York Central Partnership

York Central

Leeman Road - Transport Modelling

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Contents

Appendices

Cinder Lane Traffic Flows

Appendix D

Plots of Identified Junctions

Executive Summary

Ove Arup and Partners Ltd (Arup) has been commissioned by York Central Partnership to test the traffic impact of different development quantum options and different highway configurations (access location; Leeman Road open/closed) for the York Central site. Development scenarios at May 2017 (hereon referred to as the May 2017 Development Scenario) which informed the Access Options study, and at August 2017 (hereon referred to the August 2017 Development Scenario) have been considered in this report.

Table 1: Development Scenarios & Trips Generated below summarises the development scenarios and identifies the number of additional vehicle trips which are generated by the proposed development based on the trip ratios proposed in the Transport Assessment Scoping Report (submitted separated to City of York Council Highways Department).

Table 1: Development Scenarios & Trips Generated

Development Scenario	Development Vehicle Trips Generated in peak hour	
	AM Peak	PM Peak
May 2017 Development Scenario: • 1,685 residential dwellings (houses / apartments) • 61,000m2 commercial (B1 Office)	826	939
August 2017 Development Scenario: • 2,460 residential dwellings (houses / apartments) • 77,000 m^2 commercial (B1 office) • 10,100 m^2 retail • 9,800 m^2 community / primary school • 13,500 m^2 hotel	1,148	1,058

City-wide Transport Impacts

City of York's current strategic highway model (CYC's SATURN model as of Summer 2017) has been used to assess the impact of the additional vehicle trips shown in Table 1 on the network. The SATURN model has also been used to assess an alternative scenario that includes the impact of placing a bus gate on Leeman Road which would prevent private vehicles using the site as a through route.(ie those vehicles which do not start/finish their journeys within the York Central development)

Analysis of the traffic flows from the strategic highway model shows that, even without the York Central development (the Do-Minimum Scenario), there is a general trend for increasing traffic volumes across the network. This is driven by general background traffic growth and additional traffic associated with the other developments set out in the York Local Plan. Comparison of the "Do-minimum scenario" (which excludes York Central" with the "Do-something scenarios" (which include York Central) allow the magnitude of the impacts generated by York Central to be assessed.

The modelling for the development scenarios for York Central does identify some localised decreases in traffic on parts of the network - in particular on roads close to the York Central site - for the "with bus gate" modelling scenarios as existing through flows of traffic are directed elsewhere. Further localised reductions in traffic on outer parts of the network will occur as a result of the displacement of traffic. This is less noticeable for the "without bus gate" scenarios as there is less traffic displacement due to the availability of a route through the York Central site.

The results of the analysis show that, at a city-wide level, Access Option E generates less additional congestion than Access Option A in both the "with" or "without bus-gate" scenarios. Placing a bus-gate on Leeman Road will force through traffic to use other routes and therefore the "with bus gate scenarios" generate more additional congestion than the "without bus gate scenarios". Unsurprisingly, the August 2017 Development Scenario generates higher additional congestion due to the greater number of vehicle trips generated.

At a local level, a number of roads around the York Central site experience increases in traffic with changes in traffic levels in excess of 10% for both Option A and Option E. This includes Holgate Road, Clifton and Water End. These increases are likely to be as a result of the additional development traffic as well as the displacement of traffic to/from other routes. Holgate Road west of York Road does, however, experience a decrease in traffic flows during the PM peak hour for Option E in the "without bus" gate scenario.

The impact of the proposed development has also been analysed in terms of the overall delay to all vehicle movements across the city relative to the base case (the base case being predicated traffic levels in 2031). These results are summarised in Table 2 and are expressed as a change in the annual delay when compared against the Do-Minimum scenario

Table 2: Saturn model outputs - Total Network Delay in the AM Peak Hour

Development Scenario	**Access Option Scenario**	**Change in Annual Delay on the Network PCU[1] Hours (300 days) and % change from base case in AM Peak**	
		With Bus Gate	**Without bus gate**
May 2017 Development Scenario	Access Option A	9,330 (+8.9%)	4,680 (+4.7%)
	Access Option E	5,430 (+5.5%)	2,280 (+2.9%)
August 2017 Development Scenario	Access Option A	11,280 (+11.7%)	6,420 (+7.3%)
	Access Option E	7,110 (+8.0%)	3,960 (+5.7%)

The magnitude of this change relative to the base case (i.e. traffic levels in 2031 without development) ranges from +2.9% to +11.7% depending on which development scenario and highway configuration combination is chosen.

[1] PCU = passenger car units, where typically cars and light goods vehicles (LGVs) are one PCU, buses and coaches are two PCUs and heavy goods vehicles (HGVs) are 2.3 PCUs.

Impacts at Local Junctions

To further assess the impact of the proposals, where the SATURN model forecast significant changes in traffic flow through road junctions and/or where junction capacity was approaching saturation, LinSig and Junctions 9 modelling was used to assess the performance of individual junctions. In total, 14 junctions were analysed assuming the August 2017 Development Scenario for the "with" and "without bus gate" scenarios for both Access Option A and Access Option E to assess the degree of spare capacity that remains. The results are presented in Table 3.

In all but three junctions, the overall level of delay experienced at the assessed junctions does not increase significantly when compared with the Do-Minimum[2] for Options A and E. This applies to both the "with" and "without" bus gate options for the AM and PM peak hours.

As highlighted in Table 3, three junctions operate at close to maximum capacity during the peak hour periods. The additional delay at these junctions may however be tolerable given the general increase in delay experienced in the Do Minimum scenario – i.e. as a result of background growth and other Local Plan developments. The implementation of the Travel Plan for the York Central site will help mitigate these impacts by seeking to reduce the number of vehicle trips generated by the site through a series of sustainable travel measures and this will have a positive impact on reducing network delays. The modelling shows that the development scenarios should be achievable subject to more detailed discussions with the Highways Authority as part of the preparation of a Transport Assessment to support a future Planning Application.

Table 3: Summary of Peak Hour Junction Analysis

Junction	Access Option	No bus gate	With bus gate	Mitigation Considered
A59 Holgate Road/Acomb Road/Poppleton Road (The Fox)	Option A & Option E	No issues - junction operates with spare capacity		No modifications proposed.
Water End/A59 Boroughbridge Road	Option A & Option E	No issues - junction operates with spare capacity		No modifications proposed.
Water End/Salisbury Road	Option A & Option E	No issues - junction operates with spare capacity		No modifications proposed.
Clifton/Water End/Water Lane	Option A & Option E	No issues - junction operates with spare capacity		No modifications proposed.
A59 Holgate Road/Hamilton Drive	Option A	Junction impacted (minor)	No issues - all junctions operate with spare capacity	No modifications proposed.

[2] The situation without the York Central development but including background traffic growth and additional growth associated with those other developments set out in the York Local Plan

Junction	Access Option	No bus gate	With bus gate	Mitigation Considered
	Option E	Junction impacted	Junction impacted	No modifications proposed – junction is physically constrained but will continue to function, albeit less efficiently.
A1036 The Mount/Dalton Terrace/Albermarle Road	Option A & Option E	No issues - junction operates with spare capacity		No modifications proposed.
A1036 The Mount/Scarcroft Road	Option A & Option E	No issues - junction operates with spare capacity		No modifications proposed.
A59 Holgate Road/Blossom Street	Option A & Option E	No issues - junction operates with spare capacity		No modifications proposed.
A1036 Blossom Street/Queen Street/Nunnery Lane	Option A & Option E	No issues - junction operates with spare capacity		No modifications proposed.
A1036 Bishopthorpe Road/Scarcroft Road	Option A & Option E	No issues - junction operates with spare capacity		No modifications proposed.
Tadcaster Road/St Helen's Road	Option A	No issues - junction operates with spare capacity		No modifications proposed.
	Option E	No issues - junction operates with spare capacity	Junction impacted	No modifications proposed – junction is physically constrained but will continue to function, albeit less efficiently
A59 Holgate Road/Dalton Terrace	Option A	No issues - junction operates with spare capacity		No modifications proposed.
	Option E	Junction impacted	Junction impacted	No modifications proposed – junction is physically constrained but will continue to function, albeit less efficiently
B1363 Wigginton Road/Crichton Avenue	Option A & Option E	No issues - junction operates with spare capacity		No modifications proposed.
A19 Bootham/A1036 St. Leonard's Place/Gillygate	Option A & Option E	No issues - junction operates with spare capacity		No modifications proposed.

Traffic Flows through the York Central Development

The SATURN analysis also enables traffic flows through the York Central development to be assessed.

For Option A, the level of traffic experienced within the York Central site increases for both of the "without bus gate" scenarios (May 2017 and August

2017 Development Scenarios) and with the August 2017 "with bus gate" development scenario when compared to the Do-Minimum traffic flows on Leeman Road. The modelling also shows that between 43% and 76% of the total traffic travelling through the York Central site are development related trips (ie those vehicles which start/finish their journey within York Central) with the lower percentages relating to the "without bus gate" scenarios. Given that the trips to non-York Central development uses (such as to/from the station car parks) will be the same for the "with" and "without bus gate" scenarios, the modelling shows that, in the "without bus gate scenario", the provision of new highway infrastructure results in a greater volume of non-development related traffic using the site roads.

Similarly, for Option E, the level of through traffic travelling across the York Central site for the "without bus gate" scenarios and the "with bus gate" increases when compared to the Do-Minimum traffic flows on Leeman Road. Of the total traffic travelling through the York Central site, the proportion of traffic which is directly associated with the York Central development (i.e. development related trips) varies from 42% to 58%, again with the lower percentages relating to the "without bus gate" scenarios. As for Option A, the trips to non-York Central uses (such as to/from the station car parks) will be the same for the "with" and "without bus gate" scenarios. Therefore, under the "without bus gate" scenario, the provision of new highway infrastructure results in an increase in through traffic using the York Central site.

The volume of traffic travelling through the York Central site and not going to the development (ie no-development traffic) is greater for Option E than it is for Option A. For Option E, development related traffic also makes up an overall lower proportion of the total traffic travelling through the site. Table 4 sets out the forecasted traffic levels on Cinder Lane.

Table 4: Forecast Traffic Flows on Cinder Lane (two-way) in the AM Peak Hour

Development Scenario	**Access Option**	**Traffic Flows on Cinder Lane – AM peak (PCU / hour – two-way flow)**	
		No bus gate	**With bus gate**
May 2017 Development Scenario	Access Option A	862	239
	Access Option E	884	286
August 2017 Development Scenario	Access Option A	941	240
	Access Option E	934	288

This demonstrates that the use of a bus gate significantly reduces the numbers of vehicles within the York Central development. Table 4 shows that Access Option A and E generate very similar levels of traffic on Cinder Lane both for the May 2017 Development Scenario and August 2017 Development Scenario.

1 Introduction

1.1 Background

Ove Arup and Partners Ltd (Arup) has been commissioned by York Central Partnership to test possible development quantum options and highway configurations for the York Central site using the York Central highway assignment model.

The assessment of York Central access options has been undertaken using the City of York Council (CYC) strategic traffic model (SATURN). The current modelling / assessment follows on from previous modelling, comprising:

- 2015/16 – Modelling of Access Option E (Southern), with 1,500 homes and 100,000m^2 commercial development (approximately 1,000 development trips in the AM and PM peak hours). Models were tested with and without a bus gate to prevent the use of York Central as a through route (Leeman Road closed/open scenarios).
- 2017 (Access Options study) – Improvements were made to the 2015/16 base model and modelling of Access Options A1/A2 (Western) and E (Southern) was undertaken assuming 1,685 homes & 61,000m^2 commercial development with 10% added for other uses (equating to approximately 1,000 development trips in the AM and PM peak hours). Models were only run with the bus gate control (i.e. Leeman Road closed and no alternative west to east general traffic route through the site).

The purpose of this transport modelling work is to assess the impact on the highway network of two different development quanta and two different access options, and also, for comparison purposes, to test them with a bus gate on Leeman Road closed to general through traffic) and without a bus gate on Leeman Road (i.e. open to all traffic). The development quantum assessed reflects the May 2017 Development Iteration Scenario (hereon referred to as the May 2017 Development Scenario), which is the development quantum assessed as part of the June Access Options study, and a development option considered in August 2017 (hereon referred to as the August 2017 Development Scenario).

Following a review of the SATURN strategic model outputs, junctions requiring further detailed assessment have been identified and local junction assessments undertaken to determine whether this results in the potential need for further highway mitigation from that previously identified.

It is important to note that a separate Transport Assessment (TA) scoping process is ongoing through which the trips rates to the used in the TA will be agreed with CYC transport/highways officers and Highways England. Feedback has been received from CYC transport/highway officers and further investigation of the trip rates for commercial development may be required as part of the TA process. The trip rates presented in this report are consistent with those presented in the TA Scoping Report. In addition, a new strategic highway model is being developed by CYC which will be provided for use as part of the TA.

The analysis is presented at a point in time as part of the development of the York Central masterplan and is based on specific iterations of the development at the time of preparation. As the scheme develops, the quantum may change which would alter the results of the trip generation and the transport modelling.

1.2 Report Structure

This report provides a summary of the methodology used to undertake the assessment at Chapter 2. The results of the SATURN model outputs are provided at Chapter 3 to identify the impacts and present a comparison of the with and without bus gate scenario testing. Chapter 4 presents the results of the local junction assessments. Chapter 5 presents a summary and conclusion of the findings of the analysis.

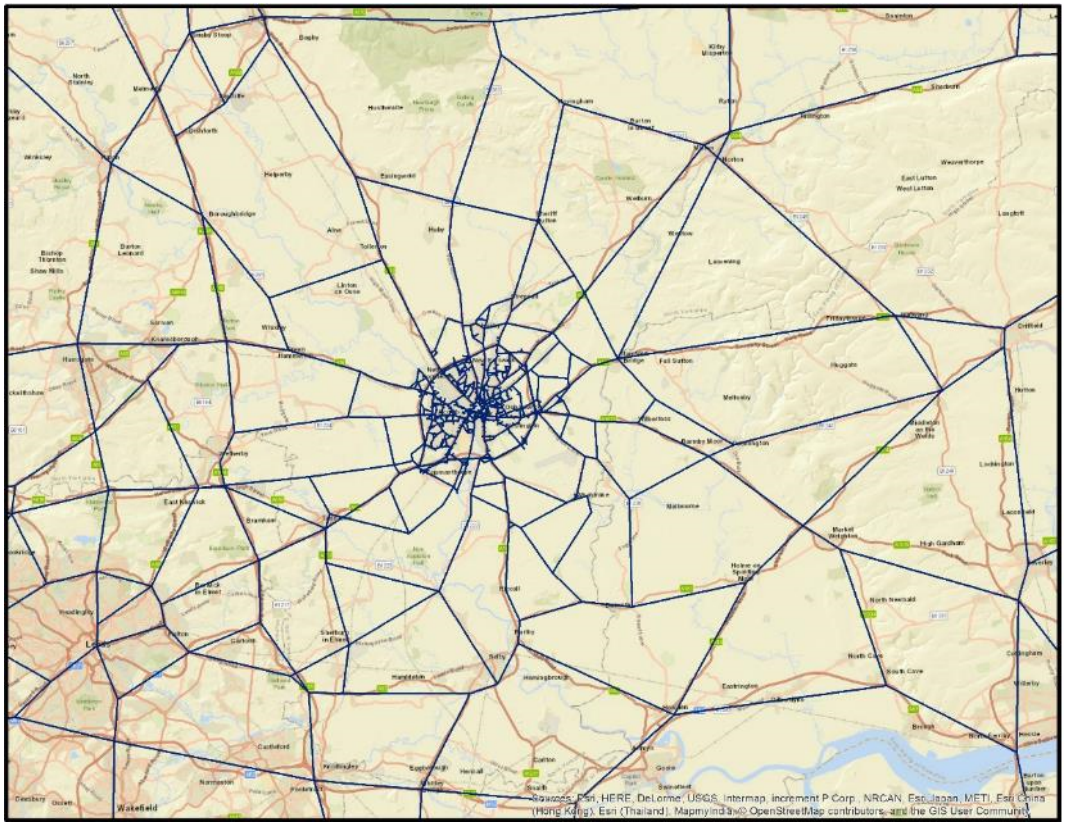
2 Methodology

2.1 Model Extent

The York SATURN model provided by CYC forms the basis for the assessment. The model was developed for a base year of 2015 and represents an average weekday. The modelled time periods are the AM peak hour (08:00 to 09:00) and the PM peak hour (17:00 to 18:00). The future year of the model is 2031.

The extent of the York SATURN model covers the city of York in the fully modelled area and areas further afield in the buffer network. Figure 1 shows the extent of the York SATURN model.

Figure 1: SATURN Model Extent



It is noted that CYC are currently in the process of updating their base city-wide SATURN model as well as developing a number of future year models. As such, all modelling will be required to be updated for future TA work. The results presented below are therefore indicative, for access option comparison purposes and may be subject to change in future assessments.

2.2 Modelling Scenarios

The access option model developed in May 2017 for the Access Options Study tested the May 2017 Development scenario with the bus gate on Leeman Road (closed). YCP has not committed to closing Leeman Road and wish to understand the impact of the May 2017 Development Scenario for both access options with

no bus gate on Leeman Road (i.e. an east-west route would be available through the development). The impact of August 2017 Development Scenario both with and without the bus gate has also been tested for both access options.

This technical note compares the impact of the proposed development for the scenarios outlined in Table 5.

Table 5: Assessment Scenarios

Development Quantum	Leeman Road	Access Option	
May 2017 Development Scenario	With bus gate	Option A	Option E
	Without bus gate	Option A	Option E
August 2017 Development Scenario	With bus gate	Option A	Option E
	Without bus gate	Option A	Option E

All modelling scenarios have been tested in the 2031 future year model with full build out of the York Central scheme and including CYC Local Plan development.

2.2.1 May 2017 Development Scenario

The May 2017 Development Scenario at York Central, as modelled for the May 2017 Access Options study, comprises:

- 1,685 residential dwellings (houses / apartments);
- 61,000m^2 commercial (B1 Office); and
- Other community land uses – not specified.

2.2.2 August 2017 Development Scenario

The August 2017 Development Scenario included in this assessment comprises:

- 2,460 residential dwellings (houses / apartments);
- 77,000m^2 commercial (B1 Office);
- 10,100m^2 retail;
- 9,800m^2 community / primary school; and
- 13,500m^2 hotel.

2.3 Trip Generation

Trip generation estimates have been calculated based on the methodology set out within the TA Scoping Study.

Person trips rates associated with the proposed land uses on the site, other than residential uses, have been estimated using the latest version of TRICS database (TRICS 7.4.1). Site specific trip rates were derived for residential developments based on surveys in 2015 as part of a previous *Stage 1 Transport Appraisal* for

York Central. A further review of the residential trips rates with TRICS has been undertaken, based on higher proportions of apartments.

Mode shares for each land use have been based on TRICS mode shares as well 2011 Census Journey to Work data. Further detail of the trip rates for each proposed land use category is set out in the TA Scoping Report, dated August 2017.

The trip generation methodology is currently under discussion with CYC and Highways England as part of the TA scoping process. There may therefore be some changes to the trip generation methodology as the scheme assessment progresses.

2.3.1 May 2017 Development Scenario

The May 2017 Development Scenario comprises up to 1,685 residential dwellings and 61,000m^2 commercial office uses. The residential trip rates are based on the 2015 survey data comprising a mix of residential houses and apartments. For the earlier access option testing, the other / community uses at the site had not been determined. For assessment purposes, the potential trip generation associated with these other uses was included as an additional 10% of the residential and commercial total trips for each time period. The vehicle trip generation associated with the May 2017 Development Scenario is provided in Table 6.

Table 6: York Central Trip Generation – May 2017 Development Scenario

Land use	AM Peak Hour 08:00 to 09:00			PM Peak Hour 17:00 to 18:00		
	Arr.	Dep.	Total	Arr.	Dep.	Total
Residential	118	256	374	297	199	495
Commercial	351	26	377	16	343	358
Total	469	282	751	312	541	854
+10%	**516**	**310**	**826**	**344**	**596**	**939**

2.3.2 August 2017 Development Scenario

The August 2017 Development Scenarios comprise up to 2,460 residential dwellings and 77,000m^2 commercial office uses. The residential trip rates are based on a revised trip rate from TRICS with a higher proportion of residential apartments. The other / community uses, used for assessment include retail and hotel development as well as a primary school. It is acknowledged that trips associated with the other / community uses may not all be new / additional to the site. A proportion of tips will be linked to other site uses, for example residents may stop at retail development. A detailed methodology to account for this has not been agreed with CYC and Highways England at this stage, therefore for the purposes of this assessment we have assumed 10% of retail trips are new / additional to the other site uses. All predicted trips associated with the primary school and hotel are included in this assessment to provide a robust assessment.

The vehicle trip generation associated with the August 2017 Development Scenario is provided in Table 7.

Table 7: York Central Trip Generation – August 2017 Development Scenario

Land use	AM Peak Hour 08:00 to 09:00			PM Peak Hour 17:00 to 18:00		
	Arr.	Dep.	Total	Arr.	Dep.	Total
Residential	108	251	251	278	187	465
Commercial	367	25	392	18	350	368
Retail (10%)	59	58	117	55	61	116
School	212	102	314	12	24	36
Hotel	22	53	75	50	23	73
Total	**767**	**489**	**1,148**	**413**	**646**	**1,058**

The trip matrices have been revised to include the estimated trip generation from the proposed August 2017 Development Scenario and these matrices are used to model the August 2017 Development Scenario.

2.4 Forecasting Outputs

The traffic impacts of the proposed York Central developments have been assessed by comparing the 2031 Do-Minimum and Do-Something scenarios for each access option and development scenario as set out in Section 2.2. The impact of the scheme has been compared based on the network wide impact – delay / travel time / distance.

The results of the assessment are provided in Chapter 3.

2.5 Junction Impacts

The impact at junctions on the local and wider highway network has been reviewed based on the following criteria extracted from the CYC SATURN model:

- Criteria 1: Increase in flow of greater than 50 Passenger Car Units (PCU)[3] per hour; and
- Criteria 2: Ratio of volume to capacity (V/C) of greater than 80%[4] in Do-Minimum (DM) or Do-Something (for each option and time period). [5]

[3] PCU = passenger car units, where typically cars and light goods vehicles (LGVs) are one PCU, buses and coaches are two PCUs and heavy goods vehicles (HGVs) are 2.3 PCUs.
[4] Indicating spare capacity at the junction of less than 20%
[5] The Do-Minimum scenario is the future baseline scenario without no development at York Central but including background traffic growth and additional growth associated with those other developments set out in the York Local Plan. The Do-Something scenario includes the York Central development.

