	veh/y	842,173	pers/y
Delay	3,548	veh-h/y	4,258	pers-h/y
Effective Stops	588,620	veh/y	706,344	pers/y
Travel Distance	710,292	veh-km/y	852,350	pers-km/y
Travel Time	13,960	veh-h/y	16,752	pers-h/y
Cost	486,715	$/y	486,715	$/y
Fuel Consumption	85,884	L/y		
Carbon Dioxide	204,815	kg/y		
Hydrocarbons	18	kg/y		
Carbon Monoxide	262	kg/y		
NOx	510	kg/y		

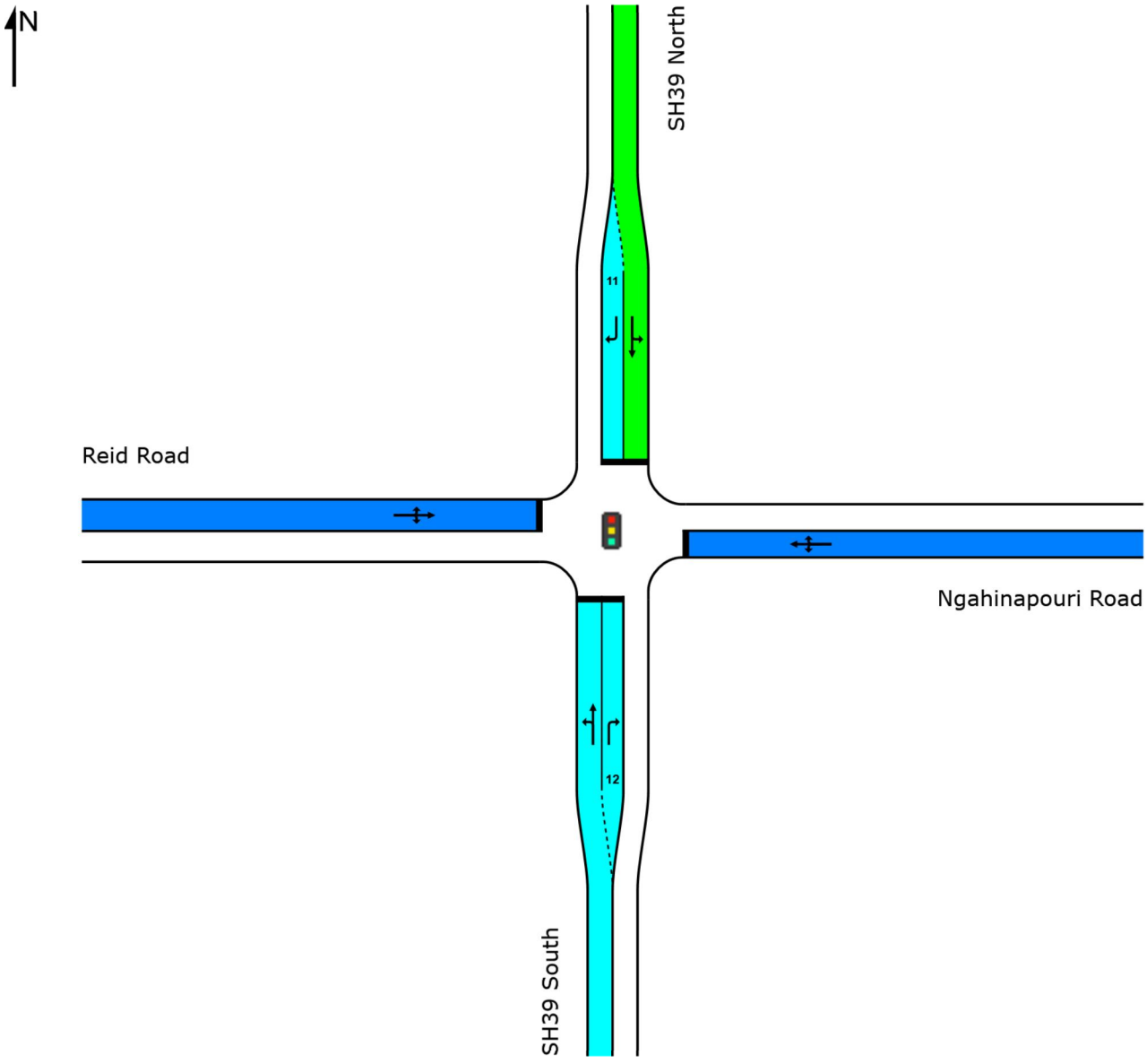
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101v [Opt2 - 2035_Hi Dev_AM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 40 seconds (Site Practical Cycle Time)

	Approaches				Intersection
	South	East	North	West	
LOS	B	C	A	C	B



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

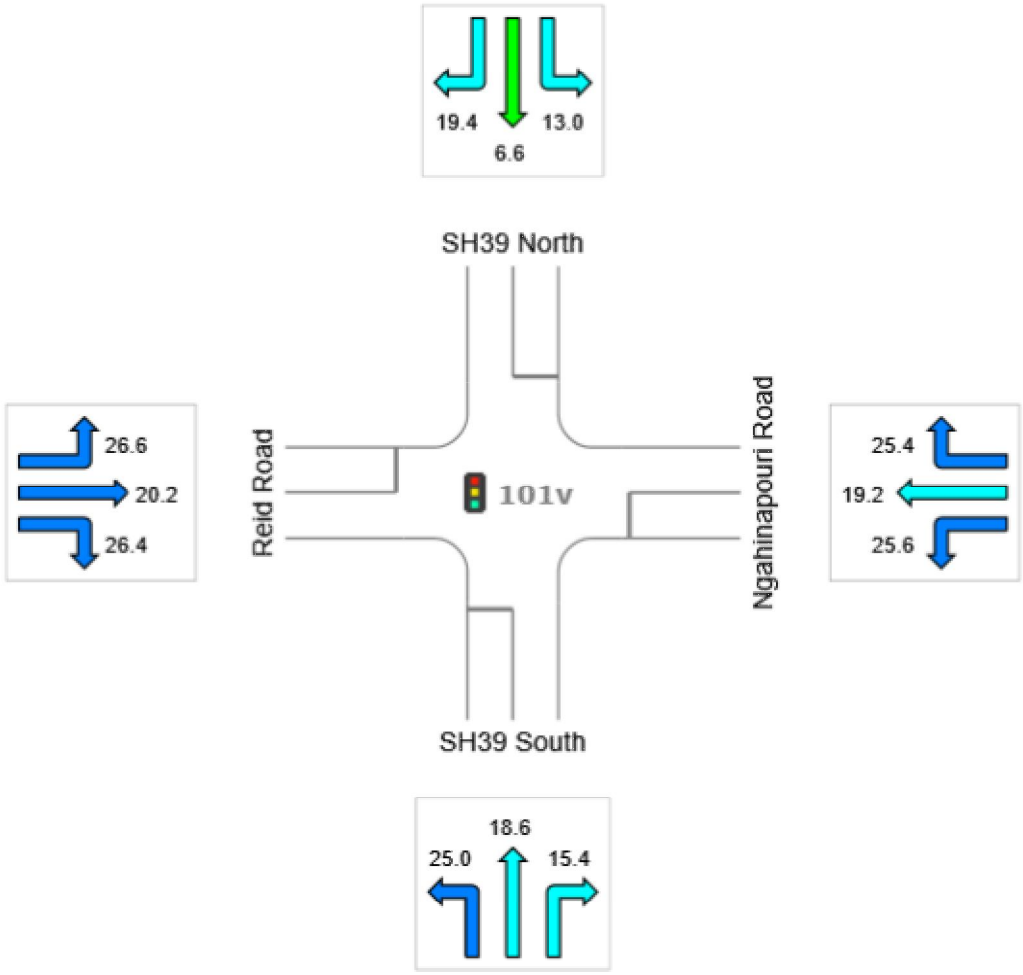
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101v [Opt2 - 2035_Hi Dev_AM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 40 seconds (Site Practical Cycle Time)

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	18.5	24.9	9.1	26.0	18.2
LOS	B	C	A	C	B



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101v [Opt2 - 2035_Hi Dev_PM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 40 seconds (Site Practical Cycle Time)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	55.3	km/h	55.3	km/h
Travel Distance (Total)	1248.4	veh-km/h	1498.1	pers-km/h
Travel Time (Total)	22.6	veh-h/h	27.1	pers-h/h
Demand Flows (Total)	1234	veh/h	1480	pers/h
Percent Heavy Vehicles (Demand)	7.5	%		
Degree of Saturation	0.783			
Practical Spare Capacity	14.9	%		
Effective Intersection Capacity	1575	veh/h		
Control Delay (Total)	4.36	veh-h/h	5.23	pers-h/h
Control Delay (Average)	12.7	sec	12.7	sec
Control Delay (Worst Lane)	23.8	sec		
Control Delay (Worst Movement)	24.3	sec	24.3	sec
Geometric Delay (Average)	2.3	sec		
Stop-Line Delay (Average)	10.4	sec		
Idling Time (Average)	6.3	sec		
Intersection Level of Service (LOS)	LOS B			
95% Back of Queue - Vehicles (Worst Lane)	12.4	veh		
95% Back of Queue - Distance (Worst Lane)	93.8	m		
Queue Storage Ratio (Worst Lane)	0.11			
Total Effective Stops	916	veh/h	1099	pers/h
Effective Stop Rate	0.74		0.74	
Proportion Queued	0.75		0.75	
Performance Index	61.1		61.1	
Cost (Total)	790.14	$/h	790.14	$/h
Fuel Consumption (Total)	151.3	L/h		
Carbon Dioxide (Total)	361.7	kg/h		
Hydrocarbons (Total)	0.032	kg/h		
Carbon Monoxide (Total)	0.455	kg/h		
NOx (Total)	0.998	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 2 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Main (Timing-Capacity) Iterations: 0.6% 0.0% 0.0%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	592,168	veh/y	710,602	pers/y
Delay	2,093	veh-h/y	2,511	pers-h/y
Effective Stops	439,534	veh/y	527,441	pers/y
Travel Distance	599,253	veh-km/y	719,103	pers-km/y
Travel Time	10,841	veh-h/y	13,010	pers-h/y
Cost	379,265	$/y	379,265	$/y
Fuel Consumption	72,642	L/y		
Carbon Dioxide	173,604	kg/y		
Hydrocarbons	15	kg/y		
Carbon Monoxide	218	kg/y		
NOx	479	kg/y		

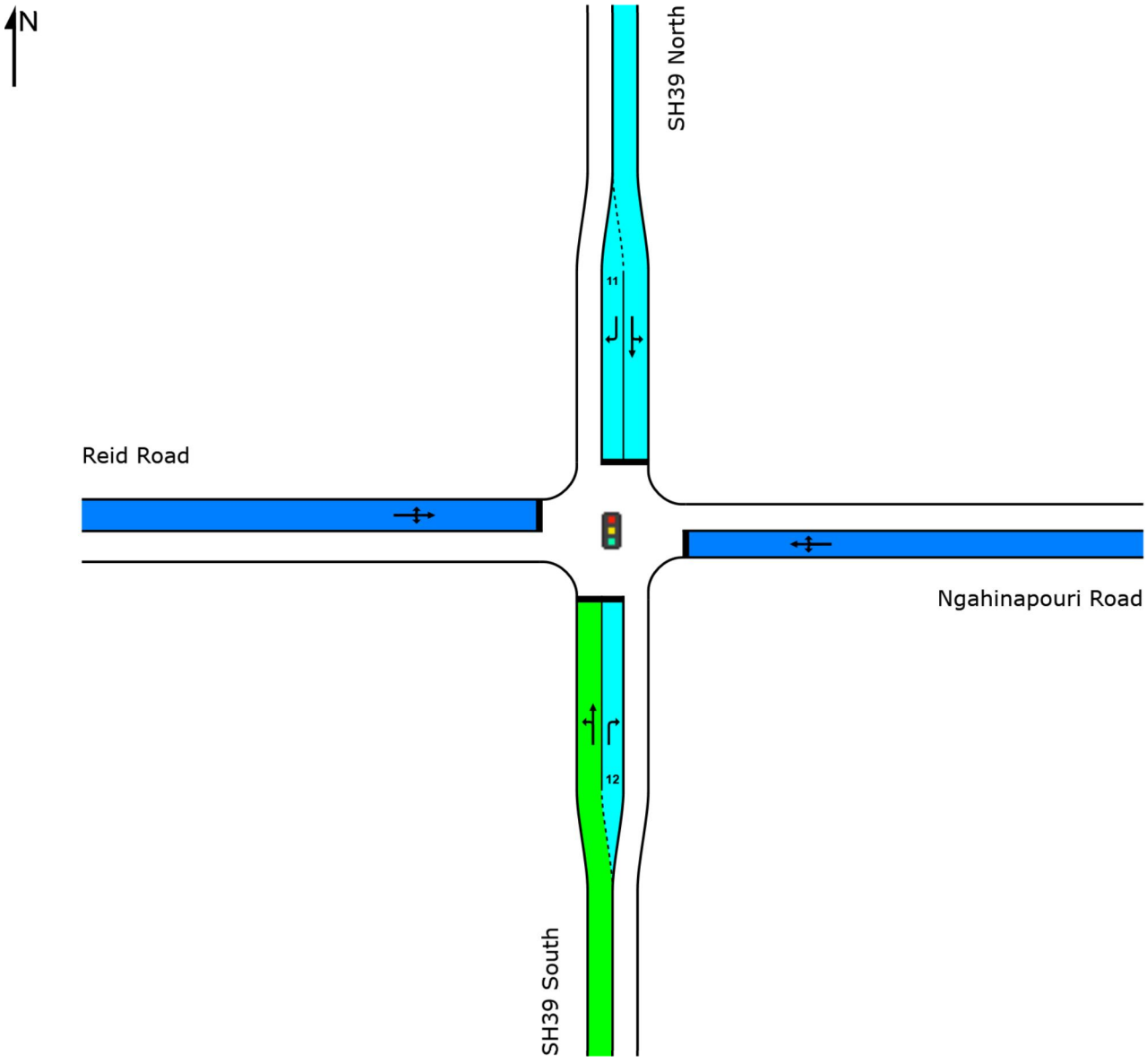
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101v [Opt2 - 2035_Hi Dev_PM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 40 seconds (Site Practical Cycle Time)

	Approaches				Intersection
	South	East	North	West	
LOS	A	C	B	C	B



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

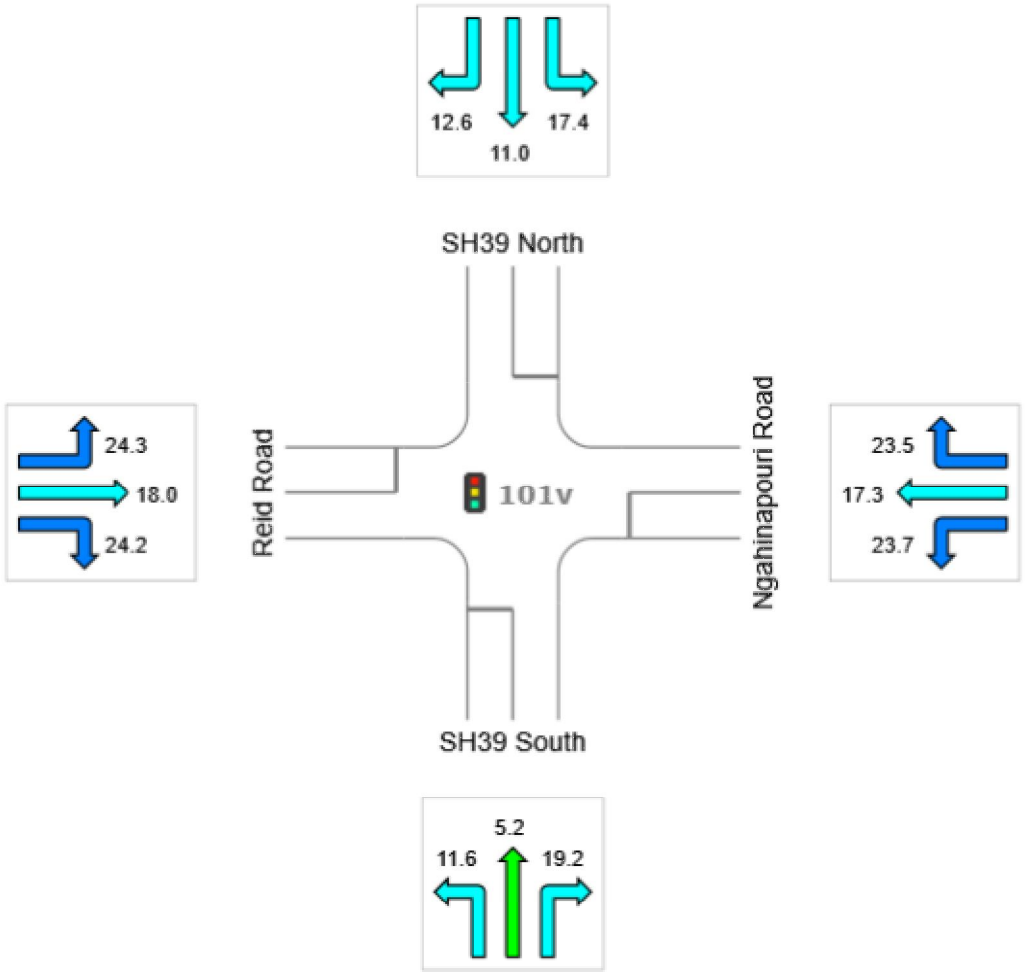
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101v [Opt2 - 2035_Hi Dev_PM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 40 seconds (Site Practical Cycle Time)

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	8.7	23.0	12.5	23.8	12.7
LOS	A	C	B	C	B



