

6 Mitigation Scenario 2 – Local Highway and Public Transport Improvements

6.1 Introduction

6.1.1 This chapter presents the main outputs from the local highway and public transport mitigation measures. In addition to the mitigation test 1 schemes, the following schemes have also been included in mitigation test 2:

- A new rail station near Stenson Road served by 30 minutes rail services in both directions throughout the day. It has been assumed that the cross country services are stopped at the new station.
- South Derby Link Road, running parallel to the A50, joining Rykneld Road with T12 link road. Figure 6.1 shows the plan for this road along and the location of the proposed rail station near Stenson Road.
- A new bus service to use South Derby Link Road, running from Mackworth to Chellaston and back. Figure 6.2 shows the route for this bus service.
- Widening of Stenson Road railway bridge allowing two-way working.
- Mick Mack express bus service, connecting Mickleover and Mackworth with Derby City Centre and railway station. Ten minutes frequency and two starting points (one in Mickleover and the other in Mackworth) have been assumed for this service. It has also been assumed that Mick Mack goes under the A38 as part of its dedicated route in order to maintain the 'express' element of the service.

Figure 6.1 The proposed Southern Derby Link Road

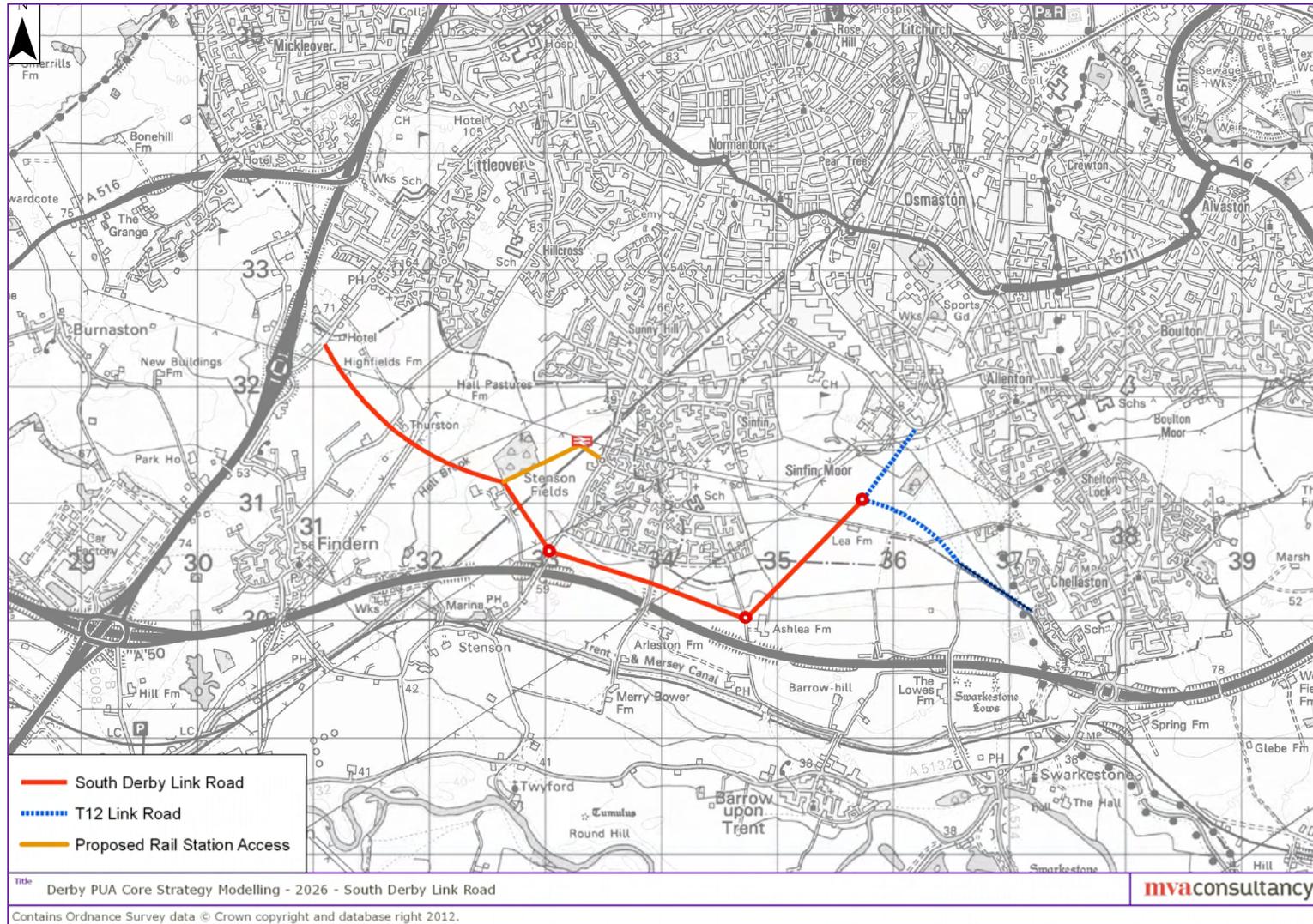
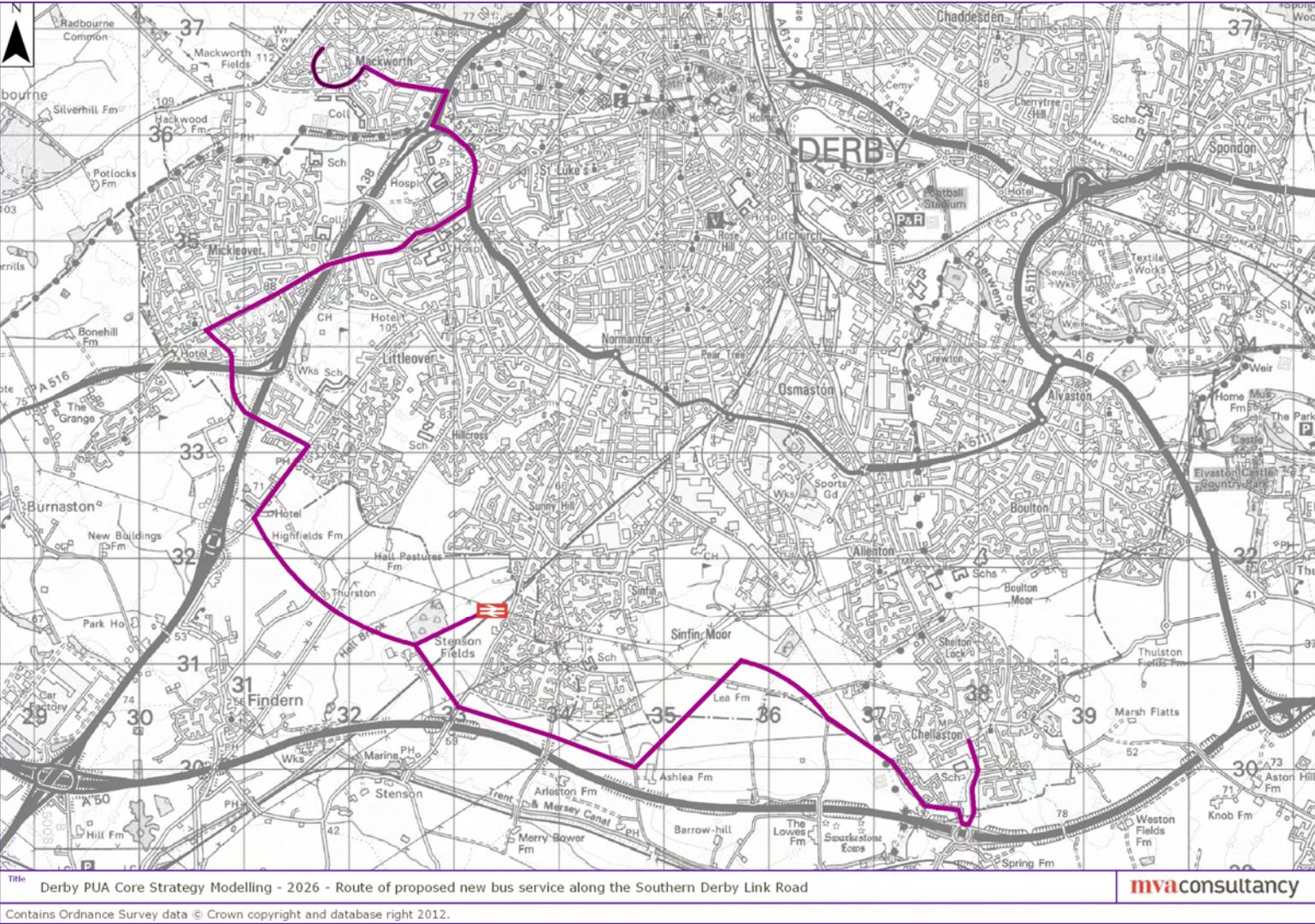