3 Saturn Modelling Outputs

Data has been extracted from the SATURN model for all identified assessment scenarios, as set out below. The performance of the wider network is reviewed based on the total network delays, total network travel times and total network travel distance.

3.1 May 2017 Development Scenario Proposal

Table 8 to Table 10 present the total network delay, total travel time and total travel distance for Options A and Option E with and without the bus gate for the AM and PM peak hours for the May 2017 Development Scenario.

Table 8: Total Network Delay – May 2017 Development Scenario 2031

Option A	**With Bus Gate**		**Without Bus Gate**	
	AM	**PM**	**AM**	**PM**
DM Total Network Delay (PCU Hrs)	205.5	218.7	205.5	218.7
DS Total Network Delay (PCU Hrs)	223.7	231.6	215.2	224.6
Change in Total Network Delay (PCU Hrs)	18.2	12.9	9.7	5.9
Change in Annual Delay PCU Hrs (300 days)	9,330		4,680	
Option E	**With Bus Gate**		**Without Bus Gate**	
	AM	**PM**	**AM**	**PM**
DM Total Network Delay (PCU Hrs)	205.5	218.7	205.5	218.7
DS Total Network Delay (PCU Hrs)	216.9	225.4	211.4	220.4
Change in Total Network Delay (PCU Hrs)	11.4	6.7	5.9	1.7
Change in Annual Delay PCU Hrs (300 days)	5,430		2,280	

The results indicate that the predicted network wide delay is lower for Access Option E (southern) than Option A in both the AM and PM peak hours. The predicted annual delay without the bus gate in place on Leeman Road is approximately half that with the bus gate in place. This is due to the re-routing of traffic on other roads in the vicinity due to the closure of Leeman Road to general traffic.

Table 9: Total Network Travel Time – May 2017 Development Scenario Proposal 2031

Option A	With Bus Gate		Without Bus Gate	
	AM	PM	AM	PM
DM Total Network Travel Time (PCU Hrs)	9,010	9,473	9,010	9,473
DS Total Network Travel Time (PCU Hrs)	9,638	9,717	9,497	9,655
Change in Total Network Travel Time (PCU Hrs)	628	244	488	182
Option E	**With Bus Gate**		**Without Bus Gate**	
	AM	**PM**	**AM**	**PM**
DM Total Network Travel Time (PCU Hrs)	9,010	9,473	9,010	9,473
DS Total Network Travel Time (PCU Hrs)	9,485	9,655	9,305	9,585
Change in Total Network Travel Time (PCU Hrs)	475	181	295	112

The results indicate that the predicted network wide travel time is lower for Access Option E (southern) than Option A in both the AM and PM peak hours. The predicted increase in travel time is less without the bus gate in place on Leeman Road.

Table 10: Total Network Travel Distance – May 2017 Development Scenario Proposal 2031

Option A	With Bus Gate		Without Bus Gate	
	AM	PM	AM	PM
DM Total Network Travel Distance (PCU Kms)	365,665	373,847	365,665	373,847
DS Total Network Travel Distance (PCU Kms)	376,856	385,134	374,194	382,883
Change in Total Network Travel Distance (PCU Kms)	11,191	11,288	8,528	9,037
Option E	**With Bus Gate**		**Without Bus Gate**	
	AM	**PM**	**AM**	**PM**
DM Total Network Travel Distance (PCU Kms)	365,665	373,847	365,665	373,847
DS Total Network Travel Distance (PCU Kms)	374,610	384,100	372,874	382,827
Change in Total Network Travel Distance (PCU Kms)	8,945	10,253	7,209	8,980

The results indicate that the predicted network wide travel distance is lower for Access Option E (southern) than Option A in both the AM and PM peak hours. The predicted increase in travel distance is less without the bus gate in place on Leeman Road.

Flow difference plots for the May 2017 Development Scenarios are provided in Appendix A. The flow difference plots compare each scenario with the 2031 Do-Minimum scenario (ie the situation with no development at York Central but considering background traffic growth and traffic growth associated with the other developments proposed in the York Local Plan). The difference plots show that the general trend is that the volume of traffic is increasing (shown in green) across the network when compared with the Do-Minimum scenario. There would, however, be increases in traffic on the network without the York Central development.

There are some decreases in traffic (shown in blue). For the with bus gate scenarios for Option A, there are some reductions close to the York Central site due to the changes to the road network with other minor increases, including the A1036/A19 Fulford Road in the AM peak hour. During the PM peak, hour, there are some minor decreases on the out ring road to the south-west of the city. For Option E with the bus gate, there are similar decreases to Option A although the roads in the area between the York Central site and the outer ring road to the west of the city does experience additional decreases in both the AM and PM peak hours. This is due to diversionary effects.

For the without bus gate scenario for Option A, there is generally less decreases in traffic in York although there are some local decreases close to the site. This is because a route through the site is maintained which does not result in any significant diversions of traffic through the site. For Option E, there are further decreases experienced on the outer ring road to the south-west of the city with a number of roads in the area between the York Central site and the outer ring road to the west of the city also experiencing a decrease in traffic due to diversionary effects.

Additional diagrams of the traffic flows on some of the roads in the immediate vicinity of the York Central site are also provided in Appendix A, showing the percentage change in the flow at these locations. This shows the following:

- The with bus gate scenarios generally see a reduction in the traffic flows on Leeman Road/Kingsland Terrace with corresponding increases in traffic on a number of roads surrounding the site. These increases are due to the implementation of the bus gate, which restricts traffic movement through the site. The locations of the increases are similar for Options A and Option E with increases in traffic in excess of 10% experienced at a number of locations, significantly so at some locations.
- For Option A, the without bus gate scenarios generally see a reduction in the traffic flows on Leeman Road/Kingsland Terrace. At two of the locations identified, the traffic increase by more than 10% during the PM peak hour. These locations are Holgate Road close to Wilton Rise (with a 13% increase) and Clifton (with a 43% increase). This is likely due to the displacement of traffic from other parts of the network.
- For Option E without the bus gate, Leeman Road experiences an increase in traffic, due to the availability of a through route. There are a number of the identified locations which experience an increase of 10% during the AM and PM peak hours. These locations include Water End, Holgate Road east of York Road and Clifton.

3.2 August 2017 Development Scenario

Table 11 to Table 13 present the total network delay, total travel time and total travel distance for Options A and Option E with and without the bus gate for the AM and PM peak hours for the August 2017 Development Scenario.

Table 11: Total Network Delay – August 2017 Development Scenario 2031

Option A	**With Bus Gate**		**Without Bus Gate**	
	AM	**PM**	**AM**	**PM**
DM Total Network Delay (PCU Hrs)	205.5	218.7	205.5	218.7
DS Total Network Delay (PCU Hrs)	229.5	232.3	220.6	225
Change in Total Network Delay (PCU Hrs)	24.0	13.6	15.1	6.3
Change in Annual Delay PCU Hrs (300 days)	11,280		6,420	
Option E	**With Bus Gate**		**Without Bus Gate**	
	AM	**PM**	**AM**	**PM**
DM Total Network Delay (PCU Hrs)	205.5	218.7	205.5	218.7
DS Total Network Delay (PCU Hrs)	221.9	226	217.2	220.2
Change in Total Network Delay (PCU Hrs)	16.4	7.3	11.7	1.5
Change in Annual Delay PCU Hrs (300 days)	7,110		3,960	

Table 12: Total Network travel Time – August 2017 Development Scenario 2031

Option A	**With Bus Gate**		**Without Bus Gate**	
	AM	**PM**	**AM**	**PM**
DM Total Network Travel Time (PCU Hrs)	9,010	9,473	9,010	9,473
DS Total Network Travel Time (PCU Hrs)	9,897	9,770	9,747	9,708
Change in Total Network Travel Time (PCU Hrs)	888	296	738	234
Option E	**With Bus Gate**		**Without Bus Gate**	
	AM	**PM**	**AM**	**PM**
DM Total Network Travel Time (PCU Hrs)	9,010	9,473	9,010	9,473
DS Total Network Travel Time (PCU Hrs)	9,675	9,710	9,515	9,642
Change in Total Network Travel Time (PCU Hrs)	665	237	505	169

Table 13: Total Travel Distance – August 2017 Development Scenario 2031

Option A	**With Bus Gate**		**Without Bus Gate**	
	AM	**PM**	**AM**	**PM**
DM Total Network Travel Distance (PCU Kms)	365,665	373,847	365,665	373,847
DS Total Network Travel Distance (PCU Kms)	381,607	386,642	378,649	384,185
Change in Total Network Travel Distance (PCU Kms)	15,942	12,795	12,983	10,338
Option E	**With Bus Gate**		**Without Bus Gate**	
	AM	**PM**	**AM**	**PM**
DM Total Network Travel Distance (PCU Kms)	365,665	373,847	365,665	373,847
DS Total Network Travel Distance (PCU Kms)	378,646	385,445	376,941	384,165
Change in Total Network Travel Distance (PCU Kms)	12,981	11,598	11,276	10,318

The results for the August 2017 Development Scenario reflect the results for the May 2017 Development Scenario. The predicted delay, travel time and travel distance are lower for Access Option E (southern) than Option A. The predicted network wide delays, travel times and travel distances are lower without the bus gate in place on Leeman Road. As expected, the August 2017 Development Scenario results is greater network delay, travel time and travel distance than the May 2017 Development Scenario, as modelled in May 2017 for the Access Options Study.

Flow difference plots for this level of development are provided in Appendix B. The flow difference plots compare each scenario with the 2031 Do-Minimum scenario. The overall trend in traffic is similar to the May 2017 Development Scenarios presented in Section 3.1. However, the overall magnitude of increase is greater given that the York Central development generates a higher level of traffic for the August 2017 Development Scenarios. Some traffic displacements or are greater which results in some decreases in traffic. This is also as a result of the greater level of traffic generated.

Additional diagrams of the traffic flows on some of the roads in the immediate vicinity of the York Central site are also provided in Appendix B, showing the percentage change in the flow at these locations. This shows the following:

- The with bus gate scenarios generally see a reduction in the traffic flows on Leeman Road/Kingsland Terrace. The magnitude of the reduction is, however, lower than the May 2017 Development Scenario scenarios. A number of roads around the site also experience an increase in traffic as a result of the bus gate implementation. The locations of the increases are similar for Options A and Option E with increases in traffic in excess of 10% experienced at a number of locations, significantly so at some locations. Some links, particular those off Holgate Road, experience a small reduction in traffic which is likely due to displacement of traffic to other routes.
- For Option A, the without bus gate scenarios also generally see a reduction in the traffic flows on Leeman Road/Kingsland Terrace. There are four locations where traffic increase by more than 10% and these are only during the PM peak hour. The locations are Holgate Road close to Wilton Rise (14%), Holgate Road close to Water End (18%), Grantham Drive (12%) and Clifton (42%). This is likely due to the displacement of traffic from other parts of the network.
- For Option E without the bus gate, Leeman Road experiences an increase in traffic, likely due to the availability of a through route. There are a number of other locations which do experience an increase in traffic of greater than 10% during the AM and PM peak hours. These locations include Water End, Holgate Road east of York Road, Holgate Road east of Hamilton Drive and Clifton (PM peak hour only), Holgate Road close to Water End does experience a 10% decrease in the AM peak hour and 13% decrease in the PM peak hour.

3.3 Bus Gate Impacts

The SATURN modelling indicates that the wider highway network is predicted to operate better without the bus gate on Leeman Road. The predicted network delays, travel time and travel distance are less in the "Without bus gate" scenario compared to the "With bus gate" scenario. The introduction of the bus gate would result in greater re-routing of trips on the highway network as Leeman Road is closed as a through route for general traffic.

It is, however, noted, that by not introducing a bus gate, routes through the York Central site, including the diverted Leeman Road (as a result of NRM expansion), will be busier. York Central trips to / from the city centre will use the eastern access and existing local trips could use Leeman Road / the site as a cut through, as currently occurs.

3.4 Impacts on Traffic Flows within York Central

3.4.1 Leeman Road

The only connection across the existing York Central site is via Leeman Road which can be accessed from Salisbury Road and Kingsland Terrace to the north-west and Station Road/Station Rise to the east. The Do-Minimum traffic flow on Leeman Road (west of Cinder Lane) is as follows:

- 695 vehicles (two-way) in the AM peak hour; and
- 828 vehicles (two-way) in the PM peak hour.

This would comprise traffic accessing the NRM, station car parking and station operational facilities on Cinder Lane and through traffic.

In all development scenarios, traffic would not be permitted to use Leeman road on its current alignment. However, there would still be route through the site available from Kingsland Terrance and the western extent of Leeman Road. Both access options (A and E) would therefore provide a second route through the site. The provision of the bus gate on Leeman Road would affect whether a through route for traffic is available or not.

3.4.2 Traffic within York Central

The level of traffic travelling to, from and through the development for access Options A and E has been considered. This accounts for the traffic associated with the residential and employment zones of the development (i.e. York Central trips), which is provided as a percentage of the overall total traffic. The analysis considers traffic at the following points:

- Access Option A – within the development west of Cinder Lane and east of the point where traffic from Kingsland Terrace/Leeman Road will join the main development route; and

- Access Option E - within the development west of Cinder Lane and east of the point where traffic from Kingsland Terrace/Leeman Road will join the main development route along with traffic entering the site from Chancery Rise.

The results of this analysis for Access Option A are shown in Table 14. The Do-Minimum traffic flows on Leeman Road have been provided for comparison.

Table 14: Access Option A – Two-way Traffic within York Central

Scenario	Total Traffic		York Central Traffic		% York Central Traffic		% Non-York Central Traffic	
	AM	PM	AM	PM	AM	PM	AM	PM
Do-Minimum	695	828	0	0	0%	0%	100%	100%
May 2017 Development Scenario								
With bus gate	561	642	384	395	69%	62%	31%	38%
Without bus gate	876	881	374	455	43%	52%	57%	48%
August 2017 Development Scenario								
With bus gate	718	804	548	558	76%	69%	24%	31%
Without bus gate	954	937	537	519	56%	55%	44%	45%

This shows that the level of traffic within the York Central site would be greater than the Do-Minimum Traffic flows on Leeman Road for all but one scenario. In general, the "without bus gate" flows through the site are higher than the "with bus gate" flows, and that these flows also account for an overall lower proportion of the total traffic. Given that the trips to/from non-York Central uses (such as the station car parks) would not change between the "with" and "without bus gate" scenarios, this shows that, for the "without bus gate" scenarios, there is an increase in through traffic using the York Central site.

The results of this analysis for Access Option E are shown in Table 15. The Do-Minimum traffic flows on Leeman Road have been provided for comparison.

Table 15: Access Option E – Two-way Traffic within York Central

Scenario	Total Traffic		York Central Traffic		% York Central Traffic		% Non-York Central Traffic	
	AM	PM	AM	PM	AM	PM	AM	PM
Do-Minimum	695	828	0	0	0%	0%	100%	100%
May 2017 Development Scenario								
With bus gate	774	780	347	403	45%	52%	55%	48%
Without bus gate	1,045	1,036	384	435	37%	42%	63%	58%
August 2017 Development Scenario								
With bus gate	903	801	525	429	58%	53%	42%	47%
Without bus gate	1,209	1,037	592	451	49%	43%	51%	57%

This shows that the level of traffic within the York Central site would be greater than the Do-Minimum Traffic flows on Leeman Road for all scenarios. The

"without bus" gate flows through the site are higher than the "with bus gate" flows, with these flows also accounting for an overall lower proportion of the total traffic. This shows that, for the "without bus gate" scenario, there is an increase in through traffic using the York Central site.

It is noted that the level of traffic travelling through the York Central site is greater for Option E, compared to Option A

3.4.3 Cinder Lane

The traffic flows within the York Central Development will vary depending on the access option and whether a bus gate is implemented on Leeman Road or not. As such, consideration as been given to the levels of traffic that would be experienced on Cinder Lane for all scenarios. The traffic flows on Cinder Lane for Option A and Option E are provided in Table 16 and Table 17. The Do-Minimum traffic flows have also been provided in Table 16 and Table 17. The traffic flows on Cinder Lane vary from those presented in Section 3.4.2 due as not all of the York Central traffic will use Cinder Lane (e.g, some trips will start/terminate before reaching Cinder Lane).

Table 16: Option A - Traffic Flows on Cinder Lane

Development Scenario	Highway arrangement	Traffic Flows on Cinder Lane (PCU / hour – two way flow)	
		AM Peak Hour	PM Peak Hour
Do-Minimum	Existing	81	114
May 2017 Development Scenario	With bus gate	239	313
	Without bus gate	862	819
August 2017 Development Scenario	With bus gate	240	313
	Without bus gate	941	875

Table 17: Option E - Traffic Flows on Cinder Lane

Development Scenario	Highway arrangement	Traffic Flows on Cinder Lane (PCU / hour – two way flow)	
		AM Peak Hour	PM Peak Hour
Do-Minimum	Existing	81	114
May 2017 Development Scenario	With bus gate	286	349
	Without bus gate	884	885
August 2017 Development Scenario	With bus gate	288	350
	Without bus gate	934	901

The analysis shows that the level of traffic using Cinder Lane would increase for both Options A and Option E with and without the bus gate, with much more significant increases for the without bus gate scenarios, as would be expected. Approximately 900 vehicle movements an hour equates to approximately one

vehicle every four seconds (one every eight seconds in each direction), meaning that Cinder Lane would feel urban and create a severance across the proposed square.

In the Do-Minimum scenario, the traffic flows on Cinder Lane are primarily vehicular traffic accessing the car park and National Railway Museum. In the without bus gate scenarios, traffic from the proposed York Central access roads (both Options A and E) will be able to travel along this link resulting in an increase.

The use of a bus gate significantly reduces the numbers of vehicles within the York Central development. The lower traffic flows generated by a bus gate would enable a more “shared space” approach to be adopted.

In general, Option E experiences a higher level of traffic flow on Cinder Lane when compared with Option A. This applies to the with and without the bus gate scenarios. However, with the exception of one scenarios (May 2017 Development Scenario without bus gate), the differences in the vehicle flows are less than 50 PCU/hr.

Details on the increases in the traffic flows are provided in Appendix C.

4 Junction Performance

4.1 Introduction

The impact at junctions on the local and wider highway network has been reviewed based on the following criteria extracted from the CYC SATURN model:

- Criteria 1: Increase in flow greater than 50 PCU per hour; and
- Criteria 2: V/C greater than 80% in DM or DS (for each option and time period).

Junctions that satisfy the above criteria are identified for further investigation. Criteria 1 was used to determine the number of junctions that would be subject to further investigation while Criteria 2 was used to determine whether any further junction modelling should be undertaken. These criteria were selected on the basis that if the V/C was less than 80%, the junction performance would be acceptable.

It should be noted that the junction performance assessment has been undertaken for the August 2017 Development Scenario only on the basis that the outcome of the modelling would be a busiest-case scenario. However, this has been undertaken for both Options A and E for the with and without bus gate scenario. Based on the outcome of the assessment presented in the following sections, no further mitigation would be required for the August 2017 Development Scenario and therefore this would also apply to the lower development quantum.

The analysis in this section will enable a comparison between the Option A and Option E with and without bus gate scenarios to be drawn. The analysis will also compare with the 2016 *Stage 1 Transport Appraisal* to determine whether any further mitigation, on top of that identified as part of the *Stage 1 Transport Appraisal*, is required.

4.2 Considered Junctions

Following consideration of the increases in flows of greater than 50 PCU (Criteria 1) and differences in the junction V/C (Criteria 2), a number of junctions were considered for further investigation for the AM and PM peak hours for the Options A and E for the with and without bus gate scenarios. The total number of junctions considered for each options and scenario is set out in Table 18.

Table 18: Junctions considered for further investigation

Option	With Bus Gate		Without Bus Gate	
	AM	PM	AM	PM
Option A	20	14	17	10
Option E	17	9	9	8

Plots of the identified junctions can be found in Appendix D for each of the scenarios identified in Table 18. Upon further investigation of the outputs of the

strategic modelling, it was found that the majority of the identified links were located on the York Outer Ring Road. The results were then further interrogated to identify the percentage increase in the traffic flows at the junctions (on the approach arms which was identified as being greater than PCU per hour). The actual increases in the V/C have also been considered.

A summary of this analysis of the outer ring is presented is Table 19.

Table 19: Outer Ring Road - Further Analysis of Strategic Modelling Results

Scenario / Option	Summary of Findings
Option A without bus gate	AM peak hour - % change in traffic flows is less than 10% for all junctions. Given total traffic flow on the outer ring road, this increase is not considered significant. Where the V/C is over 80% on any approach for the Option A scenario, it is also over 80% for the Do-Minimum scenarios. One junction was identified to have a V/C of 100% for the Option A scenario. However, the V/C for the Do-Minimum was 98%. PM peak hour – all junctions with the exception of one experience a flow increase of less than 10% with only small increases in the V/C where the V/C is over 80%. One junction, does, however, experience an increase in flow of 12% with a corresponding increase in V/C of 9% to 81%. Given that the Option A V/C is just greater than 80%, no has further assessment been considered.
Option A with bus gate	AM peak hour - % change in traffic flows is less than 10% for all junctions. Given total traffic flow on the outer ring road, this increase is not considered significant. Where the V/C is over 80% on any approach for the Option A scenario, it is also over 80% for the Do-Minimum scenario. PM peak hour – all junctions with the exception of one experience a change in flow of less than 10% with only small increases in the V/C where the V/C is over 80%. One junction, does, however, experience an increase in flow of 15% with a corresponding increase in V/C of 10% to 83%. Given that the Option A V/C is just greater than 80%, no has further assessment been considered.
Option E without bus gate	AM peak hour - % change in traffic flows is less than 10% for all junctions. Given total traffic flow on the outer ring road, this increase is not considered significant. Where the V/C is over 80% on any approach for the Option E scenario, it is also over 80% for the Do-Minimum scenario. PM peak hour – all junctions with the exception of one experience a change in flow of less than 10% with only small increases in the V/C where the V/C is over 80%. One junction, does, however, experience an increase in flow of 14% with a corresponding increase in V/C of 10% to 82%. Given that the Option A V/C is just greater than 80%, no has further assessment been considered.
Option E with bus gate	AM peak hour - % change in traffic flows is less than 10% for all junctions. Given total traffic flow on the outer ring road, this increase is not considered significant. Where the V/C is over 80% on any approach for the Option E scenario, it is also over 80% for the Do-Minimum scenario. PM peak hour – all junctions with the exception of one experience a change in flow of less than 10% with only small increases in the V/C where the V/C is over 80%. One junction, does, however, experience an increase in flow of 14% with a corresponding increase in V/C of 10% to 83%. Given that the Option A V/C is just greater than 80%, no has further assessment been considered.