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101v [Opt2 - 2018_Low Dev_AM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 30 seconds (Site Practical Cycle Time)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	55.3	km/h	55.3	km/h
Travel Distance (Total)	1043.9	veh-km/h	1252.7	pers-km/h
Travel Time (Total)	18.9	veh-h/h	22.7	pers-h/h
Demand Flows (Total)	1032	veh/h	1238	pers/h
Percent Heavy Vehicles (Demand)	6.7	%		
Degree of Saturation	0.740			
Practical Spare Capacity	21.6	%		
Effective Intersection Capacity	1394	veh/h		
Control Delay (Total)	3.60	veh-h/h	4.31	pers-h/h
Control Delay (Average)	12.5	sec	12.5	sec
Control Delay (Worst Lane)	18.1	sec		
Control Delay (Worst Movement)	18.7	sec	18.7	sec
Geometric Delay (Average)	2.7	sec		
Stop-Line Delay (Average)	9.9	sec		
Idling Time (Average)	5.6	sec		
Intersection Level of Service (LOS)	LOS B			
95% Back of Queue - Vehicles (Worst Lane)	6.5	veh		
95% Back of Queue - Distance (Worst Lane)	49.4	m		
Queue Storage Ratio (Worst Lane)	0.06			
Total Effective Stops	791	veh/h	949	pers/h
Effective Stop Rate	0.77		0.77	
Proportion Queued	0.82		0.82	
Performance Index	45.6		45.6	
Cost (Total)	667.02	$/h	667.02	$/h
Fuel Consumption (Total)	126.6	L/h		
Carbon Dioxide (Total)	302.2	kg/h		
Hydrocarbons (Total)	0.027	kg/h		
Carbon Monoxide (Total)	0.384	kg/h		
NOx (Total)	0.797	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 2 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Main (Timing-Capacity) Iterations: 0.0% 0.0% 0.0%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	495,158	veh/y	594,190	pers/y
Delay	1,726	veh-h/y	2,071	pers-h/y
Effective Stops	379,554	veh/y	455,465	pers/y
Travel Distance	501,065	veh-km/y	601,278	pers-km/y
Travel Time	9,061	veh-h/y	10,873	pers-h/y
Cost	320,168	$/y	320,168	$/y
Fuel Consumption	60,770	L/y		
Carbon Dioxide	145,038	kg/y		
Hydrocarbons	13	kg/y		
Carbon Monoxide	184	kg/y		
NOx	383	kg/y		

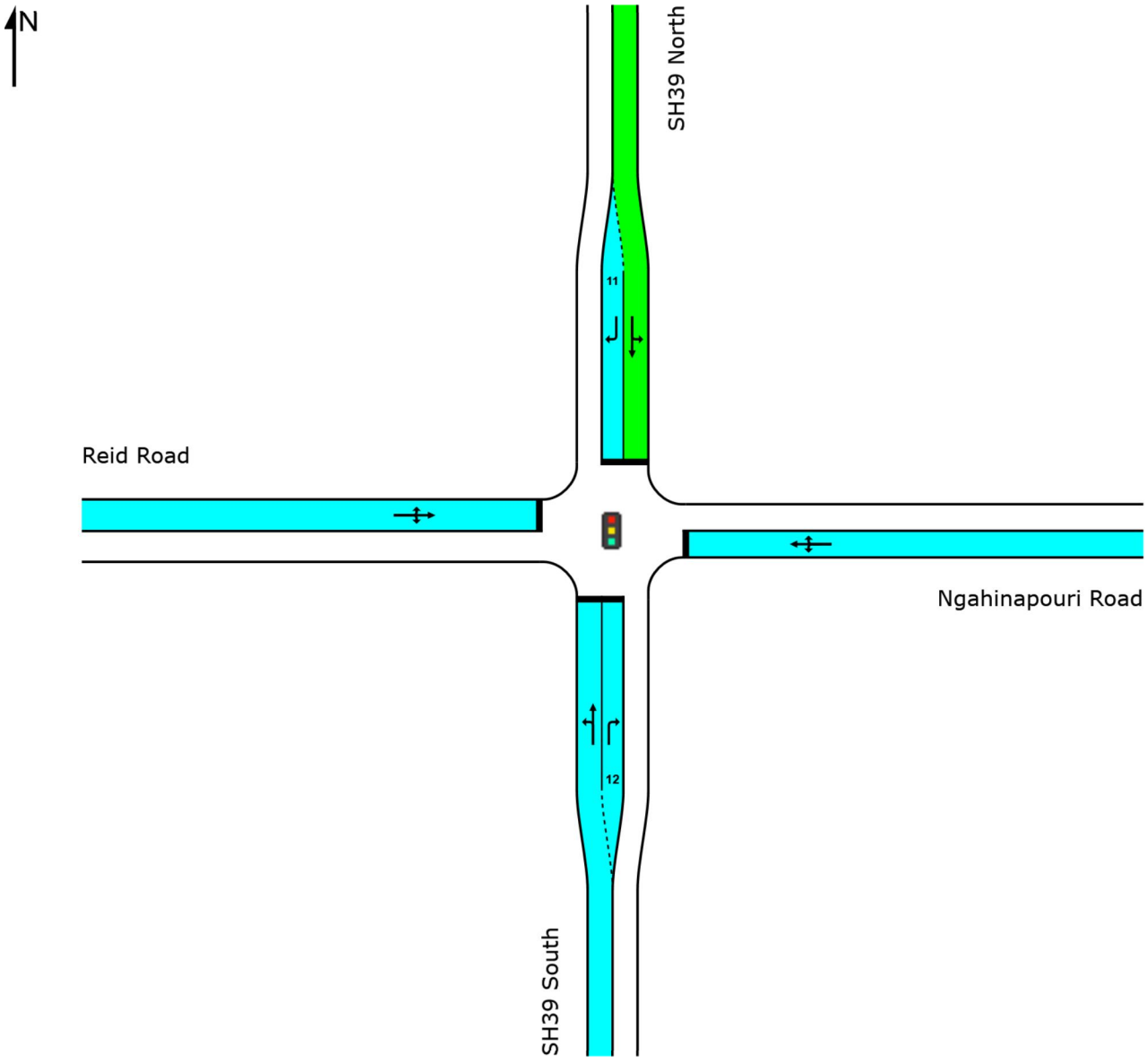
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101v [Opt2 - 2018_Low Dev_AM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 30 seconds (Site Practical Cycle Time)

	Approaches				Intersection
	South	East	North	West	
LOS	B	B	A	B	B



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

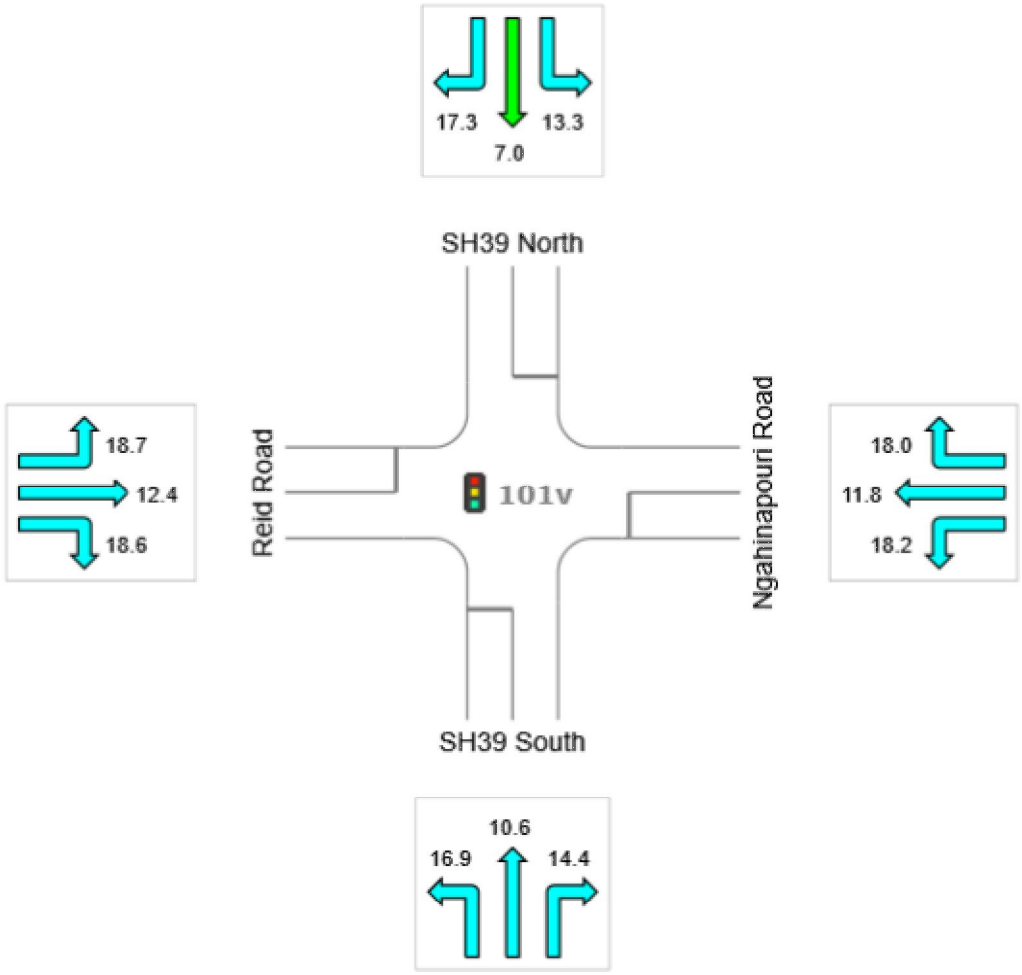
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101v [Opt2 - 2018_Low Dev_AM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 30 seconds (Site Practical Cycle Time)

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	12.0	17.5	9.3	18.1	12.5
LOS	B	B	A	B	B



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101v [Opt2 - 2018_Low Dev_PM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 30 seconds (Site Practical Cycle Time)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	55.2	km/h	55.2	km/h
Travel Distance (Total)	911.8	veh-km/h	1094.1	pers-km/h
Travel Time (Total)	16.5	veh-h/h	19.8	pers-h/h
Demand Flows (Total)	901	veh/h	1081	pers/h
Percent Heavy Vehicles (Demand)	7.6	%		
Degree of Saturation	0.779			
Practical Spare Capacity	15.5	%		
Effective Intersection Capacity	1156	veh/h		
Control Delay (Total)	3.21	veh-h/h	3.85	pers-h/h
Control Delay (Average)	12.8	sec	12.8	sec
Control Delay (Worst Lane)	18.7	sec		
Control Delay (Worst Movement)	18.7	sec	18.7	sec
Geometric Delay (Average)	2.2	sec		
Stop-Line Delay (Average)	10.6	sec		
Idling Time (Average)	5.6	sec		
Intersection Level of Service (LOS)	LOS B			
95% Back of Queue - Vehicles (Worst Lane)	8.1	veh		
95% Back of Queue - Distance (Worst Lane)	61.3	m		
Queue Storage Ratio (Worst Lane)	0.08			
Total Effective Stops	729	veh/h	875	pers/h
Effective Stop Rate	0.81		0.81	
Proportion Queued	0.84		0.84	
Performance Index	41.6		41.6	
Cost (Total)	598.38	$/h	598.38	$/h
Fuel Consumption (Total)	115.8	L/h		
Carbon Dioxide (Total)	276.7	kg/h		
Hydrocarbons (Total)	0.024	kg/h		
Carbon Monoxide (Total)	0.342	kg/h		
NOx (Total)	0.805	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 2 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Main (Timing-Capacity) Iterations: 0.0% 0.0% 0.0%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	432,505	veh/y	519,006	pers/y
Delay	1,541	veh-h/y	1,849	pers-h/y
Effective Stops	350,074	veh/y	420,089	pers/y
Travel Distance	437,652	veh-km/y	525,182	pers-km/y
Travel Time	7,927	veh-h/y	9,512	pers-h/y
Cost	287,223	$/y	287,223	$/y
Fuel Consumption	55,564	L/y		
Carbon Dioxide	132,804	kg/y		
Hydrocarbons	12	kg/y		
Carbon Monoxide	164	kg/y		
NOx	386	kg/y		

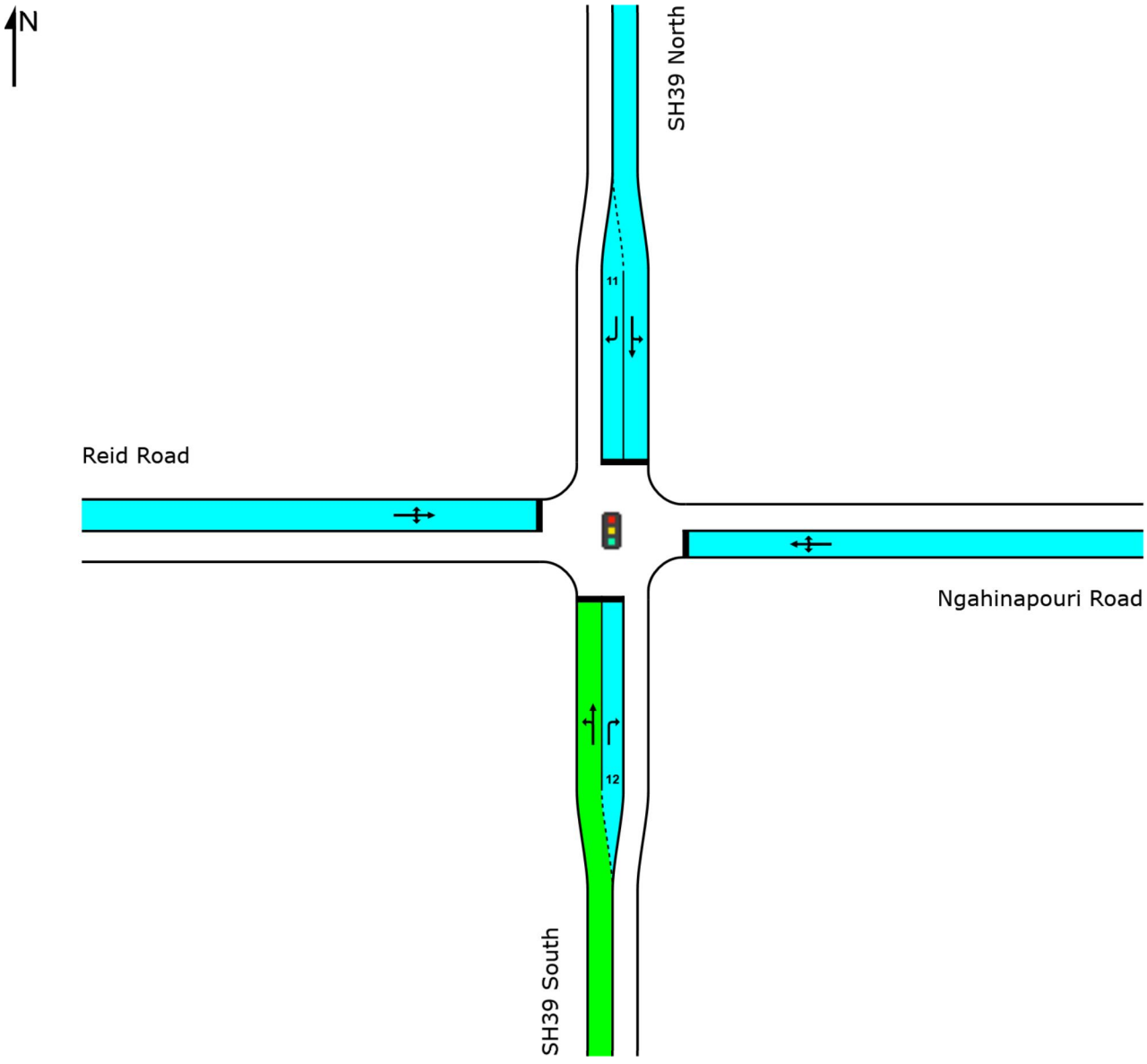
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101v [Opt2 - 2018_Low Dev_PM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 30 seconds (Site Practical Cycle Time)

	Approaches				Intersection
	South	East	North	West	
LOS	A	B	B	B	B



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

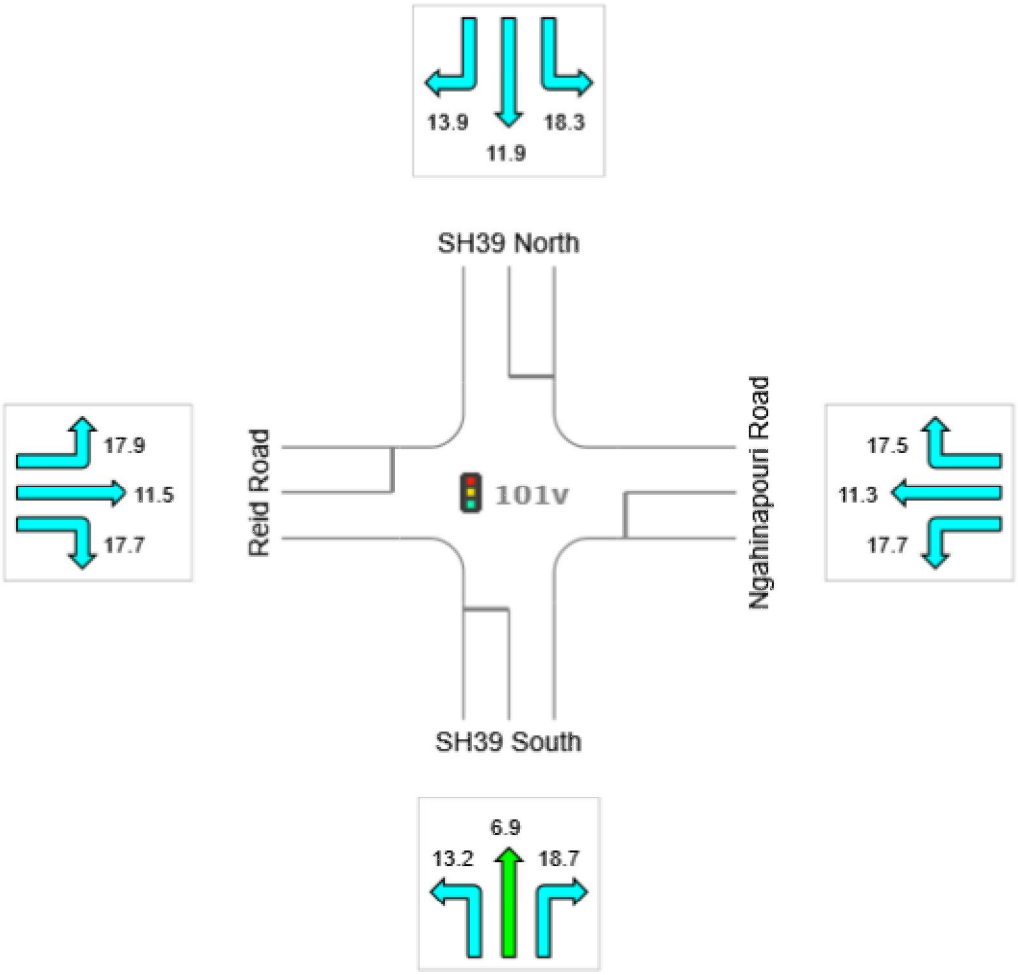
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101v [Opt2 - 2018_Low Dev_PM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 30 seconds (Site Practical Cycle Time)

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	9.9	17.1	13.4	17.2	12.8
LOS	A	B	B	B	B



