Clonburris Development **13/12/2024**

Reference number IE01T24A69

BRIDGE REMOVAL ASSESSMENT ASSESSMENT MODELLING REPORT

CLONBURRIS DEVELOPMENT

CLONBURRIS DEVELOPMENT: BRIDGE REMOVAL ASSESSMENT

IDENTIFICATION TABLE	
Client/Project owner	SDCC
Project	Clonburris Development
Study	Bridge Removal Assessment
Type of document	Report- FINAL
Date	13/12/2024
File name	ClonburrisDevelopment-revisit_Modelling_Report_v0-5.docx
Reference number	IE01T24A69
Number of pages	36

APPROVAL

Version	Name		Position	Date	Modifications
1	Author	Sam Carr	Associate	04/12/2024	DRAFT
	Checked by	Helen O'Mara	Associate Director	10/12/2024	
	Approved by	Andrew Archer	Director	13/12/2024	
2	Author	Sam Carr	Associate	25/07/2025	FINAL
	Checked by	Helen O'Mara	Associate Director	25/07/2025	
	Approved by	Andrew Archer	Director	25/07/2025	

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

1.1 Overview

1.1.1 SYSTRA have been asked to provide an assessment modelling report by SDCC to support an amendment to a previously approved scheme in relation to the Clonburris SDZ.

1.1.2 Previous work on the Clonburris SDZ carried out in 2018 provided for a multimodal bridge, crossing the canal within the development area linking the North and South Link Streets. SDCC would like to understand the impacts of an alternative proposal that would restrict access on the bridge to cycle and pedestrians only.

1.1.3 Utilising the previous model developed by SYSTRA for the Clonburris SDZ in 2018, the purpose of this exercise is to examine the impact of the proposed road link removal, in terms of potential changes to the distribution of traffic and potential impact on the operation of the local network.

1.2 Methodology

1.2.1 The SATURN Local Area Model (LAM) previously developed for the original assessment was used to ensure that the impacts of removing vehicular access on the bridge remains consistent with the planning application. The assessment was carried out in five stages.

- **Task 1: Baseline and LAM Review:**

An initial review of the previously developed LAM has been undertaken to compare the coded junctions within the LAM to more up to date junction designs along the North and South Link Streets.

In addition, a check has been undertaken to compare the LAM modelled flows, with more recently collated traffic count data in the local area, to ensure that the LAM flows and recent counts are largely consistent, and that the LAM is therefore fit for purpose for this assessment.

- **Task 2: Network Wide Impact**

Utilising the LAM, an assessment has been undertaken comparing the previous full Clonburris SDZ development 'With Link' scenario with a new 'No Link' scenario with the access on the bridge restricted to active modes only.

No other changes were made to the model to ensure consistency with the previously approved SDZ scheme.

In accordance with TII's Traffic and Transport Assessment Guidelines (2014), this exercise will identify areas of the network which require greater evaluation, based on the following threshold considerations:

- **Congested Areas:** Locations that experience heavy congestion and where traffic flows from the network change result in a 5% (or greater) increase in traffic flows on the adjoining road network.

- **Non-congested areas:** Locations that do not experience congestion, but where traffic flows from the network change result in a 10% (or greater) increase in traffic flows on the adjoining road network.

- **Stage 3: Junction Operational Assessment**

Individual Junction models have been developed in LinSig, Arcady or PICADY (Depending on junction type) to provide a more detailed analysis of each impacted junction.

- **Stage 4: Reporting**

This model report has been prepared highlighting the impact of the closure of the bridge to vehicles on the surrounding junctions. This report details all modelling assumptions as well as all model outputs.

2. BASE MODEL

2.1 Introduction

2.1.1 The previous strategic model developed by SYSTRA using SATURN for the Clonburris SDZ in 2018 has been used, this has been compared to 2023 observed counts to understand how the 2018 base model validates to 2023 count data

2.1.2 The peaks considered for the comparison are:

- AM Peak: 08:00 - 09:00 AM
- PM Peak: 17:00 - 18:00 PM

2.2 Methodology

2.2.1 Count have been obtained for the local area from the client, including both automatic traffic counts (ATC) and junction traffic counts (JTC) data. The count sites are processed and compressed to link based flows. Comparison has been undertaken between 2023 observed counts and 2018 base model for validation based on DMRB and PAG compliance.

2.2.2 The 2023 observed counts considering both JTC and ATC sites are segmented as light vehicles (LVs) and heavy vehicles (HVs) independently for comparative purposes across the study area network for both AM and PM peaks. The modelled flows are also extracted into LVs and HVs for both AM and PM peaks. The sum total of LVs and HVs is calculated for both observed counts and modelled flows respectively for both AM and PM peaks.

2.2.3 The model flows and observed count data were evaluated using the model validation criteria set out in DMRB and PAG.

2.3 Validation Results

2.3.1 TAG Unit M3.1 Table 2 sets out validation guidelines for comparing modelled and observed traffic flows based on the level of flow in vehicles per hour (vph). These are:

- **For observed flows less than 700 vph,** at least 85% of model flows should be within 100 vph of observations.
- **For observed flows of between 700 and 2,700 vph,** at least 85% of model flows should be within 15% of observations.
- **For observed flows greater than 2,700 vph,** at least 85% of model flows should be within 400 vph of observations.

2.3.2 In addition to the flow criteria described above, TAG also refers to the GEH statistic, where

$$GEH = \sqrt{\frac{(M-C)^2}{(M+C)\ /2}}$$

and M is the modelled flow and C is the counted (observed) flow.

2.3.3 The GEH statistic is a form of Chi squared statistic, incorporating both relative and absolute errors. TAG recommends that greater than 85% of counted links should have a GEH value of less than 5.0.

2.3.4 PAG advice on counts meeting flow criteria and GEH criteria is as follows that:

"These two measures are broadly consistent and link flows that meet either criterion should be regarded as satisfactory."

2.3.5 A total of 130 links have been compared on the basis of 2023 observed counts and 2018 base model flows. Data has been compressed into a link-based format for JTCs.

2.3.6 The base model validation performance can be summarised as:

- The performance of AM model is satisfactory, meeting either the Flow Validation or GEH performance criteria for 85% of the links.
- The performance of PM model is less strong, with 61% of the links meeting either the Flow Validation or GEH performance
- Whilst the PM peak is lower than the 85% threshold, it is to be noted that this is comparing 2023 observed counts with 2018 modelled flows, and therefore it is expected to have some differences.

2.3.7 The comparative assessments for strategic modelling results between 2023 count flows to 2018 base model flows for both AM and PM peaks are shown in Table 1 and Table 2.

Table 1. Validation Performance Base Model 2023 - AM Peak

Base_Model_AM			
Validation Criteria	LV's	HV's	Total
GEH5	**72%**	**53%**	**77%**
GEG10	72%	53%	77%
GEH15	95%	94%	95%
GEH20	100%	100%	100%
Average GEH	3.6	4.9	3.7
DMRB	**75%**	**91%**	**65%**
Pass	**86%**	**91%**	**85%**

Table 2. Validation Performance Base Model 2023 - PM Peak

Base_Model_PM			
Validation Criteria	LV's	HV's	Total
GEH5	**60%**	**39%**	**57%**
GEG10	60%	39%	57%
GEH15	92%	79%	94%
GEH20	95%	95%	97%
Average GEH	5.1	6.7	5.0
DMRB	**55%**	**90%**	**55%**
Pass	**65%**	**90%**	**61%**

2.4 Conclusion

2.4.1 Key findings from the base model review indicate that the AM peak model compares well, meeting performance criteria for 85% of the links. However, the PM peak model shows weaker comparison, meeting criteria for 61% of the links. This result is attributed to comparing 2023 observed counts with 2018 base modelled flows, which indeed introduces some differences. Given these known differences, forecast modelling will be undertaken with these validation statistics in mind.

2.4.2 The appraisal of the road scheme has been performed for the future year scenario which considers the full build out of Clonburris, and therefore the slight variation in the PM peak is considered acceptable for this exercise.

3. FORECAST MODEL

3.1 Introduction

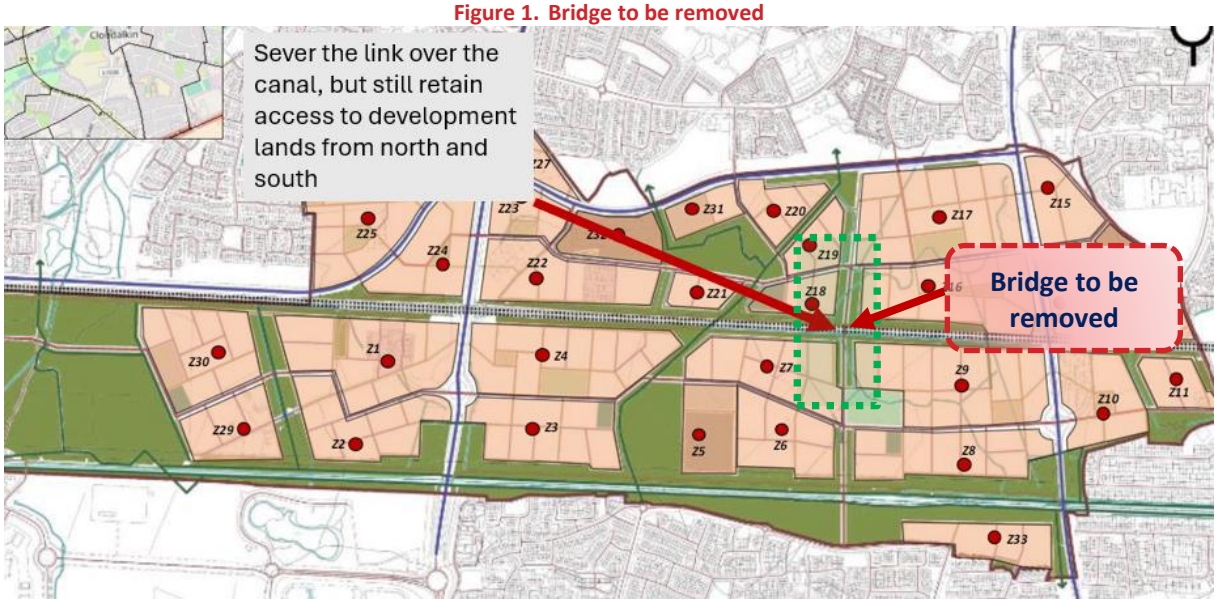
3.1.1 The forecast model has been developed for the assessment year 2035 to evaluate the impact of the removal of a bridge link to vehicles in the study area. The study reviews the traffic flow distribution changes between the Do-minimum (with bridge) and Do-something (without bridge) models and identifies any junctions which become congested and require more detailed local junction modelling to fully assess.

3.2 Methodology

3.2.1 This study makes use of a 2035 forecast model that was developed during modelling work previously undertaken in 2018 which also includes the full buildout of the Clonburris development.

3.2.2 The Do-minimum (DM) scenario was developed by undertaking network updates to reflect the latest scheme changes. The DM scenario is assessed with a bridge connecting the northern and southern sections of the study area shown in Figure 1.

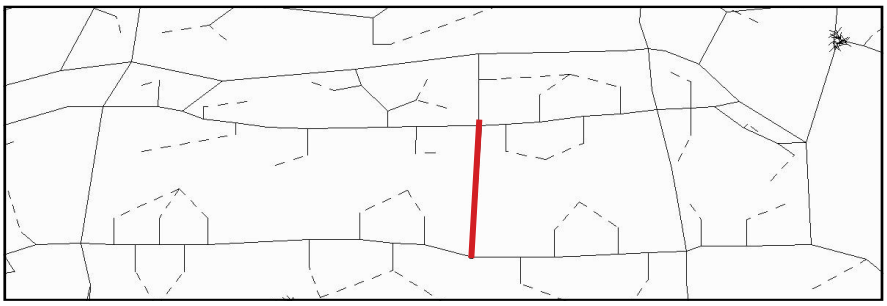
Figure 1. Bridge to be removed



3.2.3 The purpose of the assessment is to compare the Do-minimum (with bridge) and Do-something (without bridge) flow difference plots to evaluate the potential differences to the distribution of traffic flows and on the operation of the LAM for both AM and PM peaks. Further analysis will identify potential impacted junctions that will require more detailed assessment with local junction modelling.