As a result of the analysis of the outer ring road junctions outlined in Table 19, no further assessment of the outer ring road junctions has been considered at this stage.

Two junctions which are located within the outer ring road has been identified to experience a flow increase of over 50 PCU and have a V/C of greater than 80% in at least one scenarios. These junctions are:

- A19 Bootham with A1036 St. Leonard's Place and Gillygate (Node 1034 as identified in the plans in Appendix D); and
- B1363 Wigginton Road with Crichton Avenue (Node 1010 as identified in the plans in Appendix D).

These junctions have been subject to further assessment as described in Section 4.3.

4.3 Further Junction Modelling

4.3.1 Junctions Assessed

As well as the two junctions identified for further assessment in Section 4.2, 12 further junctions have been assessed to understand the level of impact. The 12 junctions assessed were included in the 2016 *Stage 1 Transport Appraisal*. These junctions were assessed as part of the *Stage 1 Transport Appraisal* at the request of CYC. All junctions assess are detailed in Table 20.

Table 20: Summary of Junctions Modelled by Arup

Ref. No.	Location	Type
1	A59 Holgate Road/Acomb Road/Poppleton Road (The Fox Junction)	Traffic Signals
2	Water End/A59 Boroughbridge Road	Traffic Signals
3	Water End/Salisbury Road	Traffic Signals
4	Clifton/Water End/Water Lane	Traffic Signals
5	A59 Holgate Road/Hamilton Drive	Priority Junction
6	A1036 The Mount/Dalton Terrace/Albermarle Road	Traffic Signals
7	A1036 The Mount/Scarcroft Road	Traffic Signals
8	A59 Holgate Road/Blossom Street	Traffic Signals
9	A1036 Blossom Street/Queen Street/Nunnery Lane	Traffic Signals
10	A1036 Bishopthorpe Road/Scarcroft Road	Traffic Signals
11	Tadcaster Road/St Helen's Road	Traffic Signals
12	A59 Holgate Road/Dalton Terrace	Priority Junction
13	B1363 Wigginton Road/Crichton Avenue	Traffic Signals
14	A19 Bootham/A1036 St. Leonard's Place/Gillygate	Traffic Signals

4.3.2 Junction Modelling Methodology

Where a junction is under traffic signal control, 'LinSig' software has been used. LinSig is used to indicate the performance of a signalised junction under a given set of traffic flows. The software calculates the Degree of Saturation (DoS), expressed as a percentage, for each approach to a junction. Approaches where the degree of saturation is forecast to exceed 90% are considered over-capacity. Alongside this the mean maximum queue (MMQ), is calculated, to represent the average position of the furthest vehicle from the stop line in each cycle. All junctions with are under traffic signal control, as identified in Table 20, have been modelled using LinSig.

Where a junction is priority (give-way) control or is a roundabout, 'Junctions 9' software has been used. Junction 9 is used to indicate the performance priority junctions and roundabouts junction under a given set of traffic flows. The software calculates the Ratio of Flow to Capacity (RFC) expressed as a percentage, for each approach to a junction. Approaches where the degree of saturation is forecast to exceed 85% are considered over-capacity. Alongside this, the MMQ, is calculated, to represent the average position of the furthest vehicle from the stop line in each cycle. All junctions with are under priority control, as identified in Table 20, have been modelled using LinSig.

4.3.3 Modelling Inputs

To enable junction assessments to be undertaken, CYC has provided the following information:

- SATURN modelling demand traffic flows;

- Traffic signal timing information as included in the models used for the Stage 1 Transport Appraisal, where the junctions were previously modelled;
- Signal staging and arrangements for the two additional junctions considered as part of this assessment; and
- Measurements from Google Earth to inform estimates of saturation flows (lane widths) and intergreens for the signalled junctions.

4.4 Junction Modelling Results

Findings from the junction modelling for each scenario are presented in the following sections. For each scenario, the results present the spare junction capacity for the assessed scenarios (i.e. the with and without bus gate scenarios for access Options A and E) as well as the average delay (seconds per PCU) for these scenarios. The spare capacity provides an indication of the ability of the junction cope with the additional traffic with a higher percentage spare capacity indicating a greater ability of a junction to do so. A junction would be at capacity at 0% and over capacity with a negative percentage.

The Do-Minimum[6] average delay is also provided to show the change in delay resulting from the York Central development. For signalised junctions, the average delay is calculated based on the weighted average of the delay per PCU one each approach while for priority junctions, the average delay is the highest average delay on any approach to the junction. The delay percentage is the average delay for individual vehicles (in seconds).

4.4.1 Option A – with bus gate

A concise summary Option A with bus gate junction modelling results are presented in Table 21.

Table 21: Option A with Bus Gate Modelling Results

Ref. No.	Junction	2031 'Spare' Capacity		Average Delay (seconds/PCU) – Do Something		Average Delay (seconds/PCU) – Do Minimum	
		AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
1	A59 Holgate Road/Acomb Road/Poppleton Road	50%	62%	23s	20s	23s	7s
2	Water End/A59 Boroughbridge Road	18%	18%	39s	43s	35s	36s
3	Water End/Salisbury Road	16%	55%	35s	30s	33s	32s
4	Clifton/Water End/Water Lane	7%	10%	53s	50s	48s	41s

[6] The situation without any York Central development but with additional background traffic growth and growth associated with the York Local Plan development

Ref. No.	Junction	2031 'Spare' Capacity		Average Delay (seconds/PCU) – Do Something		Average Delay (seconds/PCU) – Do Minimum	
		AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
5	A59 Holgate Road/Hamilton Drive	2%	9%	33s	27s	39s	38s
6	A1036 The Mount/Dalton Terrace/Albermarle Road	42%	38%	37s	34s	34s	34s
7	A1036 The Mount/Scarcroft Road	226%	122%	16s	17s	13s	15s
8	A59 Holgate Road/Blossom Street	37%	41%	24s	24s	24s	22s
9	A1036 Blossom Street/Queen Street/Nunnery Lane	14%	7%	54s	69s	51s	63s
10	A1036 Bishopthorpe Road/Scarcroft Road	27%	39%	25s	23s	24s	28s
11	Tadcaster Road/St Helen's Road	3%	24%	40s	26s	32s	24s
12	A59 Holgate Road/Dalton Terrace	8%	7%	26s	26s	24s	37s
13	B1363 Wigginton Road/Crichton Avenue	31%	40%	31s	25s	29s	24s
14	A19 Bootham/A1036 St. Leonard's Place/Gillygate	18%	5%	48s	56s	49s	54s

For Option A with the bus gate, the results show that all junctions would operate with spare capacity for the AM and PM peak hours. Overall, the average delay at each junction does not vary significantly from the Do-Minimum scenario. No further mitigation would be required for this scenario.

4.4.2 Option A – without bus gate

A concise summary Option A without bus gate junction modelling results are presented in Table 22.

Table 22: Option A without Bus Gate Modelling Results

Ref. No.	Junction	2031 Do Something 'Spare' Capacity		Average Delay (seconds/PCU) – Do Something		Average Delay (seconds/PCU) – Do Minimum	
		AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
1	A59 Holgate Road/Acomb Road/Poppleton Road	74%	15%	23s	19s	23s	7s
2	Water End/A59 Boroughbridge Road	30%	33%	38s	39s	35s	36s

Ref. No.	Junction	2031 Do Something 'Spare' Capacity		Average Delay (seconds/PCU) – Do Something		Average Delay (seconds/PCU) – Do Minimum	
		AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
3	Water End/Salisbury Road	60%	90%	30s	27s	33s	32s
4	Clifton/Water End/Water Lane	12%	20%	49s	45s	48s	41s
5	A59 Holgate Road/Hamilton Drive	-2%	2%	39s	33s	39s	38s
6	A1036 The Mount/Dalton Terrace/Albermarle Road	51%	34%	37s	35s	34s	34s
7	A1036 The Mount/Scarcroft Road	204%	111%	16s	17s	13s	15s
8	A59 Holgate Road/Blossom Street	37%	42%	23s	22s	24s	22s
9	A1036 Blossom Street/Queen Street/Nunnery Lane	20%	13%	51s	66s	51s	63s
10	A1036 Bishopthorpe Road/Scarcroft Road	20%	35%	27s	23s	24s	28s
11	Tadcaster Road/St Helen's Road	12%	29%	34s	25s	32s	24s
12	A59 Holgate Road/Dalton Terrace	5%	24%	28s	18s	24s	37s
13	B1363 Wigginton Road/Crichton Avenue	34%	43%	30s	25s	29s	24s
14	A19 Bootham/A1036 St. Leonard's Place/Gillygate	18%	5%	49s	57s	49s	54s

For Option A without the bus gate, the results show that all junctions with the exception of A59 Holgate Road/Hamilton Drive would operate with spare capacity for the AM and PM peak hours. At the junction of A59 Holgate Road/Hamilton Drive, the spare capacity has been identified as -2% for the AM peak hour. However, the highest RFC at the junction is 72% with a MMQ of two PCU. In terms of the average delay, overall there is little change to the average delay is similar to the Do-Minimum scenario for all junctions. The potential for mitigation is considered further in Section 4.4.5.

Compared with Option A with the bus gate, there is, in general, a greater level of space capacity available at the assessed junctions.

4.4.3 Option E – with bus gate

A concise summary Option E with bus gate junction modelling results are presented in.

Table 23: Option E with Bus Gate Modelling Results

Ref. No.	Junction	2031 Do Something 'Spare' Capacity		Average Delay (seconds/PCU) – Do Something		Average Delay (seconds/PCU) – Do Minimum	
		AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
1	A59 Holgate Road/Acomb Road/Poppleton Road	83%	100%	22s	18s	23s	7s
2	Water End/A59 Boroughbridge Road	40%	53%	35s	36s	35s	36s
3	Water End/Salisbury Road	19%	40%	34s	33s	33s	32s
4	Clifton/Water End/Water Lane	5%	10%	54s	50s	48s	41s
5	A59 Holgate Road/Hamilton Drive	-8%	15%	53s	24s	39s	38s
6	A1036 The Mount/Dalton Terrace/Albermarle Road	39%	33%	39s	39s	34s	34s
7	A1036 The Mount/Scarcroft Road	225%	128%	15s	17s	13s	15s
8	A59 Holgate Road/Blossom Street	37%	40%	24s	24s	24s	22s
9	A1036 Blossom Street/Queen Street/Nunnery Lane	14%	14%	54s	66s	51s	63s
10	A1036 Bishopthorpe Road/Scarcroft Road	27%	31%	26s	24s	24s	28s
11	Tadcaster Road/St Helen's Road	-3%	11%	47s	31s	32s	24s
12	A59 Holgate Road/Dalton Terrace	-15%	7%	359s	26s	24s	37s
13	B1363 Wigginton Road/Crichton Avenue	31%	41%	31s	25s	29s	24s
14	A19 Bootham/A1036 St. Leonard's Place/Gillygate	19%	4%	48s	57s	49s	54s

For Option E with the bus gate, the results show that all except three junctions operate with spare capacity for the AM and PM peak hours. Potential issues have been highlighted at the following junctions:

- At the junction of A59 Holgate Road/Hamilton Drive, the spare capacity has been identified as -8% for the AM peak hour. However, the highest RFC at the junction is 58% with a MMQ of one PCU;
- At the junction of Tadcaster Road/St. Helen's Road in the AM peak hour, the spare capacity has been identified as -3% in the AM peak hour. The highest DoS recorded is 93% with a MMQ of 25 PCU; and
- At the junction of A59 Holgate Road with Dalton Terrace, the spare capacity has been identified as -15% in the AM peak hour. The highest RFC is recorded as 0.98 with a MMQ of 14 PCU.

With the exception of the junctions identified above, the overall level of delay experienced do not vary significantly from the Do-Minimum Scenario. The additional delays, where more significant, would be acceptable given the level of increases in delay overall.

The potential for mitigation at these junctions is considered further in Section 4.4.5.

4.4.4 Option E – without bus gate

A concise summary Option E without bus gate junction modelling results are presented in **Table 24**.

Table 24: Option E without Bus Gate Modelling Results

Ref. No.	Junction	2031 Do Something 'Spare' Capacity		Average Delay (seconds/PCU) – Do Something		Average Delay (seconds/PCU) – Do Minimum	
		AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
1	A59 Holgate Road/Acomb Road/Poppleton Road	88%	111%	21s	19s	23s	7s
2	Water End/A59 Boroughbridge Road	39%	56%	35s	35s	35s	36s
3	Water End/Salisbury Road	22%	36%	35s	34s	33s	32s
4	Clifton/Water End/Water Lane	5%	16%	55s	46s	48s	41s
5	A59 Holgate Road/Hamilton Drive	-16%	6%	167s	29s	39s	38s
6	A1036 The Mount/Dalton Terrace/Albermarle Road	40%	35%	38s	39s	34s	34s
7	A1036 The Mount/Scarcroft Road	200%	178%	12s	14s	13s	15s
8	A59 Holgate Road/Blossom Street	45%	72%	23s	21s	24s	22s
9	A1036 Blossom Street/Queen Street/Nunnery Lane	14%	30%	53s	63s	51s	63s
10	A1036 Bishopthorpe Road/Scarcroft Road	37%	37%	24s	24s	24s	28s
11	Tadcaster Road/St Helen's Road	6%	22%	37s	26s	32s	24s
12	A59 Holgate Road/Dalton Terrace	-9%	2%	91s	32s	24s	37s
13	B1363 Wigginton Road/Crichton Avenue	33%	45%	30s	24s	29s	24s
14	A19 Bootham/A1036 St. Leonard's Place/Gillygate	19%	4%	49s	57s	49s	54s

For Option E without the bus gate, the results show that all except two junctions operate with spare capacity for the AM and PM peak hours. Potential issues have been highlighted at the following junctions:

- At the junction of A59 Holgate Road/Hamilton Drive, the spare capacity has been identified as -16% for the AM peak hour. However, the highest RFC at the junction is 98% with a MMQ of nine PCU;
- At the junction of A59 Holgate Road with Dalton Terrace, the spare capacity has been identified as -15% in the AM peak hour. The highest RFC is recorded as 89% with a MMQ of seven PCU.

With the exception of the junctions identified above, the overall level of delay experienced do not vary significantly from the Do-Minimum Scenario. The additional delays, where more significant, would be acceptable given the level of increases in delay overall.

The potential for mitigation at these junctions is considered further in Section 4.4.5.

Compared with Option E without the bus gate, there is, in general, a greater level of space capacity available at the assessed junctions.

4.4.5 Summary of Analysis and Mitigation Considered

Table 25 outlines a summary of the analysis and whether any junction modification is required.

Table 25: Summary of Analysis and Mitigation Considered

Junction Ref. No.	Junction	Mitigation Considered
1	A59 Holgate Road/Acomb Road/Poppleton Road (The Fox)	No junction modification proposals have been progressed for the Fox junction. The results show significant spare capacity for all scenarios during the AM and PM peaks.
2	Water End/A59 Boroughbridge Road	No junction modification proposals have been progressed for the Water End/A59 Boroughbridge Road junction. The results show significant spare capacity for all scenarios during the AM and PM peaks.
3	Water End/Salisbury Road	No junction modification proposals have been progressed for Water End/Salisbury Road junction. The results show significant spare capacity for all scenarios during the AM and PM peaks.
4	Clifton/Water End/Water Lane	No junction modification proposals have been progressed for Clifton/Water End/Water Lane junction. The results show spare capacity for all scenarios during the AM and PM peaks.
5	A59 Holgate Road/Hamilton Drive	Whilst the results forecast the junction to be over capacity during the AM peak for the Option A without bus gate scenario and the Option E with and without bus gate scenarios, this capacity issue only

Junction Ref. No.	Junction	Mitigation Considered
		affects one lane of one leg of the junction and is considered to be minor in nature. Whilst the RFC is greater than 85% and the junction will not operate as efficiently for Option E with and without the bus gate, it is not fully saturated and will continue to function. Modifications to the junction are likely to be difficult due to the physical constraints at the site. On this basis, junction modifications are not proposed.
6	A1036 The Mount/Dalton Terrace/Albermarle Road	No junction modification proposals have been progressed at the A1036 The Mount/Dalton Terrace/Albermarle Road junction. The results show spare capacity for all scenarios during the AM and PM peaks.
7	A1036 The Mount/Scarcroft Road	No junction modification proposals have been progressed at the A1036 The Mount/Scarcroft Road junction. The results show significant spare capacity for all scenarios during the AM and PM peaks.
8	A59 Holgate Road/Blossom Street	No junction modification proposals have been progressed at the A59 Holgate Road/Blossom Street junction. The results show spare capacity for all scenarios during the AM and PM peaks.
9	A1036 Blossom Street/Queen Street/Nunnery Lane	No junction modification proposals have been progressed at the A1036 Blossom Street/Queen Street/Nunnery Lane junction. The results show spare capacity for all scenarios during the AM and PM peaks.
10	A1036 Bishopthorpe Road/Scarcroft Road	No junction modification proposals have been progressed at the A1036 Bishopthorpe Road/Scarcroft Road junction. The results show spare capacity for all scenarios during the AM and PM peaks.
11	Tadcaster Road/St Helen's Road	Whilst the results forecast the junction to be over capacity during the AM peak for the Option E with bus gate, this capacity issue only affects one lane of one leg of the junction and is considered to be minor in nature. Whilst the DoS is greater than 90% and the junction will not operate as efficiently for Option E with bus gate, it is not fully saturated and will continue to function. Modifications to the junction are likely to be difficult due to the physical constraints at the site. On this basis, junction modifications are not proposed.
12	A59 Holgate Road/Dalton Terrace	Whilst the results forecast the junction to be over capacity during the AM peak for the Option E with and without the bus gate, this capacity issue only affects one lane of one leg of the junction and is considered to be minor in nature.

Junction Ref. No.	Junction	Mitigation Considered
		Whilst the RFC is greater than 85% and the junction will not operate as efficiently for Option E with and without the bus gate, it is not fully saturated and will continue to function. Modifications to the junction are likely to be difficult due to the physical constraints at the site. On this basis, junction modifications are not proposed.
13	B1363 Wigginton Road/Crichton Avenue	No junction modification proposals have been progressed at the B1363 Wigginton Road/Crichton Avenue junction. The results show spare capacity for all scenarios during the AM and PM peaks.
14	A19 Bootham/A1036 St. Leonard's Place/Gillygate	No junction modification proposals have been progressed at the A19 Bootham/A1036 St. Leonard's Place/Gillygate junction. The results show spare capacity for all scenarios during the AM and PM peaks.

The modelling undertaken assumes optimised signal timings (for signalised junctions) and while physical mitigation measures have not been suggested, there may be opportunities for CYC to explore on-street optimisation of signal timings to ensure coordination between junctions (not limited to those included as part of this assessment). This could be explored as part of the microsimulation modelling which will be undertaken as part of the full Transport Assessment.

In addition, a Travel Plan will be required to support the York Central development which will seek to implement a range of measures to encourage sustainable travel. The Travel Plan will set targets to increase the mode share by walking, cycling and public transport with corresponding targets for the reduction in private vehicle trips. Other sustainable measures such as car sharing (to reduce single occupancy vehicle trips) will also be considered. A Travel Plan Framework will be prepared as part of the full Transport Assessment for the York Central scheme which will be submitted as part of the planning submission.

5 Conclusions

This report has been prepared to provide a comparison of the impacts of Leeman Road with the bus gate (closed to general traffic) and without the bus gate (open) for both access Options A (western) and E (southern). At the same time, both the May 2017 Development Scenario proposals, and a August 2017 Development Scenario, have been tested. In doing this, a strategic and local assessment has been carried out. The report also serves to identify what level of mitigation might be required.

The strategic assessment found that for both the May 2017 Development Scenario and August 2017 Development Scenarios, the predicted delay, travel time and travel distance are lower for Access Option E rather than Option A. The predicted network wide delays, travel times and travel distances are lower without the bus gate in place on Leeman Road. As expected, August 2017 Development Scenario results in greater network delay, travel time and travel distance than the May 2017 Development Scenario, as modelled in May 2017 for the Access Options Study.

The SATURN modelling indicates that the wider highway network is predicted to operate better without the bus gate on Leeman Road. The predicted network delays, travel time and travel distance are less in the without bus gate scenario than with the bus gate. However, by not introducing a bus gate, routes through the York Central site, including the diverted Leeman Road (as a result of NRM expansion), will be busier. York Central trips to / from the city centre will use the eastern access and existing local trips could use Leeman Road / the site as a cut through, as currently occurs.

Analysis of the traffic flows from the strategic model shows that general trend is that the volume of traffic is increasing across the network. There are some decreases in traffic, particularly close to the York Central site for the “with bus gate” scenarios. Reductions in traffic on outer parts of the network will occur as a result of the displacement of traffic. This is, however, less noticeable for the “without bus gate” scenarios as there is less traffic displacement due to the availability of a route through the York Central site.

This analysis shows that at a city-wide level, Access Option E generates less congestion that Access Option A. Placing a bus-gate on Leeman Road will force through traffic to use other routes and therefore the “with bus gat”e scenarios generate greater congestion than the “without bus gate” scenarios, particularly so for the August 2017 Development Scenario.

At a more local level and close to the York Central site, there is generally a decrease in the level of traffic using Leeman Road for the with bus gate scenarios with the exception of Option E for the August 2017 Development Scenario without the bus gate.

A number of roads around the site do experience increases in traffic with many in excess of 10% for both Option A and Option E. This includes Holgate Road, Clifton and Water End. These increases are likely to be as a result of the additional development traffic as well as the displacement of traffic to/from other routes. Holgate Road west of York Road does, however, experience a decrease in

traffic flows during the PM peak hour of Option E for the “without bus gate” scenario.

The impact of the development on the York outer ring road has also been considered for all scenarios. While some junctions do experience an increase in flow of greater than 50 PCU, the increase in traffic flows are typically less than 10% and where the V/C is greater than 80%, it is typically greater than 80% in the Do-Minimum scenarios also.

The local assessment has identified that majority of junctions assessed would have spare capacity for all scenarios during the AM and PM peak hours with and without the bus gate. While certain junctions, particularly the junctions of A59 Holgate/Dalton Street and A59 Holgate/Hamilton Drive East, would operate above capacity, it is only one arm of the junction in the AM peak hour of the affected scenarios that would operate with the RFC of greater than 85%. As such, the junction would continue to function. Modifications to these junctions are likely to be difficult due to the physical constraints at the site. On this basis, junction modifications are not likely to be required to these or any other junctions.