Figure 6.2 The Proposed Bus Route along South Derby Link Road



6.2 Impact of the new Public Transport Services

- 6.2.1 Table 6.1 shows the patronage on the new bus services and the utilisation of the new rail station as forecast by the model.
- 6.2.2 The patronage along the Mick-Mack and Southern bus route is insignificant.
- 6.2.3 The passenger boardings on the new rail station are 130 persons in the AM peak. 40% of this patronage represents people transferring from Derby Station. Boarding patronage in the PM peak is insignificant although the levels of passengers alighting at the station is similar to the boardings in the morning peak..

Table 6.1 Patronage on PT Services/Rail Station

Service / Facility		AM Peak	PM Peak
Mick Mack	Mackworth - Derby	19	13
	Mickleover - Derby	9	13
South Link Road Service	Mackworth - Chellaston	34	23
	Chellaston - Mackworth	36	32
Stenson Road Rail Station	Northbound to Derby	14	0
	Southbound to West Midlands	130	23

6.3 Global Indicators

- 6.3.1 The following section presents highway indicators for the whole of the Core Strategy Area to provide a way of gauging the overall impact the potential Core Strategy sites and the impacts of the local highway mitigation on the full ACS area. A brief explanation of each indicator is provided below.

- **Average speed** - expressed as kilometres per hour for all traffic within the highway model simulation area. Increased traffic levels should lead to more delays resulting in lower average speeds.
- **Over capacity queues** - Time spent queuing at junctions that are over capacity. As traffic levels increase we expect to see a growing number of junctions reaching capacity and the time spent queuing at these over capacity junctions increasing.
- **Total Travel Time (pcu-hrs)** – Overall travel time for all trips during the peak hours.
- **Total Travel Distance (pcu-kms)** – Overall travel distance for all trips during the peak hours.
- **Severity Index**- this indicator has been developed by MVA and takes account of the length of the roads affected by congestion, number of vehicles affected by congestion and also the level of congestion. This indicator is a number (without a unit) and gives a realistic indication of levels and severity of congestion in any particular scenario. This index only shows severity along the roads which are at, above or approaching capacity.

- **Environmental Indicators** – carbon emissions predicted from the highway model outputs.

6.3.2 Table 6.2 shows the performance of the mitigation package against the global highway indicators. It also shows the level of mitigation achieved with the mitigation package in place.

6.3.3 In terms of average speed, the mitigation package is forecast to mitigate the impacts of the development strategy by 39% in the AM peak and 30% in the PM peak.

6.3.4 Against the congestion indicator, the mitigation achieved by the package is 44% in the AM peak and 42% in the PM peak.

6.3.5 The Local Highway mitigation package is forecast to fully mitigate the impacts of the development strategy in terms of severity index. This is mainly attributed to the provision of the Southern Derby Link Road which provides relief to the A50 as well as other local roads within Derby. This is in line with the flow difference plots provided in Figures 6.3 and 6.4. A reduction in traffic flow on existing network results in a decrease in severity index.