3.2.4 The 2035 Do-something (DS) model was developed from the 2035 Do-minimum model. The DS (without bridge) scenario was created by adjusting the network to remove the bridge link to vehicular traffic shown in Figure 2.

Figure 2. DS (without bridge) scenario

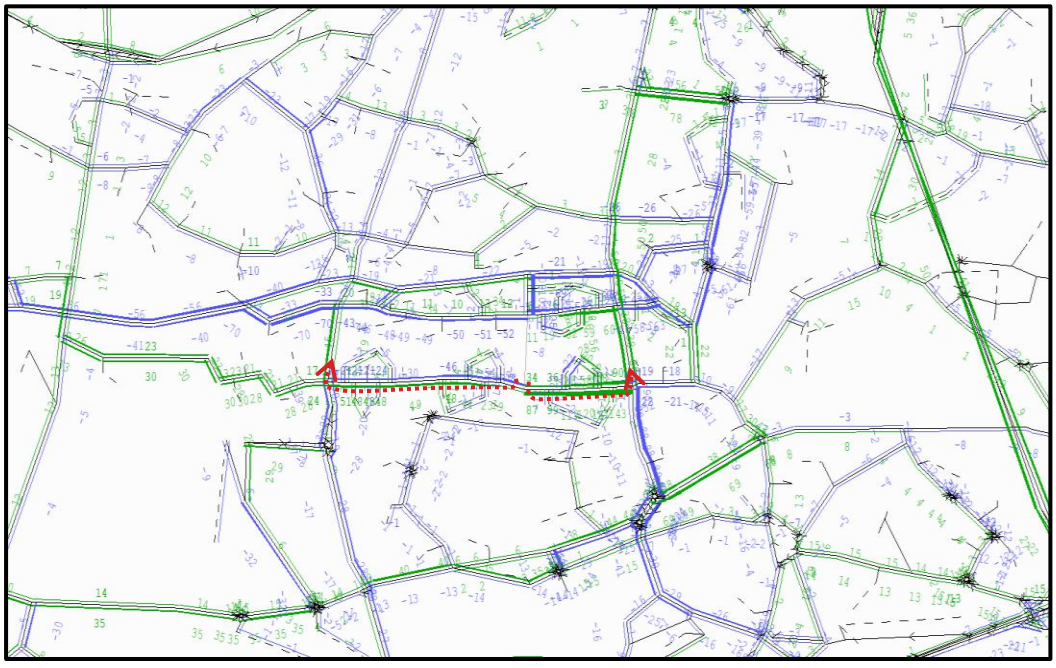


Link Removed in the DS Scenario

3.3 LAM Modelling Outputs:

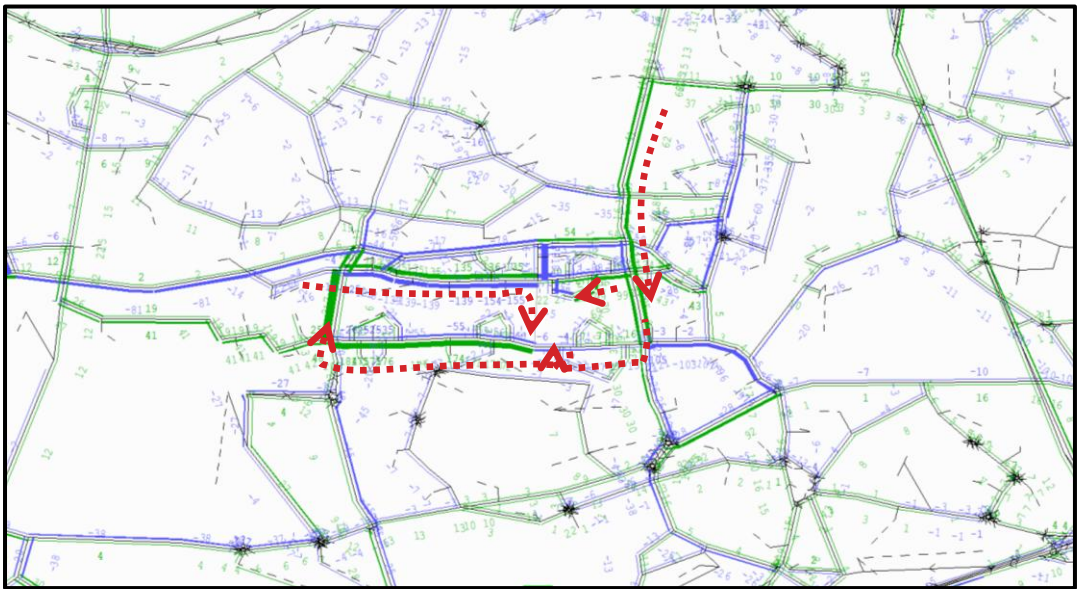
3.3.1 The change in flows for the AM Peak is shown in Figure 3. Trips are rerouting via the Fonthill Road North junction with Seven Mills which would have previously routed via Fonthills Road North and Thomas Omer Way. A decrease is forecast in trips on Adams Town Avenue, with traffic instead routing via Lynch's Lane. There are also minor knock-on impacts on the network generated by wider rerouting.

Figure 3. Flow Change - AM Peak



3.3.2 The change in flow for the PM Peak is shown in Figure 4. There is a significant increase in outbound trips via the new link road and Grange Castle Road South junction, heading north. Rerouting is forecast around the northern two east-west link roads. There is a decrease in trips on Adams Town Avenue, with traffic instead routing via Lynch's Lane. There are also minor knock-on impacts for wider rerouting.

Figure 4. Flow Change - PM Peak



4. NETWORK HOTSPOTS

4.1 Introduction

4.1.1 Junction analysis has been undertaken to identify the flow changes impacting junctions. This will look at a comparison in flow change between the DM and DS models and categorise into thresholds of flow change. Junctions identified as having a significant impact due to the closure of the bridge are referred to as hotspots within this report.

Junction are considered hotspots when they exceed certain thresholds of change between the DM and DS scenarios. In this case we have defined a junction hotspot as junctions that experience a 5% flow change for congested junctions, and a 10% flow change for non-congested junctions.

4.2 Methodology

4.2.1 Flow data from both the DM and DS model (with and without bridge) has been extracted from the 2035 models and processed to compress link flows to a node level, which is representative of junctions. A sifting process was then used to remove any dummy nodes (nodes that don't represent a junction on the network) from the node list.

4.2.2 Comparison have then been made to compare DM and DS flows at nodes, to understand where flows around a node exceed certain thresholds.

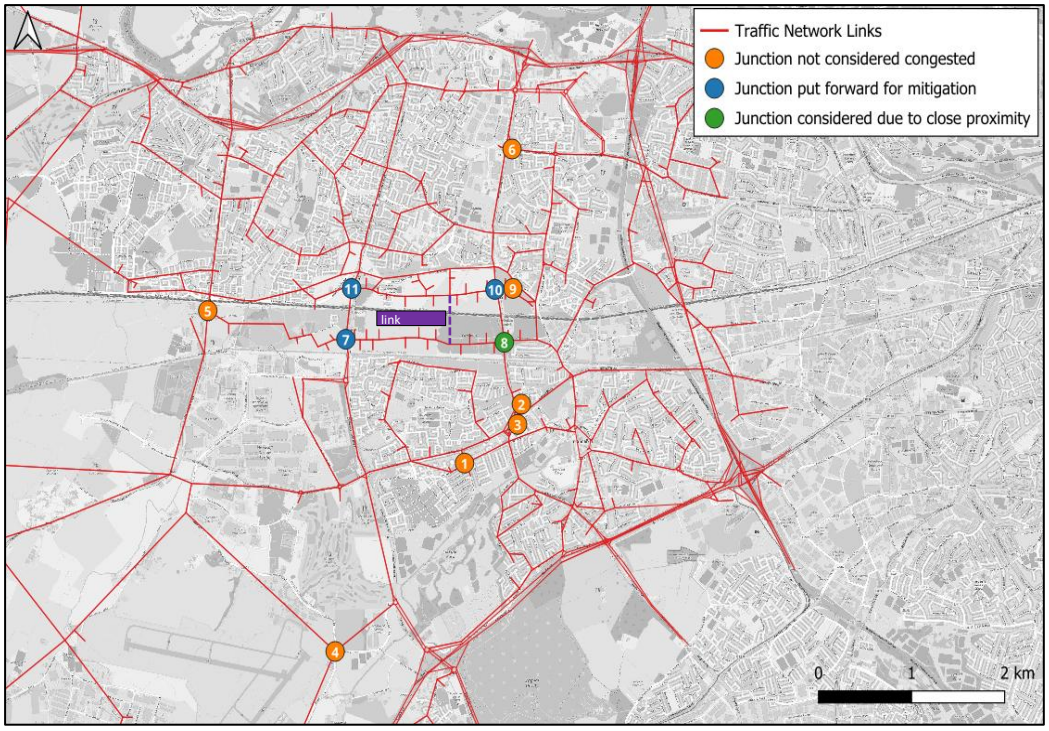
4.2.3 The thresholds are:

- **Congested Areas:** Locations that experience heavy congestion and where traffic flows from the network change result in a 5% (or greater) increase in traffic flows on the adjoining road network.
- **Non-congested areas:** Locations that do not experience congestion, but where traffic flows from the network change result in a 10% (or greater) increase in traffic flows on the adjoining road network.

4.3 Hotspots

4.3.1 Flow change patterns between the DM (with bridge) and DS (without bridge) scenario have been compared to identify junctions which require further local junction modelling.

Figure 5. Hotspots Map



4.3.2 Hotspots locations are shown on the map in Figure 5. This depicts all junctions impacted, over the 5% (congested junctions) and 10% (non- congested junctions) thresholds.

4.3.3 Following identification of the junctions, a further sifting process was undertaken to understand the level of congestion around each junction and to understand the change in the flow around the junction due to the scheme. Junction were excluded if they weren't considered congested and below the 10% flow change criteria. This sifting exercise has excluded Junctions 1- 6 and 9.

4.3.4 The remaining junctions that are considered congested, and therefore meet the criteria for further analysis are junctions 7, 10 and 11. Junction 8 has also been considered due to its proximity to the bridge and the junction operation.

4.3.5 Junction delays and the ration of volume to capacity at junctions (V/C's) have been reviewed and the junctions have been categorised into those considered for local junction modelling and those that were not as shown in Table 3.