In general, with the exception of the aforementioned junctions, the overall level of delay experienced at the assessed junctions does not increase significantly when compared with the Do-Minimum for Options A and E in the “with” and “without bus gate” scenarios for the AM and PM peak hours. The additional delays, where more significant, may be acceptable given the level of increases in delay caused by background traffic increases and other developments. The implementation of the Travel Plan for the York Central site will seek to reduce the number of vehicle trips generated by the site through a series of sustainable travel measures.

The modelling shows that the development scenarios should be achievable subject to more detailed discussions with the Highways Authority as part of the preparation of a Transport Assessment to support a future Planning Application.

Appendix A

May 2017 Development Scenario Proposal Flow Difference Plots

A1 May 2017 Development Scenario with Bus Gate - Access Option A

Figure 2: Option A May 2017 Development Scenario with Bus Gate - AM Peak Hour Difference Plot

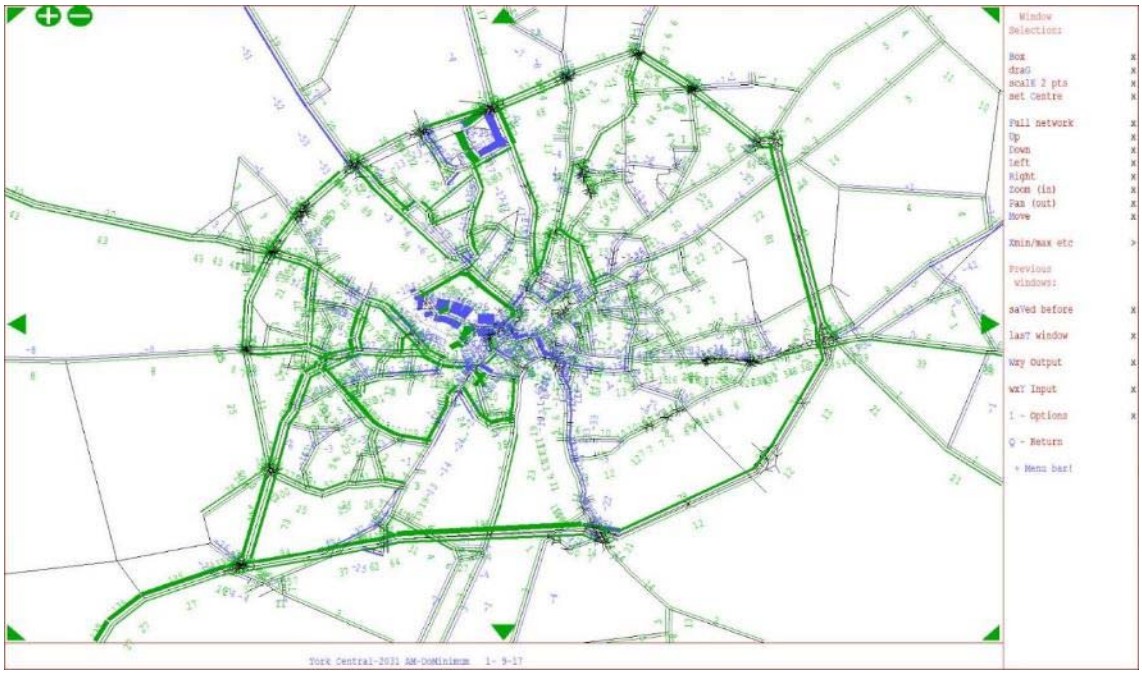


Figure 3: Option A May 2017 Development Scenario with Bus Gate - PM Peak Hour Difference Plot

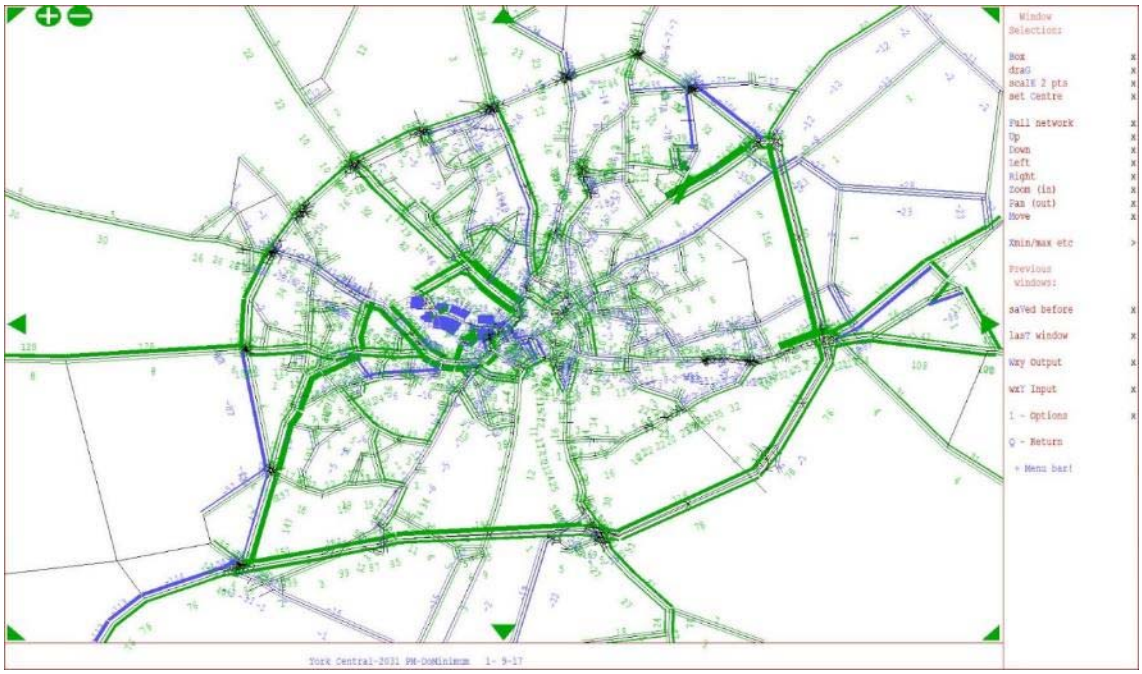


Figure 4: Option A May 2017 Development Scenario with Bus Gate - AM Peak Hour Traffic Flows

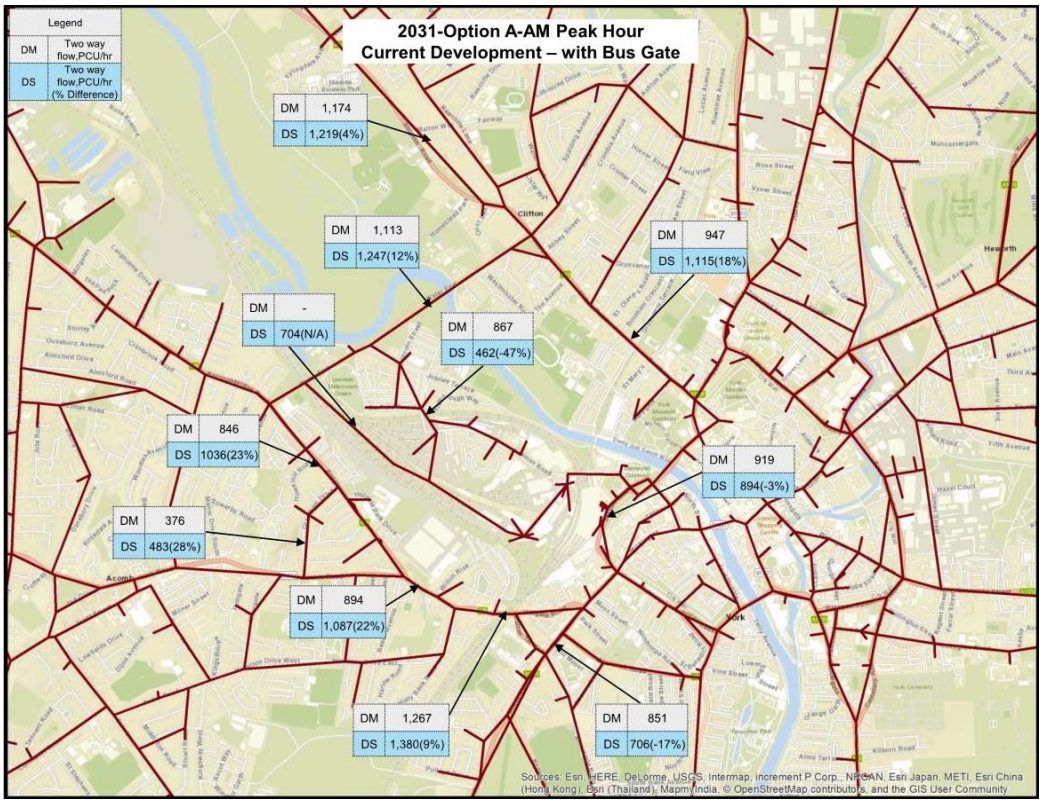
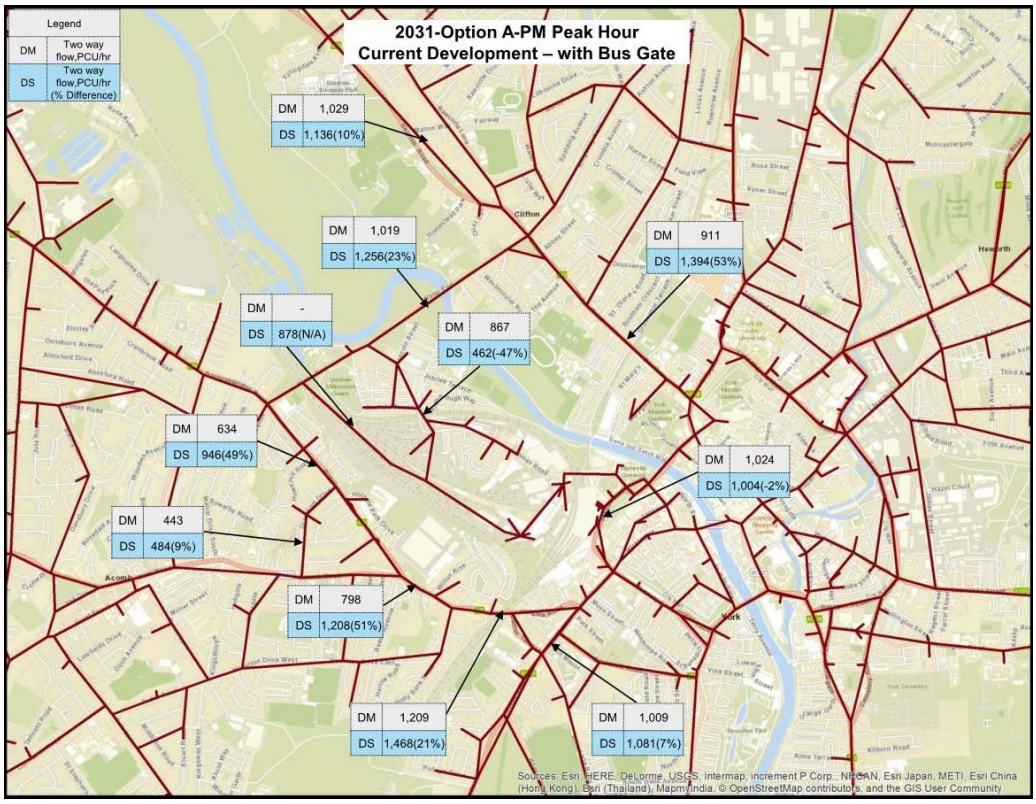


Figure 5: Option A May 2017 Development Scenario with Bus Gate - PM Peak Hour Traffic Flows



A2 May 2017 Development Scenario with Bus Gate - Access Option E

Figure 6: Option E May 2017 Development Scenario with Bus Gate - AM Peak Hour Difference Plot

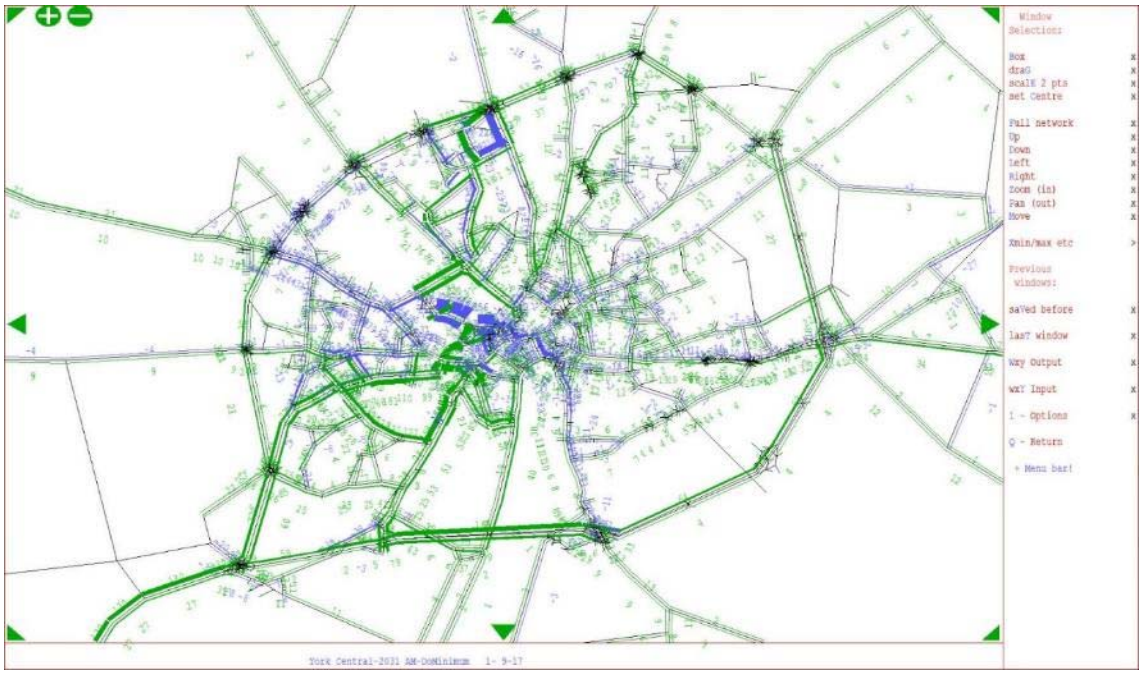


Figure 7: Option E May 2017 Development Scenario with Bus Gate - PM Peak Hour Difference Plot

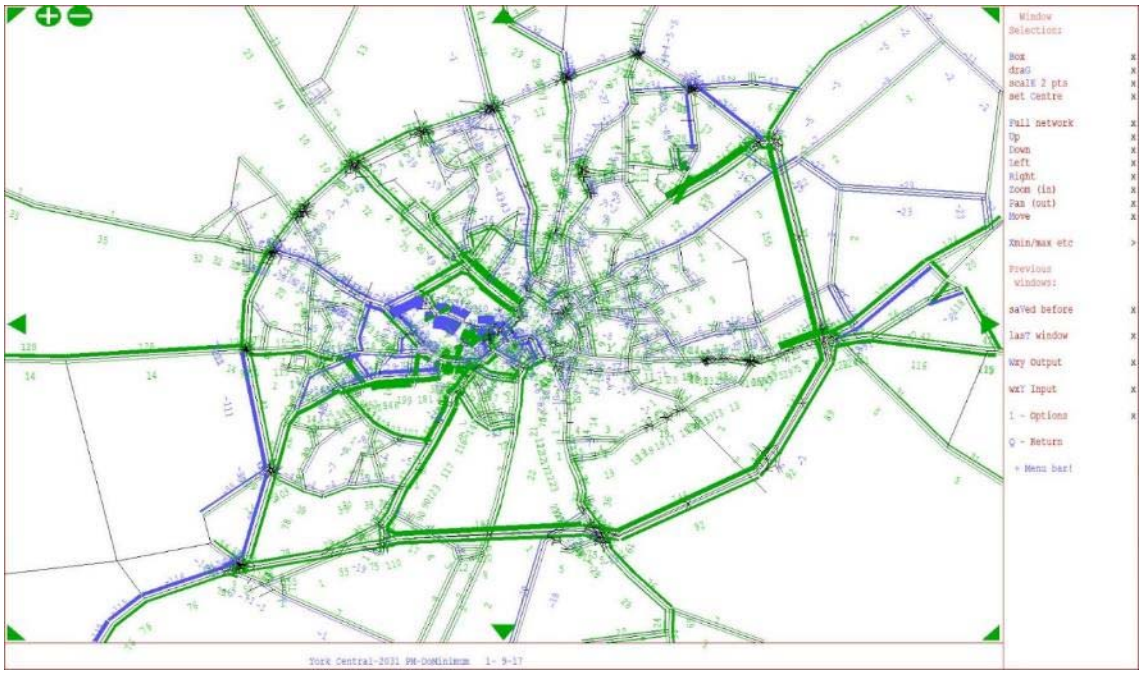


Figure 8: Option E May 2017 Development Scenario with Bus Gate - AM Peak Hour Traffic Flows

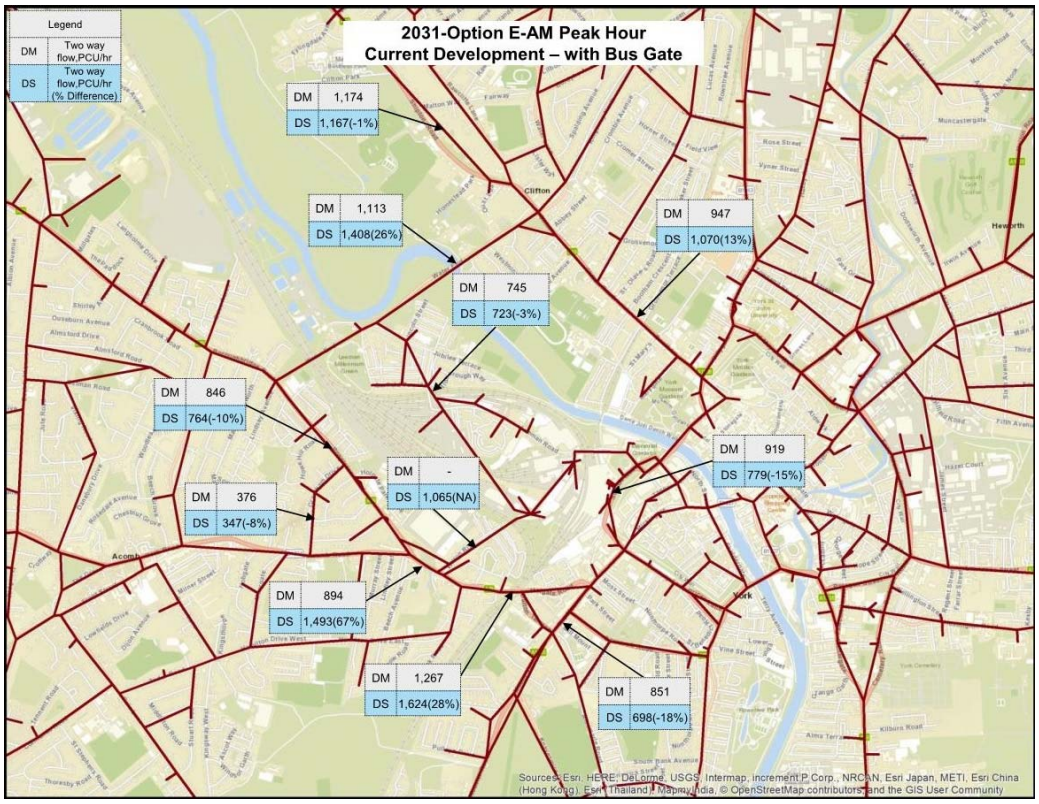
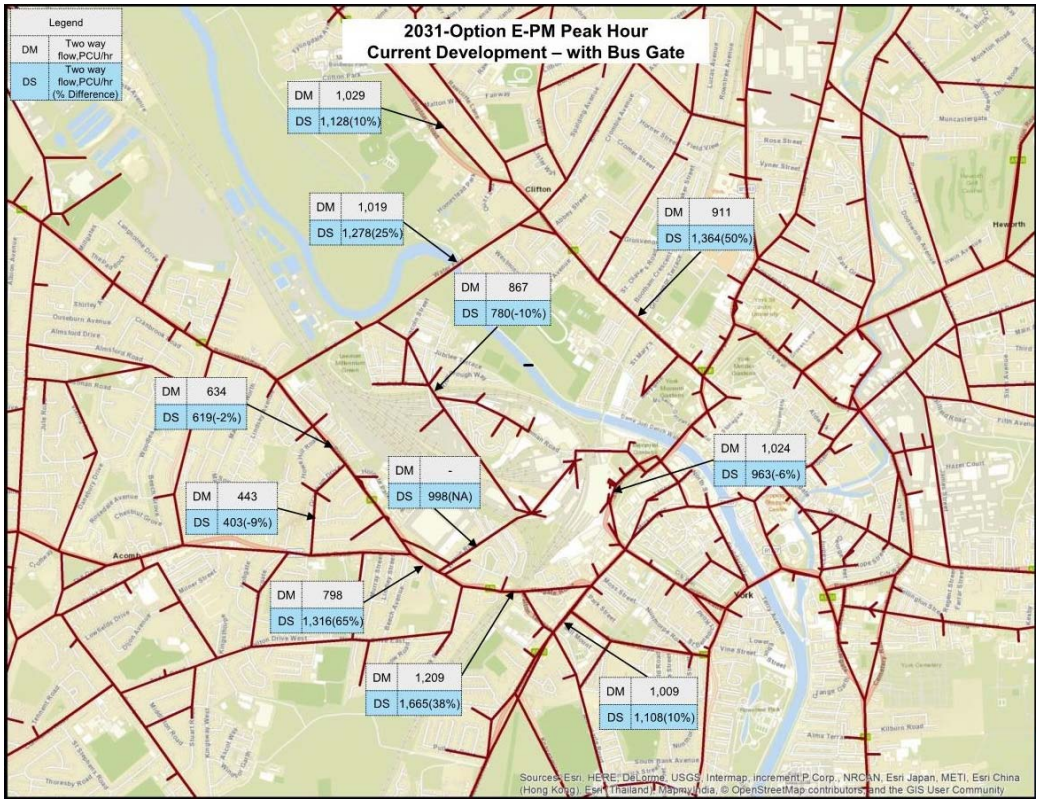


Figure 9: Option E May 2017 Development Scenario with Bus Gate - PM Peak Hour Traffic Flows