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101v [Opt2 - 2018_Hi Dev_AM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 30 seconds (Site Practical Cycle Time)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	54.0	km/h	54.0	km/h
Travel Distance (Total)	1167.8	veh-km/h	1401.3	pers-km/h
Travel Time (Total)	21.6	veh-h/h	25.9	pers-h/h
Demand Flows (Total)	1154	veh/h	1384	pers/h
Percent Heavy Vehicles (Demand)	6.0	%		
Degree of Saturation	0.751			
Practical Spare Capacity	19.9	%		
Effective Intersection Capacity	1537	veh/h		
Control Delay (Total)	4.48	veh-h/h	5.37	pers-h/h
Control Delay (Average)	14.0	sec	14.0	sec
Control Delay (Worst Lane)	21.1	sec		
Control Delay (Worst Movement)	21.7	sec	21.7	sec
Geometric Delay (Average)	3.0	sec		
Stop-Line Delay (Average)	11.0	sec		
Idling Time (Average)	6.1	sec		
Intersection Level of Service (LOS)	LOS B			
95% Back of Queue - Vehicles (Worst Lane)	6.5	veh		
95% Back of Queue - Distance (Worst Lane)	49.4	m		
Queue Storage Ratio (Worst Lane)	0.06			
Total Effective Stops	928	veh/h	1113	pers/h
Effective Stop Rate	0.80		0.80	
Proportion Queued	0.86		0.86	
Performance Index	53.5		53.5	
Cost (Total)	755.66	$/h	755.66	$/h
Fuel Consumption (Total)	139.0	L/h		
Carbon Dioxide (Total)	331.2	kg/h		
Hydrocarbons (Total)	0.030	kg/h		
Carbon Monoxide (Total)	0.427	kg/h		
NOx (Total)	0.807	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 2 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Main (Timing-Capacity) Iterations: 0.0% 7.1% 0.3%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	553,769	veh/y	664,522	pers/y
Delay	2,148	veh-h/y	2,578	pers-h/y
Effective Stops	445,351	veh/y	534,421	pers/y
Travel Distance	560,539	veh-km/y	672,647	pers-km/y
Travel Time	10,373	veh-h/y	12,448	pers-h/y
Cost	362,716	$/y	362,716	$/y
Fuel Consumption	66,710	L/y		
Carbon Dioxide	158,996	kg/y		
Hydrocarbons	14	kg/y		
Carbon Monoxide	205	kg/y		
NOx	388	kg/y		

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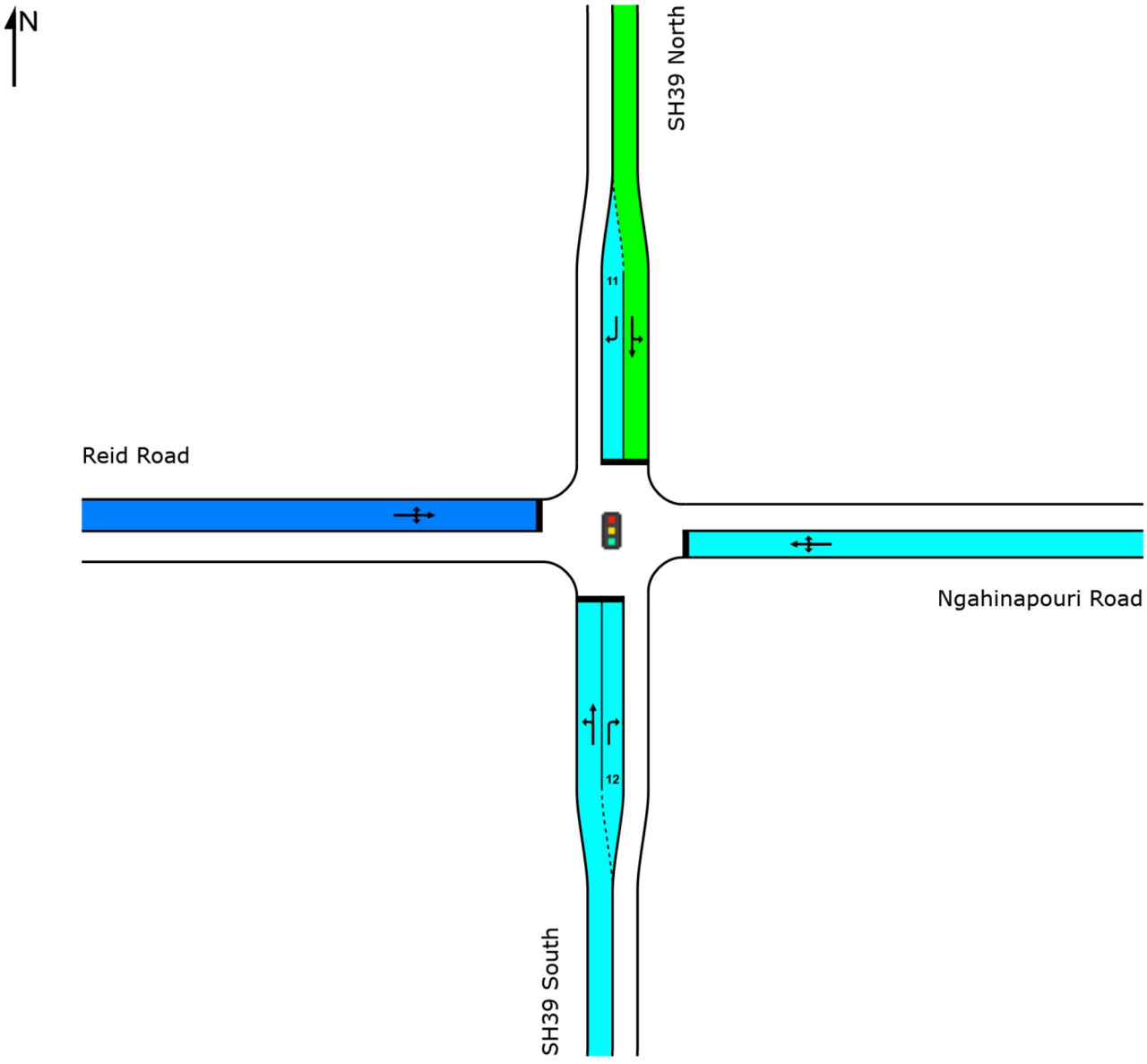
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101v [Opt2 - 2018_Hi Dev_AM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 30 seconds (Site Practical Cycle Time)

	Approaches				Intersection
	South	East	North	West	
LOS	B	B	A	C	B



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101vv [Opt3to5 - 2018_Hi Dev_PM]

New Site
Site Category: (None)
Roundabout

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	58.7	km/h	58.7	km/h
Travel Distance (Total)	973.2	veh-km/h	1167.8	pers-km/h
Travel Time (Total)	16.6	veh-h/h	19.9	pers-h/h
Demand Flows (Total)	943	veh/h	1132	pers/h
Percent Heavy Vehicles (Demand)	7.3	%		
Degree of Saturation	0.424			
Practical Spare Capacity	100.4	%		
Effective Intersection Capacity	2223	veh/h		
Control Delay (Total)	1.76	veh-h/h	2.11	pers-h/h
Control Delay (Average)	6.7	sec	6.7	sec
Control Delay (Worst Lane)	11.4	sec		
Control Delay (Worst Movement)	12.9	sec	12.9	sec
Geometric Delay (Average)	5.9	sec		
Stop-Line Delay (Average)	0.8	sec		
Idling Time (Average)	0.0	sec		
Intersection Level of Service (LOS)	LOS A			
95% Back of Queue - Vehicles (Worst Lane)	3.6	veh		
95% Back of Queue - Distance (Worst Lane)	27.3	m		
Queue Storage Ratio (Worst Lane)	0.02			
Total Effective Stops	486	veh/h	583	pers/h
Effective Stop Rate	0.51		0.51	
Proportion Queued	0.36		0.36	
Performance Index	27.0		27.0	
Cost (Total)	575.44	$/h	575.44	$/h
Fuel Consumption (Total)	120.1	L/h		
Carbon Dioxide (Total)	286.8	kg/h		
Hydrocarbons (Total)	0.024	kg/h		
Carbon Monoxide (Total)	0.352	kg/h		
NOx (Total)	0.850	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 1.4 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 2.3% 1.3% 0.6%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	452,716	veh/y	543,259	pers/y
Delay	843	veh-h/y	1,012	pers-h/y
Effective Stops	233,101	veh/y	279,722	pers/y
Travel Distance	467,139	veh-km/y	560,567	pers-km/y
Travel Time	7,959	veh-h/y	9,551	pers-h/y
Cost	276,211	$/y	276,211	$/y
Fuel Consumption	57,637	L/y		
Carbon Dioxide	137,651	kg/y		
Hydrocarbons	12	kg/y		
Carbon Monoxide	169	kg/y		
NOx	408	kg/y		

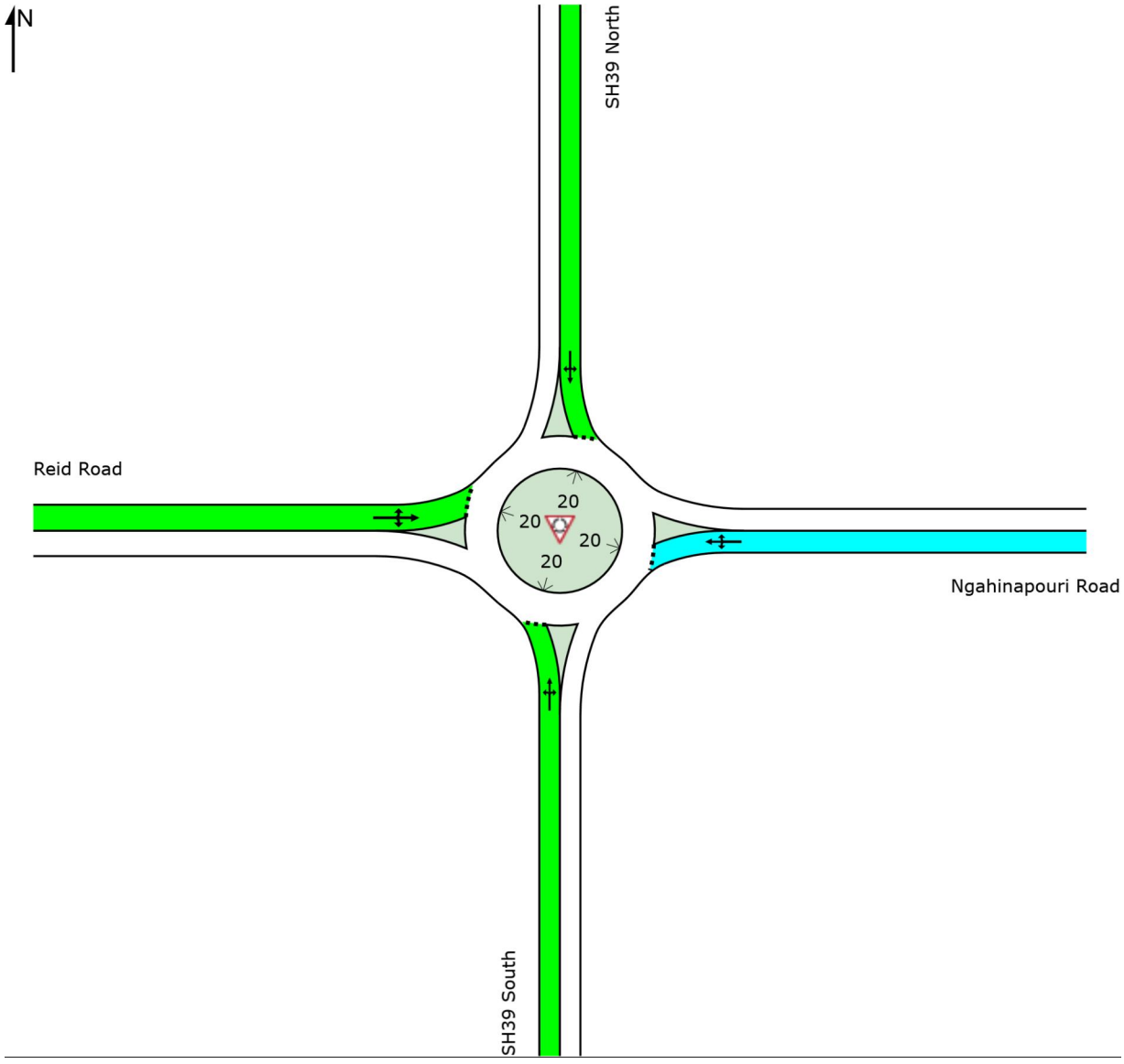
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101vv [Opt3to5 - 2018_Hi Dev_PM]

New Site
Site Category: (None)
Roundabout

	Approaches				Intersection
	South	East	North	West	
LOS	A	B	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Roundabout Level of Service Method: SIDRA Roundabout LOS
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

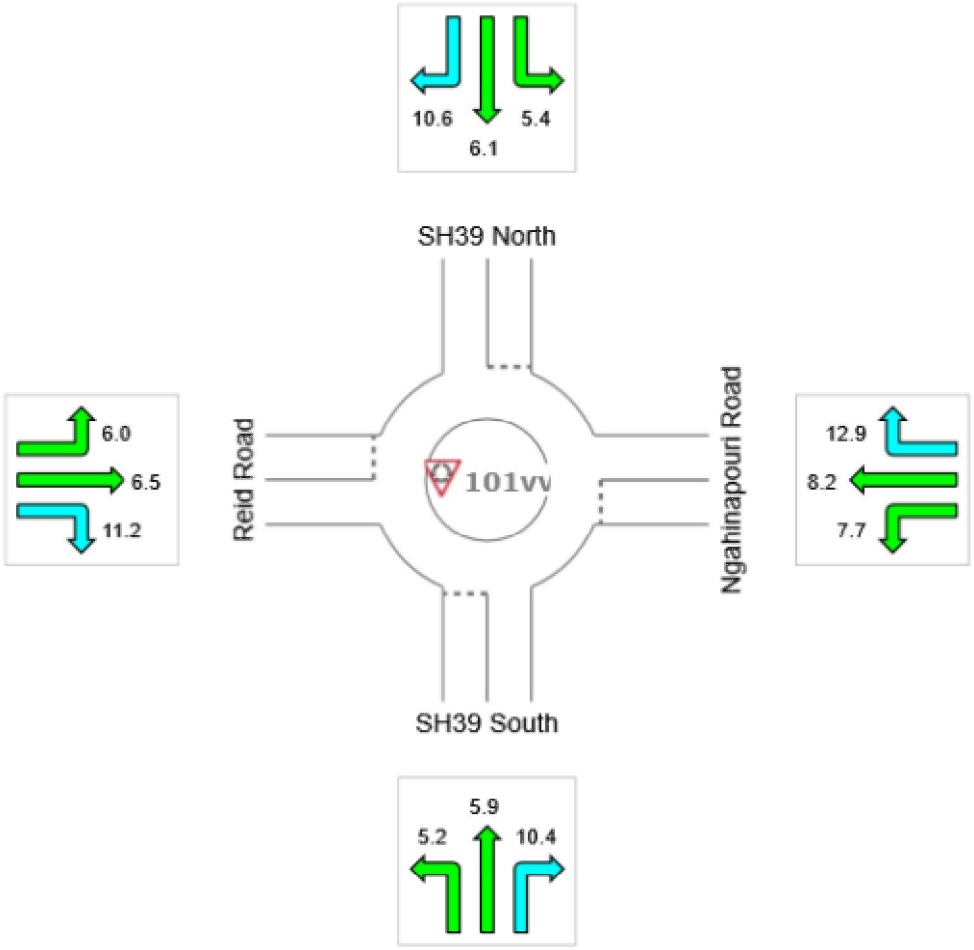
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101vv [Opt3to5 - 2018_Hi Dev_PM]

New Site
Site Category: (None)
Roundabout

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	6.8	11.4	6.4	7.2	6.7
LOS	A	B	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Roundabout Level of Service Method: SIDRA Roundabout LOS
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101vv [Opt3to5 - 2035_Low Dev_AM]

New Site
Site Category: (None)
Roundabout

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	57.5	km/h	57.5	km/h
Travel Distance (Total)	1385.2	veh-km/h	1662.2	pers-km/h
Travel Time (Total)	24.1	veh-h/h	28.9	pers-h/h
Demand Flows (Total)	1340	veh/h	1608	pers/h
Percent Heavy Vehicles (Demand)	6.9	%		
Degree of Saturation	0.581			
Practical Spare Capacity	46.3	%		
Effective Intersection Capacity	2306	veh/h		
Control Delay (Total)	2.99	veh-h/h	3.59	pers-h/h
Control Delay (Average)	8.0	sec	8.0	sec
Control Delay (Worst Lane)	11.4	sec		
Control Delay (Worst Movement)	15.5	sec	15.5	sec
Geometric Delay (Average)	6.2	sec		
Stop-Line Delay (Average)	1.8	sec		
Idling Time (Average)	0.3	sec		
Intersection Level of Service (LOS)	LOS A			
95% Back of Queue - Vehicles (Worst Lane)	6.4	veh		
95% Back of Queue - Distance (Worst Lane)	47.7	m		
Queue Storage Ratio (Worst Lane)	0.04			
Total Effective Stops	791	veh/h	950	pers/h
Effective Stop Rate	0.59		0.59	
Proportion Queued	0.56		0.56	
Performance Index	43.5		43.5	
Cost (Total)	847.03	$/h	847.03	$/h
Fuel Consumption (Total)	171.5	L/h		
Carbon Dioxide (Total)	409.2	kg/h		
Hydrocarbons (Total)	0.035	kg/h		
Carbon Monoxide (Total)	0.505	kg/h		
NOx (Total)	1.164	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 2.7 %
Number of Iterations: 7 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 2.0% 1.0% 0.5%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	643,200	veh/y	771,840	pers/y
Delay	1,437	veh-h/y	1,725	pers-h/y
Effective Stops	379,806	veh/y	455,768	pers/y
Travel Distance	664,873	veh-km/y	797,847	pers-km/y
Travel Time	11,566	veh-h/y	13,879	pers-h/y
Cost	406,575	$/y	406,575	$/y
Fuel Consumption	82,322	L/y		
Carbon Dioxide	196,437	kg/y		
Hydrocarbons	17	kg/y		
Carbon Monoxide	243	kg/y		
NOx	559	kg/y		