Table 3. Junction: DM vs DS Flow Change Analysis

J_ID	Do Minimum		Do Something +		AM	PM	AM	PM	Either	AM	PM	Either	HotSpot Comments
	AM Flow (PCUs)	PM Flow (PCUs)	AM Flow (PCUs)	PM Flow (PCUs)	% Flow Change	% Flow Change	Over 5%	Over 5%	Over 5%	Over 10%	Over 10%	Over 10%	
1	330.13	359.2	364.63	340.96	10.5%	-5.1%	1	0	5%	1	0	10%	Junction not considered congested. On the cusp of the 10% threshold.
2	1163.09	1354.11	1269.72	1432.69	9.2%	5.8%	1	1	5%	0	0	-	Junction not considered congested.
3	1216.05	1662.09	1191.75	1752.99	-2.0%	5.5%	0	1	5%	0	0	-	Junction not considered congested.
4	1512.95	1169.66	1519.06	1235.7	0.4%	5.6%	0	1	5%	0	0	-	Junction not considered congested.
5	1163.45	1440.53	1225.86	1523.56	5.4%	5.8%	1	1	5%	0	0	-	Junction not considered congested.
6	1346.89	1599. 26	1480.62	1629.63	9.9%	1.9%	1	0	5%	0	0	-	Junction not considered congested.
7	**2412.38**	**2127.62**	**2466.13**	**2367.77**	**2.2%**	**11.3%**	**0**	**1**	**5%**	**0**	**1**	**10%**	**Junction put forward for mitigation**
8	**2442.45**	**2558.33**	**2508.76**	**2570.53**	**3%**	**0%**	**0**	**0**	**-**	**0**	**0**	**-**	**Junction considered due to proximity to bridge.**
9	612.25	375.33	526.93	408.54	-14%	9%	0	1	5%	0	0	-	Junction not considered congested.
10	**2437.55**	**2205.72**	**2497.29**	**2343.56**	**2.5%**	**6.2%**	**0**	**1**	**5%**	**0**	**0**	**-**	**Junction put forward for mitigation**
11	**2366.36**	**1787.51**	**2334.35**	**1878.4**	**-1%**	**5%**	**0**	**1**	**5%**	**0**	**0**	**-**	**Junction put forward for mitigation**

5. LOCAL JUNCTION MODELLING

5.1 Introduction

5.1.1 Local junction modelling has been undertaken for the impacted junctions identified as network hotspots in Chapter 4 due to the removal of the bridge to vehicular traffic.

5.1.2 All of the junctions identified are signalised junctions.

5.2 Methodology

5.2.1 Network hotspot junctions within the study area have been modelled based on the industry standard using LinSig for signalised junctions.

5.2.2 2035 forecast signalised junction models have been developed using LinSig for the Do-minimum (with Bridge) and Do-something (without Bridge) scenarios. The traffic flows are extracted from the 2035 DM (with Bridge) and 2035 DS (without Bridge) LAM for both the AM and PM peaks for use in the LinSig models.

5.2.3 The list of network hotspots that are evaluated is shown in Table 4.

Table 4. List of Network Hotspot Junctions

Network Hotspot	Junction	Type	Modelling Software
7	Southern Network: Grange Castle Road / Lynch's Lane / Access Road	Signalised	LinSig
8	Southern Network: Fonthill Road North / Eastern / Western Road	Signalised	LinSig
10	Northern Network: Fonthill Road North / Eastern / Western Road	Signalised	LinSig
11	Northern Network: Grange Castle Road / Eastern / Western Road	Signalised	LinSig

5.2.4 The identified hotspot signalised junctions are evaluated using LinSig and the results are summarised to show the following for each approach arm, for each scenario:

- **Degree of Saturation (DOS)** – is the % of what level the junction is at capacity
- **Maximum Queue** – The maximum queue length experienced during the hour period
- **Average Delay** – the average delay in seconds that a vehicle will experience to pass through the junction
- **Practical reserve capacity** – The remaining capacity for the junction. A positive PRC indicates that a junction has spare capacity and may be able to accept more traffic. A negative PRC indicates that the junction is over capacity and is suffering from traffic congestion.

5.2.5 The Practical Reserve Capacity (PRC) provides an indication of the overall junction performance. The results are compared between the Do-minimum (with Bridge) and Do-something (without Bridge) scenarios for both AM and PM peaks.

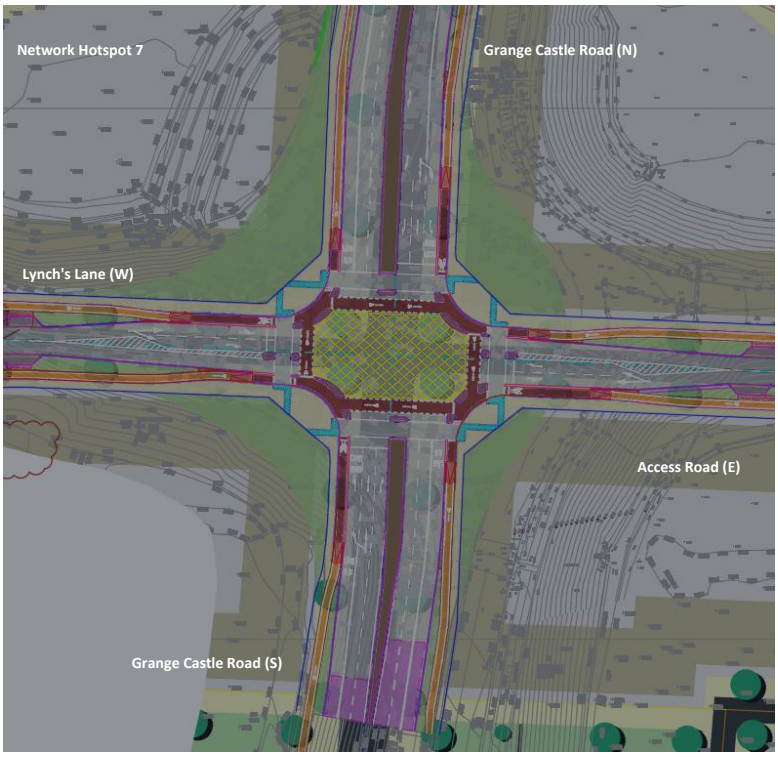
5.2.6 The threshold of DOS used is where we see a 5.5% increase between the Do Minimum and Do Something models, where the DS is above 90%, has been used to understand if the junctions need further consideration.

5.3 Network Hotspot 7: Grange Castle Road / Lynch's Lane / Access Road

5.3.1 The Southern Network: Grange Castle Road / Lynch's Lane / Access Road is a 4-arm signalised junction and has been assessed for both Do-Minimum and Do Something scenarios for the forecast year 2035.

5.3.2 The layout design for the Network Hotspot 7 is shown in Figure 6.

Figure 6. Network Hotspot 7



5.3.3 The capacity assessment results for both AM and PM peaks are shown in Table 5 and Table 6. The corresponding LinSig model layouts are shown from Figure 7 to Figure 10.

Table 5. Network Hotspot 7 Results - AM Peak

Site	Link Name	Lane	ARM (Turning)	AM Peak (08:00 - 09:00 AM)										
				DM 2035				DS 2035				Diff (DS-DM)		
				Queue (PCU)	DoS (%)	Av Delay (s/pcu)	Flows (PCU)	Queue (PCU)	DoS (%)	Av Delay (s/pcu)	Flows (PCU)	DoS (%)	Area for Consideration	Flow (%)
Network Hotspot 7 Southern Network Grange Castle Road Lynch's Lane Access Road	Grange Castle Road (N) - Entry	1/1	Left Ahead	26.70	87.00	25.3	49	29.00	93.60	28.4	69	6.6	YES	40.8%
		1/2	Ahead	26.70	87.00	25.3	874	29.00	93.60	28.4	874	6.6	YES	0.0%
		1/3	Right	0.40	2.60	13.8	23	0.40	2.70	15.2	23	0.1	NO	0.0%
	Access Road (E) - Entry	2/1	Left Ahead	8.00	75.60	45.2	236	9.30	93.70	44.5	264	18.1	YES	11.9%
		2/2	Right (flare)	8.00	75.60	45.2	83	9.30	93.70	44.5	112	18.1	YES	34.9%
	Grange Castle Road (S) - Entry	3/1	Left Ahead	16.60	65.60	20.9	42	16.60	66.40	22.7	41	0.8	NO	-2.4%
		3/2	Ahead	16.60	65.60	20.9	657	16.60	66.40	22.7	633	0.8	NO	-3.7%
		3/3	Right	1.00	6.50	14	59	0.80	5.20	15.4	45	-1.3	NO	-23.7%
	Lynch's Lane (W) - Entry	4/1	Left Ahead	11.60	84.80	43.8	335	11.90	81.80	41.8	349	-3	NO	4.2%
		4/2	Right (flare)	11.60	84.80	43.8	53	11.90	81.80	41.8	56	-3	NO	5.7%
		Cycle Time (s)		120				120						
		PRC (%)		3.4				-4.1						
		Total Delay (PCU/Hr)		19.6				21.3						

Table 6. Network Hotspot 7 Results- PM Peak

Site	Link Name	Lane	ARM (Turning)	PM Peak (17:00 - 18:00 PM)										
				DM 2035				DS 2035				Diff (DS-DM)		
				Queue (PCU)	DoS (%)	Av Delay (s/pcu)	Flows (PCU)	Queue (PCU)	DoS (%)	Av Delay (s/pcu)	Flows (PCU)	DoS (%)	Area for Consideration	Flow (%)
Network Hotspot 7 Southern Network Grange Castle Road Lynch's Lane Access Road	Grange Castle Road (N) - Entry	1/1	Left Ahead	15.90	65.00	19.5	86	18.60	74.70	25.6	95	9.7	NO	10.5%
		1/2	Ahead	15.90	65.00	19.5	621	18.60	74.70	25.6	617	9.7	NO	-0.6%
		1/3	Right	0.80	5.60	13	52	0.80	5.60	17	46	0	NO	-11.5%
	Access Road (E) - Entry	2/1	Left Ahead	8.30	72.40	42.7	246	14.00	88.30	40.3	334	15.9	NO	35.8%
		2/2	Right (flare)	8.30	72.40	42.7	71	14.00	88.30	40.3	195	15.9	NO	174.6%
	Grange Castle Road (S) - Entry	3/1	Left Ahead	20.50	74.80	21.2	90	25.60	88.90	28.8	54	14.1	NO	-40.0%
		3/2	Ahead	20.50	74.80	21.2	731	25.60	88.90	28.8	802	14.1	NO	9.7%
		3/3	Right	0.90	6.40	13.1	60	0.50	3.10	16.8	26	-3.3	NO	-56.7%
	Lynch's Lane (W) - Entry	4/1	Left Ahead	3.10	37.80	43.2	114	4.00	36.40	36.2	153	-1.4	NO	34.2%
		4/2	Right (flare)	3.10	37.80	43.2	56	4.00	36.40	36.2	44	-1.4	NO	-21.4%
		Cycle Time (s)		120				120						
		PRC (%)		20.3				1.3						
		Total Delay (PCU/Hr)		14.9				20.2						