Table 6.2 Global Highway Indicators - Mitigation Scenario 2

	AM Peak			
	Reference Case	Core Strategy (no mitigation)	Mitigation Scenario 2	% Mitigated
Average Speed	38	36	37	39%
Over Capacity Queues	772	1,290	1,063	44%
Total Travel Time	14,849	16,544	15,905	38%
Total Travel Distance	566,599	594,231	585,881	30%
Severity Index	322	352	267	281%
	PM Peak			
	Reference Case	Core Strategy (no mitigation)	Mitigation Scenario 2	% Mitigated
Average Speed	38	35	36	30%
Over Capacity Queues	837	1,448	1,193	42%
Total Travel Time	15,566	17,524	16,969	28%
Total Travel Distance	583,652	617,280	609,666	23%
Severity Index	211	258	180	168%

6.4 Carbon Emissions Indicator

- 6.4.1 The impact of each of the options on greenhouse gas emissions has been measured using the MVA Environmental Appraisal software, *ENEVAL*. This software provides an indication of the main carbon dioxide equivalent emission impacts caused by road traffic on a network wide basis. The ENEVAL results for different schemes have been compared to highlight how carbon dioxide equivalent emissions change by scenario.
- 6.4.2 Table 6.3 provides a summary of the change in carbon dioxide equivalent values as a result of the local highway mitigation.

Table 6.3 Carbon Emissions - Mitigation Scenario 2

	Reference Case	Core Strategy No Mitigation	Mitigation Scenario 2	% Mitigation
Annual CO ₂ (tonnes)	427,504	437,582	430,910	66%

- 6.4.3 The Local Highway mitigation package is forecast to provide 65% mitigation in terms of reducing the carbon emissions induced by the development traffic.
- 6.4.4 The local highway mitigation package is predicted to have a significant impact in addressing the additional carbon emissions as a result of the potential Core Strategy sites. This is due to a reduction in delays across the highway network.

6.5 General Highway Impacts

- 6.5.1 The following section of the report presents a series of highway plots which highlight the impact that the Local Highway Mitigation strategy has on reducing the transportation impact of the potential Core Strategy sites. The following indicators are provided;

- **Flow Change** – Predicted changes in traffic flow levels on the highway network.
- **Volume/ Capacity plots** – these show the levels of congestion at junctions in 2026 with Mitigation Package 2 (local highway) in place and also the change in congestion relative to the No Mitigation Scenario.

Flow Change

- 6.5.2 The levels of flow reduction on the network as a result of the Local Highway Mitigation are shown in Figures 6.3 and 6.4.
- 6.5.3 These plots show that the reductions in vehicle flows are widespread throughout the network. The mitigation package is forecast to reduce traffic flows through the local residential areas and along the following main routes:
- A50;
 - Osmaston Road;
 - London Road;

- Sections of A5111; and
- T12 Link Road.

6.5.4 Vehicles are transferring to the new South Derby Link road that is part of Mitigation Strategy 2 (Local Highway). This is easing pressure on the local highway network, however there is predicted to be increases in vehicle flow along:

- Stenson Road;
- A5132; and
- Sections of the A38.