A3 May 2017 Development Scenariowithout Bus Gate - Access Option A

Figure 10: Option A May 2017 Development Scenario without Bus Gate - AM Peak Hour Difference Plot

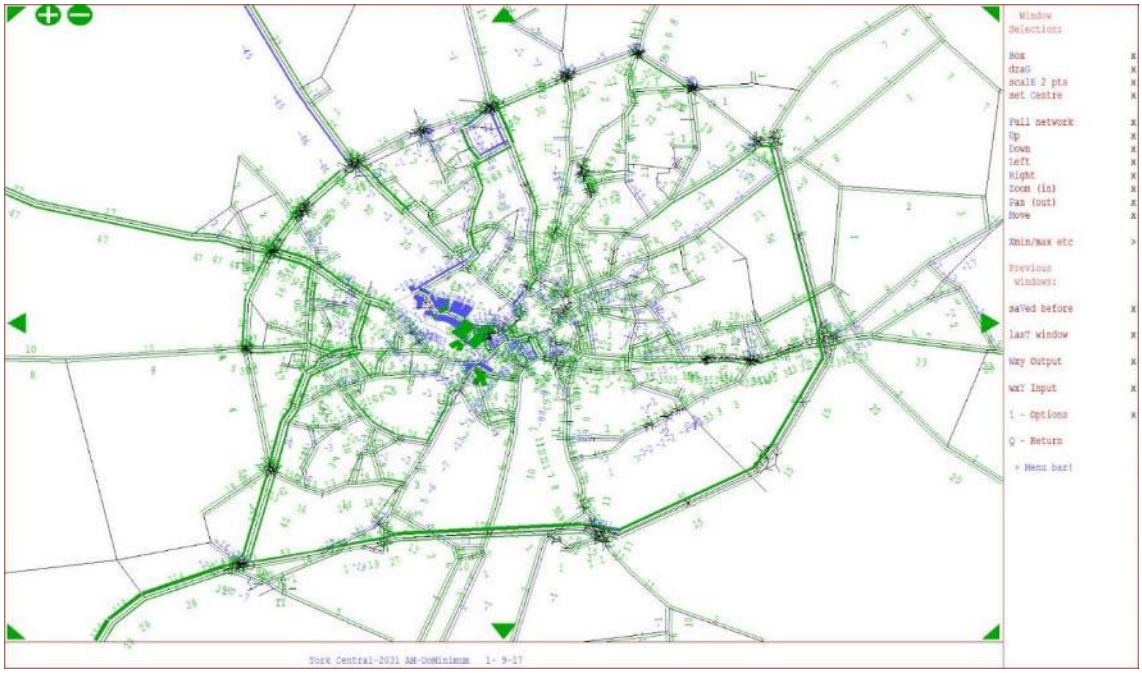


Figure 11: Option A May 2017 Development Scenario without Bus Gate - PM Peak Hour Difference Plot

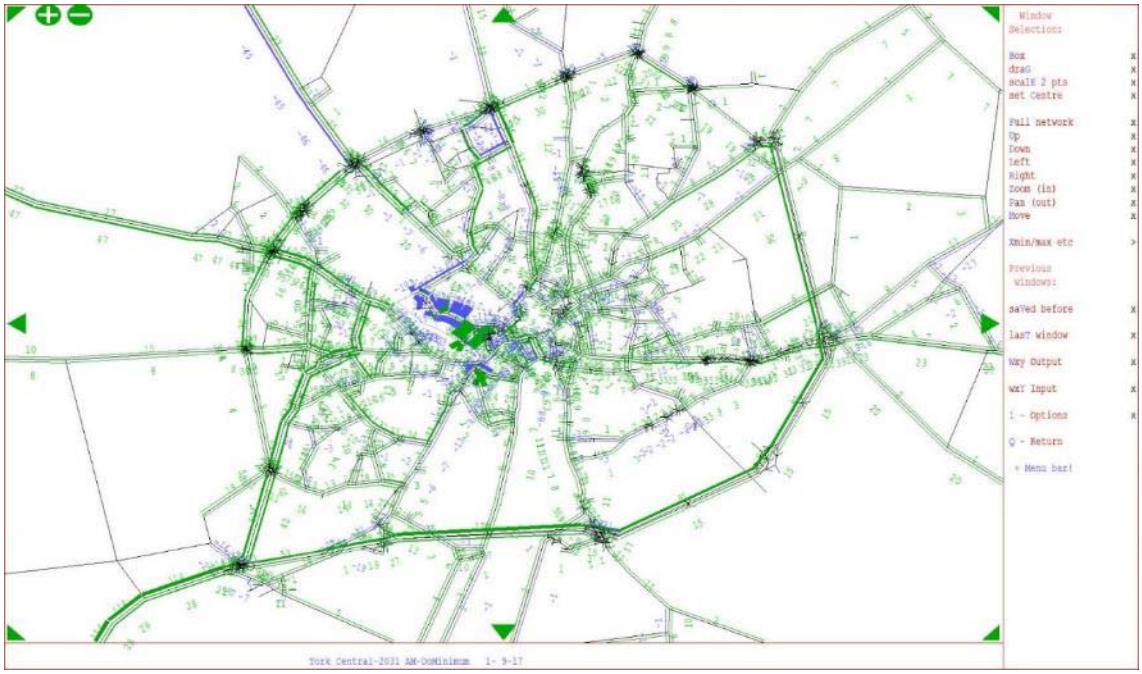


Figure 12: Option A May 2017 Development Scenario without Bus Gate - AM Peak Hour Traffic Flows

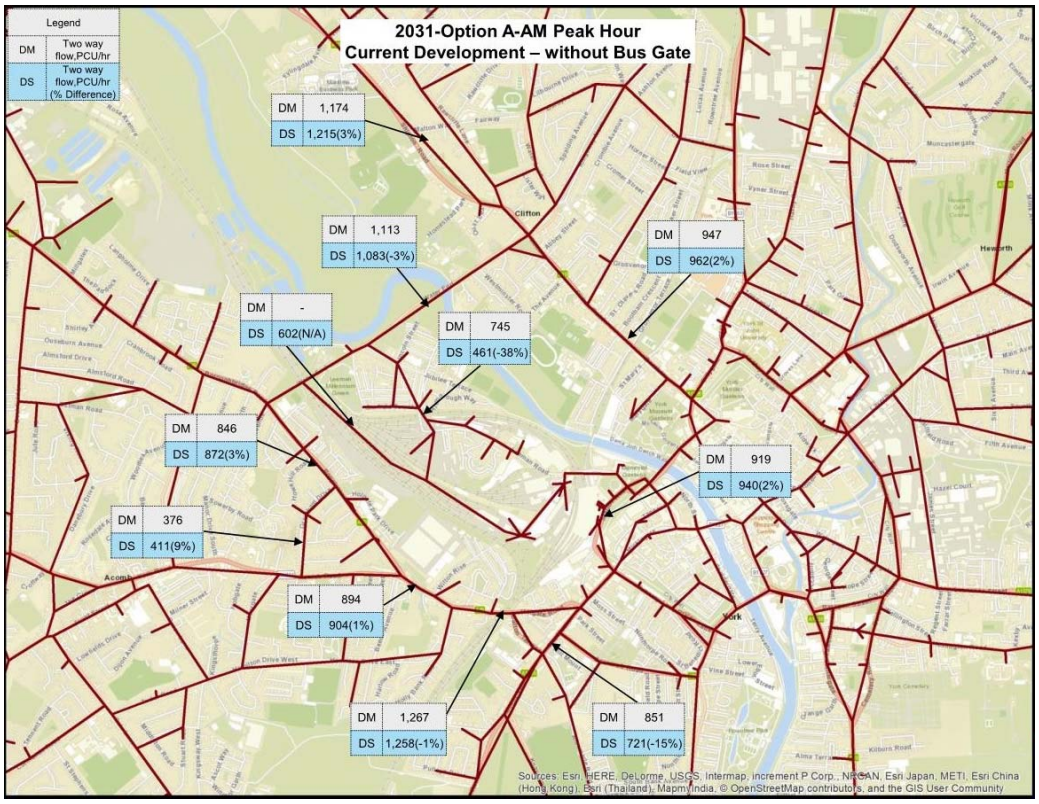
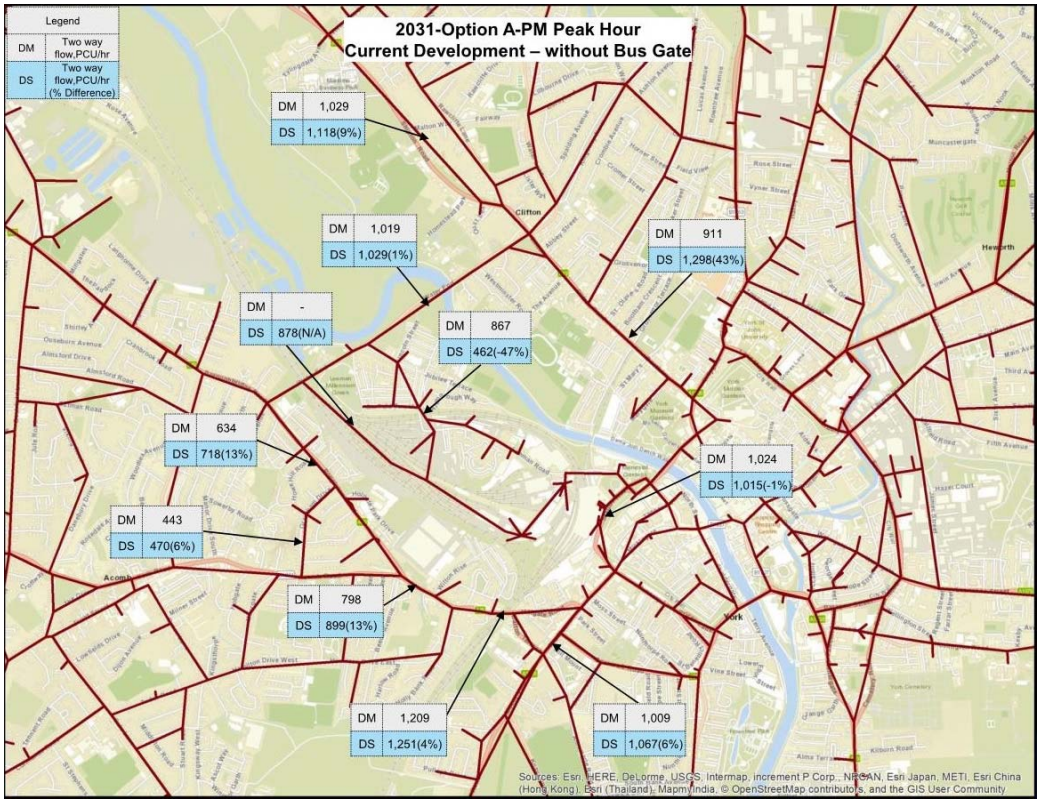


Figure 13: Option A May 2017 Development Scenario without Bus Gate - PM Peak Hour Traffic flows



A4 May 2017 Development Scenario without Bus Gate - Access Option E

Figure 14: Option E May 2017 Development Scenario without Bus Gate - AM Peak Hour Difference Plot

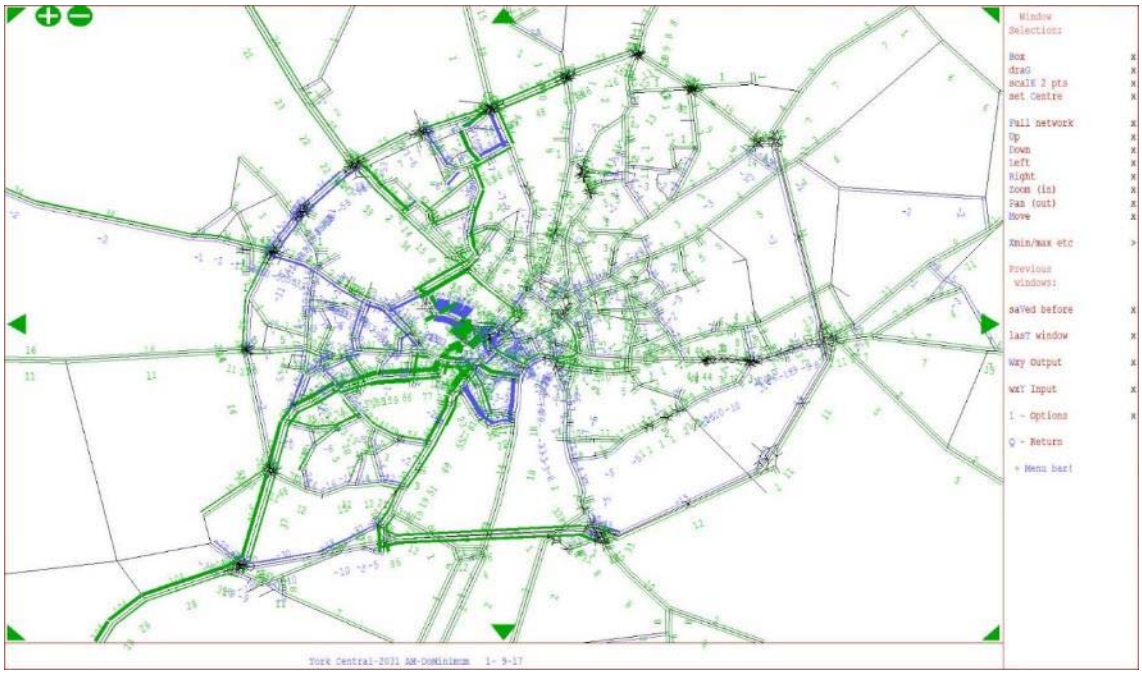


Figure 15: Option E May 2017 Development Scenario without Bus Gate - PM Peak Hour Difference Plot

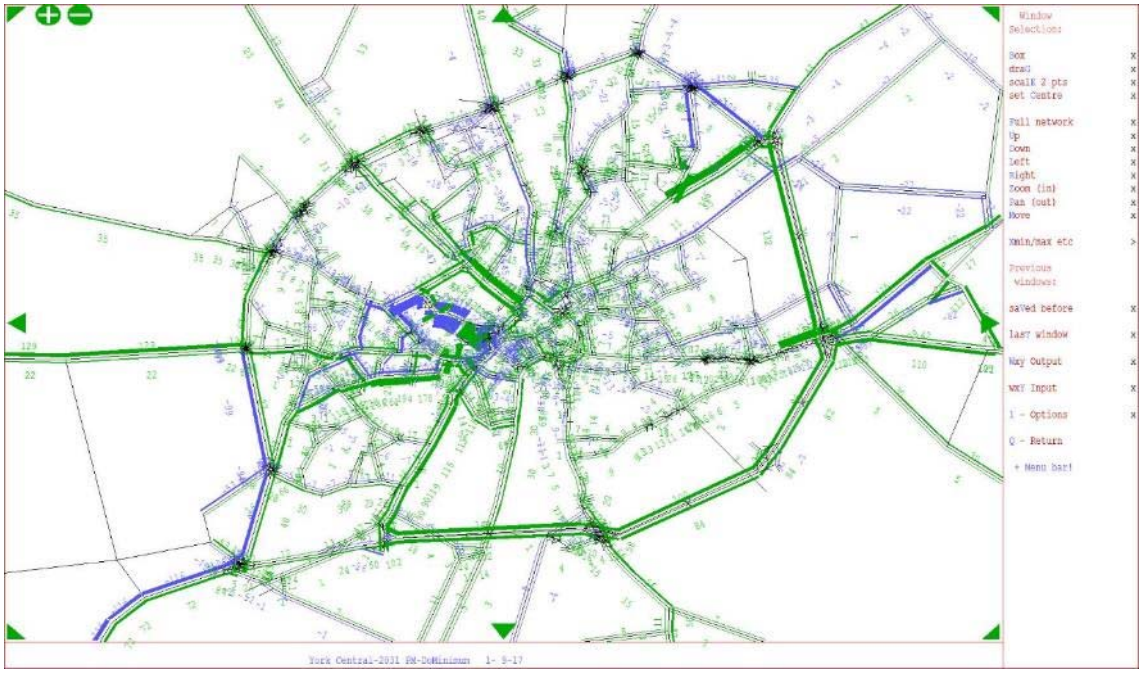


Figure 16: Option E May 2017 Development Scenario without Bus Gate - AM Peak Traffic Flows

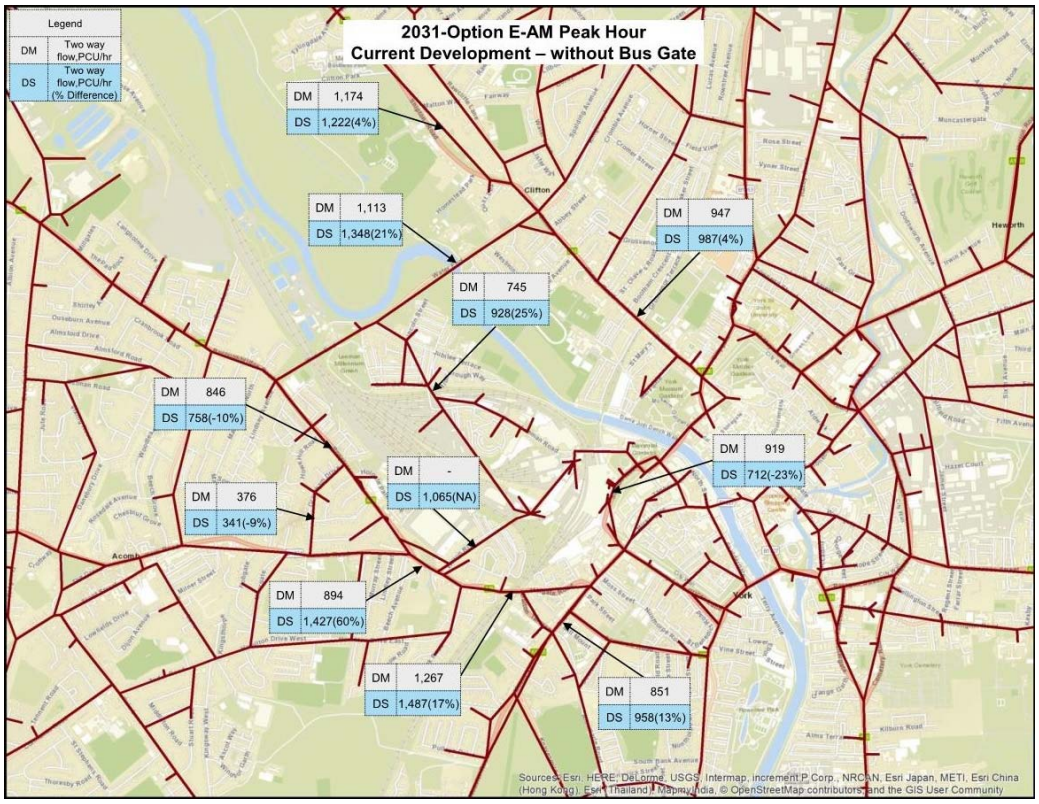
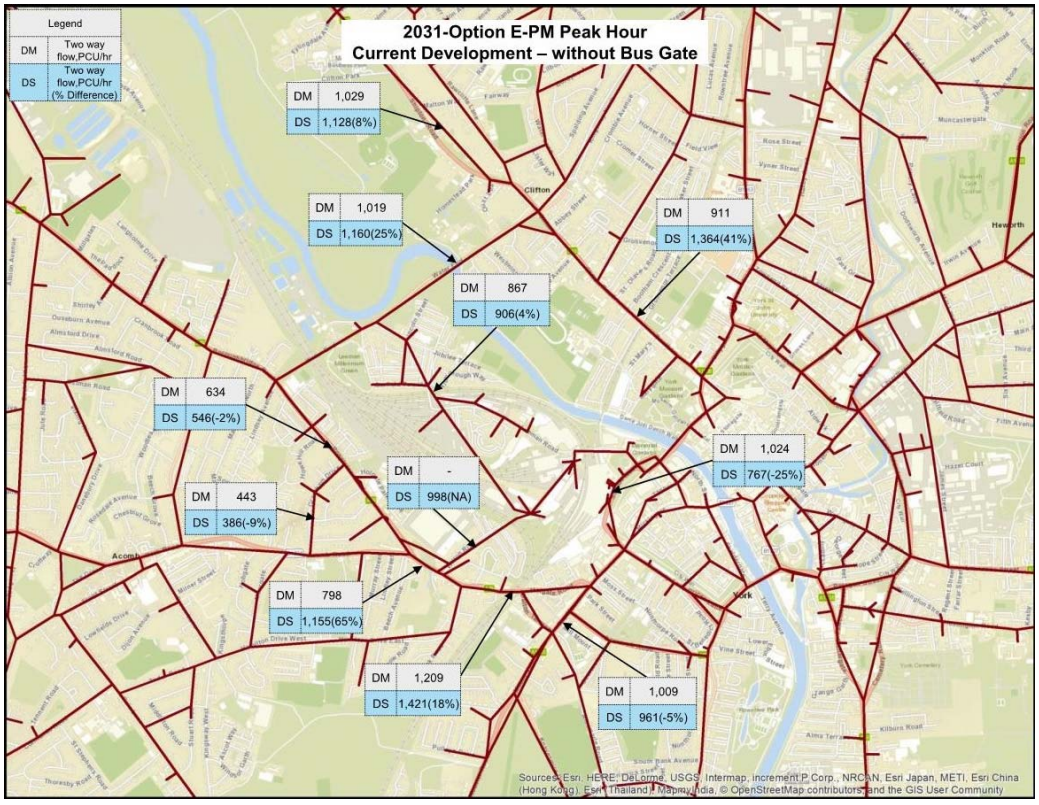


Figure 17: Option E May 2017 Development Scenario without Bus Gate - PM Peak Hour Traffic Flows



Appendix B

August 2017 Development Scenario Flow Difference Plots

B1 August 2017 Development Scenario with Bus Gate - Access Option A

Figure 18: Option A August 2017 Development Scenario with Bus Gate - AM Peak Hour Difference Plot