Figure 7. Network Hotspot 7 Junction Layout- 2035 DM AM

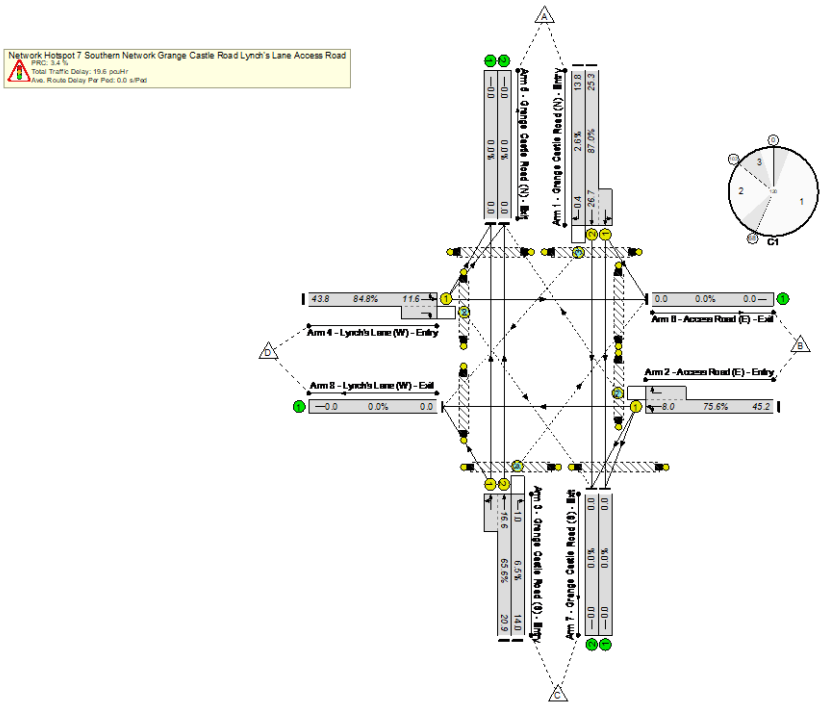


Figure 8. Network Hotspot 7 Junction Layout - 2035 DS AM

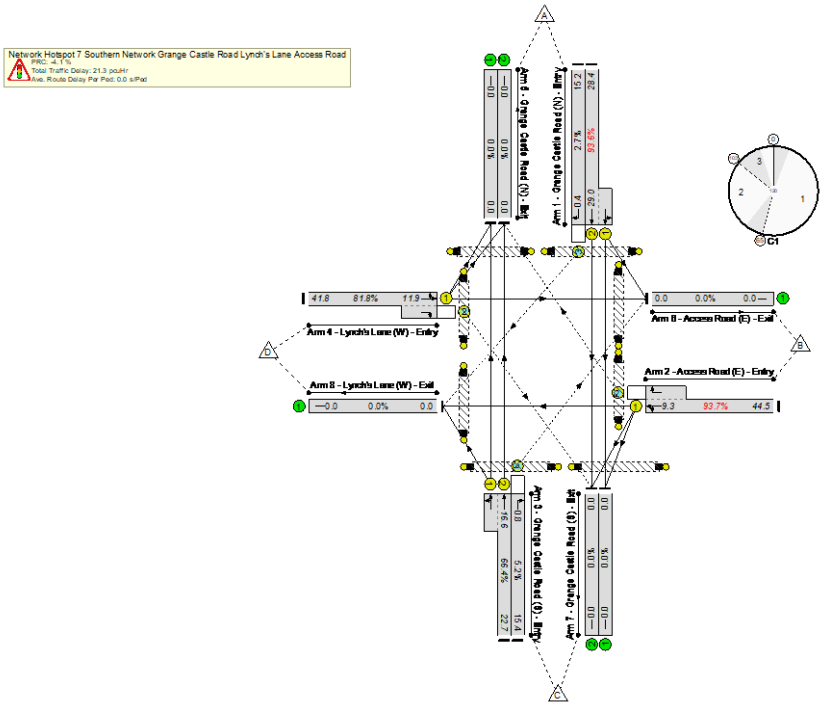


Figure 9. Network Hotspot 7 Junction Layout - 2035 DM PM

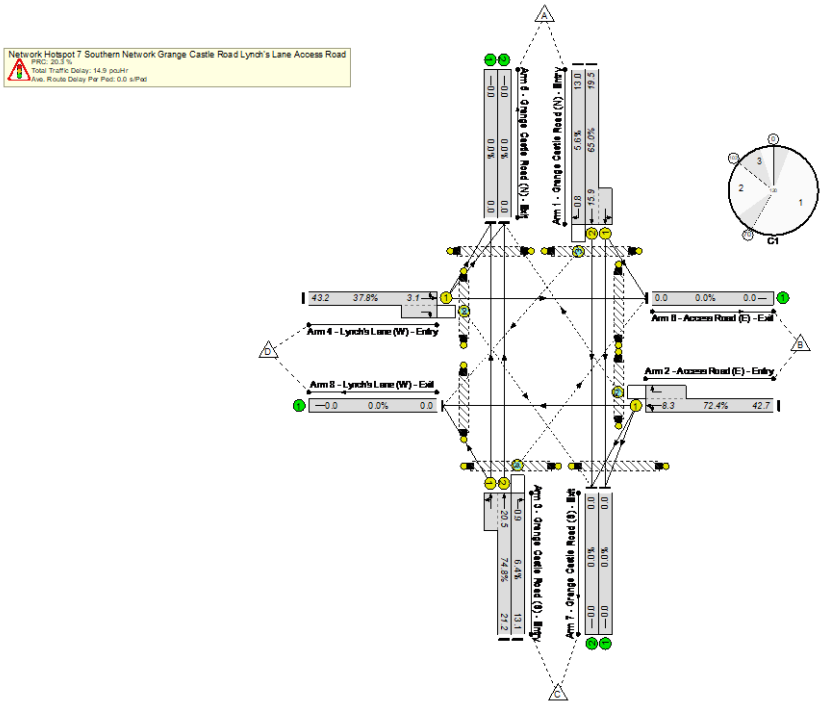
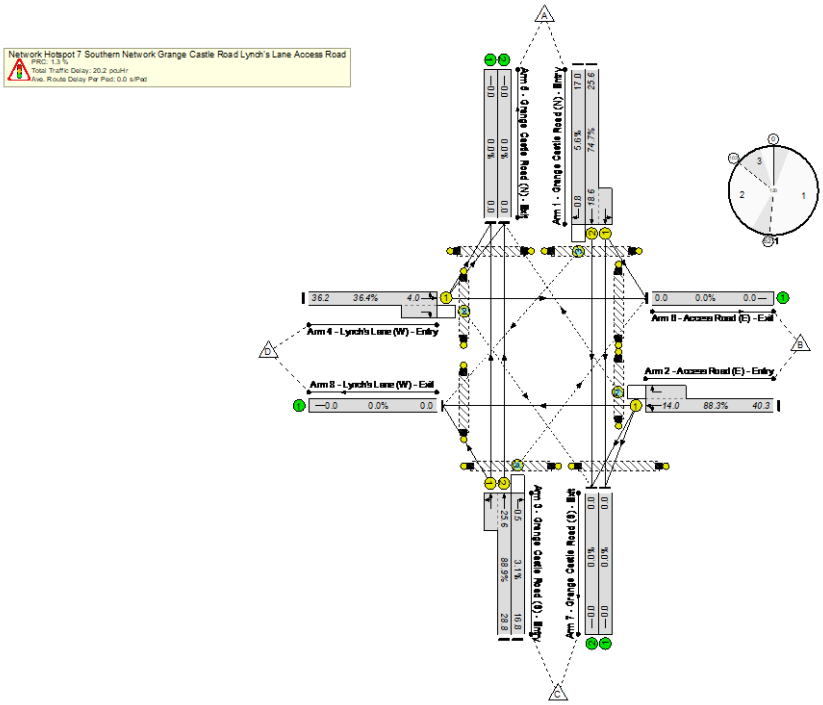


Figure 10. Network Hotspot 7 Junction Layout- 2035 DS PM



5.3.4 The local junction model assessment for Junction 7 forecasts that the AM peak has two arms that are marginally exceeding thresholds and are possible areas of consideration. There are no identified exceedances in the PM peak. The two arms identified are:

- In the AM on Grange Castle Road (N) on the left flare and straight-ahead lane are showing a worsening between the DM and DS scenarios, with a DOS increase of 6.6%.
- In the AM on Access Road (E) on the Left/Ahead and Right flare show a worsening of DOS of 18.1%.

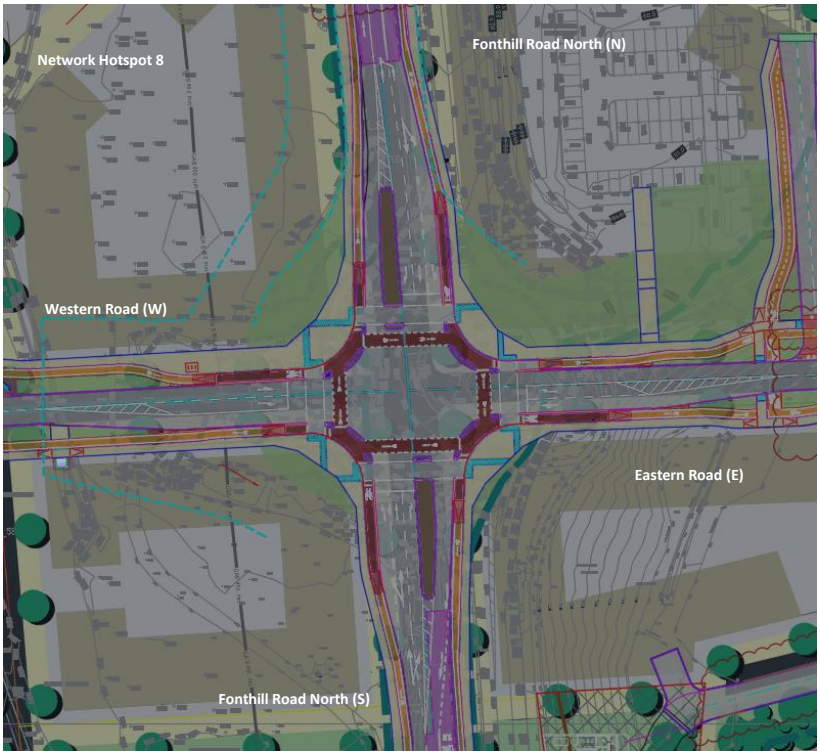
5.3.5 Further analysis of these junctions indicates that whilst they exceed the threshold for DOS, the junction operation is still within limits, and the level of delay experienced on these arms in the DS scenario is considered acceptable. As such, this junction is considered to be operating well in the DS scenario, and no further mitigation is necessary.

5.4 Network Hotspot 8: Fonthill Road North / Eastern / Western Road

5.4.1 The Southern Network: Fonthill Road North / Eastern / Western Road is a 4-arm signalised junction and has been assessed for both Do-Minimum and Do Something scenarios for the forecast year 2035.

5.4.2 The layout design for the Network Hotspot 8 is shown in Figure 11.

Figure 11. Network Hotspot 8



5.4.3 The capacity assessment results for both AM and PM peaks are shown in Table 7 and Table 8. The corresponding LinSig model layouts are shown from Figure 12 to Figure 15.