6.5.5 There is a gap in Figure 6.3

Figure 6.3 Difference in Highway Flows due to Mitigation Scenario 2 - AM Peak

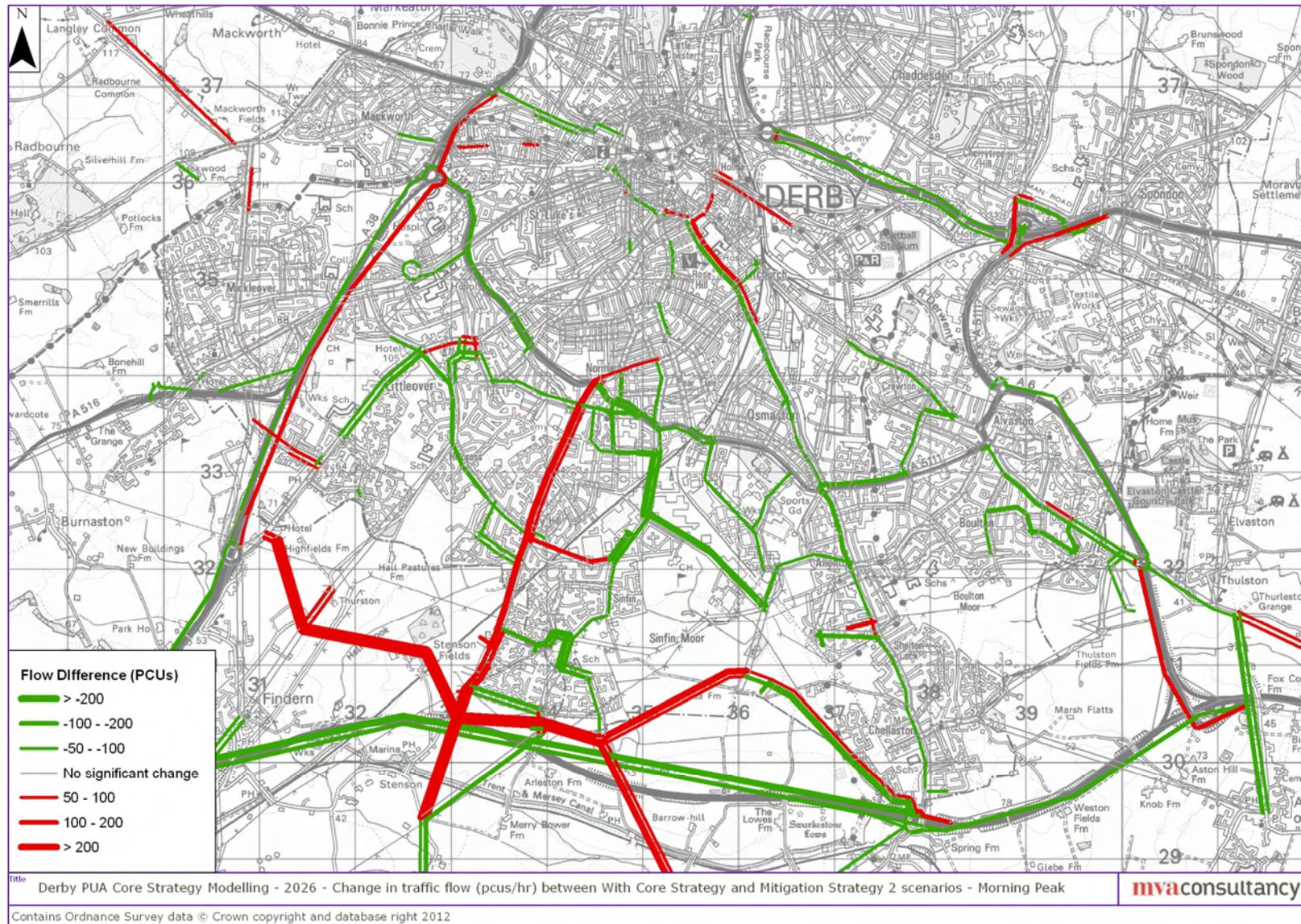
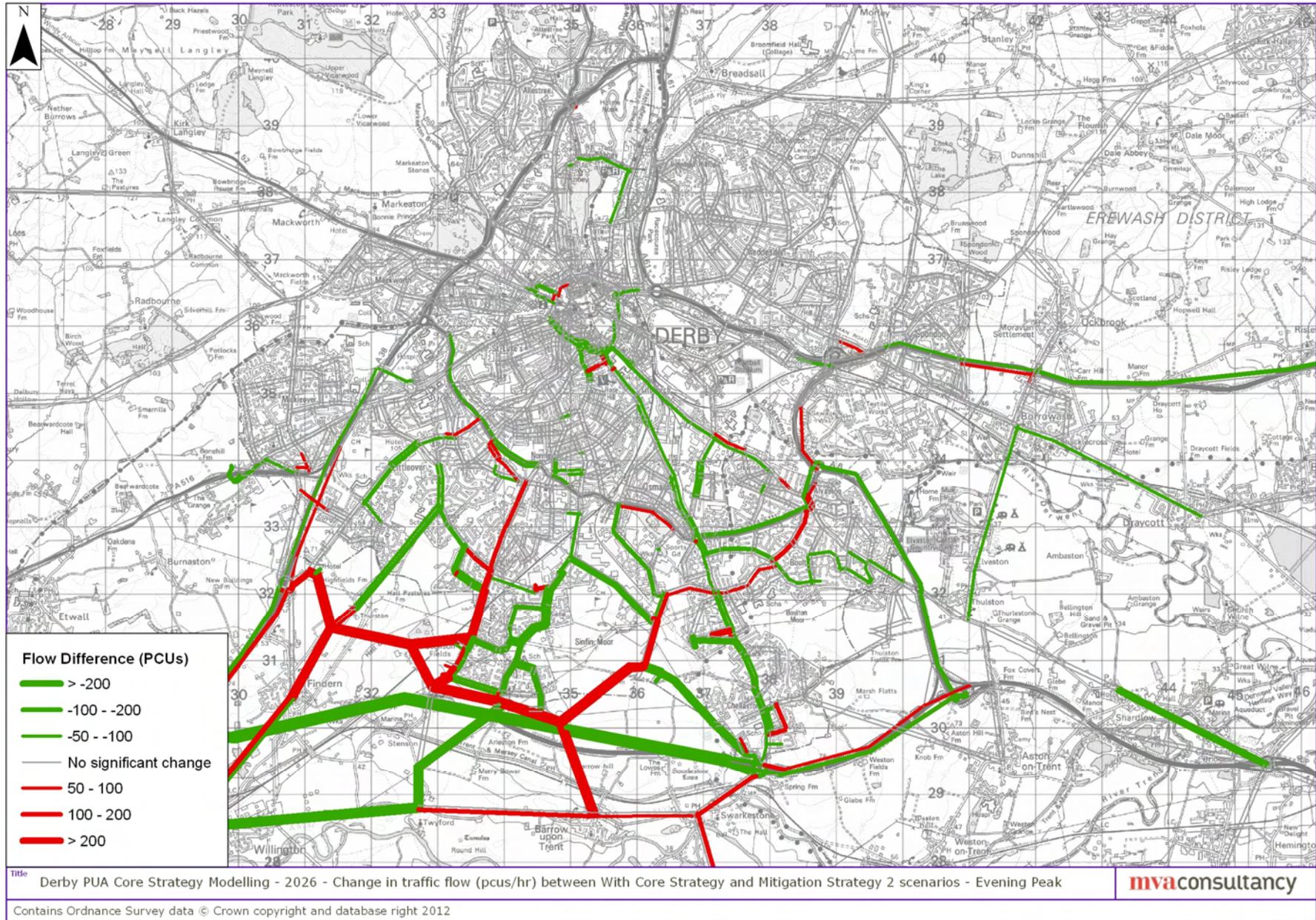