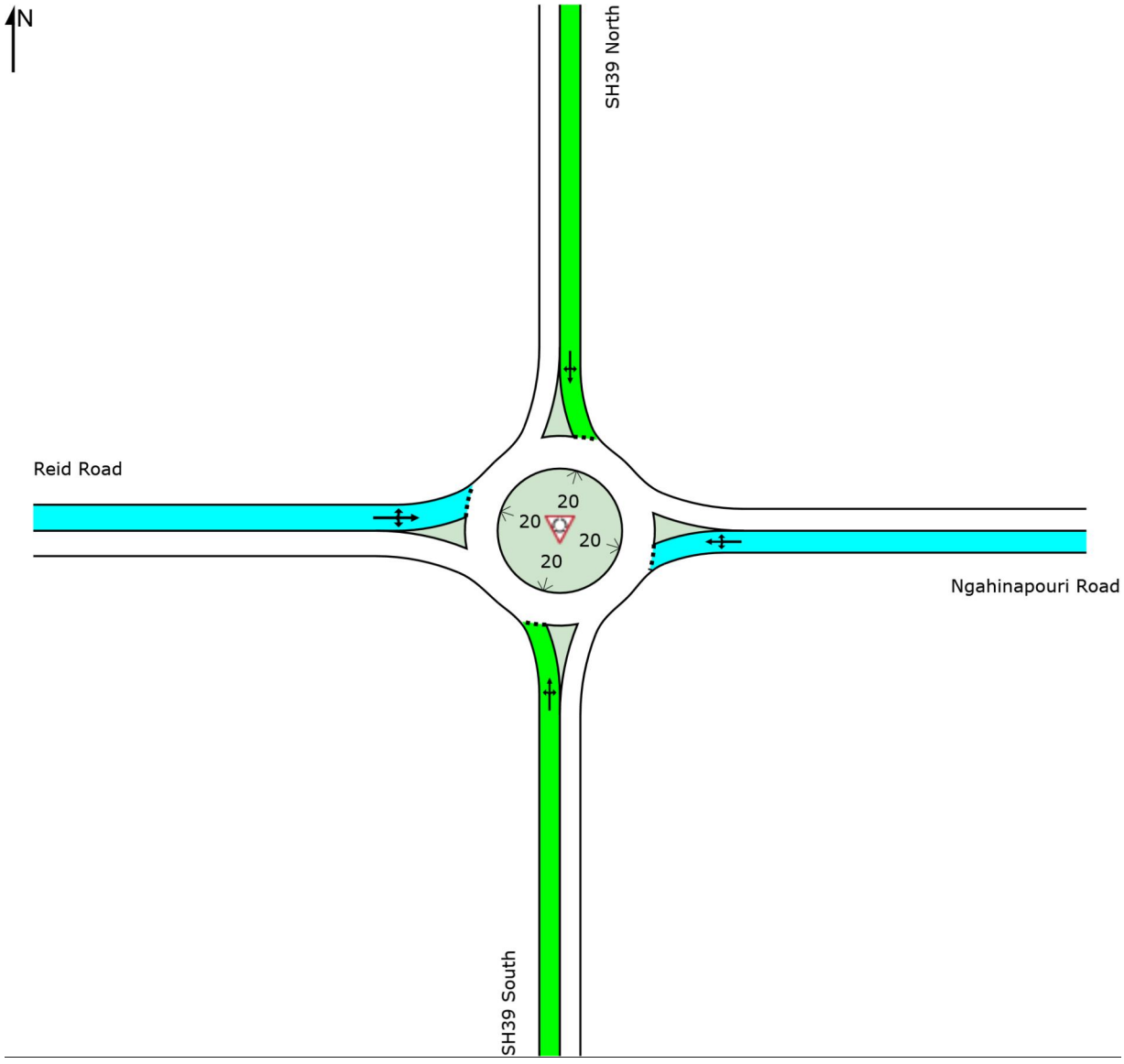
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101vv [Opt3to5 - 2035_Low Dev_AM]

New Site
Site Category: (None)
Roundabout

	Approaches				Intersection
	South	East	North	West	
LOS	A	B	A	B	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Roundabout Level of Service Method: SIDRA Roundabout LOS
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

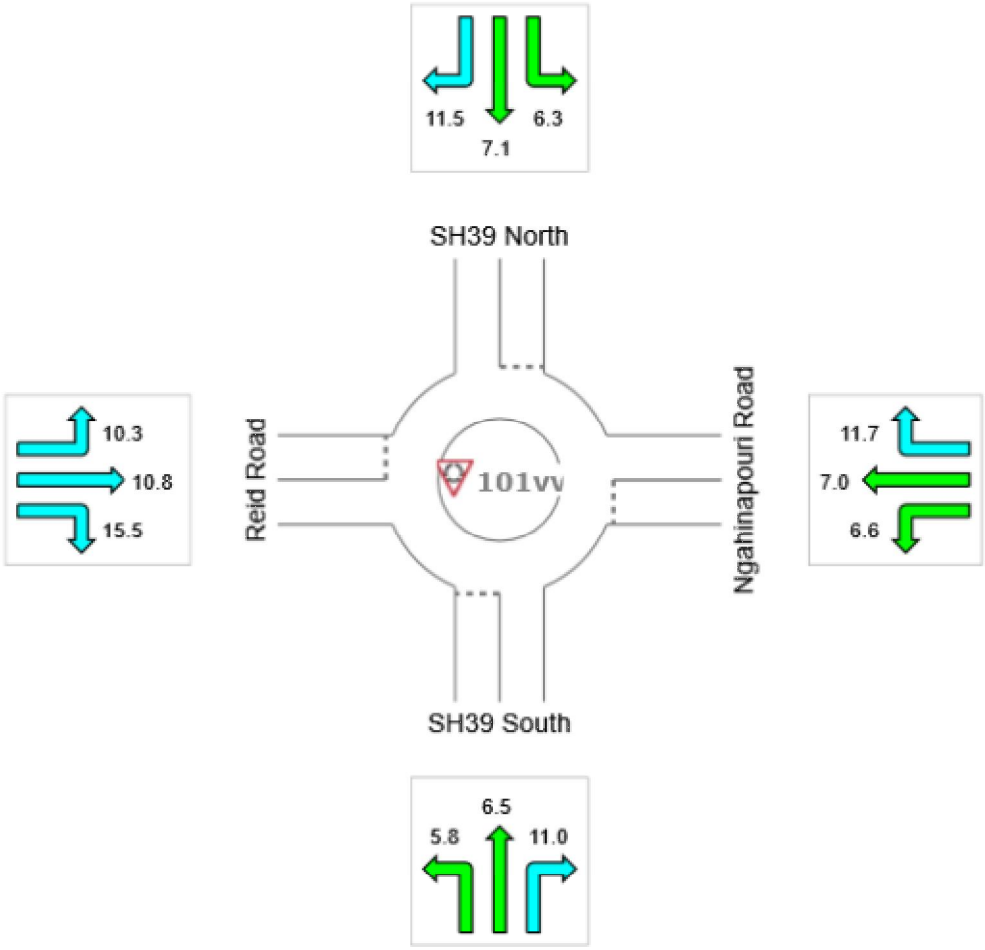
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101vv [Opt3to5 - 2035_Low Dev_AM]

New Site
Site Category: (None)
Roundabout

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	7.4	10.2	7.4	11.4	8.0
LOS	A	B	A	B	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Roundabout Level of Service Method: SIDRA Roundabout LOS
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101vv [Opt3to5 - 2035_Low Dev_PM]

New Site
Site Category: (None)
Roundabout

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	58.2	km/h	58.2	km/h
Travel Distance (Total)	1231.2	veh-km/h	1477.4	pers-km/h
Travel Time (Total)	21.2	veh-h/h	25.4	pers-h/h
Demand Flows (Total)	1193	veh/h	1431	pers/h
Percent Heavy Vehicles (Demand)	7.7	%		
Degree of Saturation	0.567			
Practical Spare Capacity	49.9	%		
Effective Intersection Capacity	2103	veh/h		
Control Delay (Total)	2.31	veh-h/h	2.77	pers-h/h
Control Delay (Average)	7.0	sec	7.0	sec
Control Delay (Worst Lane)	12.6	sec		
Control Delay (Worst Movement)	14.2	sec	14.2	sec
Geometric Delay (Average)	5.9	sec		
Stop-Line Delay (Average)	1.0	sec		
Idling Time (Average)	0.0	sec		
Intersection Level of Service (LOS)	LOS A			
95% Back of Queue - Vehicles (Worst Lane)	6.1	veh		
95% Back of Queue - Distance (Worst Lane)	45.5	m		
Queue Storage Ratio (Worst Lane)	0.04			
Total Effective Stops	623	veh/h	748	pers/h
Effective Stop Rate	0.52		0.52	
Proportion Queued	0.45		0.45	
Performance Index	36.9		36.9	
Cost (Total)	742.48	$/h	742.48	$/h
Fuel Consumption (Total)	155.6	L/h		
Carbon Dioxide (Total)	371.8	kg/h		
Hydrocarbons (Total)	0.031	kg/h		
Carbon Monoxide (Total)	0.450	kg/h		
NOx (Total)	1.142	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 2.2 %
Number of Iterations: 6 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 2.6% 1.3% 0.7%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	572,463	veh/y	686,956	pers/y
Delay	1,107	veh-h/y	1,329	pers-h/y
Effective Stops	299,212	veh/y	359,054	pers/y
Travel Distance	590,971	veh-km/y	709,166	pers-km/y
Travel Time	10,159	veh-h/y	12,191	pers-h/y
Cost	356,391	$/y	356,391	$/y
Fuel Consumption	74,679	L/y		
Carbon Dioxide	178,459	kg/y		
Hydrocarbons	15	kg/y		
Carbon Monoxide	216	kg/y		
NOx	548	kg/y		

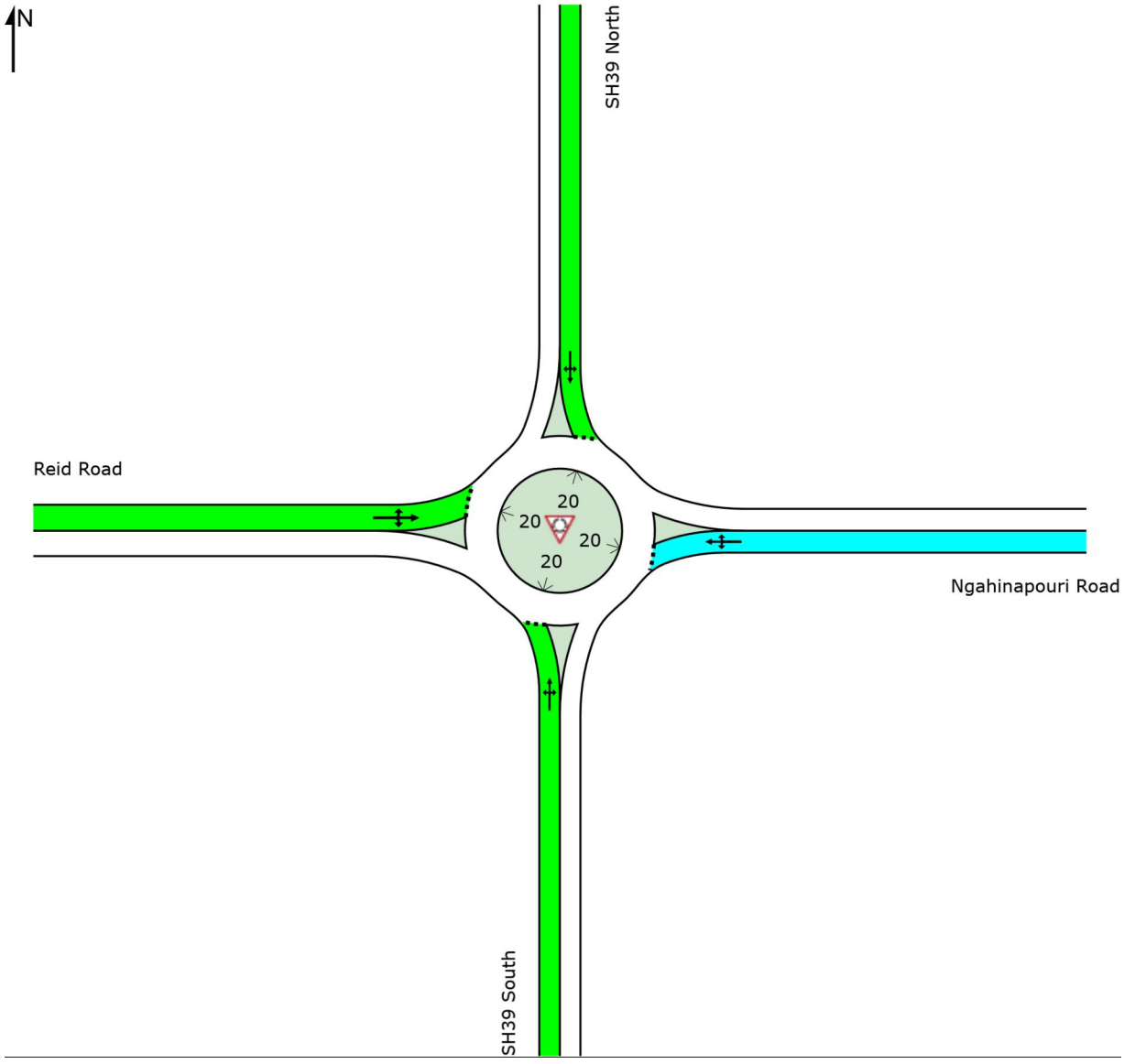
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101vv [Opt3to5 - 2035_Low Dev_PM]

New Site
Site Category: (None)
Roundabout

	Approaches				Intersection
	South	East	North	West	
LOS	A	B	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Roundabout Level of Service Method: SIDRA Roundabout LOS
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

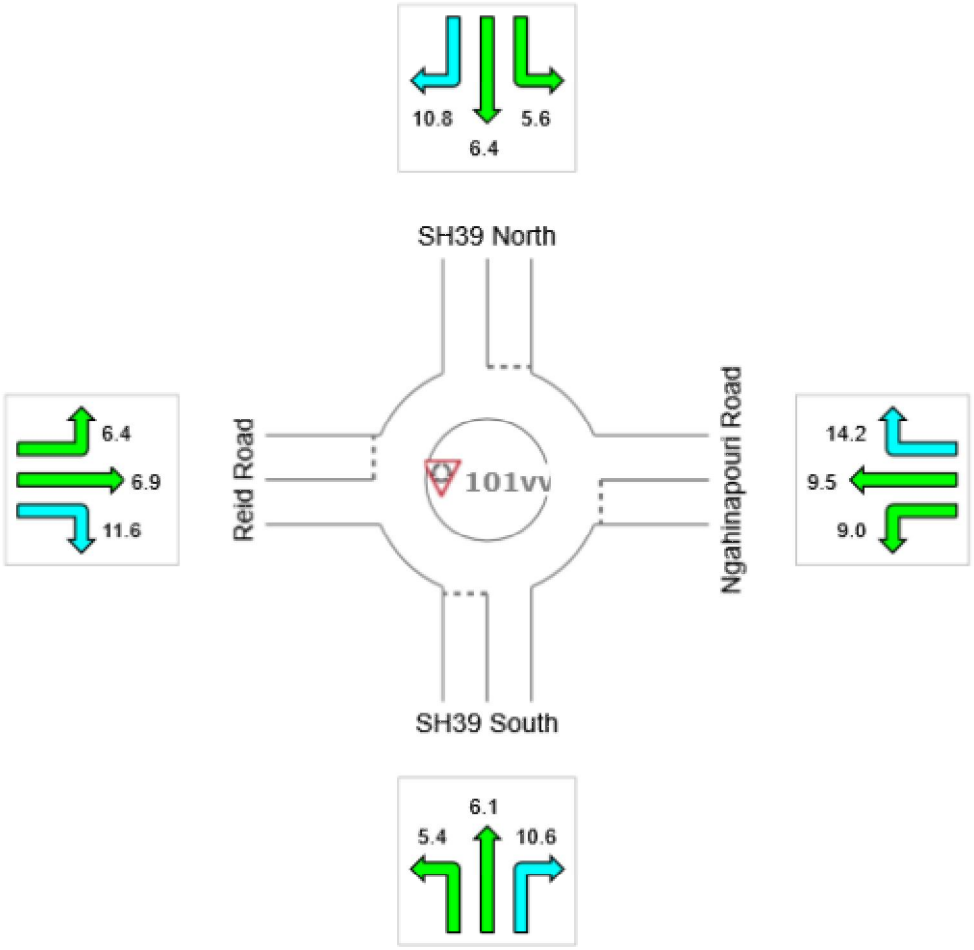
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101vv [Opt3to5 - 2035_Low Dev_PM]

New Site
Site Category: (None)
Roundabout

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	7.0	12.6	6.6	7.6	7.0
LOS	A	B	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Roundabout Level of Service Method: SIDRA Roundabout LOS
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101v [Opt3to5 - 2035_Hi Dev_AM]

New Site
Site Category: (None)
Roundabout

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	57.2	km/h	57.2	km/h
Travel Distance (Total)	1510.1	veh-km/h	1812.2	pers-km/h
Travel Time (Total)	26.4	veh-h/h	31.7	pers-h/h
Demand Flows (Total)	1462	veh/h	1755	pers/h
Percent Heavy Vehicles (Demand)	6.3	%		
Degree of Saturation	0.581			
Practical Spare Capacity	46.2	%		
Effective Intersection Capacity	2515	veh/h		
Control Delay (Total)	3.50	veh-h/h	4.20	pers-h/h
Control Delay (Average)	8.6	sec	8.6	sec
Control Delay (Worst Lane)	12.5	sec		
Control Delay (Worst Movement)	16.5	sec	16.5	sec
Geometric Delay (Average)	6.2	sec		
Stop-Line Delay (Average)	2.4	sec		
Idling Time (Average)	0.5	sec		
Intersection Level of Service (LOS)	LOS A			
95% Back of Queue - Vehicles (Worst Lane)	6.4	veh		
95% Back of Queue - Distance (Worst Lane)	47.9	m		
Queue Storage Ratio (Worst Lane)	0.04			
Total Effective Stops	927	veh/h	1112	pers/h
Effective Stop Rate	0.63		0.63	
Proportion Queued	0.60		0.60	
Performance Index	48.6		48.6	
Cost (Total)	924.86	$/h	924.86	$/h
Fuel Consumption (Total)	183.6	L/h		
Carbon Dioxide (Total)	437.7	kg/h		
Hydrocarbons (Total)	0.038	kg/h		
Carbon Monoxide (Total)	0.548	kg/h		
NOx (Total)	1.176	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 2.7 %
Number of Iterations: 7 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 2.0% 1.0% 0.5%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	701,811	veh/y	842,173	pers/y
Delay	1,680	veh-h/y	2,016	pers-h/y
Effective Stops	444,737	veh/y	533,685	pers/y
Travel Distance	724,870	veh-km/y	869,844	pers-km/y
Travel Time	12,682	veh-h/y	15,218	pers-h/y
Cost	443,935	$/y	443,935	$/y
Fuel Consumption	88,134	L/y		
Carbon Dioxide	210,097	kg/y		
Hydrocarbons	18	kg/y		
Carbon Monoxide	263	kg/y		
NOx	564	kg/y		