Table 7. Hotspot 8 Results - AM Peak

Site	Link Name	Lane	ARM (Turning)	AM Peak (08:00 - 09:00 AM)										
				DM 2035				DS 2035				Diff (DS-DM)		
				Queue (PCU)	DoS (%)	Av Delay (s/pcu)	Flows (PCU)	Queue (PCU)	DoS (%)	Av Delay (s/pcu)	Flows (PCU)	DoS (%)	Area for Consideration	Flow (%)
Network Hotspot 8 Southern Network Fonthill Road North	Fonthill Road North (N) - Entry	1/1	Left Ahead	0.90	6.80	15.5	54	0.70	5.40	13	46	-1.4	NO	-14.8%
		1/2	Ahead	14.00	57.50	19.4	620	11.00	47.70	15.4	556	-9.8	NO	-10.3%
		1/3	Right	0.50	31.10	51.6	30	17.70	121.10	398.4	140	90	YES	366.7%
	Eastern Road (E) - Entry	2/1	Left Ahead	6.20	84.30	43.5	156	7.40	78.80	46.6	208	-5.5	NO	33.3%
		2/2	Right (flare)	6.20	84.30	43.5	176	7.40	78.80	46.6	72	-5.5	NO	-59.1%
	Fonthill Road North (S) - Entry	3/1	Left Ahead	1.10	9.00	15.6	62	0.70	6.00	13	44	-3	NO	-29.0%
		3/2	Ahead	28.10	88.40	25.3	954	26.90	84.20	21.5	980	-4.2	NO	2.7%
		3/3	Right	0.30	7.00	28.8	19	0.00	0.30	21.3	1	-6.7	NO	-94.7%
	Western Road (W) - Entry	4/1	Left Ahead	7.00	84.90	44.2	153	62.30	127.30	451.3	262	42.4	YES	71.2%
		4/2	Right (flare)	7.00	84.90	44.2	218	62.30	127.30	451.3	199	42.4	YES	-8.7%
		Cycle Time (s)		120				120						
		PRC (%)		1.8				-41.4						
		Total Delay (PCU/Hr)		19.7				85.5						

Table 8. Hotspot 8 Results - PM Peak

Site	Link Name	Lane	ARM (Turning)	PM Peak (17:00 - 18:00 PM)										
				DM 2035				DS 2035				Diff (DS-DM)		
				Queue (PCU)	DoS (%)	Av Delay (s/pcu)	Flows (PCU)	Queue (PCU)	DoS (%)	Av Delay (s/pcu)	Flows (PCU)	DoS (%)	Area for Consideration	Flow (%)
Network Hotspot 8 Southern Network Fonthill Road North	Fonthill Road North (N) - Entry	1/1	Left Ahead	0.50	3.70	22.6	23	0.40	3.10	16.8	23	-0.6	NO	0.0%
		1/2	Ahead	16.60	70.50	28.9	604	14.70	60.40	21.5	621	-10.1	NO	2.8%
		1/3	Right	0.50	40.00	60.6	24	1.50	100.40	69.2	73	60.4	YES	204.2%
	Eastern Road (E) - Entry	2/1	Left Ahead	20.80	100.00	37.8	406	59.80	114.90	295.9	420	14.9	YES	3.4%
		2/2	Right (flare)	20.80	100.00	37.8	292	59.80	114.90	295.9	174	14.9	YES	-40.4%
	Fonthill Road North (S) - Entry	3/1	Left Ahead	3.50	27.50	24.7	156	1.50	12.30	17.4	84	-15.2	NO	-46.2%
		3/2	Ahead	27.70	98.80	34.7	846	30.50	94.50	28.4	971	-4.3	NO	14.8%
		3/3	Right	0.40	10.10	42.1	18	0.00	0.00	0	0	-10.1	NO	-100.0%
	Western Road (W) - Entry	4/1	Left Ahead	3.40	60.90	34.1	62	3.30	60.20	38.4	78	-0.7	NO	25.8%
		4/2	Right (flare)	3.40	60.90	34.1	128	3.30	60.20	38.4	126	-0.7	NO	-1.6%
		Cycle Time (s)		120				120						
		PRC (%)		-11.1				-27.6						
		Total Delay (PCU/Hr)		24.0				64.3						

Figure 12. Hotspot 8 Junction Layout - 2035 DM AM

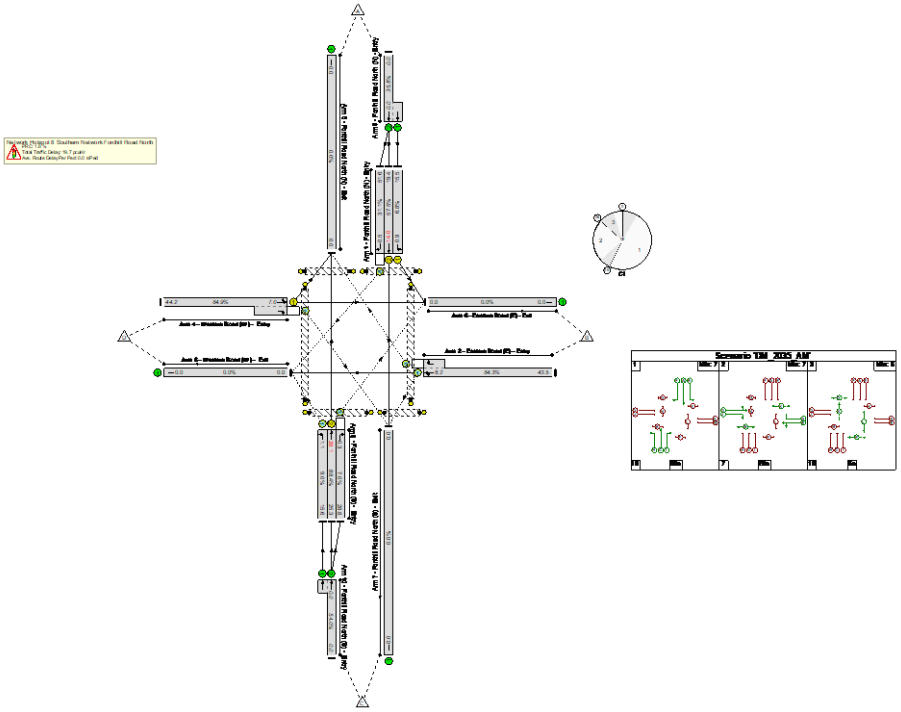


Figure 13. Hotspot 8 Junction Layout - 2035 DS AM

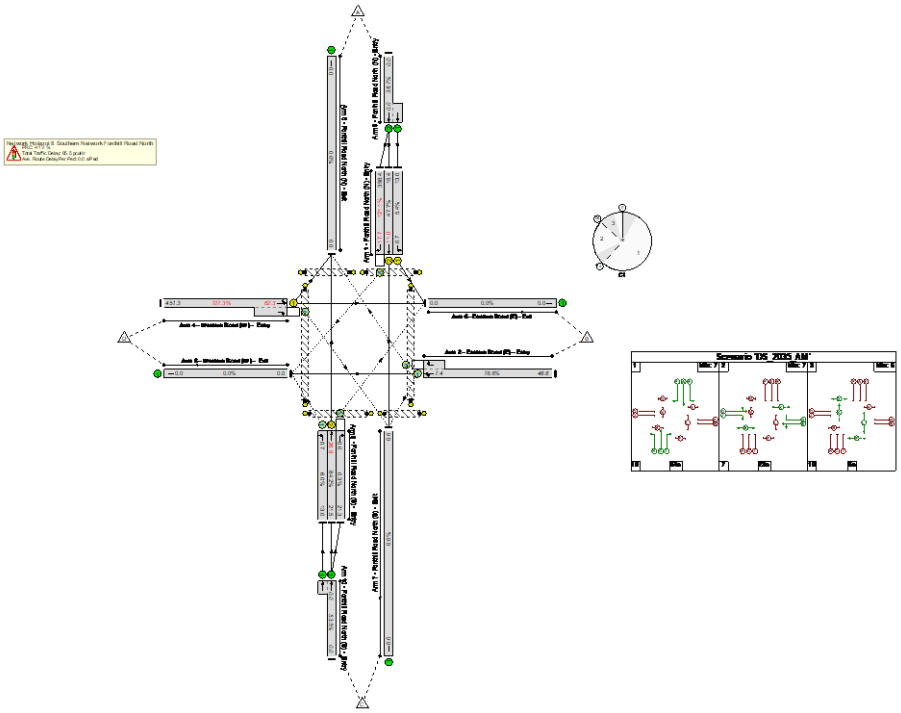


Figure 14. Hotspot 8 Junction Layout - 2035 DM PM

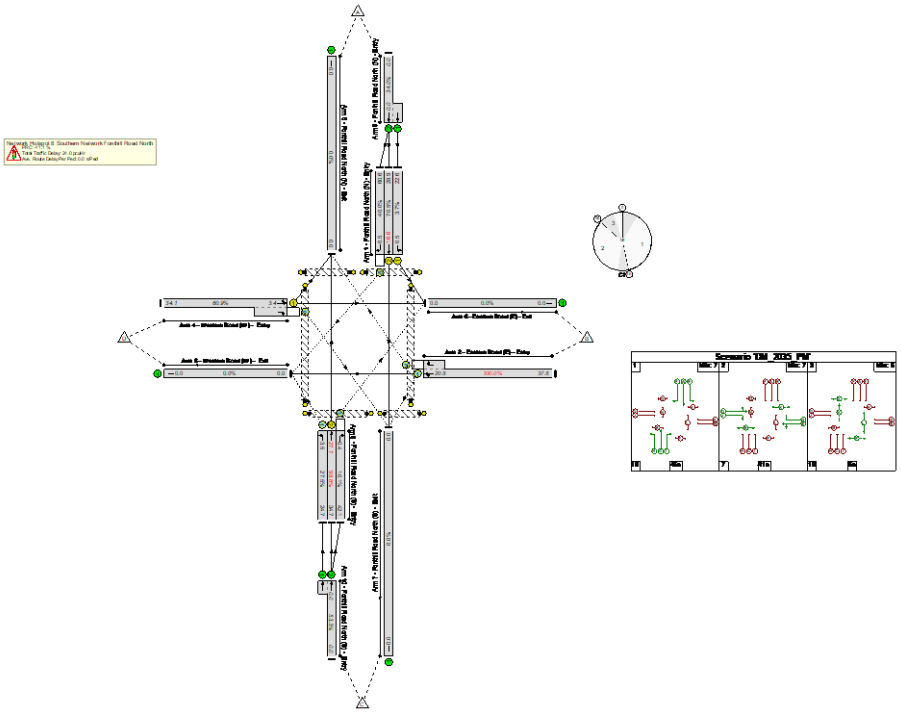
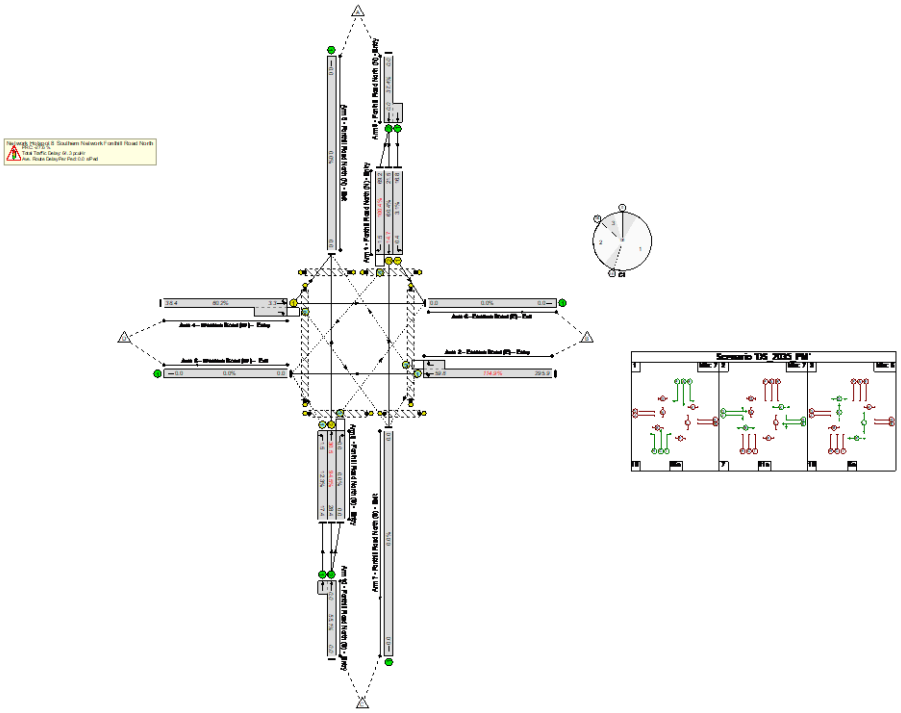


Figure 15. Hotspot 8 Junction Layout - 2035 DS PM



5.4.4 The local junction model assessment for Junction 8 forecast that in the AM and PM peaks 2 arms are exceeding the thresholds and are possible areas of consideration. The arms identified are:

- In the AM on Fonthill Road North (N) on the right turn lane is showing a worsening between the DM and DS scenarios, with a DOS increase of 90%.
- In the AM on Western Road (W) on the Left/Ahead and Right flare show a worsening of DOS of 42.4%.
- In the PM on Fonthill Road North (N) on the right turn lane is showing a worsening between the DM and DS scenarios, with a DOS increase of 60.4%.
- In the PM on Eastern Road (E) on the right turn lane is showing a worsening between the DM and DS scenarios, with a DOS increase of 14.9%.