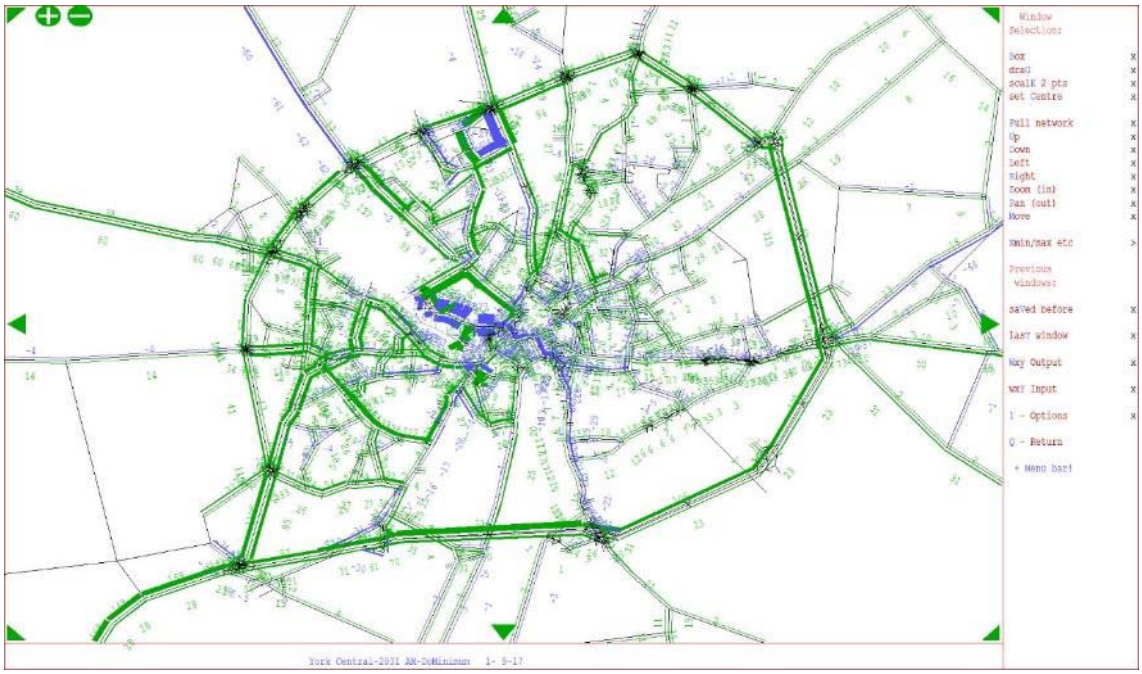


Figure 19: Option A August 2017 Development Scenario with Bus Gate - PM Peak Hour Difference Plot

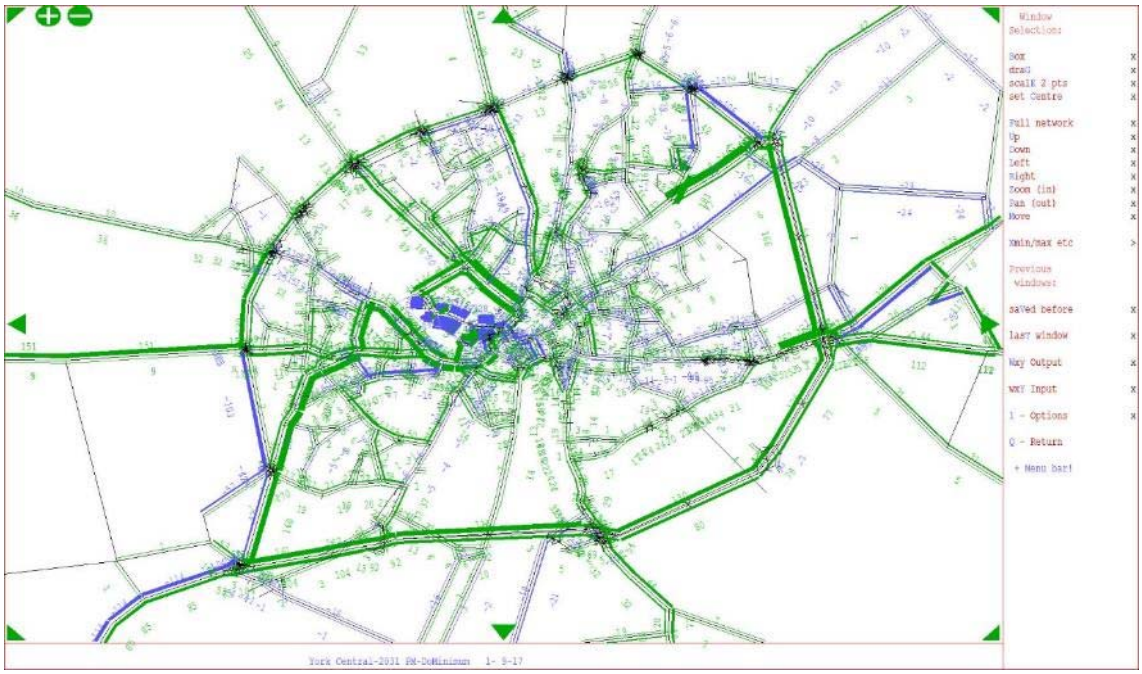


Figure 20: Option A August 2017 Development Scenario with Bus Gate - AM Peak Hour Traffic Flows

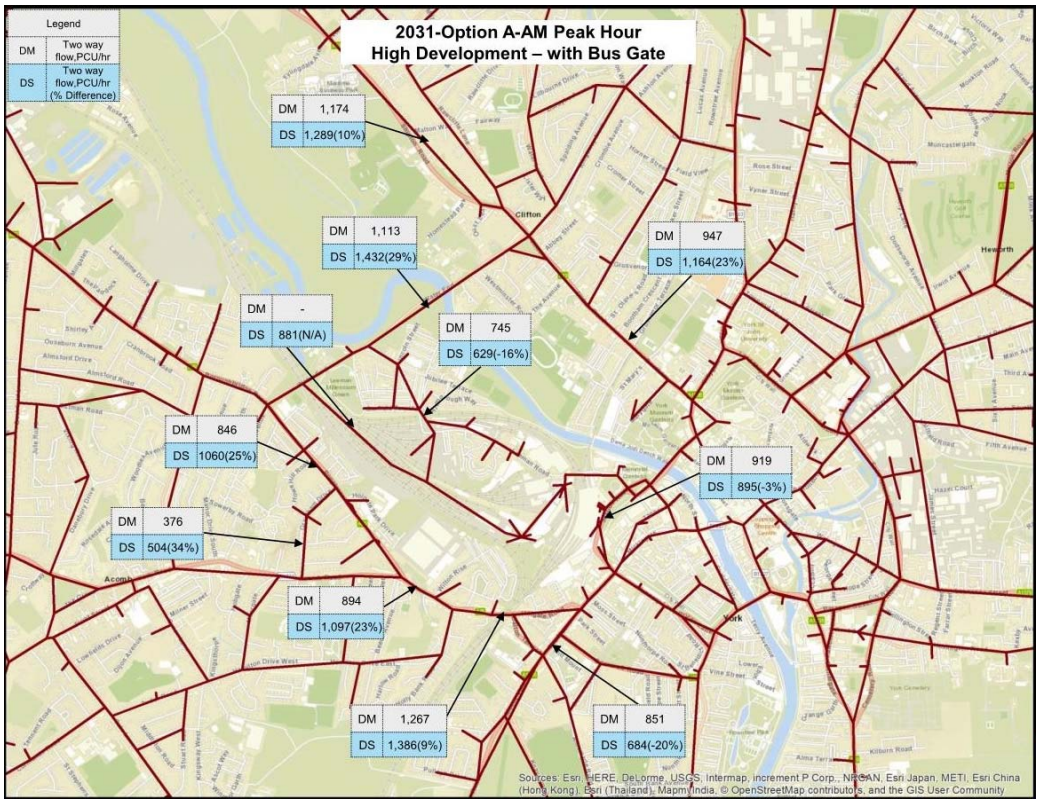
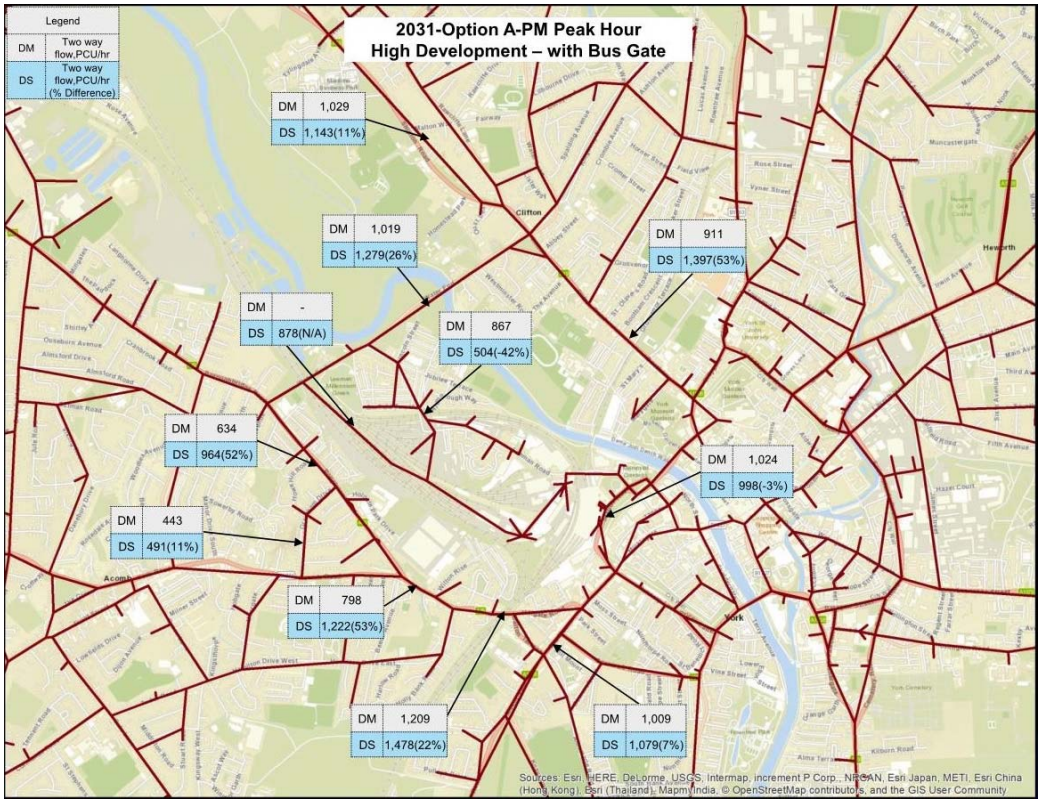


Figure 21: Option A August 2017 Development Scenario with Bus Gate - PM Peak Hour Traffic Flows



B2 August 2017 Development Scenario with Bus Gate - Access Option E

Figure 22: Option E August 2017 Development Scenario with Bus Gate - AM Peak Hour Difference Plot

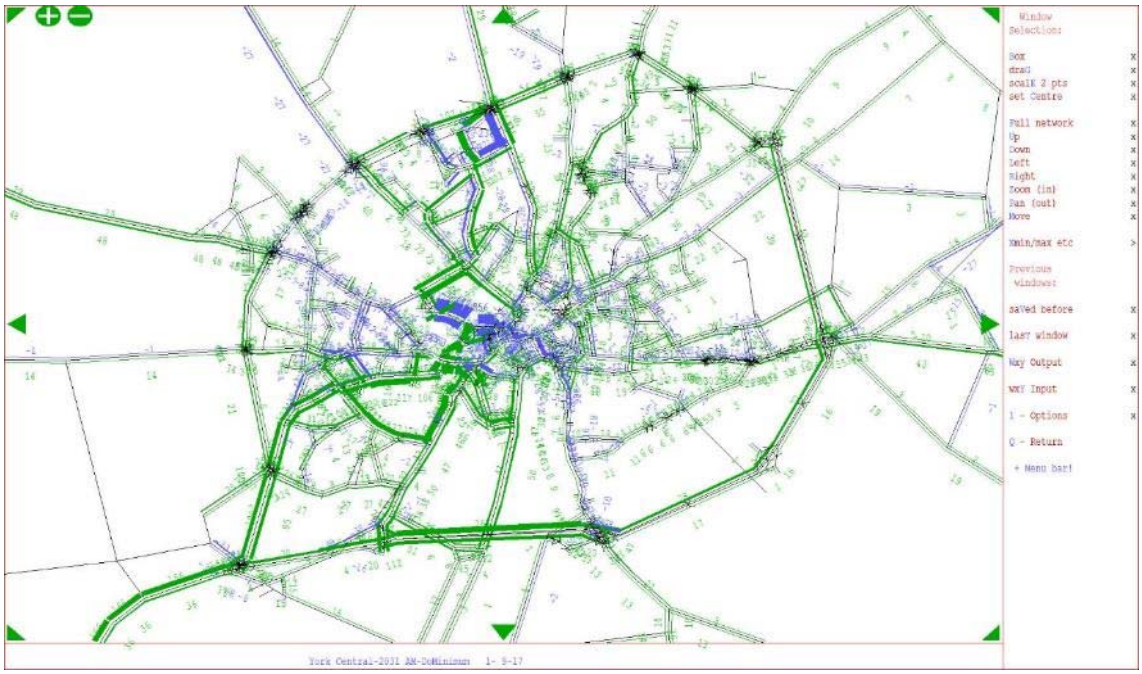


Figure 23: Option E August 2017 Development Scenario with Bus Gate - PM Peak Hour Difference Plot

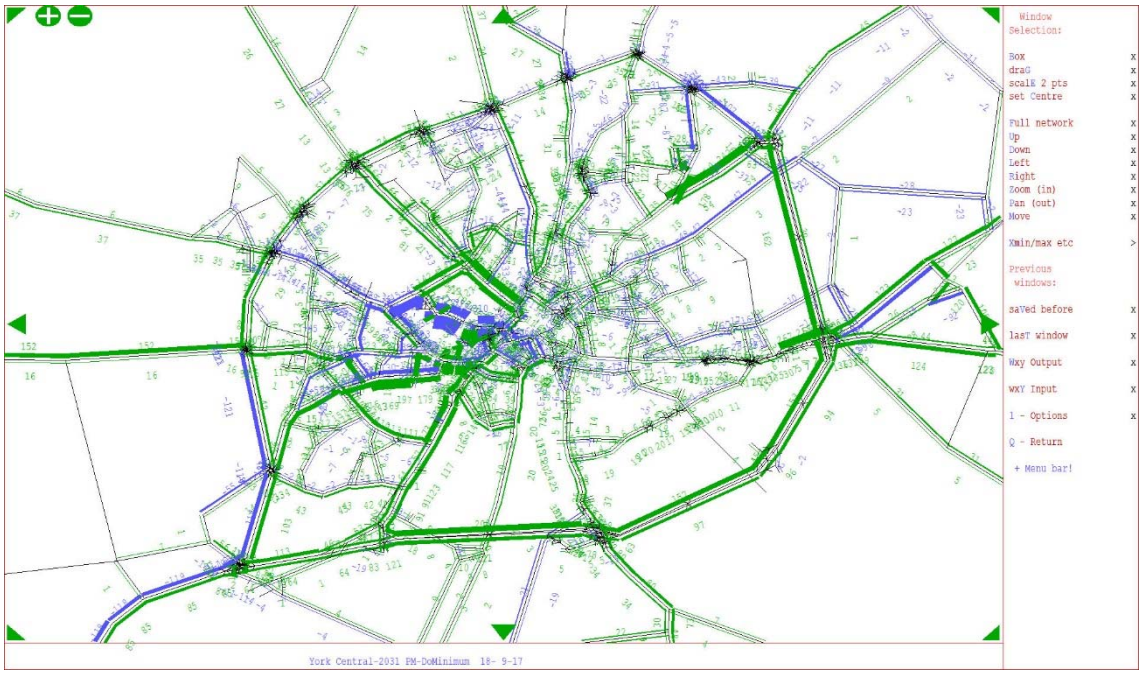


Figure 24: Option E August 2017 Development Scenario with Bus Gate - AM Peak Hour Traffic Flows

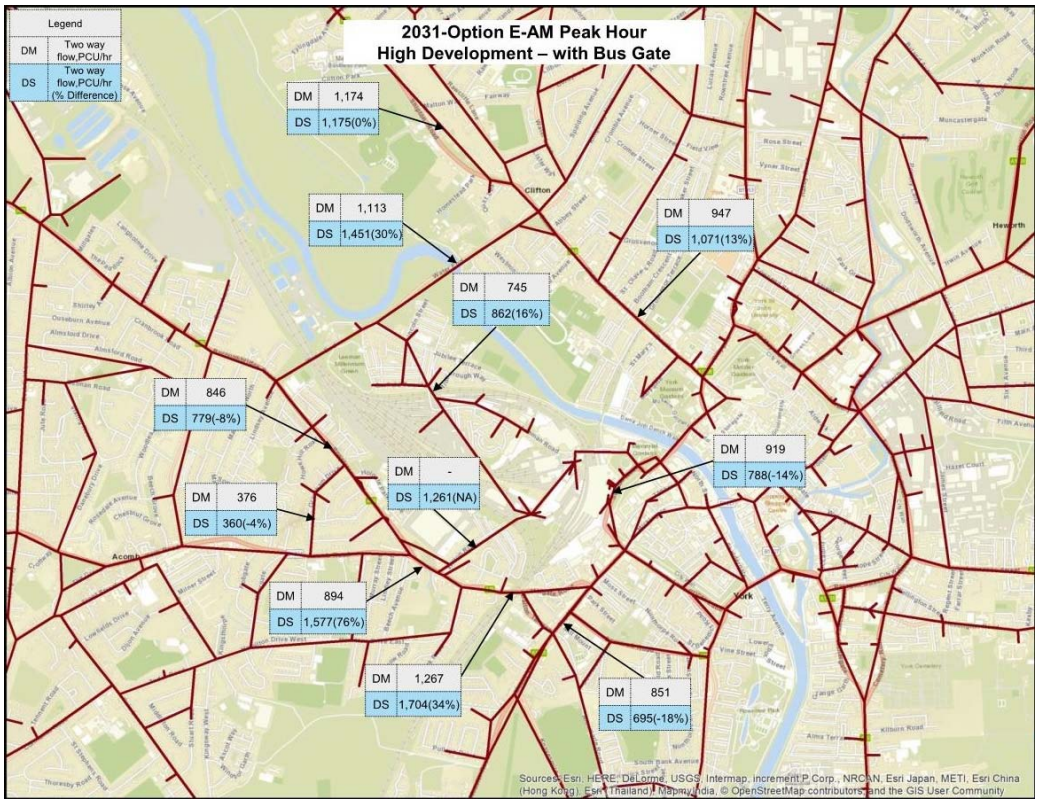
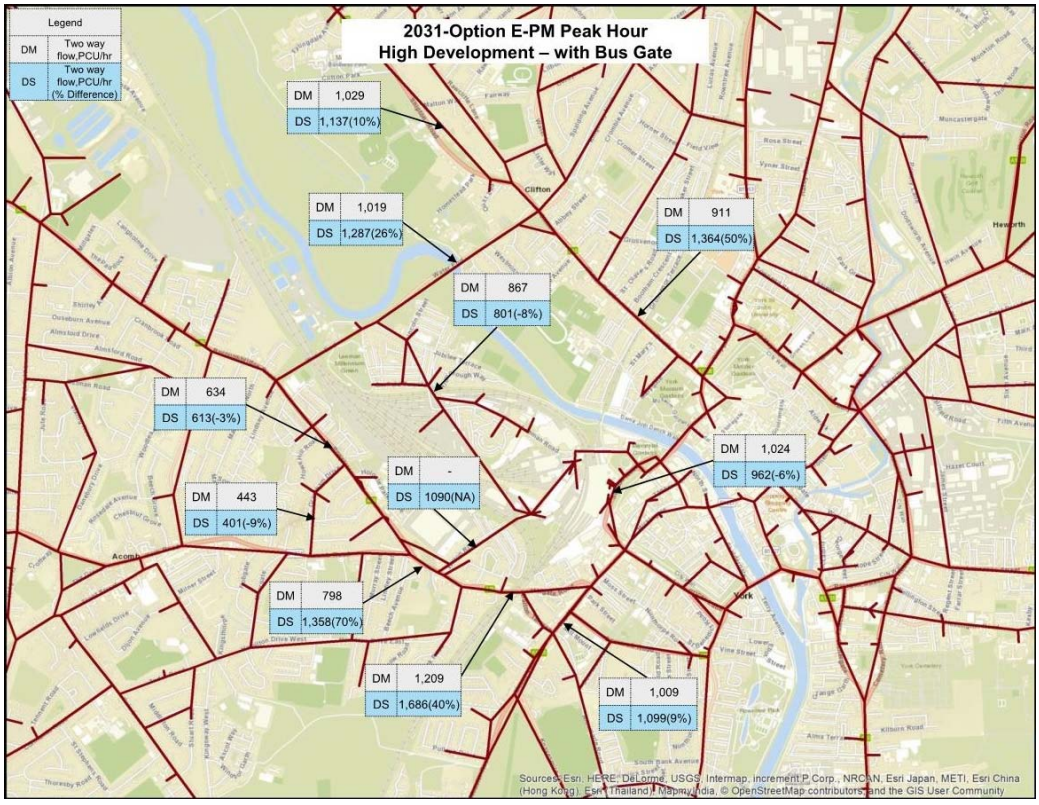


Figure 25: Option E August 2017 Development Scenario with Bus Gate - PM Peak Hour Traffic Flows



B3 August 2017 Development Scenario without Bus Gate - Access Option A

Figure 26: Option A August 2017 Development Scenario without Bus Gate - AM Peak Hour Difference Plot

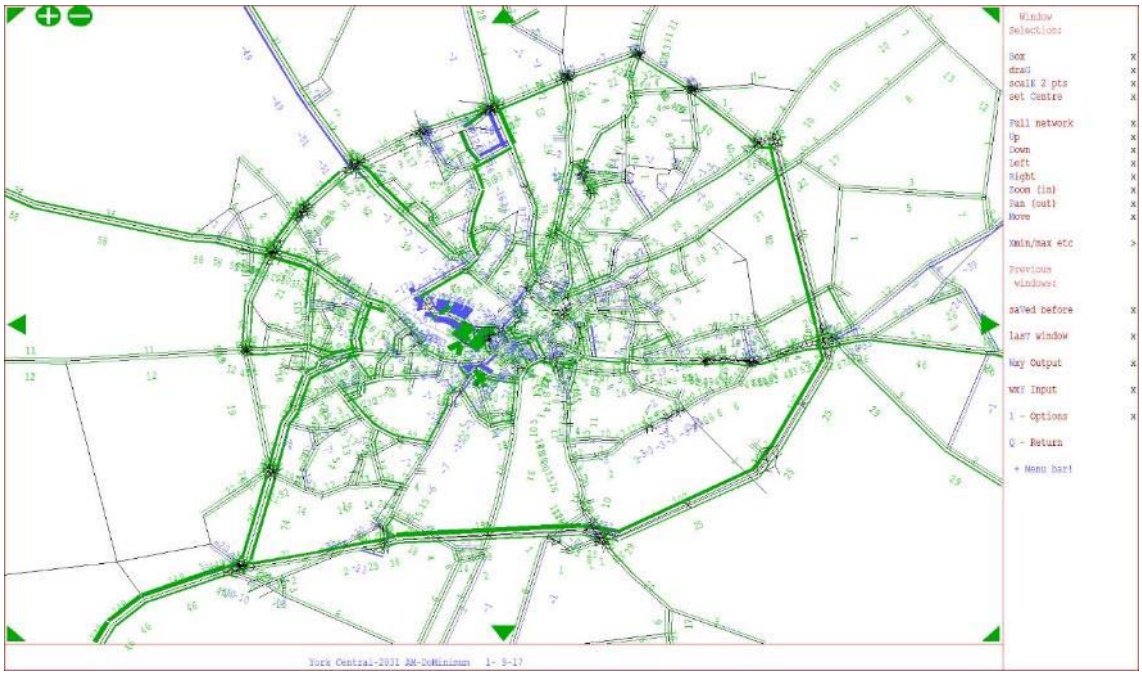


Figure 27: Option A August 2017 Development Scenario without Bus Gate - PM Peak Hour Difference Plot