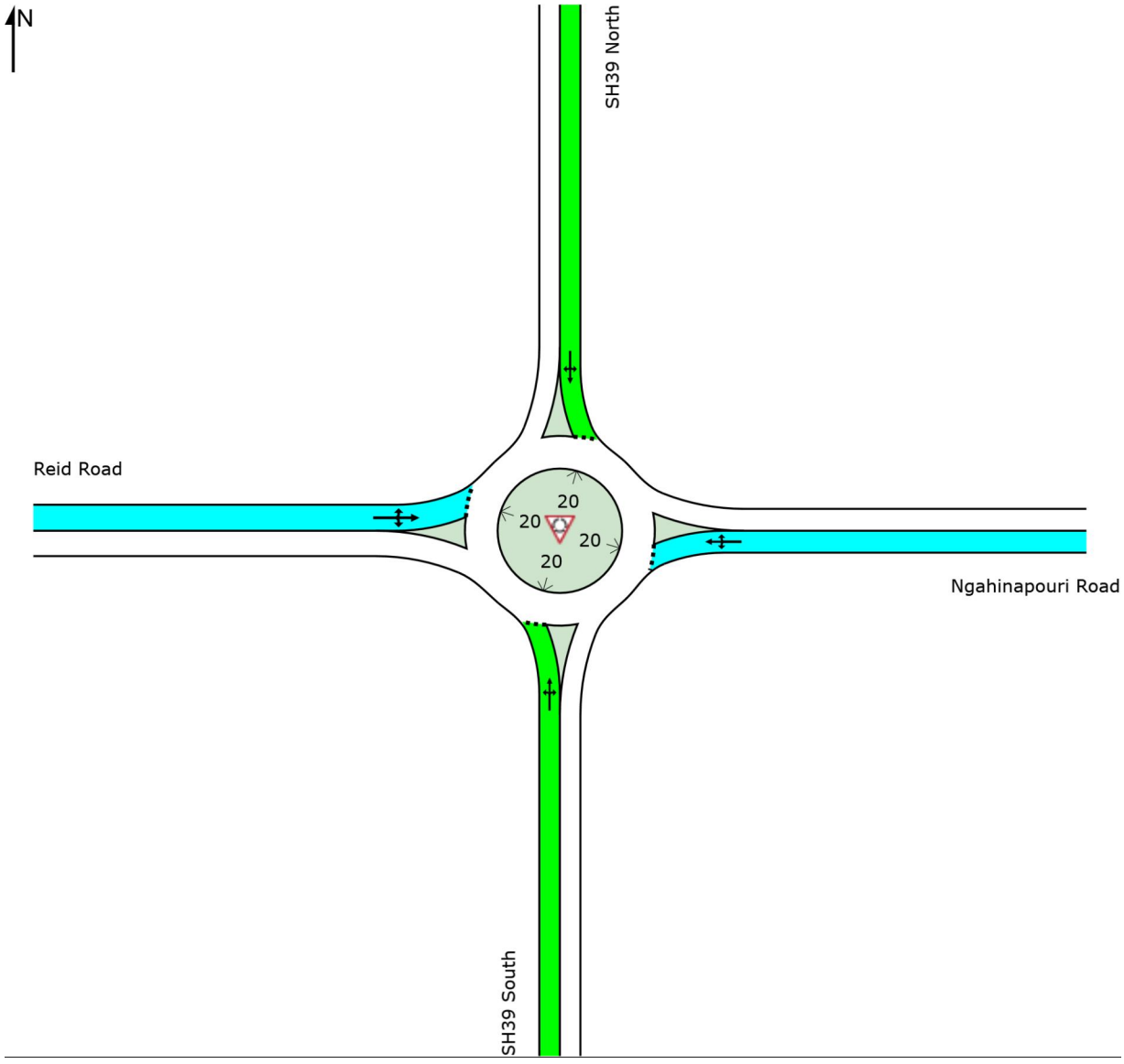
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101v [Opt3to5 - 2035_Hi Dev_AM]

New Site
Site Category: (None)
Roundabout

	Approaches				Intersection
	South	East	North	West	
LOS	A	B	A	B	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Roundabout Level of Service Method: SIDRA Roundabout LOS
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

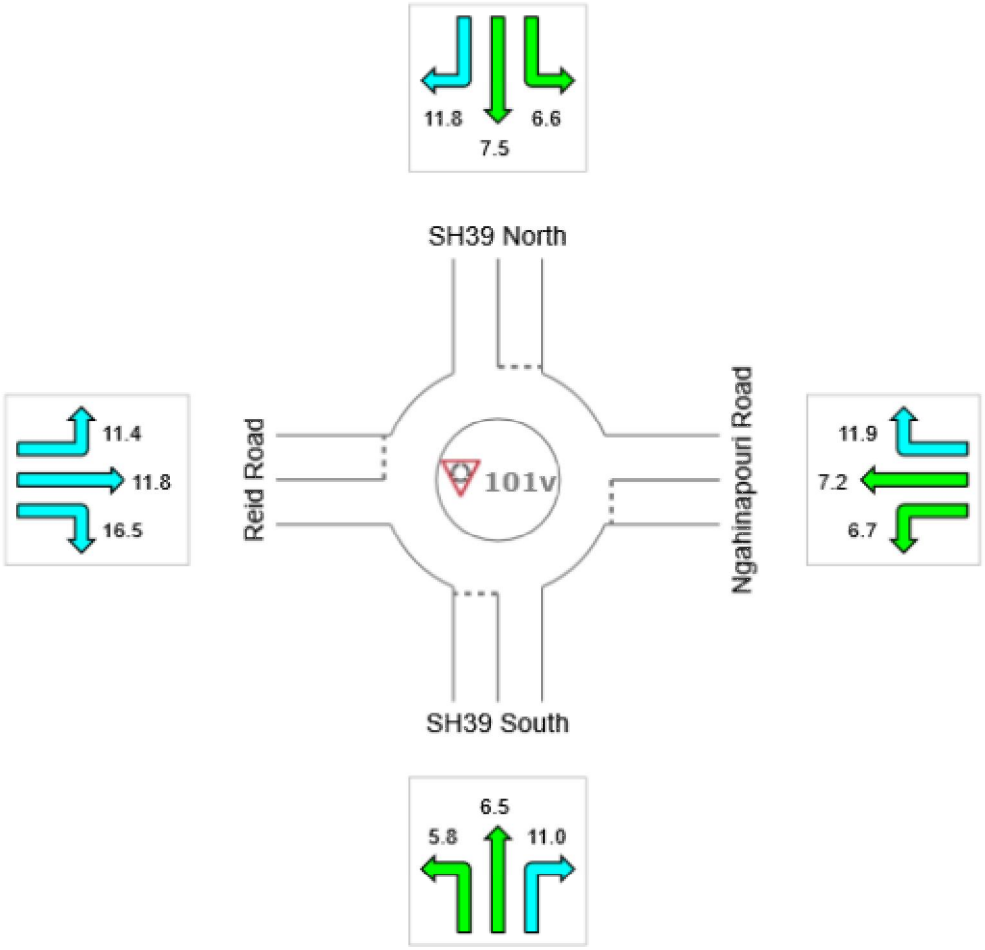
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101v [Opt3to5 - 2035_Hi Dev_AM]

New Site
Site Category: (None)
Roundabout

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	7.4	10.4	7.7	12.5	8.6
LOS	A	B	A	B	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Roundabout Level of Service Method: SIDRA Roundabout LOS
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101v [Opt3to5 - 2035_Hi Dev_PM]

New Site
Site Category: (None)
Roundabout

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	58.1	km/h	58.1	km/h
Travel Distance (Total)	1273.2	veh-km/h	1527.8	pers-km/h
Travel Time (Total)	21.9	veh-h/h	26.3	pers-h/h
Demand Flows (Total)	1234	veh/h	1480	pers/h
Percent Heavy Vehicles (Demand)	7.5	%		
Degree of Saturation	0.578			
Practical Spare Capacity	47.1	%		
Effective Intersection Capacity	2135	veh/h		
Control Delay (Total)	2.43	veh-h/h	2.91	pers-h/h
Control Delay (Average)	7.1	sec	7.1	sec
Control Delay (Worst Lane)	12.7	sec		
Control Delay (Worst Movement)	14.2	sec	14.2	sec
Geometric Delay (Average)	5.9	sec		
Stop-Line Delay (Average)	1.2	sec		
Idling Time (Average)	0.0	sec		
Intersection Level of Service (LOS)	LOS A			
95% Back of Queue - Vehicles (Worst Lane)	6.2	veh		
95% Back of Queue - Distance (Worst Lane)	46.2	m		
Queue Storage Ratio (Worst Lane)	0.04			
Total Effective Stops	660	veh/h	792	pers/h
Effective Stop Rate	0.53		0.53	
Proportion Queued	0.47		0.47	
Performance Index	38.3		38.3	
Cost (Total)	767.35	$/h	767.35	$/h
Fuel Consumption (Total)	159.7	L/h		
Carbon Dioxide (Total)	381.4	kg/h		
Hydrocarbons (Total)	0.032	kg/h		
Carbon Monoxide (Total)	0.465	kg/h		
NOx (Total)	1.148	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 2.4 %
Number of Iterations: 6 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 2.8% 1.4% 0.7%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	592,168	veh/y	710,602	pers/y
Delay	1,165	veh-h/y	1,398	pers-h/y
Effective Stops	316,683	veh/y	380,019	pers/y
Travel Distance	611,135	veh-km/y	733,362	pers-km/y
Travel Time	10,517	veh-h/y	12,620	pers-h/y
Cost	368,328	$/y	368,328	$/y
Fuel Consumption	76,645	L/y		
Carbon Dioxide	183,082	kg/y		
Hydrocarbons	15	kg/y		
Carbon Monoxide	223	kg/y		
NOx	551	kg/y		

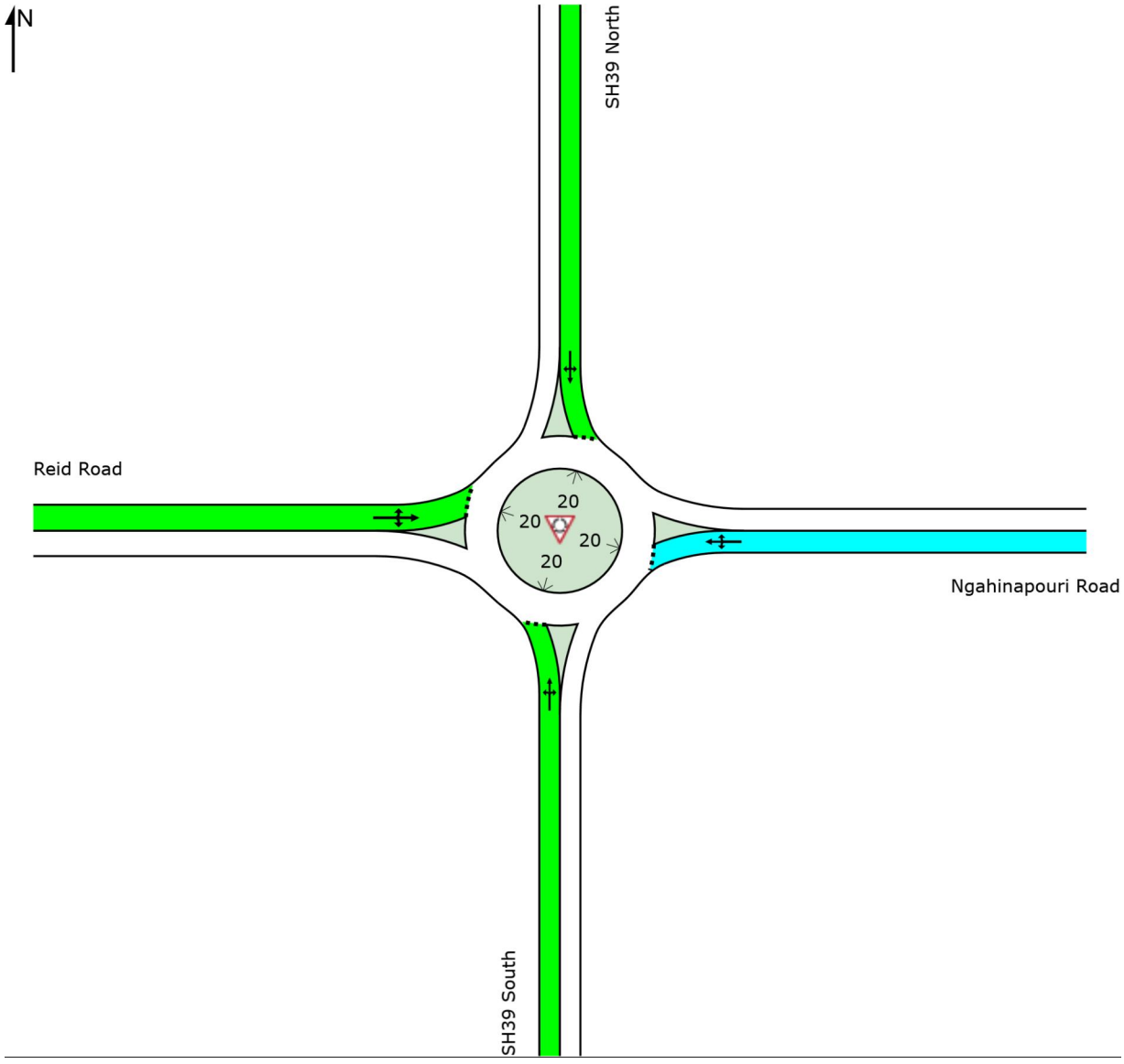
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101v [Opt3to5 - 2035_Hi Dev_PM]

New Site
Site Category: (None)
Roundabout

	Approaches				Intersection
	South	East	North	West	
LOS	A	B	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Roundabout Level of Service Method: SIDRA Roundabout LOS
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

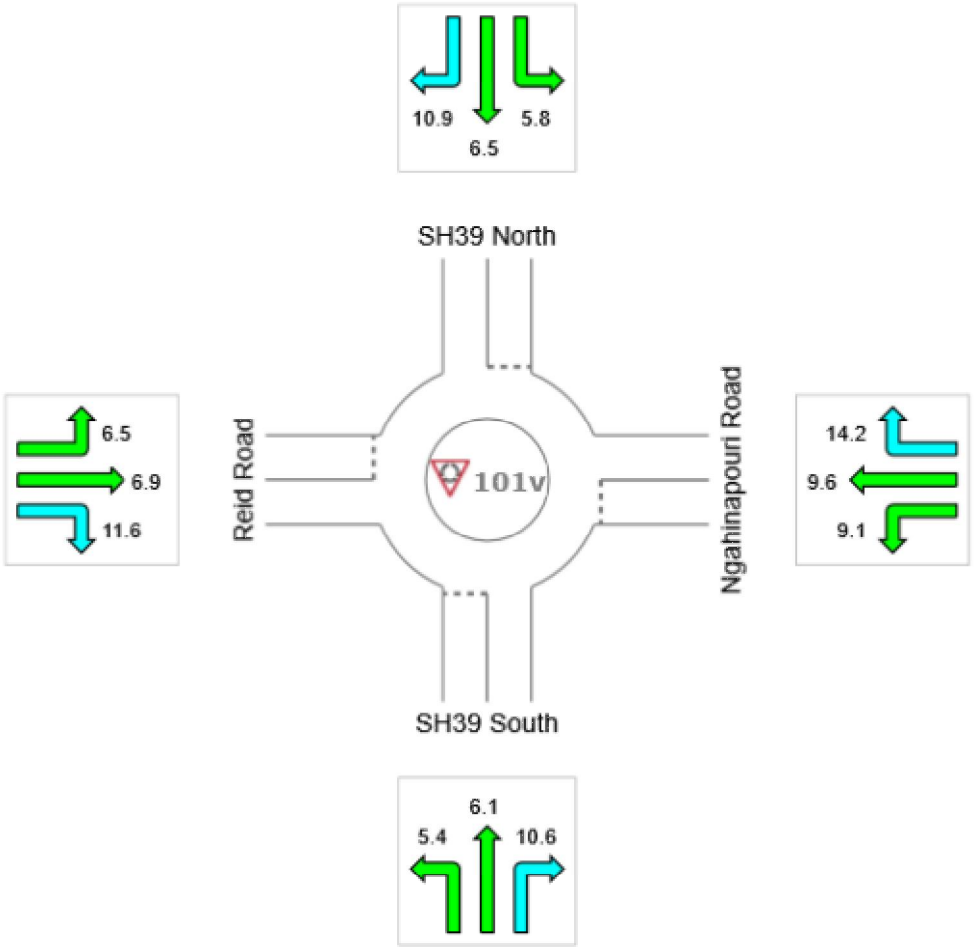
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101v [Opt3to5 - 2035_Hi Dev_PM]

New Site
Site Category: (None)
Roundabout

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	7.0	12.7	6.8	7.6	7.1
LOS	A	B	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Roundabout Level of Service Method: SIDRA Roundabout LOS
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101vv [Opt3to5 - 2018_Low Dev_AM]