5.4.5 Further analysis indicates the delay changes in both the AM and PM are considered significant. On Fonthill Road North in the AM peak, the delay is forecast to be approximately 400 seconds, and in the PM the delay is forecast to be approximately 70 seconds. On the Western Road in the AM the delay is forecast to be approximately 450 seconds, and on the Eastern Road in the PM the delay is forecast to be approximately 300 seconds.

5.4.6 The delay experiences on these turns in the DS scenario is considered significant and the junction is considered congested.

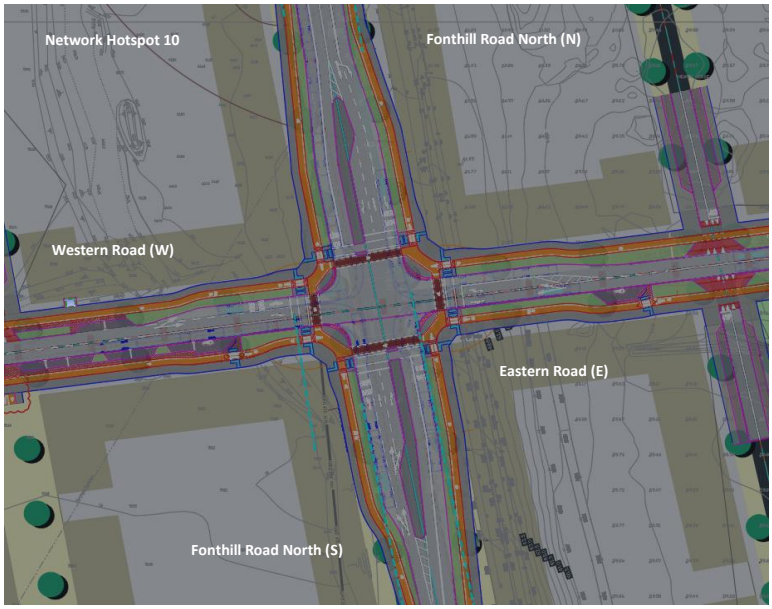
5.4.7 Additional mitigation may be required at this junction to address the impacts of the bridge closure.

5.5 Network Hotspot 10: Fonthill Road North / Eastern / Western Road

5.5.1 The Northern Network: Fonthill Road North / Eastern / Western Road is a 4-arm signalised junction and has been assessed for both Do-Minimum and Do Something scenarios for the forecast year 2035.

5.5.2 The layout design for the Network Hotspot 10 Northern Network: Fonthill Road North / Eastern / Western Road is shown in Figure 16

Figure 16. Network Hotspot 10



5.5.3 The capacity assessment results for both AM and PM peaks are shown in Table 9 and Table 10. The corresponding LinSig model layouts are shown from Figure 17 to Figure 20.

Table 9. Network Hotspot 10 Results - AM Peak

Site	Link Name	Lane	ARM (Turning)	AM Peak (08:00 - 09:00 AM)										
				DM 2035				DS 2035				Diff (DS-DM)		
				Queue (PCU)	DoS (%)	Av Delay (s/pcu)	Flows (PCU)	Queue (PCU)	DoS (%)	Av Delay (s/pcu)	Flows (PCU)	DoS (%)	Area for Consideration	Flow (%)
Network Hotspot 10 Northern Network Fonthill Road North	Fonthill Road North (N) - Entry	1/1	Left Ahead	1.20	7.90	18.3	65	1.40	9.10	17.3	77	1.2	NO	18.5%
		1/2	Ahead	7.80	37.50	19.6	374	8.80	41.10	18.9	424	3.6	NO	13.4%
		1/3	Right	1.10	72.30	58	59	1.00	70.10	57.8	55	-2.2	NO	-6.8%
	Eastern Road (E) - Entry	2/1	Left Ahead	5.50	39.60	33.4	207	4.00	31.30	34	154	-8.3	NO	-25.6%
		2/2	Right (flare)	5.50	39.60	33.4	0	4.00	31.30	34	6	-8.3	NO	-
	Fonthill Road North (S) - Entry	3/1	Left Ahead	4.30	26.60	19.5	214	5.90	34.50	19.2	286	7.9	NO	33.6%
		3/2	Ahead	25.80	87.40	27.7	868	25.40	85.50	26.2	878	-1.9	NO	1.2%
		3/3	Right	2.70	30.30	27.5	120	1.70	25.50	26.9	95	-4.8	NO	-20.8%
	Western Road (W) - Entry	4/1	Left Ahead	14.40	86.80	40.1	363	13.40	86.30	40.8	322	-0.5	NO	-11.3%
		4/2	Right (flare)	14.40	86.80	40.1	167	13.40	86.30	40.8	199	-0.5	NO	19.2%
		Cycle Time (s)		120				120						
		PRC (%)		3.0				4.3						
		Total Delay (PCU/Hr)		19.9				19.5						

Table 10. Network Hotspot 10 Results - PM Peak

Site	Link Name	Lane	ARM (Turning)	PM Peak (17:00 - 18:00 PM)										
				DM 2035				DS 2035				Diff (DS-DM)		
				Queue (PCU)	DoS (%)	Av Delay (s/pcu)	Flows (PCU)	Queue (PCU)	DoS (%)	Av Delay (s/pcu)	Flows (PCU)	DoS (%)	Area for Consideration	Flow (%)
Network Hotspot 10 Northern Network Fonthill Road North	Fonthill Road North (N) - Entry	1/1	Left Ahead	0.80	4.80	13	49	0.90	5.60	13.5	55	0.8	NO	12.2%
		1/2	Ahead	6.30	30.90	13.7	362	8.40	39.10	15	451	8.2	NO	24.6%
		1/3	Right	0.70	47.60	51.6	43	0.70	53.40	52.6	46	5.8	NO	7.0%
	Eastern Road (E) - Entry	2/1	Left Ahead	9.80	81.40	44.6	281	9.00	75.30	43	252	-6.1	NO	-10.3%
		2/2	Right (flare)	9.80	81.40	44.6	51	9.00	75.30	43	79	-6.1	NO	54.9%
	Fonthill Road North (S) - Entry	3/1	Left Ahead	3.20	19.90	13.7	190	5.10	30.60	15.1	284	10.7	NO	49.5%
		3/2	Ahead	25.90	82.70	21.2	963	24.00	79.20	21	909	-3.5	NO	-5.6%
		3/3	Right	0.30	4.30	17	22	0.90	13.00	20.6	56	8.7	NO	154.5%
	Western Road (W) - Entry	4/1	Left Ahead	4.90	71.10	46.2	78	3.20	73.00	46.3	116	1.9	NO	48.7%
		4/2	Right (flare)	4.90	71.10	46.2	166	3.20	73.00	46.3	94	1.9	NO	-43.4%
		Cycle Time (s)		120				120						
		PRC (%)		8.8				13.6						
		Total Delay (PCU/Hr)		15.9				16.2						