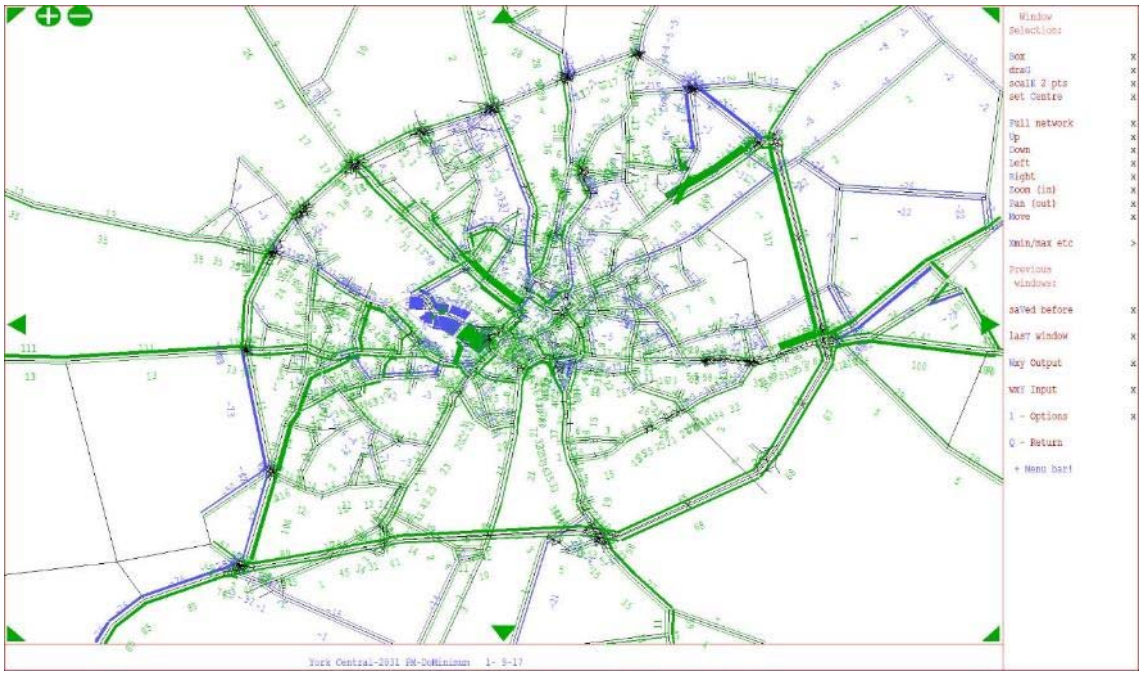


Figure 28: Option A August 2017 Development Scenario without Bus Gate - AM Peak Hour Traffic Flows

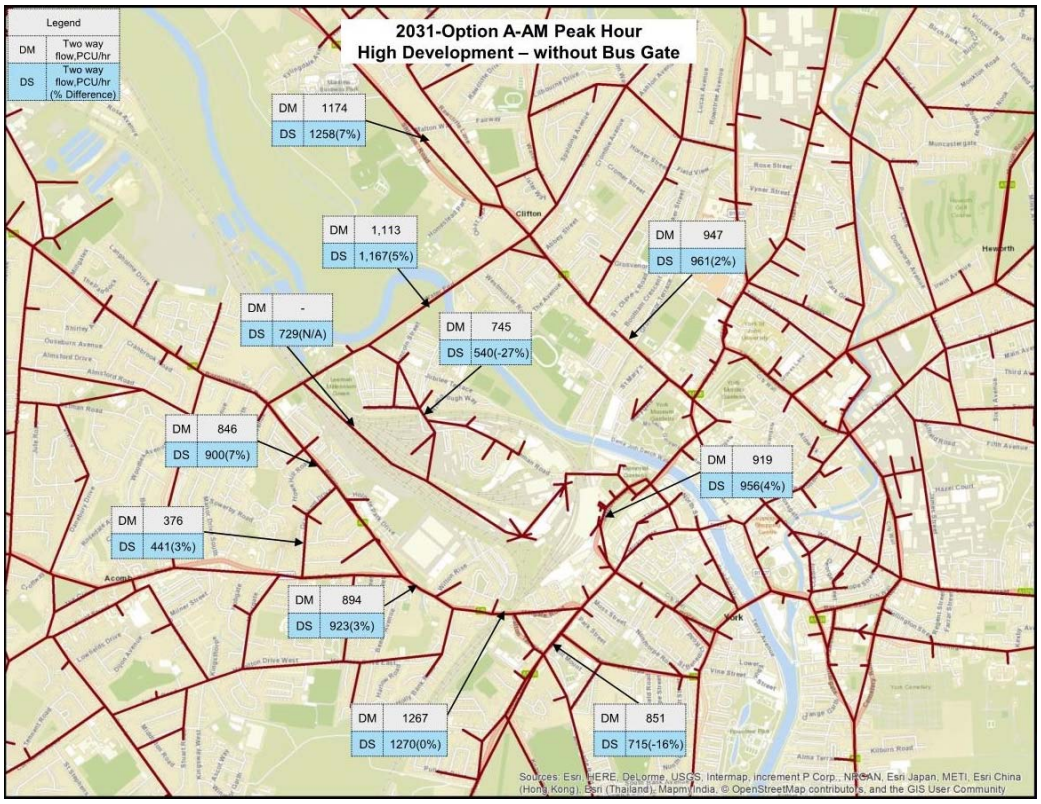
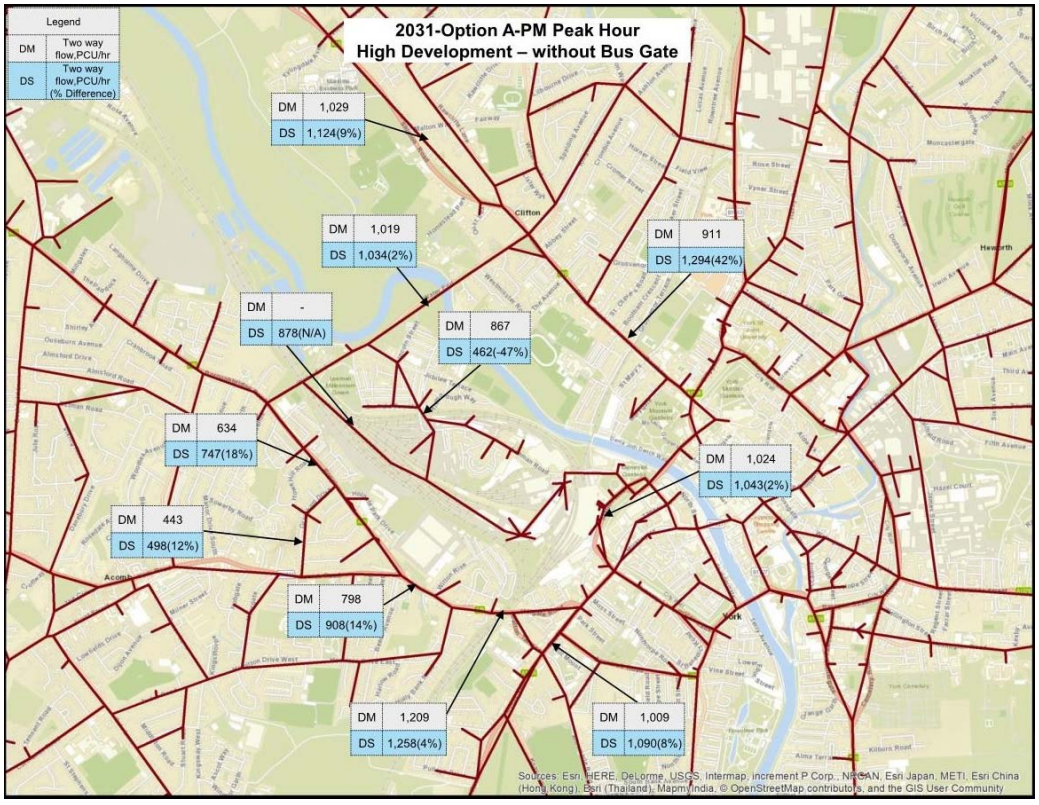


Figure 29: Option A August 2017 Development Scenario without Bus Gate - PM Peak Hour Traffic Flows



B4 August 2017 Development Scenario without Bus Gate - Access Option E

Figure 30: Option E August 2017 Development Scenario without Bus Gate - AM Peak Hour Difference Plot

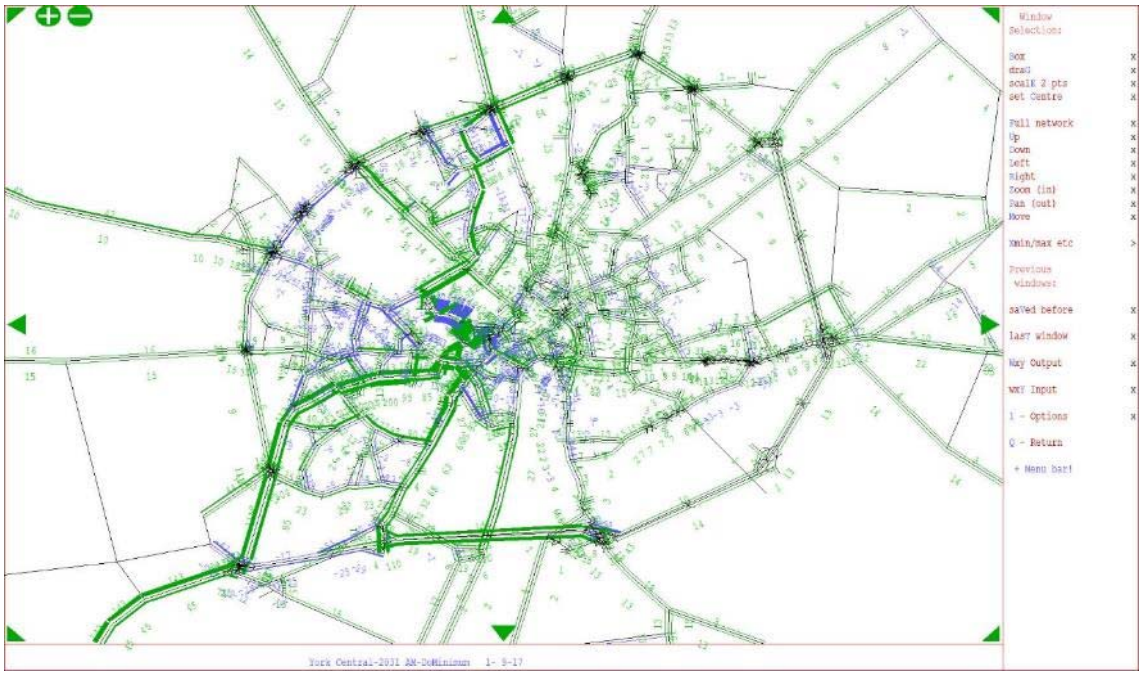


Figure 31: Option E August 2017 Development Scenario without Bus Gate - PM Peak Hour Difference Plot

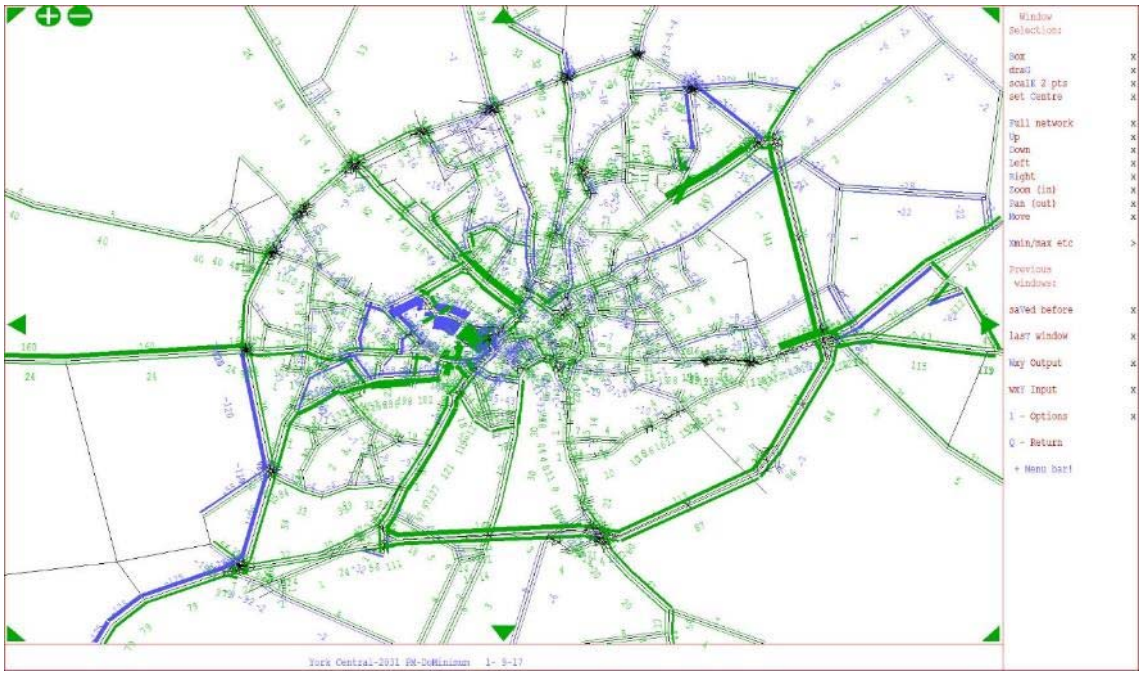


Figure 32: Option E August 2017 Development Scenario without Bus Gate - AM Peak Hour Traffic Flows

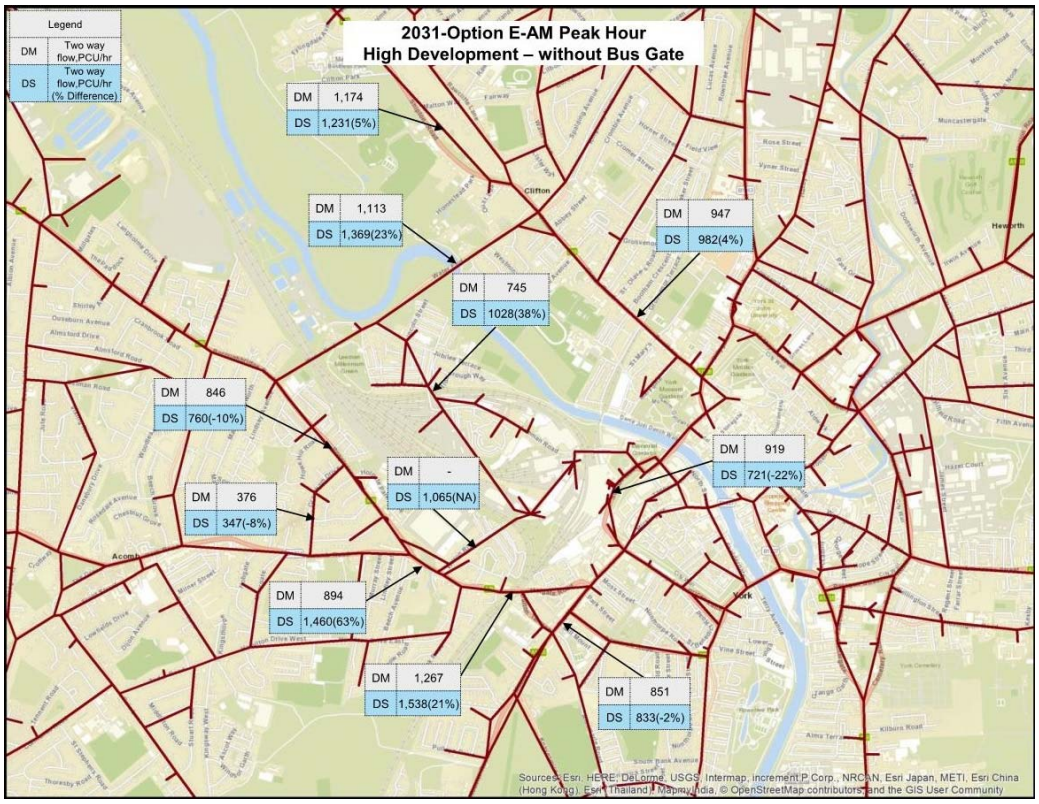
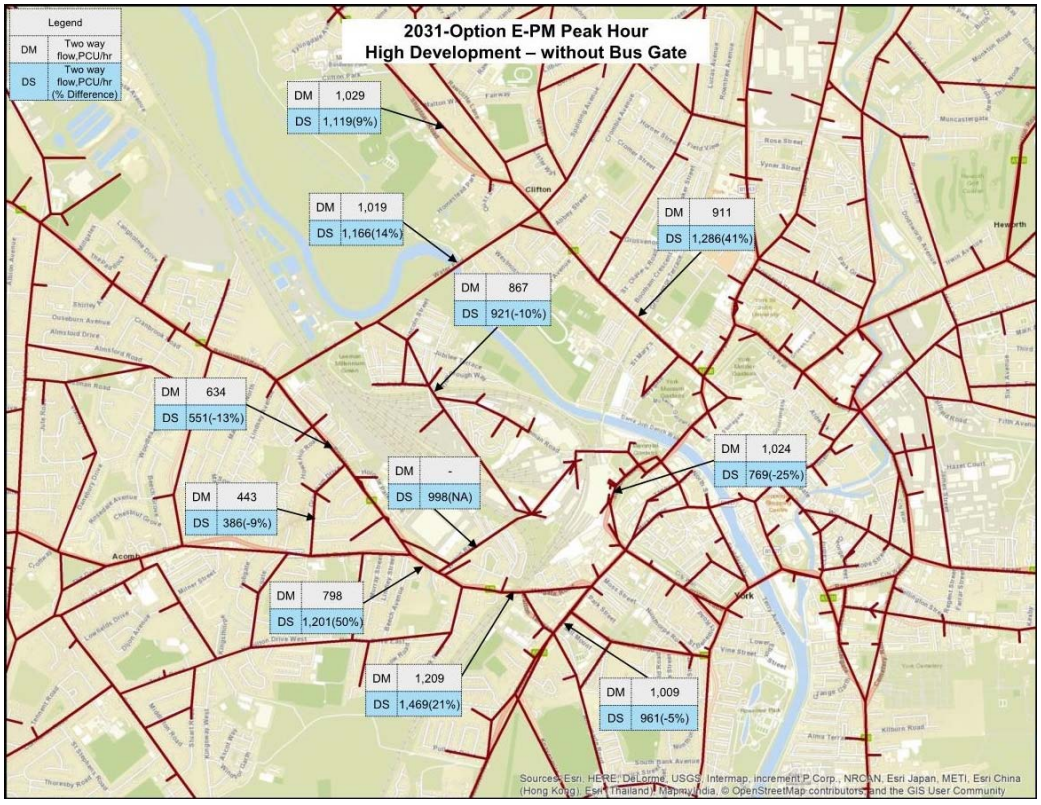


Figure 33: Option E August 2017 Development Scenario without Bus Gate - PM Peak Hour Traffic Flows