New Site
Site Category: (None)
Roundabout

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	58.2	km/h	58.2	km/h
Travel Distance (Total)	1066.0	veh-km/h	1279.2	pers-km/h
Travel Time (Total)	18.3	veh-h/h	22.0	pers-h/h
Demand Flows (Total)	1032	veh/h	1238	pers/h
Percent Heavy Vehicles (Demand)	6.7	%		
Degree of Saturation	0.421			
Practical Spare Capacity	102.1	%		
Effective Intersection Capacity	2453	veh/h		
Control Delay (Total)	2.14	veh-h/h	2.56	pers-h/h
Control Delay (Average)	7.5	sec	7.5	sec
Control Delay (Worst Lane)	9.7	sec		
Control Delay (Worst Movement)	13.4	sec	13.4	sec
Geometric Delay (Average)	6.2	sec		
Stop-Line Delay (Average)	1.3	sec		
Idling Time (Average)	0.1	sec		
Intersection Level of Service (LOS)	LOS A			
95% Back of Queue - Vehicles (Worst Lane)	3.7	veh		
95% Back of Queue - Distance (Worst Lane)	28.0	m		
Queue Storage Ratio (Worst Lane)	0.02			
Total Effective Stops	576	veh/h	692	pers/h
Effective Stop Rate	0.56		0.56	
Proportion Queued	0.43		0.43	
Performance Index	30.6		30.6	
Cost (Total)	636.12	$/h	636.12	$/h
Fuel Consumption (Total)	129.4	L/h		
Carbon Dioxide (Total)	308.7	kg/h		
Hydrocarbons (Total)	0.026	kg/h		
Carbon Monoxide (Total)	0.384	kg/h		
NOx (Total)	0.860	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 1.7 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 2.7% 1.6% 0.8%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	495,158	veh/y	594,190	pers/y
Delay	1,025	veh-h/y	1,230	pers-h/y
Effective Stops	276,605	veh/y	331,926	pers/y
Travel Distance	511,687	veh-km/y	614,025	pers-km/y
Travel Time	8,787	veh-h/y	10,544	pers-h/y
Cost	305,340	$/y	305,340	$/y
Fuel Consumption	62,106	L/y		
Carbon Dioxide	148,161	kg/y		
Hydrocarbons	13	kg/y		
Carbon Monoxide	184	kg/y		
NOx	413	kg/y		

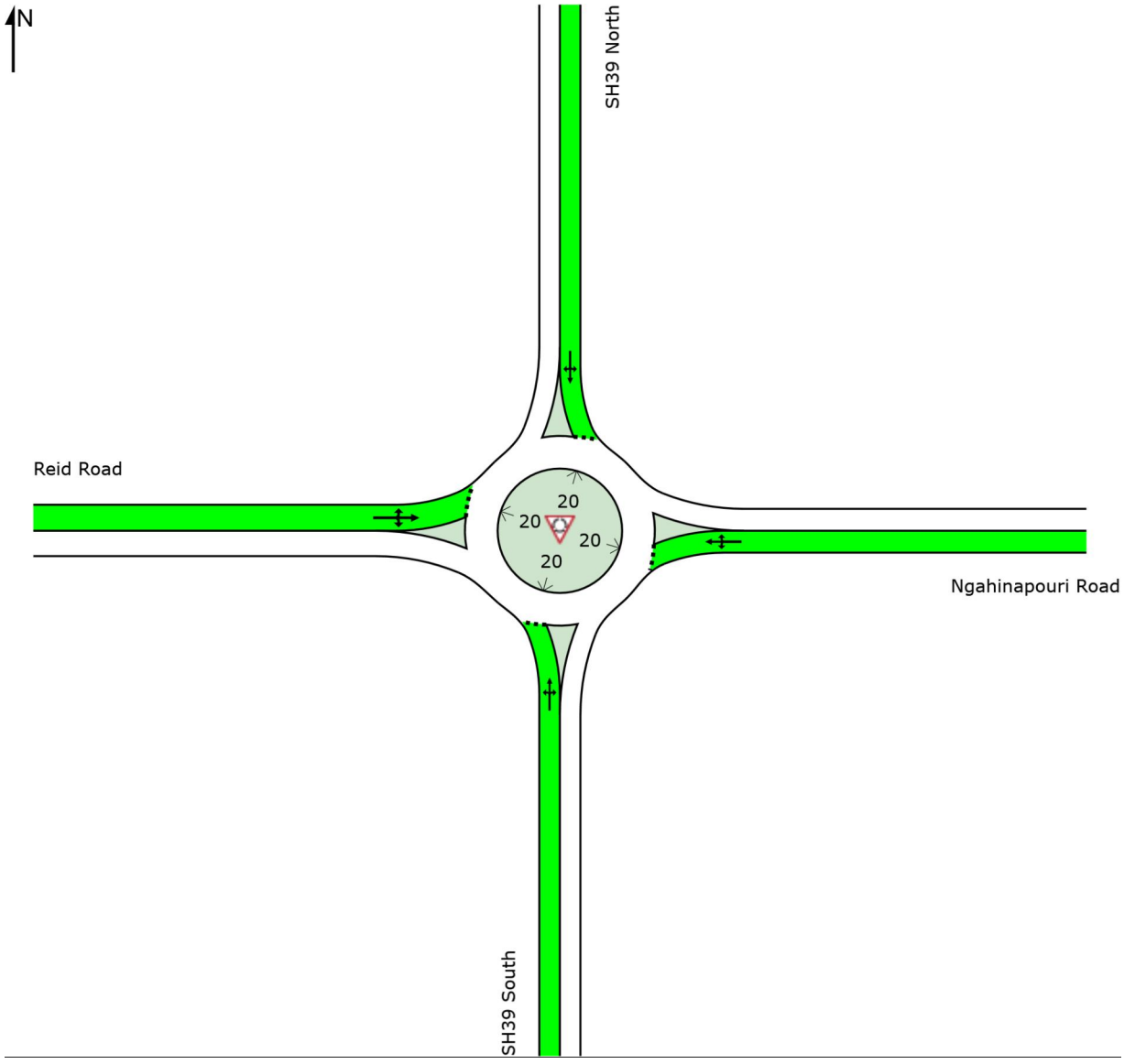
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101vv [Opt3to5 - 2018_Low Dev_AM]

New Site
Site Category: (None)
Roundabout

	Approaches				Intersection
	South	East	North	West	
LOS	A	A	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Roundabout Level of Service Method: SIDRA Roundabout LOS
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

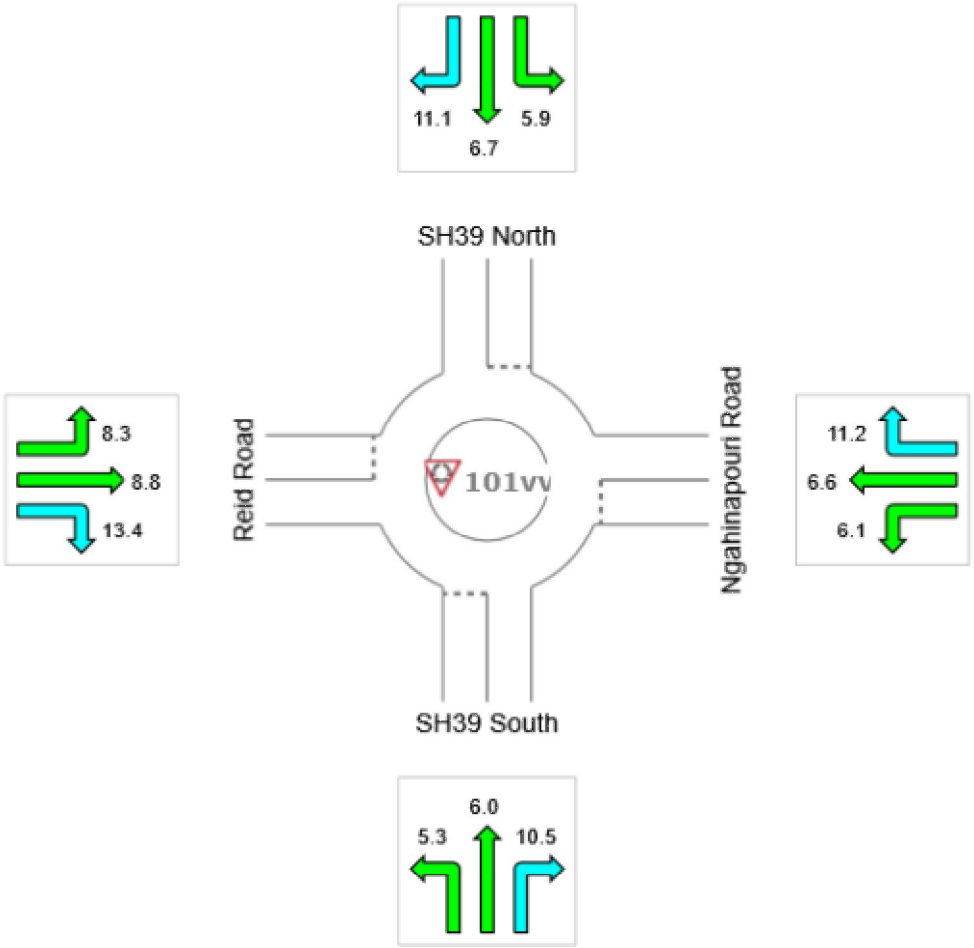
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101vv [Opt3to5 - 2018_Low Dev_AM]

New Site
Site Category: (None)
Roundabout

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	6.9	9.7	6.9	9.4	7.5
LOS	A	A	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Roundabout Level of Service Method: SIDRA Roundabout LOS
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101vv [Opt3to5 - 2018_Low Dev_PM]

New Site
Site Category: (None)
Roundabout

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	58.8	km/h	58.8	km/h
Travel Distance (Total)	930.1	veh-km/h	1116.1	pers-km/h
Travel Time (Total)	15.8	veh-h/h	19.0	pers-h/h
Demand Flows (Total)	901	veh/h	1081	pers/h
Percent Heavy Vehicles (Demand)	7.6	%		
Degree of Saturation	0.415			
Practical Spare Capacity	104.9	%		
Effective Intersection Capacity	2172	veh/h		
Control Delay (Total)	1.65	veh-h/h	1.98	pers-h/h
Control Delay (Average)	6.6	sec	6.6	sec
Control Delay (Worst Lane)	11.3	sec		
Control Delay (Worst Movement)	12.8	sec	12.8	sec
Geometric Delay (Average)	5.9	sec		
Stop-Line Delay (Average)	0.7	sec		
Idling Time (Average)	0.0	sec		
Intersection Level of Service (LOS)	LOS A			
95% Back of Queue - Vehicles (Worst Lane)	3.6	veh		
95% Back of Queue - Distance (Worst Lane)	26.9	m		
Queue Storage Ratio (Worst Lane)	0.02			
Total Effective Stops	454	veh/h	545	pers/h
Effective Stop Rate	0.50		0.50	
Proportion Queued	0.33		0.33	
Performance Index	25.8		25.8	
Cost (Total)	550.77	$/h	550.77	$/h
Fuel Consumption (Total)	116.0	L/h		
Carbon Dioxide (Total)	277.1	kg/h		
Hydrocarbons (Total)	0.023	kg/h		
Carbon Monoxide (Total)	0.337	kg/h		
NOx (Total)	0.844	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 1.3 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 2.0% 1.2% 0.6%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	432,505	veh/y	519,006	pers/y
Delay	792	veh-h/y	951	pers-h/y
Effective Stops	218,137	veh/y	261,764	pers/y
Travel Distance	446,444	veh-km/y	535,733	pers-km/y
Travel Time	7,598	veh-h/y	9,118	pers-h/y
Cost	264,369	$/y	264,369	$/y
Fuel Consumption	55,670	L/y		
Carbon Dioxide	133,025	kg/y		
Hydrocarbons	11	kg/y		
Carbon Monoxide	162	kg/y		
NOx	405	kg/y		

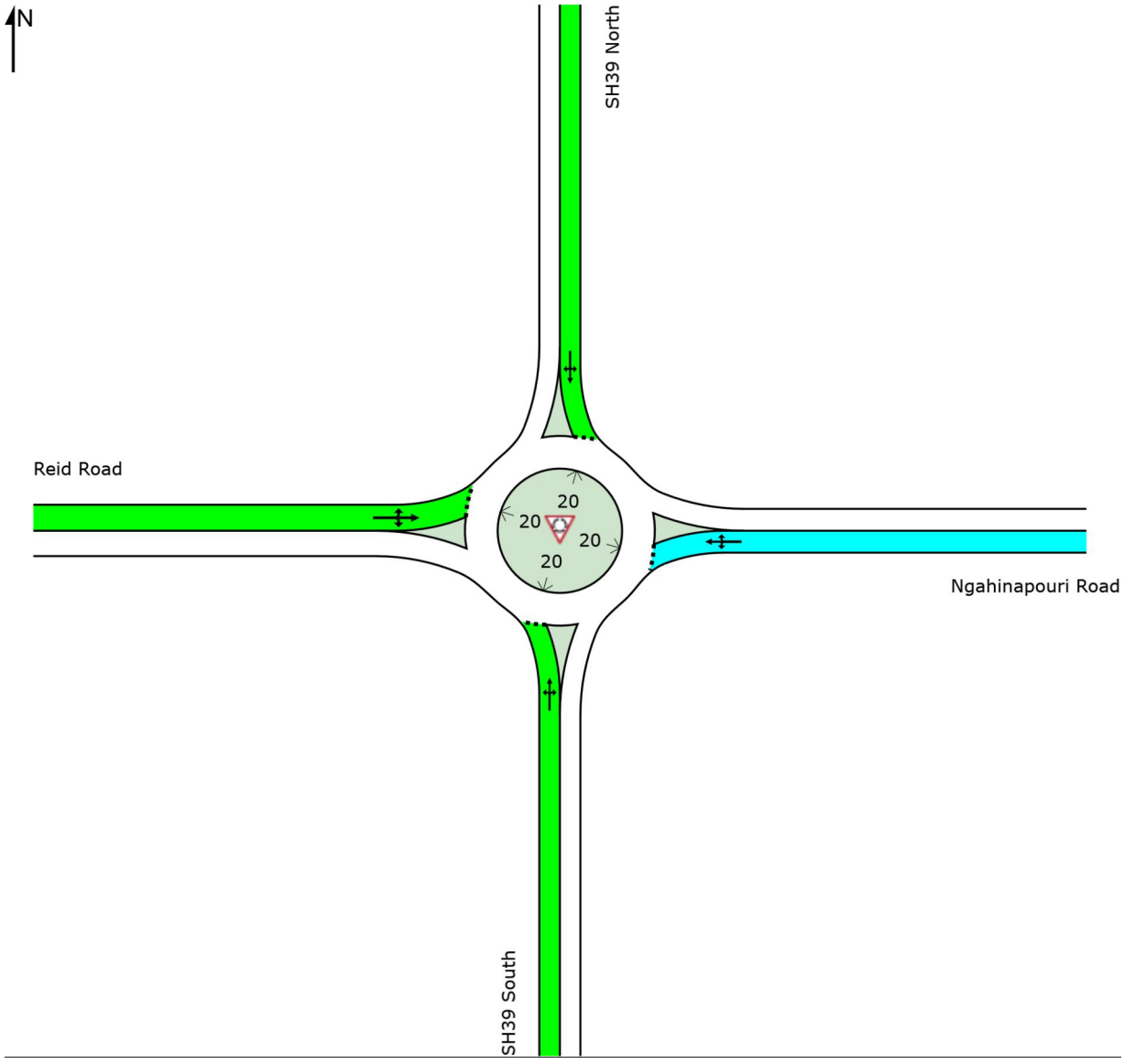
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101vv [Opt3to5 - 2018_Low Dev_PM]

New Site
Site Category: (None)
Roundabout

	Approaches				Intersection
	South	East	North	West	
LOS	A	B	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Roundabout Level of Service Method: SIDRA Roundabout LOS
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

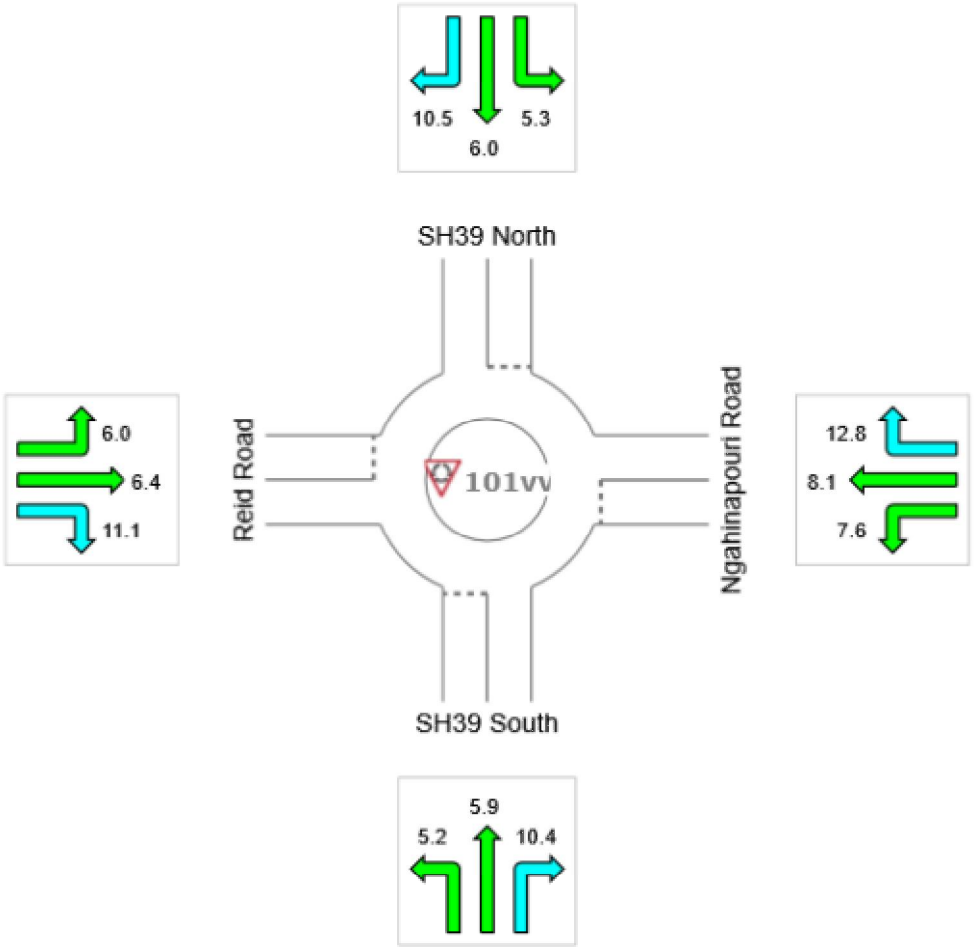
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101vv [Opt3to5 - 2018_Low Dev_PM]

New Site
Site Category: (None)
Roundabout

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	6.8	11.3	6.2	7.1	6.6
LOS	A	B	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Roundabout Level of Service Method: SIDRA Roundabout LOS
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

INTERSECTION SUMMARY

Site: 101vv [Opt3to5 - 2018_Hi Dev_AM]