Figure 17. Network Hotspot 10 Junction Layout - 2035 DM AM

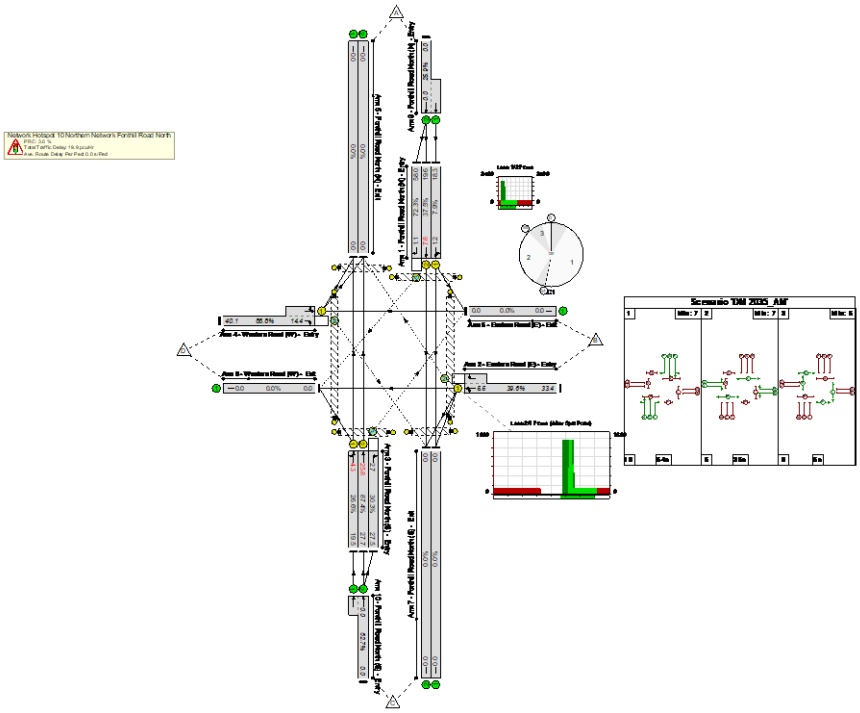


Figure 18. Network Hotspot 10 Junction Layout - 2035 DS AM

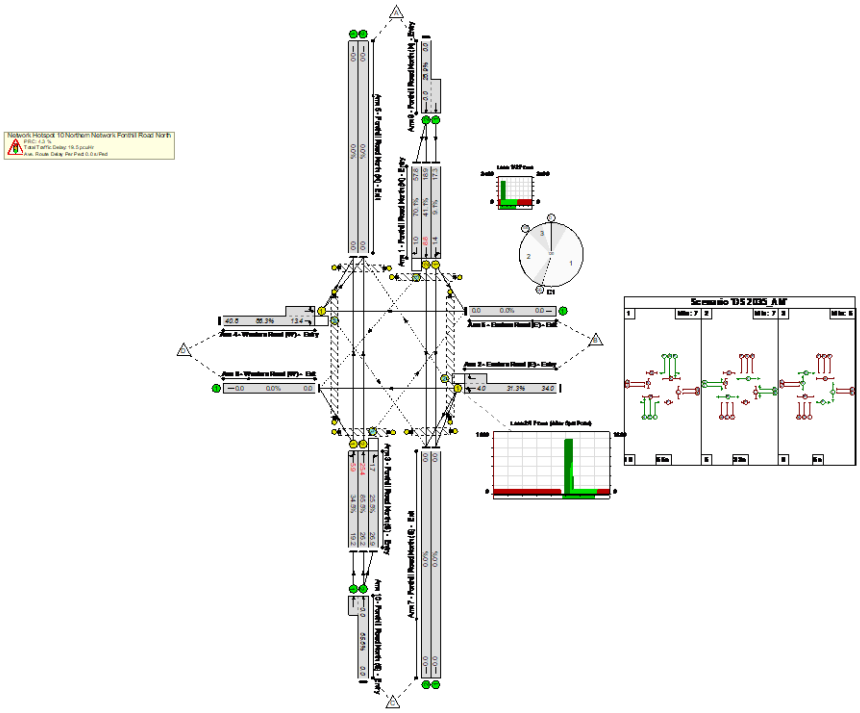


Figure 19. Network Hotspot 10 Junction Layout - 2035 DM PM

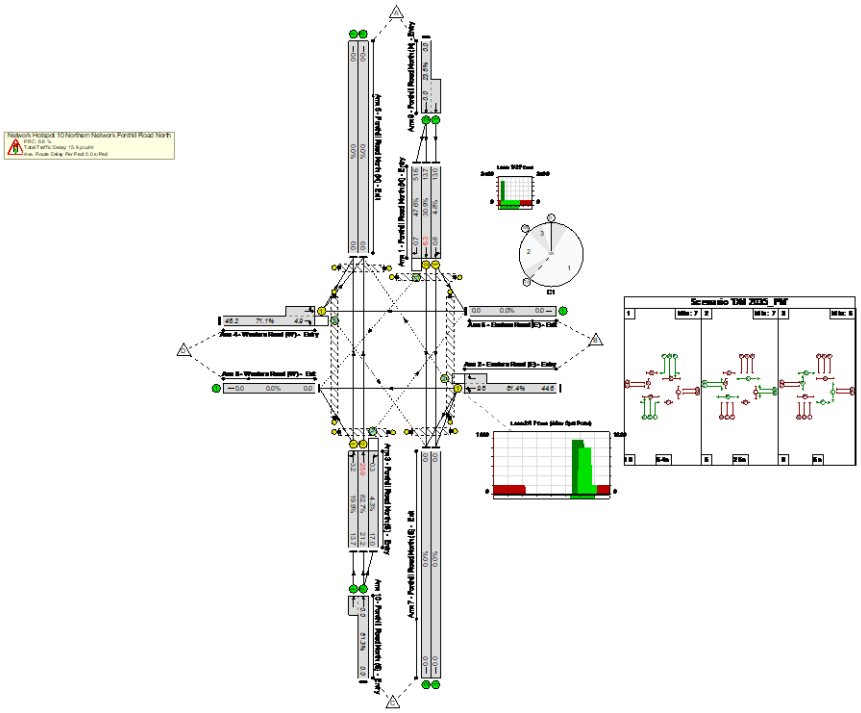
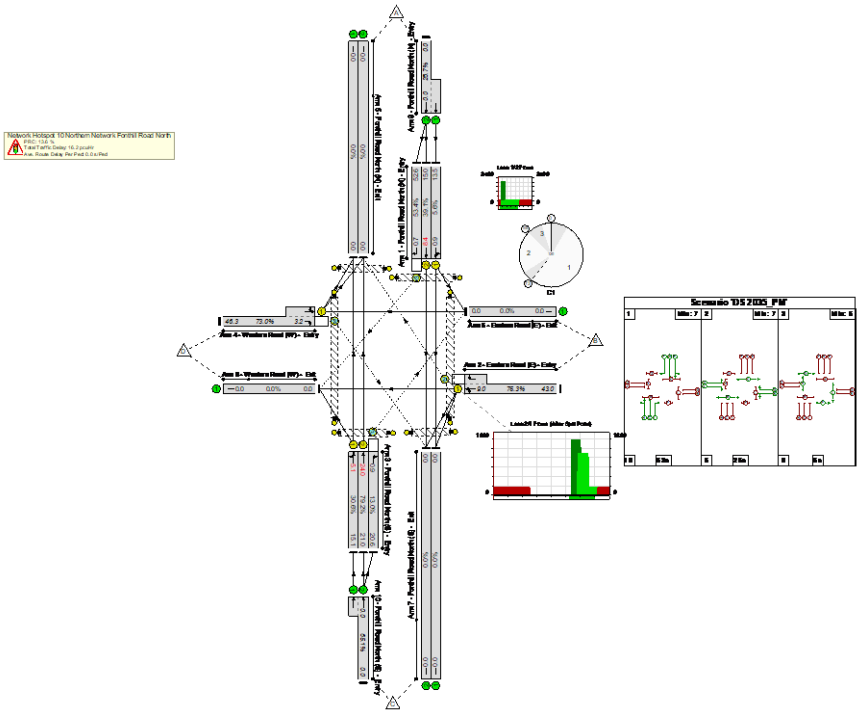


Figure 20. Network Hotspot 10 Junction Layout - 2035 DS PM



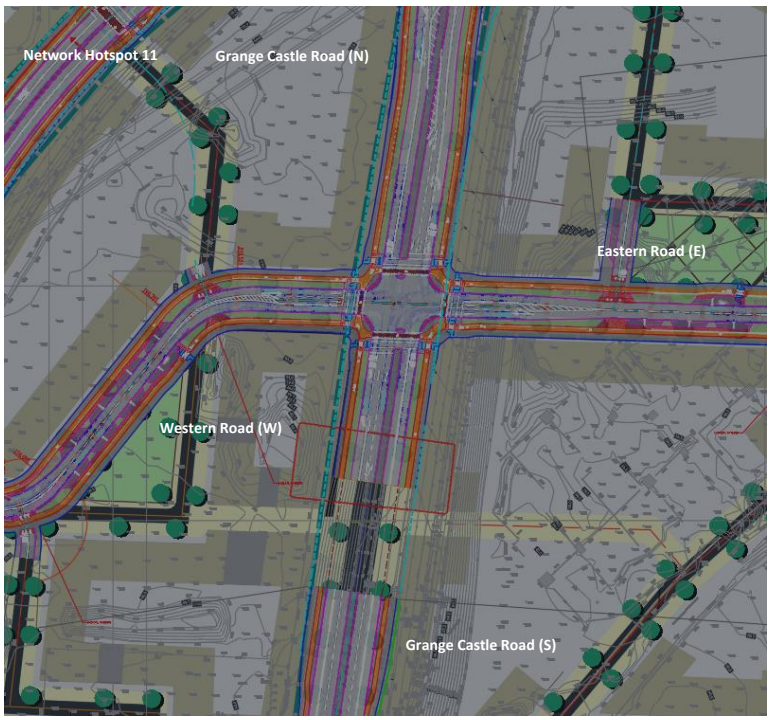
5.5.4 There are no threshold exceedances at Junction 10, the junction is considered to be performing well within operation. No further mitigation is required at this junction.

5.6 Network Hotspot 11: Grange Castle Road / Eastern / Western Road

5.6.1 The Northern Network: Grange Castle Road / Eastern / Western Road is a 4-arm signalised junction and has been assessed for both Do-Minimum and Do Something scenarios for the forecast year 2035.

5.6.2 The layout design for the Network Hotspot 11 Northern Network: Grange Castle Road / Eastern / Western Road is shown in Figure 21.

Figure 21. Network Hotspot 11



5.6.3 The capacity assessment results for both AM and PM peaks are shown in Table 11 and Table 12. The corresponding LinSig model layouts are shown from Figure 22 to Figure 25.

Table 11. Network Hotspot 11 Results - AM Peak

Site	Link Name	Lane	ARM (Turning)	AM Peak (08:00 - 09:00 AM)										
				DM 2035				DS 2035				Diff (DS-DM)		
				Queue (PCU)	DoS (%)	Av Delay (s/pcu)	Flows (PCU)	Queue (PCU)	DoS (%)	Av Delay (s/pcu)	Flows (PCU)	DoS (%)	Area for Consideration	Flow (%)
Network Hotspot 11 Northern Network Grange Castle Road	Grange Castle Road (N) - Entry	1/1	Left Ahead	1.30	8.80	18.4	70	1.00	6.90	17.1	58	-1.9	NO	-17.1%
		1/2	Ahead	16.30	65.80	23.5	654	16.30	64.70	22.2	665	-1.1	NO	1.7%
		1/3	Right	0.00	0.10	17.9	1	0.00	0.10	16.8	1	0	NO	0.0%
	Eastern Road (E) - Entry	2/1	Left Ahead	8.50	62.00	39.5	268	7.20	58.20	40.5	230	-3.8	NO	-14.2%
		2/2	Right (flare)	8.50	62.00	39.5	54	7.20	58.20	40.5	50	-3.8	NO	-7.4%
	Grange Castle Road (S) - Entry	3/1	Left Ahead	0.60	4.30	18	35	0.70	4.40	16.9	37	0.1	NO	5.7%
		3/2	Ahead	20.30	75.30	25.2	755	19.90	73.30	23.7	761	-2	NO	0.8%
		3/3	Right	2.10	13.80	18.8	111	2.80	17.70	18.1	148	3.9	NO	33.3%
	Western Road (W) - Entry	4/1	Left Ahead	11.10	74.90	41.9	294	10.30	73.70	41.9	286	-1.2	NO	-2.7%
		4/2	Right (flare)	11.10	74.90	41.9	126	10.30	73.70	41.9	100	-1.2	NO	-20.6%
		Cycle Time (s)		120				120						
		PRC (%)		19.6				22.1						
		Total Delay (PCU/Hr)		19.8				18.7						

Table 12. Network Hotspot 11 Results - PM Peak

Site	Link Name	Lane	ARM (Turning)	PM Peak (17:00 - 18:00 PM)										
				DM 2035				DS 2035				Diff (DS-DM)		
				Queue (PCU)	DoS (%)	Av Delay (s/pcu)	Flows (PCU)	Queue (PCU)	DoS (%)	Av Delay (s/pcu)	Flows (PCU)	DoS (%)	Area for Consideration	Flow (%)
Network Hotspot 11 Northern Network Grange Castle Road	Grange Castle Road (N) - Entry	1/1	Left Ahead	1.70	11.90	10.8	119	1.60	11.60	8	127	-0.3	NO	6.7%
		1/2	Ahead	12.70	53.00	13.1	672	10.00	46.40	9.2	643	-6.6	NO	-4.3%
		1/3	Right	0.00	0.00	0	0	0.00	0.00	0	0	0	NO	-
	Eastern Road (E) - Entry	2/1	Left Ahead	3.00	55.80	48	82	2.50	56.50	52.9	78	0.7	NO	-4.9%
		2/2	Right (flare)	3.00	55.80	48	98	2.50	56.50	52.9	1	0.7	NO	-99.0%
	Grange Castle Road (S) - Entry	3/1	Left Ahead	0.40	2.80	10.2	30	0.50	3.50	7.5	40	0.7	NO	33.3%
		3/2	Ahead	14.50	57.30	13.6	733	16.80	63.60	11.1	891	6.3	NO	21.6%
		3/3	Right	0.40	2.90	10.2	30	0.90	6.70	7.7	76	3.8	NO	153.3%
	Western Road (W) - Entry	4/1	Left Ahead	0.50	10.50	48.2	6	0.50	24.30	55.3	4	13.8	NO	-33.3%
		4/2	Right (flare)	0.50	10.50	48.2	18	0.50	24.30	55.3	18	13.8	NO	0.0%
		Cycle Time (s)		120				120						
		PRC (%)		57.1				41.5						
		Total Delay (PCU/Hr)		9.2				7.3						