Appendix C

Cinder Lane Traffic Flows

C1 Cinder Lane Traffic Flows

Figure 34: Option A - AM Peak Hour

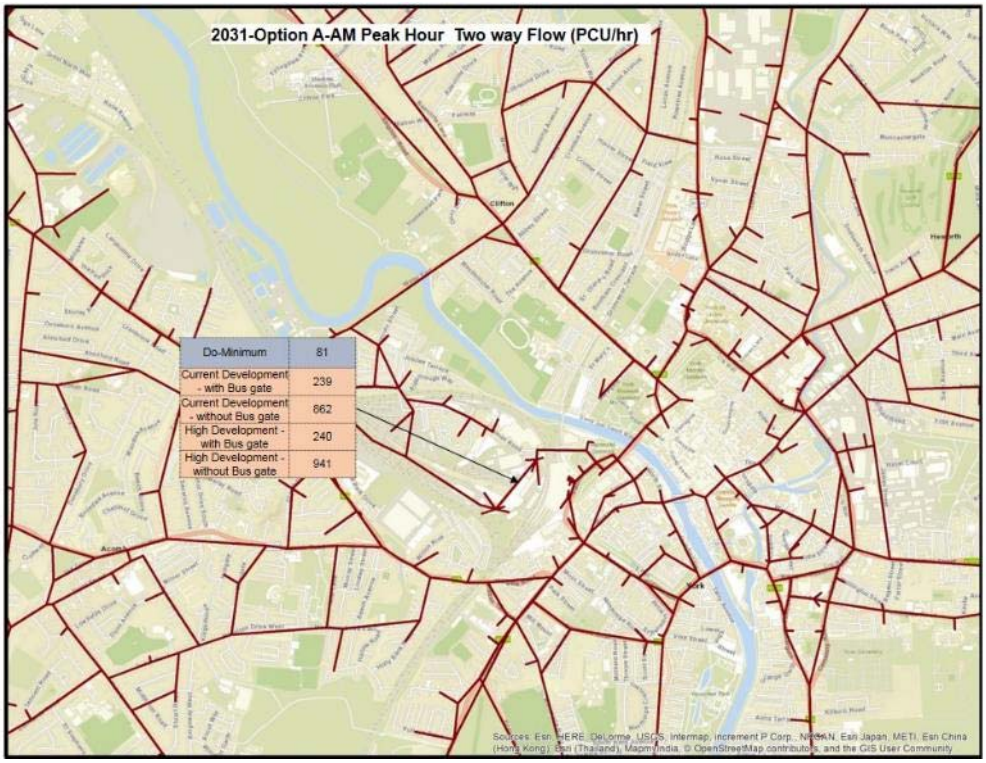


Figure 35: Option A - PM Peak Hour

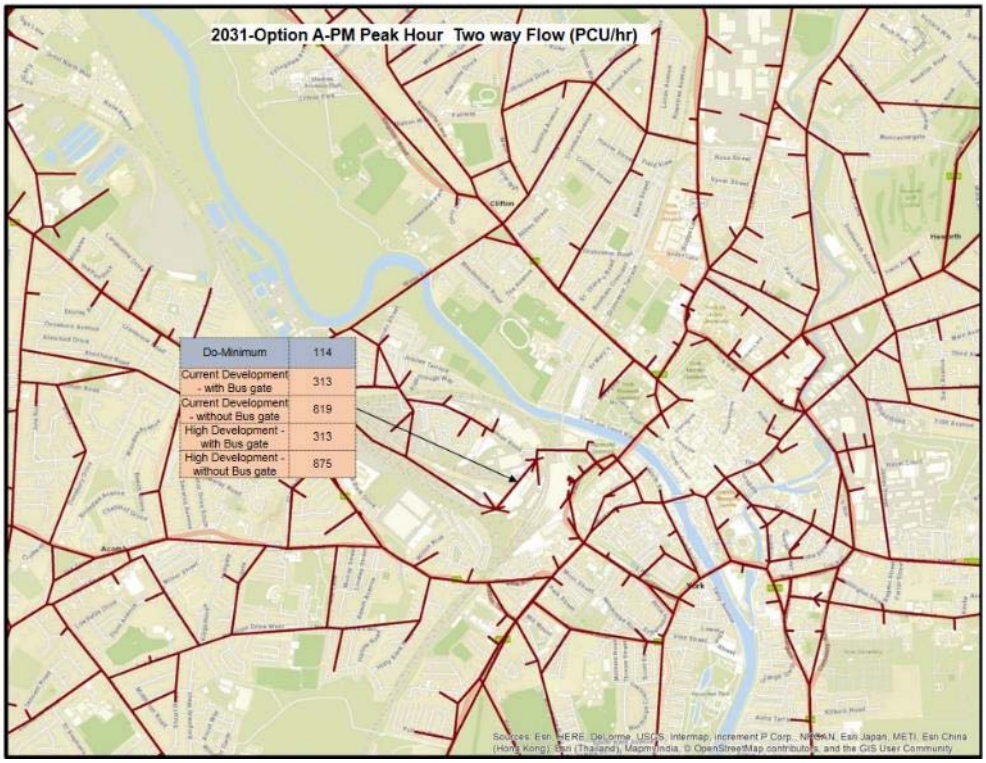


Figure 36: Option E - AM Peak Hour

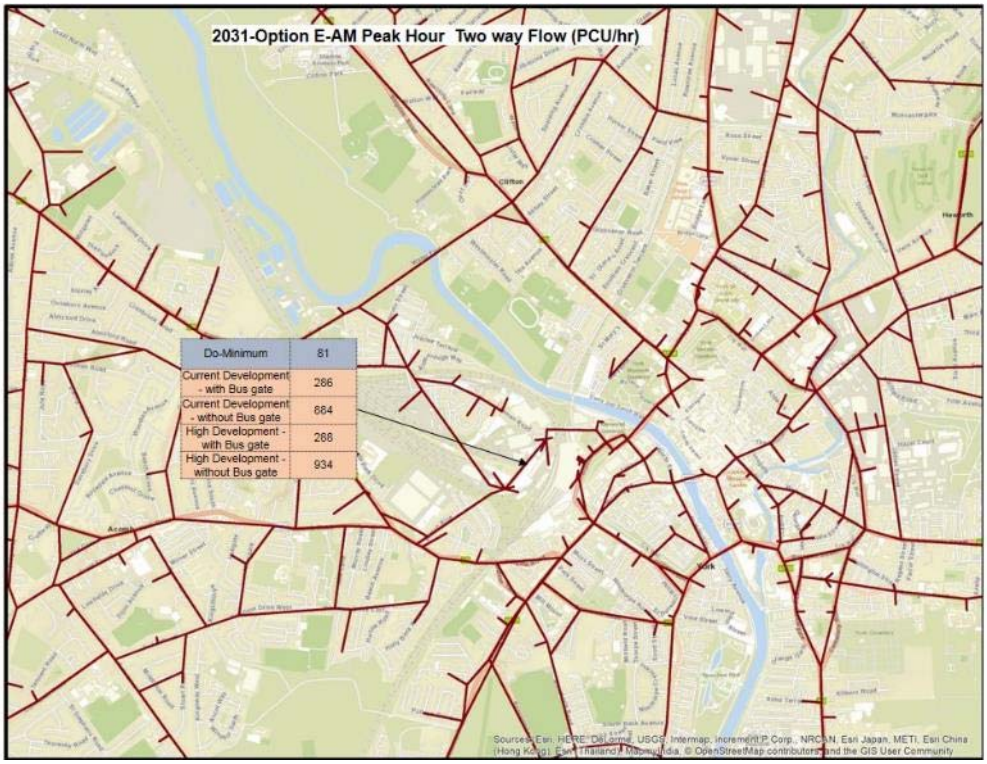
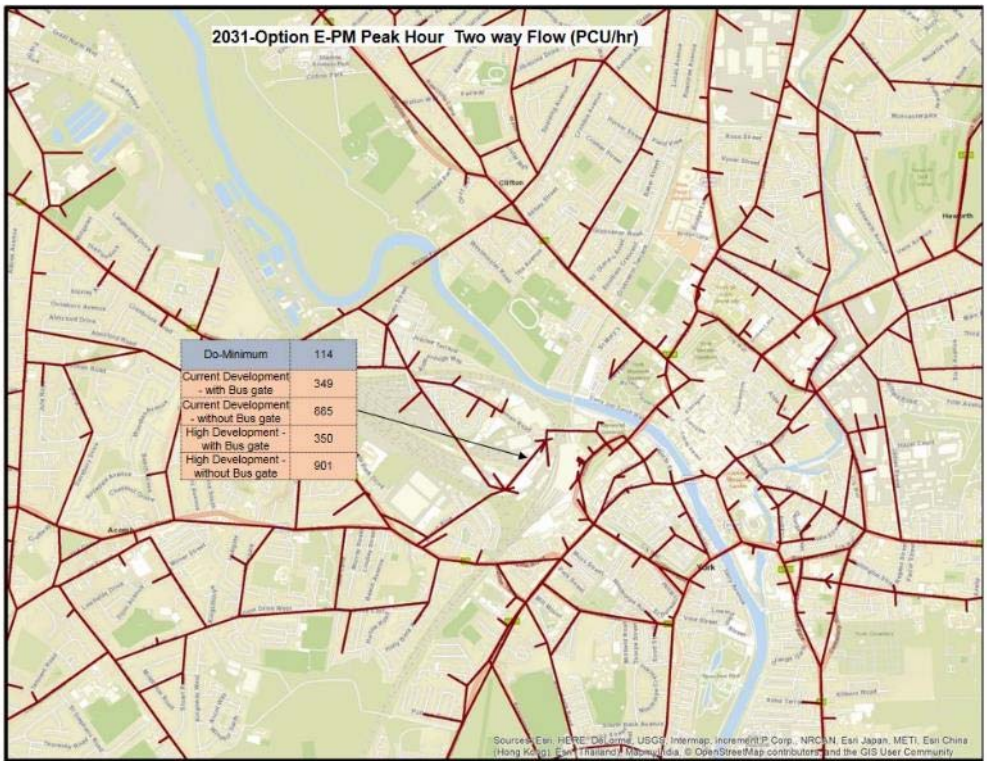


Figure 37: Option E - PM Peak Hour



Appendix D

Plots of Identified Junctions

D1 August 2017 Development Scenario – with Bus Gate

Figure 38: Option A August 2017 Development Scenario with Bus Gate - AM Peak Identified Junctions

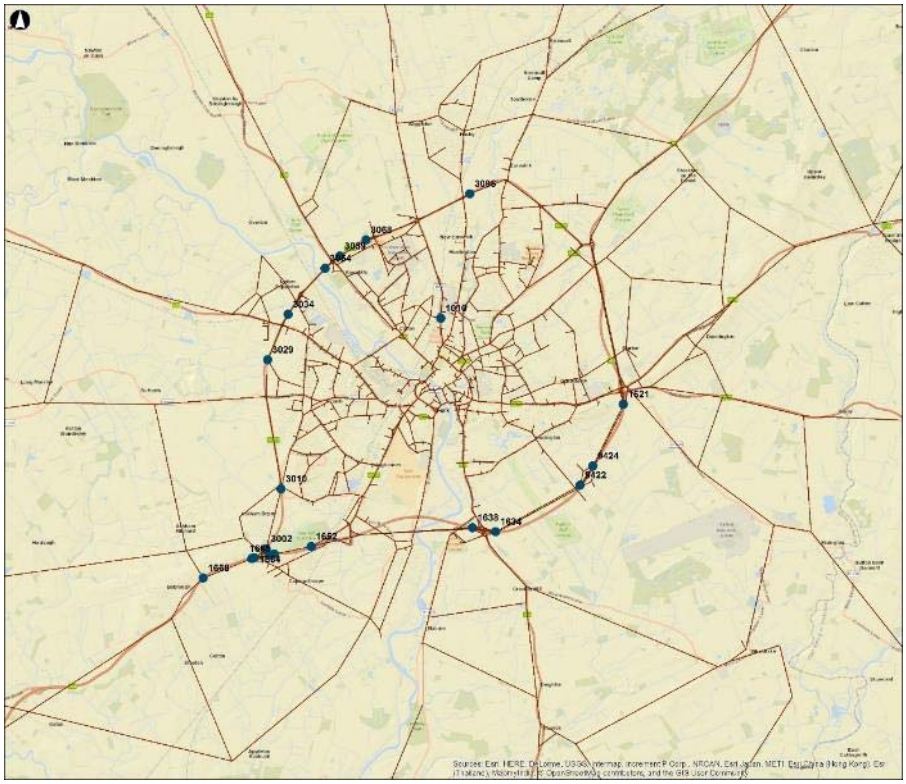


Figure 39: Option A August 2017 Development Scenario with Bus Gate - PM Peak Identified Junctions

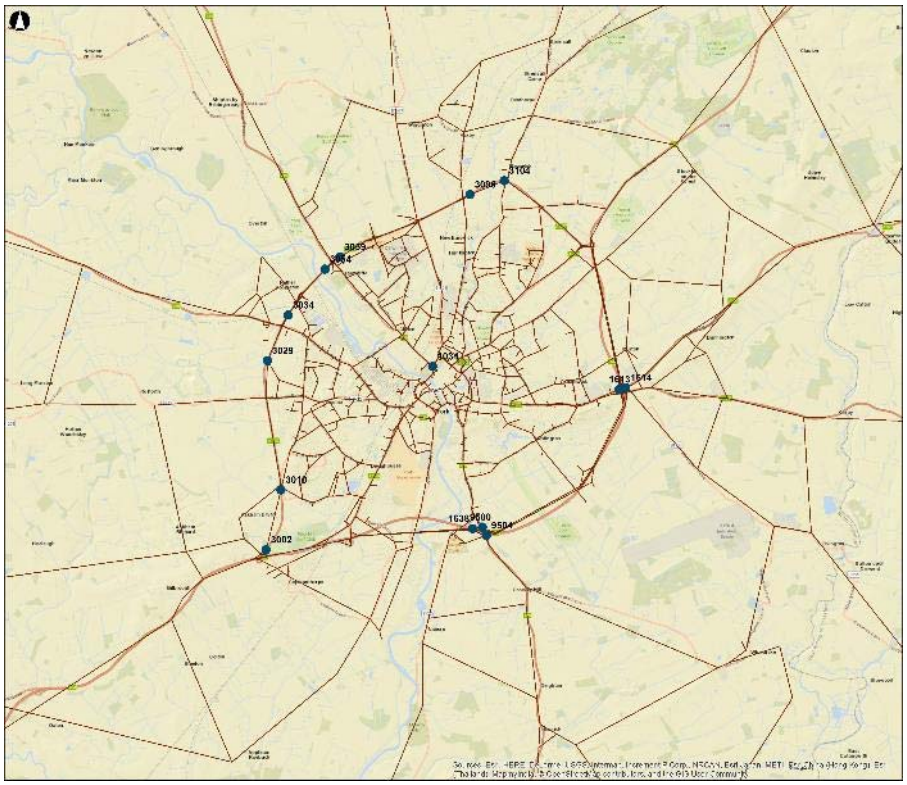


Figure 40: Option A August 2017 Development Scenario without Bus Gate - AM Peak Identified Junctions

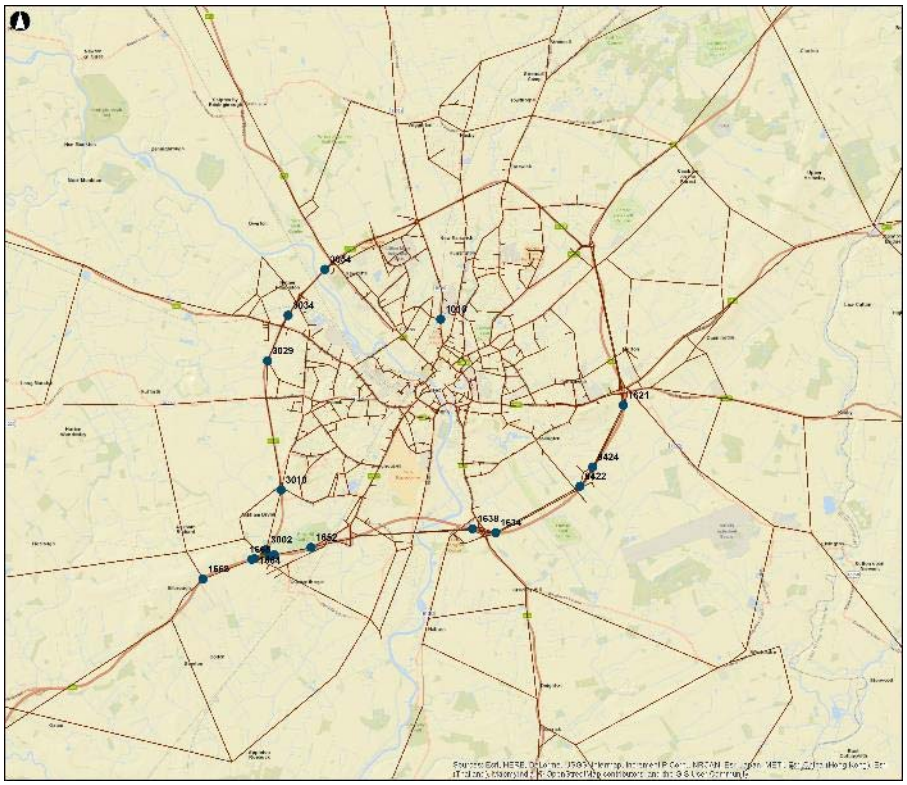


Figure 41: Option A August 2017 Development Scenario without Bus Gate - PM Peak Identified Junctions

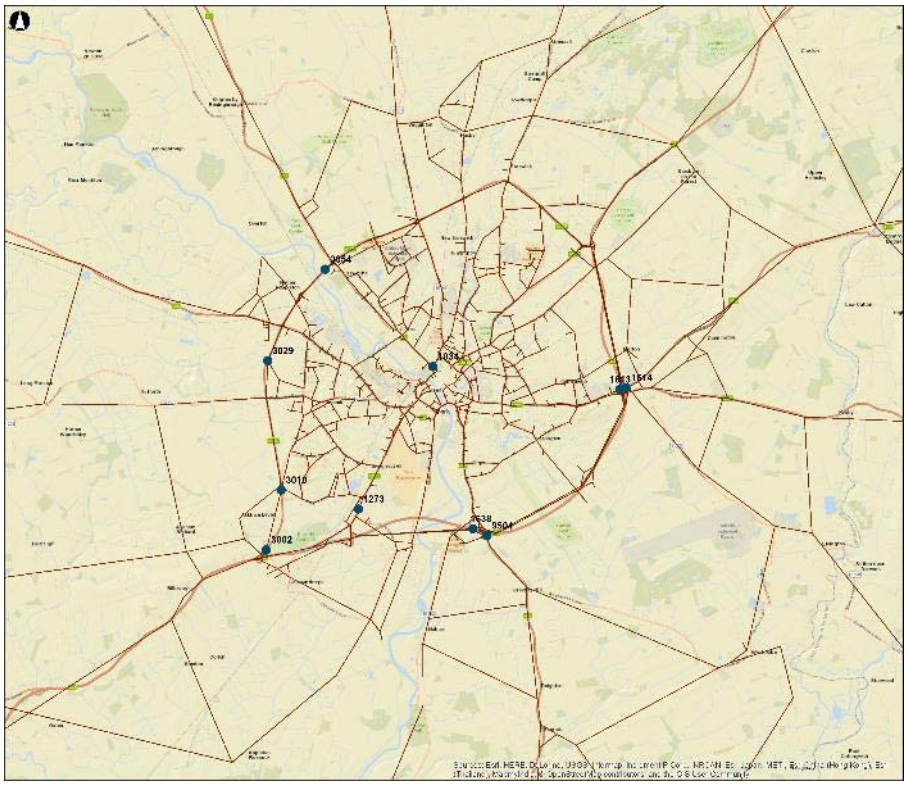


Figure 42: Option E August 2017 Development Scenario with Bus Gate - AM Peak Identified Junctions

Figure 43: Option E August 2017 Development Scenario with Bus Gate - PM Peak Identified Junctions

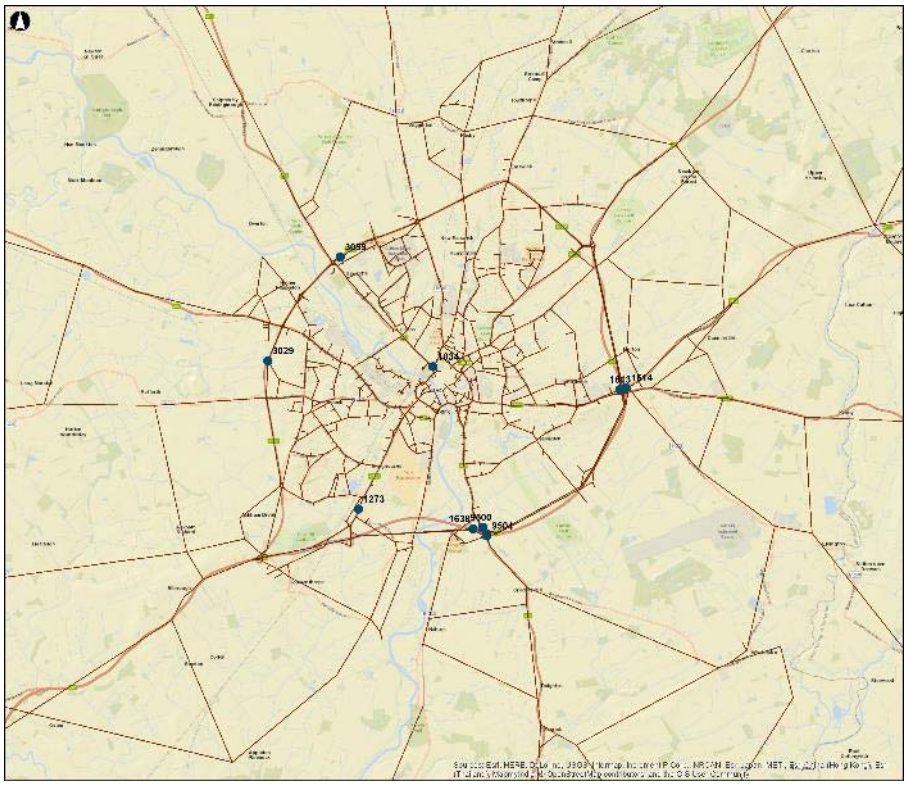


Figure 44: Option E August 2017 Development Scenario without Bus Gate - AM Peak Identified Junctions

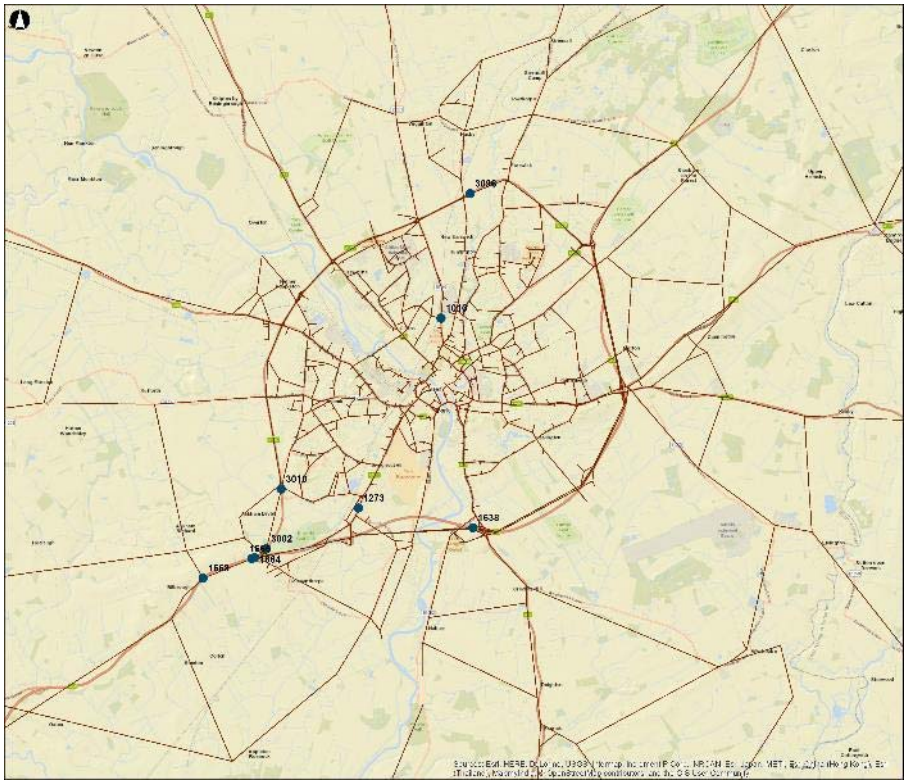


Figure 45: Option E August 2017 Development Scenario without Bus Gate - PM Peak Identified Junctions