New Site
Site Category: (None)
Roundabout

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Travel Speed (Average)	58.1	km/h	58.1	km/h
Travel Distance (Total)	1191.0	veh-km/h	1429.2	pers-km/h
Travel Time (Total)	20.5	veh-h/h	24.6	pers-h/h
Demand Flows (Total)	1154	veh/h	1384	pers/h
Percent Heavy Vehicles (Demand)	6.0	%		
Degree of Saturation	0.421			
Practical Spare Capacity	102.0	%		
Effective Intersection Capacity	2742	veh/h		
Control Delay (Total)	2.51	veh-h/h	3.01	pers-h/h
Control Delay (Average)	7.8	sec	7.8	sec
Control Delay (Worst Lane)	9.9	sec		
Control Delay (Worst Movement)	13.9	sec	13.9	sec
Geometric Delay (Average)	6.2	sec		
Stop-Line Delay (Average)	1.7	sec		
Idling Time (Average)	0.2	sec		
Intersection Level of Service (LOS)	LOS A			
95% Back of Queue - Vehicles (Worst Lane)	3.7	veh		
95% Back of Queue - Distance (Worst Lane)	28.1	m		
Queue Storage Ratio (Worst Lane)	0.02			
Total Effective Stops	687	veh/h	825	pers/h
Effective Stop Rate	0.60		0.60	
Proportion Queued	0.48		0.48	
Performance Index	34.8		34.8	
Cost (Total)	708.94	$/h	708.94	$/h
Fuel Consumption (Total)	141.2	L/h		
Carbon Dioxide (Total)	336.4	kg/h		
Hydrocarbons (Total)	0.029	kg/h		
Carbon Monoxide (Total)	0.426	kg/h		
NOx (Total)	0.872	kg/h		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 1.7 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 2.7% 1.6% 0.8%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	553,769	veh/y	664,522	pers/y
Delay	1,205	veh-h/y	1,446	pers-h/y
Effective Stops	329,850	veh/y	395,820	pers/y
Travel Distance	571,684	veh-km/y	686,020	pers-km/y
Travel Time	9,845	veh-h/y	11,814	pers-h/y
Cost	340,289	$/y	340,289	$/y
Fuel Consumption	67,770	L/y		
Carbon Dioxide	161,473	kg/y		
Hydrocarbons	14	kg/y		
Carbon Monoxide	205	kg/y		
NOx	418	kg/y		

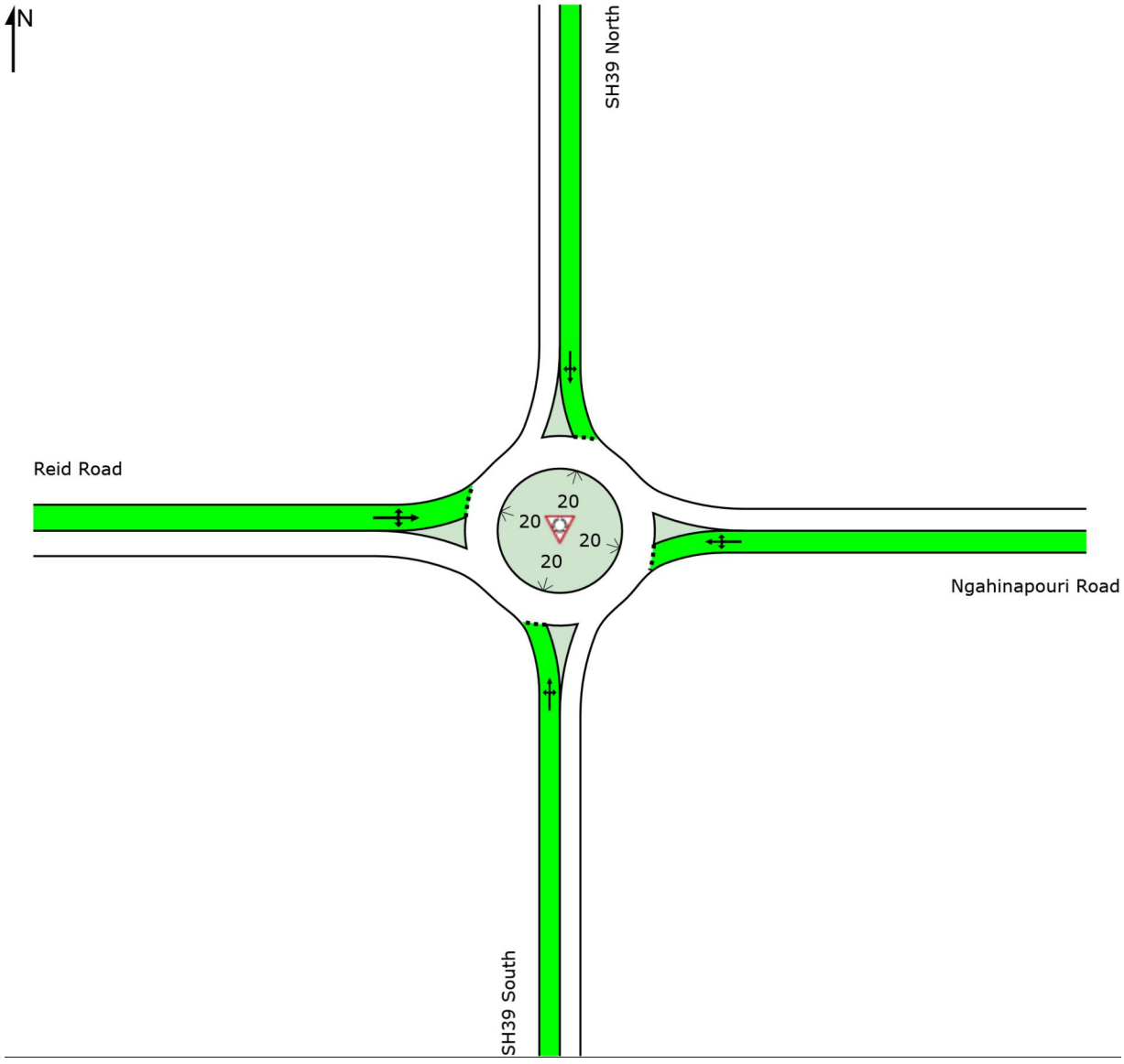
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101vv [Opt3to5 - 2018_Hi Dev_AM]

New Site
Site Category: (None)
Roundabout

	Approaches				Intersection
	South	East	North	West	
LOS	A	A	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Roundabout Level of Service Method: SIDRA Roundabout LOS
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

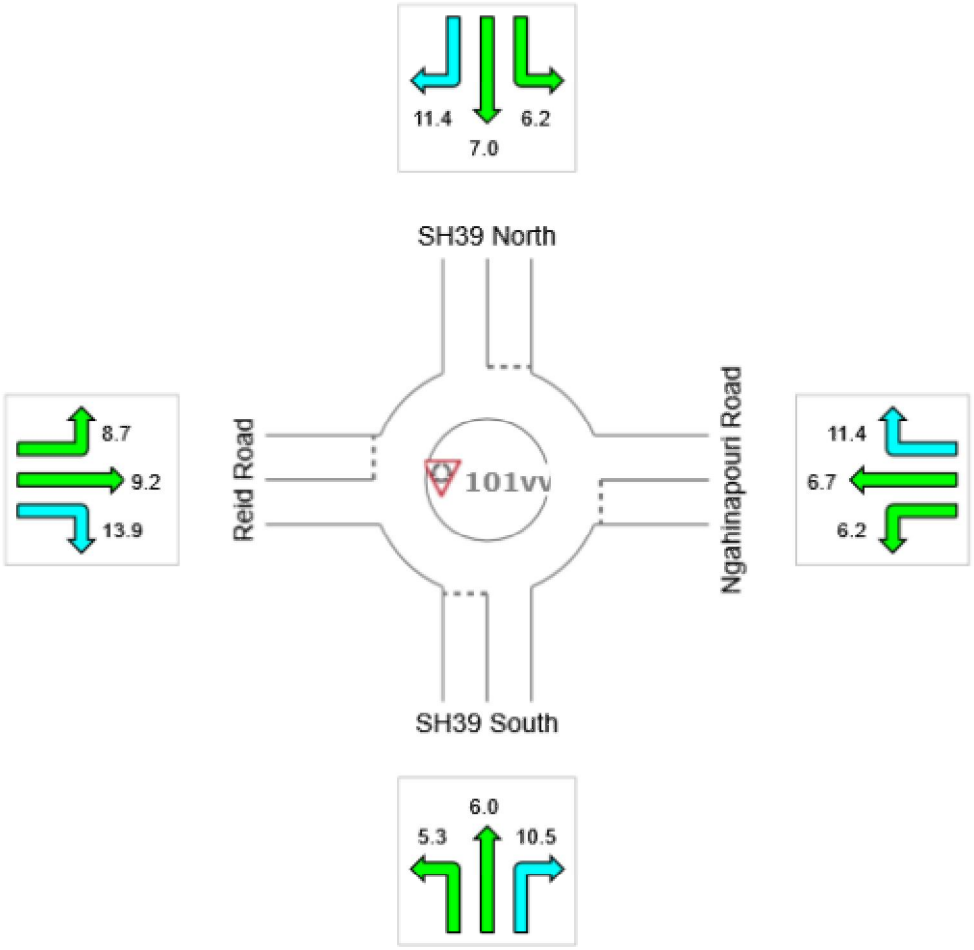
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 101vv [Opt3to5 - 2018_Hi Dev_AM]

New Site
Site Category: (None)
Roundabout

All Movement Classes

	Approaches				Intersection
	South	East	North	West	
Delay (Control)	6.9	9.9	7.2	9.8	7.8
LOS	A	A	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

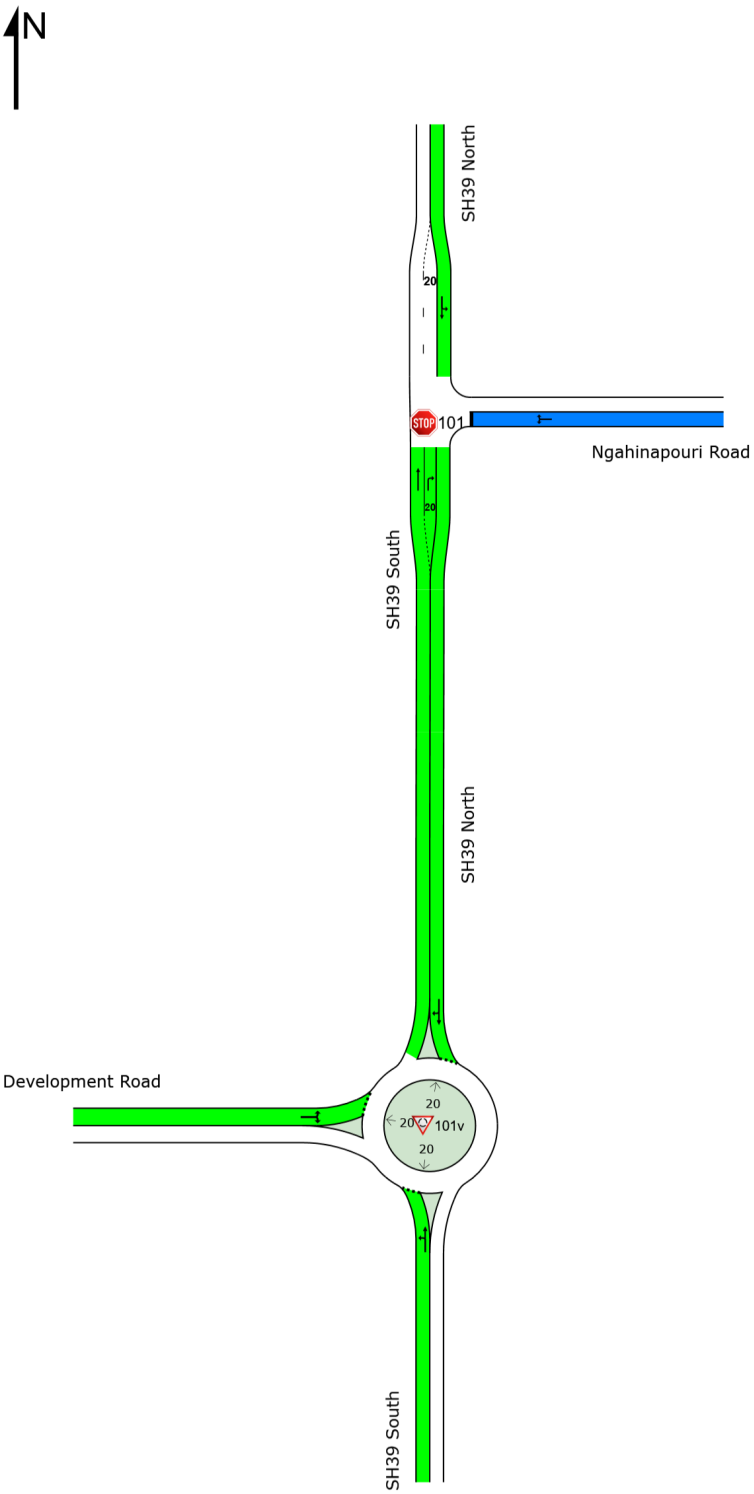
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Roundabout Level of Service Method: SIDRA Roundabout LOS
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

LEVEL OF SERVICE

Lane Level of Service

Network: N101 [2018_Low Dev_Opt6 Staggered T_AM (Network Folder: General)]

New Network
Network Category: (None)



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Delay Model: SIDRA Standard (Geometric Delay is included).

NETWORK SUMMARY

Network: N101 [2035_Hi Dev_Opt6 Staggered T_AM (Network Folder: General)]

New Network
Network Category: (None)

Network Performance - Hourly Values						
Performance Measure	**Vehicles**		**Per Unit Distance**		**Persons**	
Network Level of Service (LOS)	LOS A					
Speed Efficiency	1.00[3]					
Travel Time Index	10.00					
Congestion Coefficient	1.00					
Travel Speed (Average)	57.1	km/h			57.1	km/h
Travel Distance (Total)	1877.4	veh-km/h			2252.9	pers-km/h
Travel Time (Total)	32.9	veh-h/h			39.5	pers-h/h
Desired Speed (Input)	50.0	km/h				
Demand Flows (Total for all Sites)	2664	veh/h			3197	pers/h
Arrival Flows (Total for all Sites)	2664	veh/h			3197	pers/h
Demand Flows (Entry Total)	1462	veh/h				
Midblock Inflows (Total)	5	veh/h				
Midblock Outflows (Total)	-5	veh/h				
Percent Heavy Vehicles (Demand)	8.7	%				
Percent Heavy Vehicles (Arrival)	8.7	%				
Degree of Saturation	0.518					
Control Delay (Total)	3.84	veh-h/h			4.61	pers-h/h
Control Delay (Average)	5.2	sec			5.2	sec
Control Delay (Worst Lane)	38.6	sec				
Control Delay (Worst Movement)	47.1	sec			47.1	sec
Geometric Delay (Average)	3.3	sec				
Stop-Line Delay (Average)	1.9	sec				
Ave. Queue Storage Ratio (Worst Lane)	0.03					
Total Effective Stops	959	veh/h			1151	pers/h
Effective Stop Rate	0.36		0.51	per km	0.36	
Proportion Queued	0.25				0.25	
Performance Index	50.1				50.1	
Cost (Total)	1467.45	$/h	0.78	$/km	1467.45	$/h
Fuel Consumption (Total)	218.1	L/h	116.2	mL/km		
Fuel Economy	11.6	L/100km				
Carbon Dioxide (Total)	521.1	kg/h	277.6	g/km		
Hydrocarbons (Total)	0.044	kg/h	0.023	g/km		
Carbon Monoxide (Total)	0.622	kg/h	0.331	g/km		
NOx (Total)	1.419	kg/h	0.756	g/km		

Network Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation or Queue Storage Ratios for the last three Network Iterations: 0.0% 0.0% 0.0%
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Software Setup used: New Zealand.

3 Calculated Average Travel Speed exceeds the specified Desired Speed.

Network Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total for all Sites)	1,278,821	veh/y	1,534,585	pers/y
Delay	1,846	veh-h/y	2,215	pers-h/y
Effective Stops	460,452	veh/y	552,542	pers/y
Travel Distance	901,153	veh-km/y	1,081,384	pers-km/y
Travel Time	15,791	veh-h/y	18,949	pers-h/y
Cost	704,378	$/y	704,378	$/y
Fuel Consumption	104,674	L/y		
Carbon Dioxide	250,117	kg/y		
Hydrocarbons	21	kg/y		

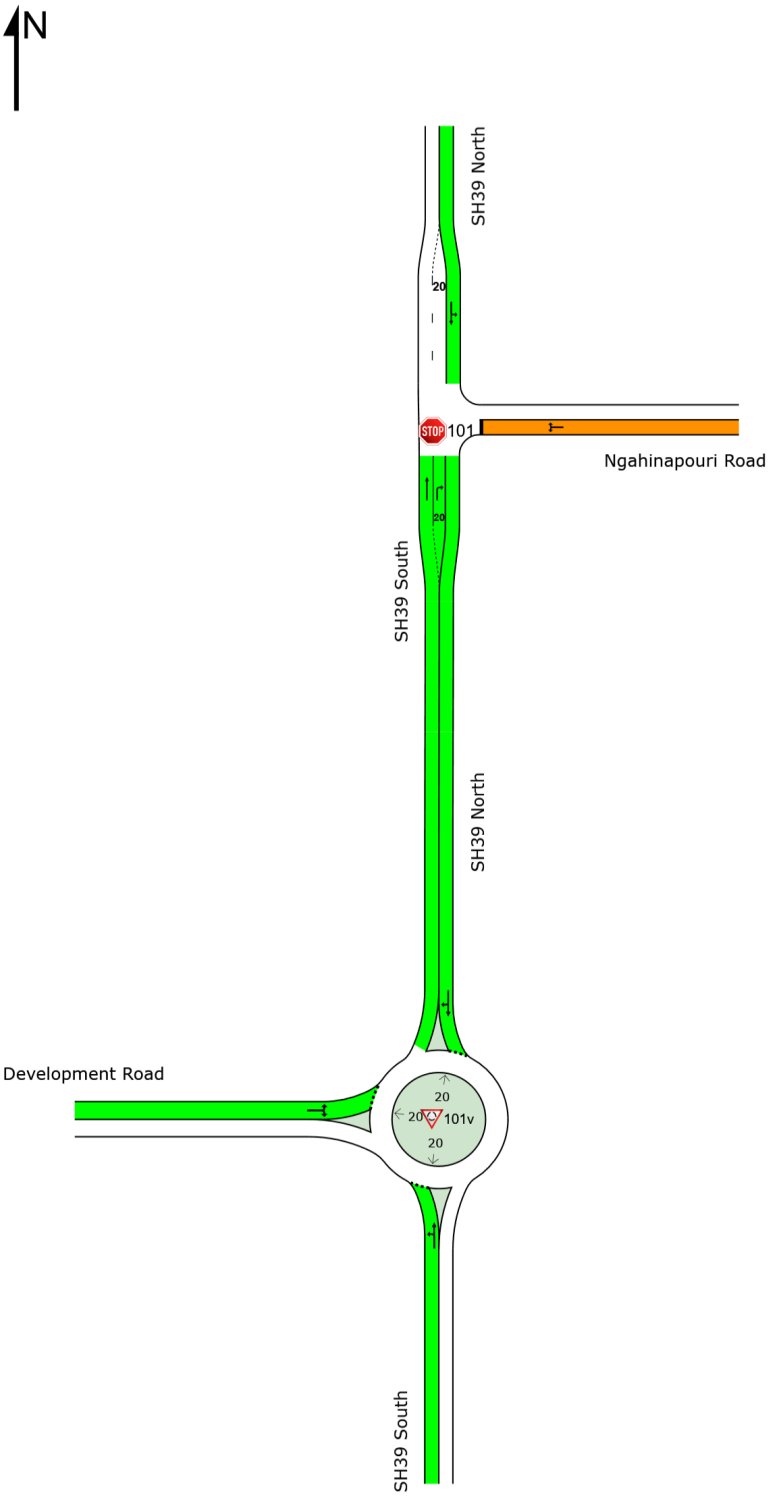
Carbon Monoxide	299	kg/y
NOx	681	kg/y

LEVEL OF SERVICE

Lane Level of Service

Network: N101 [2035_Hi Dev_Opt6 Staggered T_AM (Network Folder: General)]

New Network
Network Category: (None)



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Delay Model: SIDRA Standard (Geometric Delay is included).