Figure 22. Network Hotspot 11 Junction Layout - 2035 DM AM

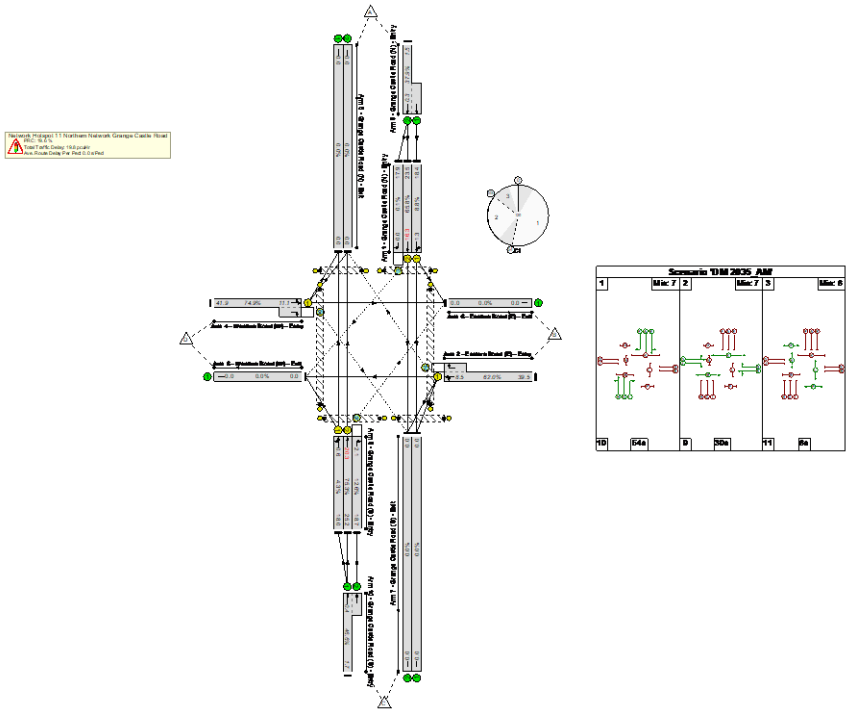


Figure 23. Network Hotspot 11 Junction Layout Road - 2035 DS AM

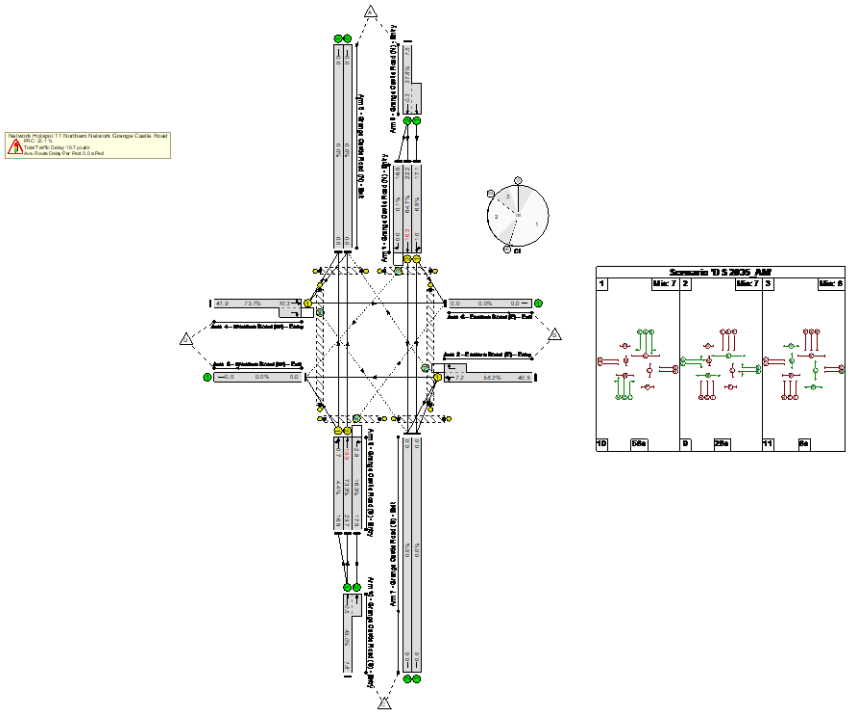


Figure 24. Network Hotspot 11 Junction Layout - 2035 DM PM

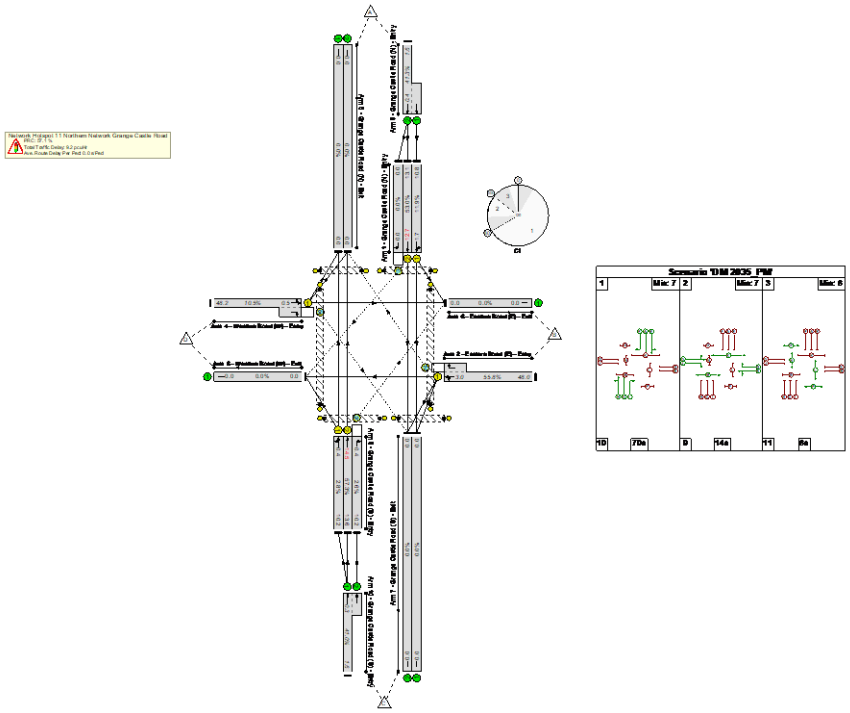
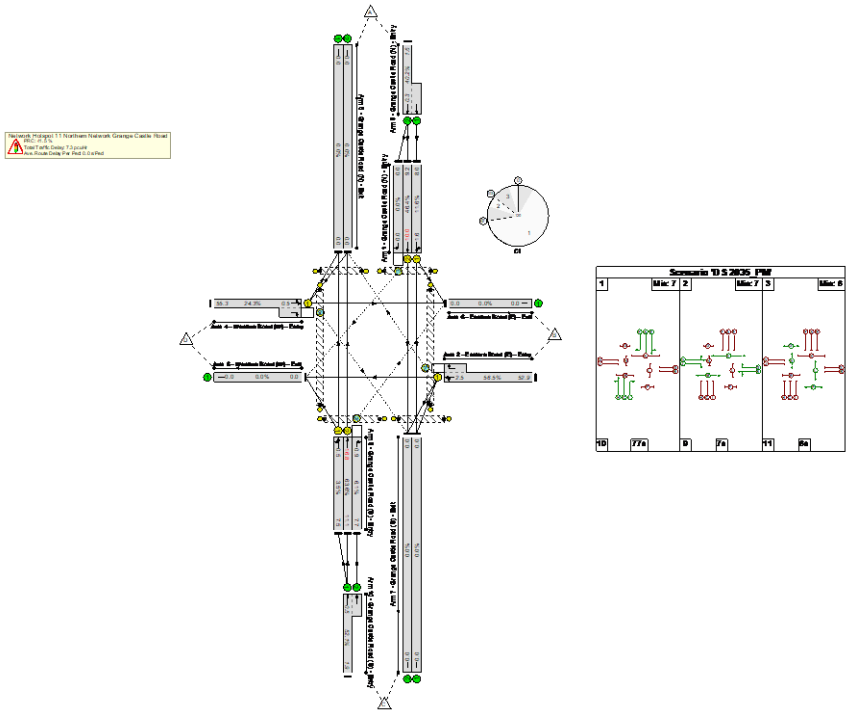


Figure 25. Network Hotspot 11 Junction Layout - 2035 DS PM



5.6.4 There are no threshold exceedances at Junction 11, the junction is considered to be performing well within operation. No further mitigation is required at this junction.

6. CONCLUSION

6.1.1 The final conclusions of the LinSig modelling for each identified hotspot junction are detailed below.

6.2 Junction 7

6.2.1 This junction has been identified as a potential issue in the LinSig modelling. An issue in the AM peak model was identified for this junction. However, upon further analysis of the LinSig model and given the level of exceedance, the junction is still considered to be operating satisfactorily. No further mitigation is recommended for this junction.

6.3 Junction 8

6.3.1 This junction has been identified as a potential issue in the LinSig model. An issue was identified in both the AM and PM for this junction. The impacts of the road removal may require mitigation to address the impact at this junction.

6.3.2 From examination of the results and review of the junction layouts, it may be feasible to mitigate the potential delays at junction 8 by increasing the capacities of the eastern and western arms of the junction. Widening of the carriageway and providing a dedicated left turn lane and extending the length of the right turn lanes on these two arms could provide the required additional capacity. Examination of the junction layout indicates that sufficient space may exist to accommodate this localised widening, if considered necessary. However, this report does not assess the deliverability of the mitigation, and further engagement would be required with the highways design team to ensure these measures are deliverable, and additional modelling may be required to test the proposed mitigation.

6.3.3 It appears that there is limited opportunity to provide additional capacity on the northern arm of the junction, although the provision of improved capacity on the east and west movements may help facilitate additional green time for the northern arm, which in turn could assist in the overall performance of the junction for vehicular traffic.

6.3.4 These assessments are based on the full build out of Clonburris, using a fixed highway demand and therefore represents a robust, worst-case assessment. Future investment in sustainable transport and policy, prompting changes in travel behaviours, are likely to result in a lower level of car traffic, which may negate the need for any future capacity enhancements. We would therefore recommend a monitor and manage approach, with the potential option to increase capacity in the future, if required.

6.4 Junction 10

6.4.1 No issues were identified in the LinSig modelling. No further mitigation is required.

6.5 Junction 11

6.5.1 No issues were identified in the LinSig modelling. No further mitigation is required.

SYSTRA provides advice on transport, to central, regional and local government, agencies, developers, operators and financiers.

A diverse group of results-oriented people, we are part of a strong team of professionals worldwide. Through client business planning, customer research and strategy development we create solutions that work for real people in the real world.

For more information visit www.systra.com/uk

Birmingham
Alpha Tower, Crowne Plaza, Suffolk Street
Birmingham, B1 1TT
T: +44 (0)121 393 4841

Bristol
33 Colston Avenue, Bristol, BS1 4UA

Cork
City Quarter, Lapps Quay, Cork City
Cork, T12 WY42, Republic of Ireland

Dublin
2nd Floor, Riverview House, 21-23 City Quay
Dublin D02 AY91, Republic of Ireland
T: +353 (0) 1 566 2028

Edinburgh
Ground Floor, 18 Charlotte Square, Edinburgh, EH2 4DF
T: +44 (0)131 460 1847

Glasgow
The Centrum Business Centre Limited, 38 Queen Street, Glasgow, G1 3DX
T: +44 (0)141 468 4205

Leeds
100 Wellington Street, Leeds, LS1 1BA
T: +44 (0)113 360 4842

London
One Carey Lane, London, England EC2V 8AE
T: +44 (0)20 3855 0079

Manchester
5th Floor, Four Hardman Street, Spinningfields
Manchester, M3 3HF
Tel: +44 (0)161 504 5026

Newcastle
Block C, First Floor, Portland House, New Bridge Street West,
Newcastle, NE1 8AL
Tel: +44 191 249 3816

Reading
Davidson House, Forbury Square,
Reading, RG1 3EU
T: +44 118 208 0111

Woking
Dukes Court, Duke Street
Woking, Surrey GU21 5BH
T: +44 (0)1483 357705

York
Meridian House, The Crescent
York, YO24 1AW
Tel: +44 1904 454 600

Other locations:

France:
Bordeaux, Lille, Lyon, Marseille, Paris

Northern Europe:
Astana, Copenhagen, Kiev, London, Moscow, Riga, Wroclaw

Southern Europe & Mediterranean: Algiers, Baku, Bucharest,
Madrid, Rabat, Rome, Sofia, Tunis

Middle East:
Cairo, Dubai, Riyadh

Asia Pacific:
Bangkok, Beijing, Brisbane, Delhi, Hanoi, Hong Kong, Manila, Seoul, Shanghai, Singapore, Shenzhen, Taipei

Africa:
Abidjan, Douala, Johannesburg, Kinshasa, Libreville, Nairobi

Latin America:
Lima, Mexico, Rio de Janeiro, Santiago, São Paulo

North America:
Little Falls, Los Angeles, Montreal, New-York, Philadelphia, Washington

SYSTRA