NETWORK SUMMARY

Network: N101 [2035_Low Dev_Opt6 Staggered T_AM (Network Folder: General)]

New Network
Network Category: (None)

Network Performance - Hourly Values						
Performance Measure	**Vehicles**		**Per Unit Distance**		**Persons**	
Network Level of Service (LOS)	LOS A					
Speed Efficiency	1.00[3]					
Travel Time Index	10.00					
Congestion Coefficient	1.00					
Travel Speed (Average)	58.0	km/h			58.0	km/h
Travel Distance (Total)	1791.7	veh-km/h			2150.0	pers-km/h
Travel Time (Total)	30.9	veh-h/h			37.0	pers-h/h
Desired Speed (Input)	50.0	km/h				
Demand Flows (Total for all Sites)	2531	veh/h			3037	pers/h
Arrival Flows (Total for all Sites)	2531	veh/h			3037	pers/h
Demand Flows (Entry Total)	1340	veh/h				
Midblock Inflows (Total)	87	veh/h				
Midblock Outflows (Total)	-1	veh/h				
Percent Heavy Vehicles (Demand)	9.2	%				
Percent Heavy Vehicles (Arrival)	9.2	%				
Degree of Saturation	0.518					
Control Delay (Total)	3.44	veh-h/h			4.13	pers-h/h
Control Delay (Average)	4.9	sec			4.9	sec
Control Delay (Worst Lane)	37.6	sec				
Control Delay (Worst Movement)	46.0	sec			46.0	sec
Geometric Delay (Average)	3.3	sec				
Stop-Line Delay (Average)	1.6	sec				
Ave. Queue Storage Ratio (Worst Lane)	0.03					
Total Effective Stops	836	veh/h			1003	pers/h
Effective Stop Rate	0.33		0.47	per km	0.33	
Proportion Queued	0.21				0.21	
Performance Index	46.0				46.0	
Cost (Total)	1382.53	$/h	0.77	$/km	1382.53	$/h
Fuel Consumption (Total)	207.6	L/h	115.8	mL/km		
Fuel Economy	11.6	L/100km				
Carbon Dioxide (Total)	496.4	kg/h	277.0	g/km		
Hydrocarbons (Total)	0.041	kg/h	0.023	g/km		
Carbon Monoxide (Total)	0.595	kg/h	0.332	g/km		
NOx (Total)	1.406	kg/h	0.785	g/km		

Network Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation or Queue Storage Ratios for the last three Network Iterations: 0.0% 0.0% 0.0%
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Software Setup used: New Zealand.

3 Calculated Average Travel Speed exceeds the specified Desired Speed.

Network Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total for all Sites)	1,214,653	veh/y	1,457,583	pers/y
Delay	1,653	veh-h/y	1,984	pers-h/y
Effective Stops	401,374	veh/y	481,649	pers/y
Travel Distance	860,006	veh-km/y	1,032,008	pers-km/y
Travel Time	14,815	veh-h/y	17,778	pers-h/y
Cost	663,616	$/y	663,616	$/y
Fuel Consumption	99,626	L/y		
Carbon Dioxide	238,251	kg/y		
Hydrocarbons	20	kg/y		

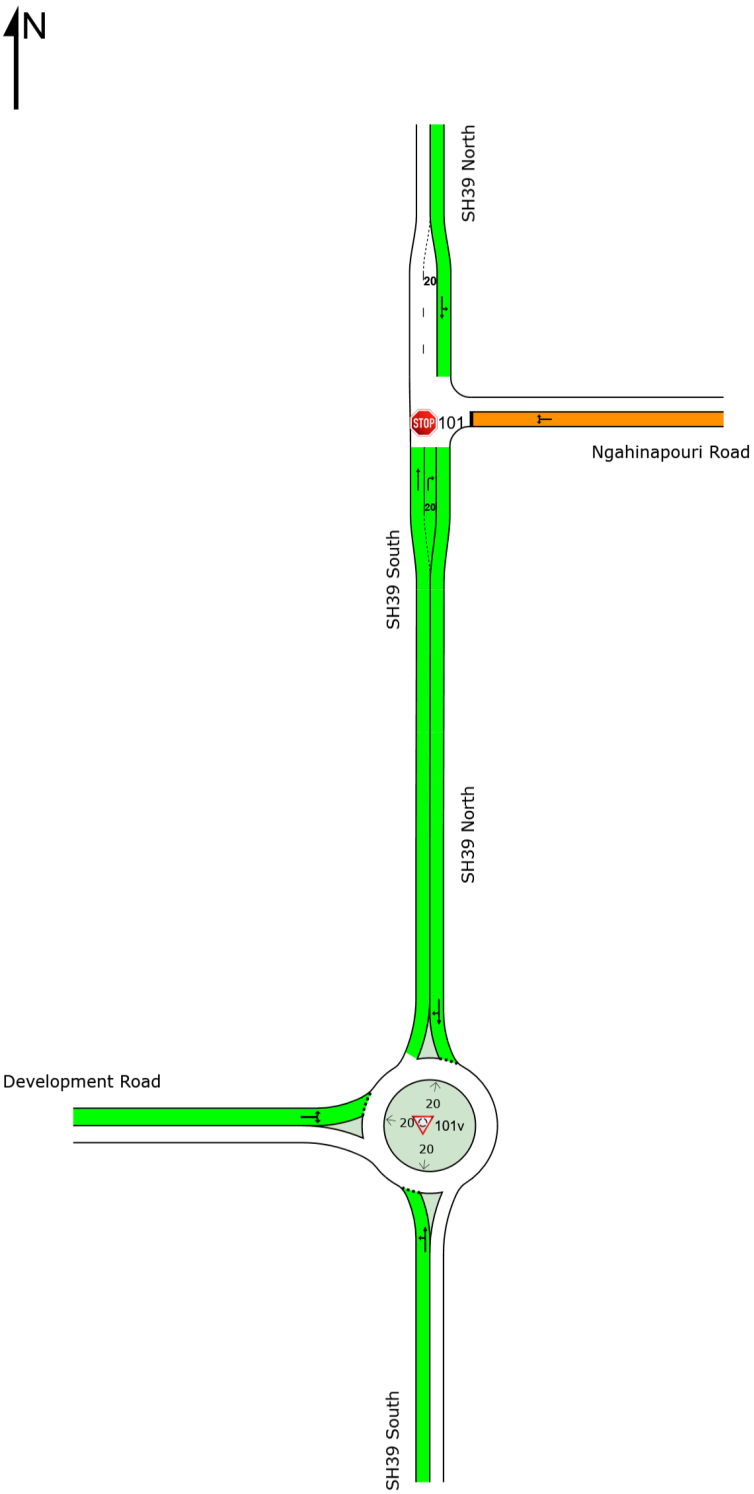
Carbon Monoxide	286	kg/y
NOx	675	kg/y

LEVEL OF SERVICE

Lane Level of Service

Network: N101 [2035_Low Dev_Opt6 Staggered T_AM (Network Folder: General)]

New Network
Network Category: (None)



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Delay Model: SIDRA Standard (Geometric Delay is included).

NETWORK SUMMARY

Network: N101 [2018_Hi Dev_Opt6 Staggered T_AM (Network Folder: General)]

New Network
Network Category: (None)

Network Performance - Hourly Values						
Performance Measure	**Vehicles**		**Per Unit Distance**		**Persons**	
Network Level of Service (LOS)	LOS A					
Speed Efficiency	1.00[3]					
Travel Time Index	10.00					
Congestion Coefficient	1.00					
Travel Speed (Average)	58.0	km/h			58.0	km/h
Travel Distance (Total)	1497.5	veh-km/h			1797.0	pers-km/h
Travel Time (Total)	25.8	veh-h/h			31.0	pers-h/h
Desired Speed (Input)	50.0	km/h				
Demand Flows (Total for all Sites)	2133	veh/h			2559	pers/h
Arrival Flows (Total for all Sites)	2133	veh/h			2559	pers/h
Demand Flows (Entry Total)	1185	veh/h				
Midblock Inflows (Total)	6	veh/h				
Midblock Outflows (Total)	-37	veh/h				
Percent Heavy Vehicles (Demand)	8.6	%				
Percent Heavy Vehicles (Arrival)	8.6	%				
Degree of Saturation	0.404					
Control Delay (Total)	2.58	veh-h/h			3.10	pers-h/h
Control Delay (Average)	4.4	sec			4.4	sec
Control Delay (Worst Lane)	20.1	sec				
Control Delay (Worst Movement)	24.6	sec			24.6	sec
Geometric Delay (Average)	3.3	sec				
Stop-Line Delay (Average)	1.1	sec				
Ave. Queue Storage Ratio (Worst Lane)	0.02					
Total Effective Stops	747	veh/h			896	pers/h
Effective Stop Rate	0.35		0.50	per km	0.35	
Proportion Queued	0.22				0.22	
Performance Index	37.7				37.7	
Cost (Total)	1153.87	$/h	0.77	$/km	1153.87	$/h
Fuel Consumption (Total)	172.5	L/h	115.2	mL/km		
Fuel Economy	11.5	L/100km				
Carbon Dioxide (Total)	412.1	kg/h	275.2	g/km		
Hydrocarbons (Total)	0.035	kg/h	0.023	g/km		
Carbon Monoxide (Total)	0.492	kg/h	0.329	g/km		
NOx (Total)	1.105	kg/h	0.738	g/km		

Network Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation or Queue Storage Ratios for the last three Network Iterations: 0.0% 0.0% 0.0%
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Software Setup used: New Zealand.

3 Calculated Average Travel Speed exceeds the specified Desired Speed.

Network Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total for all Sites)	1,023,663	veh/y	1,228,396	pers/y
Delay	1,239	veh-h/y	1,487	pers-h/y
Effective Stops	358,579	veh/y	430,295	pers/y
Travel Distance	718,790	veh-km/y	862,548	pers-km/y
Travel Time	12,387	veh-h/y	14,865	pers-h/y
Cost	553,858	$/y	553,858	$/y
Fuel Consumption	82,786	L/y		
Carbon Dioxide	197,796	kg/y		
Hydrocarbons	17	kg/y		

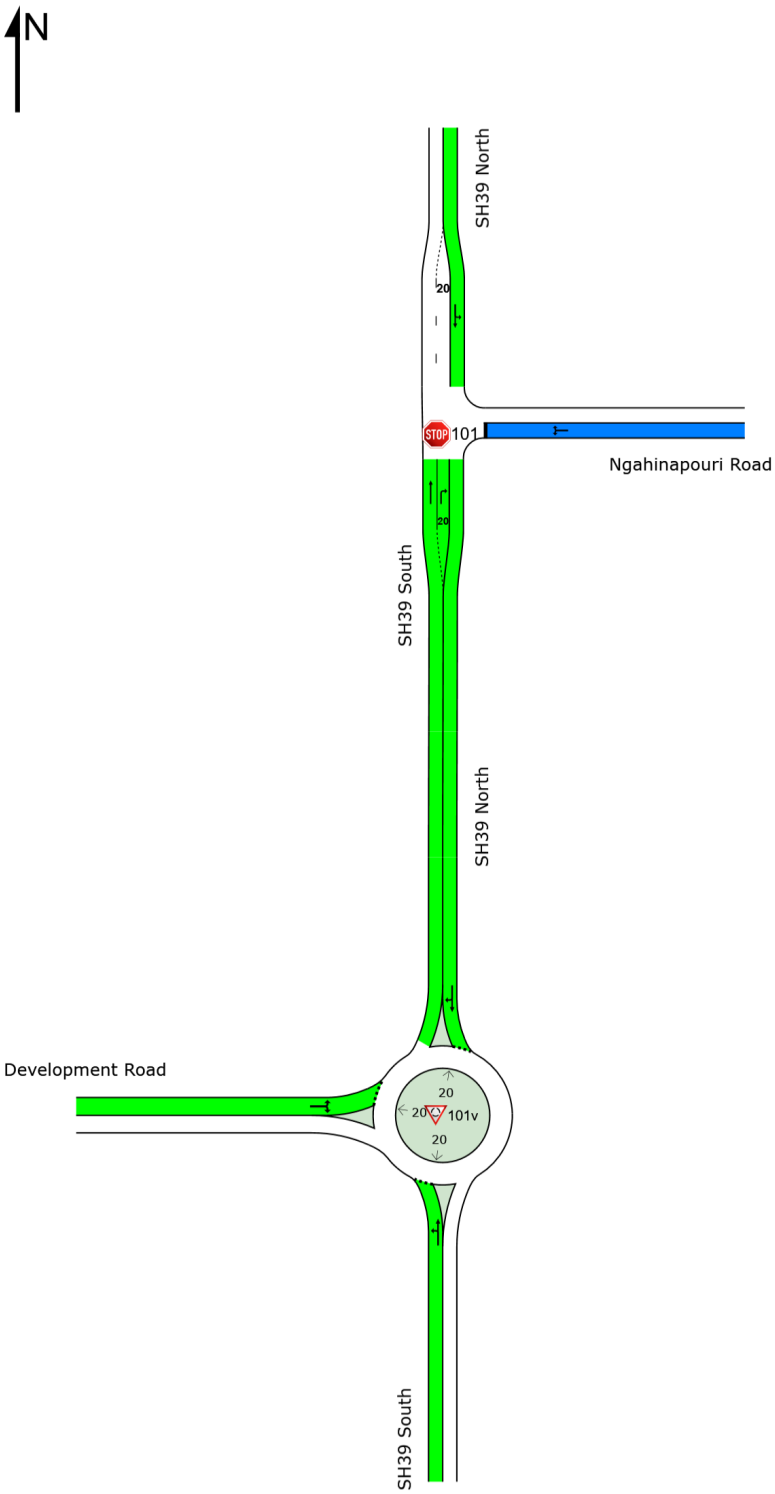
Carbon Monoxide	236	kg/y
NOx	531	kg/y

LEVEL OF SERVICE

Lane Level of Service

Network: N101 [2018_Hi Dev_Opt6 Staggered T_AM (Network Folder: General)]

New Network
Network Category: (None)



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Delay Model: SIDRA Standard (Geometric Delay is included).

NETWORK SUMMARY

Network: N101 [2018_Low Dev_Opt6 Staggered T_AM (Network Folder: General)]

New Network
Network Category: (None)

Network Performance - Hourly Values						
Performance Measure	**Vehicles**		**Per Unit Distance**		**Persons**	
Network Level of Service (LOS)	LOS A					
Speed Efficiency	1.00[3]					
Travel Time Index	10.00					
Congestion Coefficient	1.00					
Travel Speed (Average)	58.8	km/h			58.8	km/h
Travel Distance (Total)	1343.0	veh-km/h			1611.6	pers-km/h
Travel Time (Total)	22.8	veh-h/h			27.4	pers-h/h
Desired Speed (Input)	50.0	km/h				
Demand Flows (Total for all Sites)	1915	veh/h			2298	pers/h
Arrival Flows (Total for all Sites)	1915	veh/h			2298	pers/h
Demand Flows (Entry Total)	1063	veh/h				
Midblock Inflows (Total)	1	veh/h				
Midblock Outflows (Total)	-33	veh/h				
Percent Heavy Vehicles (Demand)	9.0	%				
Percent Heavy Vehicles (Arrival)	9.0	%				
Degree of Saturation	0.403					
Control Delay (Total)	2.22	veh-h/h			2.66	pers-h/h
Control Delay (Average)	4.2	sec			4.2	sec
Control Delay (Worst Lane)	17.3	sec				
Control Delay (Worst Movement)	20.8	sec			20.8	sec
Geometric Delay (Average)	3.4	sec				
Stop-Line Delay (Average)	0.8	sec				
Ave. Queue Storage Ratio (Worst Lane)	0.02					
Total Effective Stops	640	veh/h			768	pers/h
Effective Stop Rate	0.33		0.48	per km	0.33	
Proportion Queued	0.18				0.18	
Performance Index	33.0				33.0	
Cost (Total)	1028.57	$/h	0.77	$/km	1028.57	$/h
Fuel Consumption (Total)	156.4	L/h	116.5	mL/km		
Fuel Economy	11.6	L/100km				
Carbon Dioxide (Total)	373.8	kg/h	278.3	g/km		
Hydrocarbons (Total)	0.031	kg/h	0.023	g/km		
Carbon Monoxide (Total)	0.447	kg/h	0.333	g/km		
NOx (Total)	1.053	kg/h	0.784	g/km		

Network Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation or Queue Storage Ratios for the last three Network Iterations: 0.0% 0.0% 0.0%
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Software Setup used: New Zealand.

3 Calculated Average Travel Speed exceeds the specified Desired Speed.

Network Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total for all Sites)	919,074	veh/y	1,102,889	pers/y
Delay	1,066	veh-h/y	1,279	pers-h/y
Effective Stops	307,363	veh/y	368,836	pers/y
Travel Distance	644,630	veh-km/y	773,556	pers-km/y
Travel Time	10,964	veh-h/y	13,156	pers-h/y
Cost	493,714	$/y	493,714	$/y
Fuel Consumption	75,069	L/y		
Carbon Dioxide	179,420	kg/y		
Hydrocarbons	15	kg/y		

Carbon Monoxide	215	kg/y
NOx	505	kg/y

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