Figure 6.4 Difference in Highway Flows due to Mitigation Scenario 2 - PM Peak



6.6 Volume / Capacity (V/C) plots

- 6.6.1 A V/C percentage of 85% is conventionally considered to be the threshold beyond that the junction approaches its effective traffic capacity. As V/C ratios increase above this level, there is an increasing likelihood of that drivers will observe perceptible increases in delays and queues at junctions which may affect their travel behaviour or routing patterns. . It will be these links/junctions which will be of most concern to the highway authorities. A V/C ratio in excess of 100% indicates that the junction is operating beyond its theoretical traffic capacity.
- 6.6.2 Figures 6.5 and 6.6 show the reduction in V/C at congested junctions as a result of the local highways mitigation strategy compared to the no mitigation scenario.
- 6.6.3 Many of the junctions only receive a small reduction in congestion as a result of the Local Highway mitigation, less than 5%. However, there are a number of junctions within the residential areas to the south of the Ring Road that have been identified as having a significant reduction in congestion levels as a result of the mitigation package. Some of the specific routes include:
- Sinfin Lane;
 - Uttoxeter New Road;
 - Several junctions along the A5111; and
 - the A514/A50 junction.
- 6.6.4 Figures 6.7 and 6.8 show the residual congestion plots for the AM and PM peaks respectively

Figure 6.5 Reduction in congestion between the potential Core Strategy no mitigation scenario and Mitigation 2 for junctions with greater than 85% V/C ratio in the potential Core Strategy no mitigation scenario – AM Peak

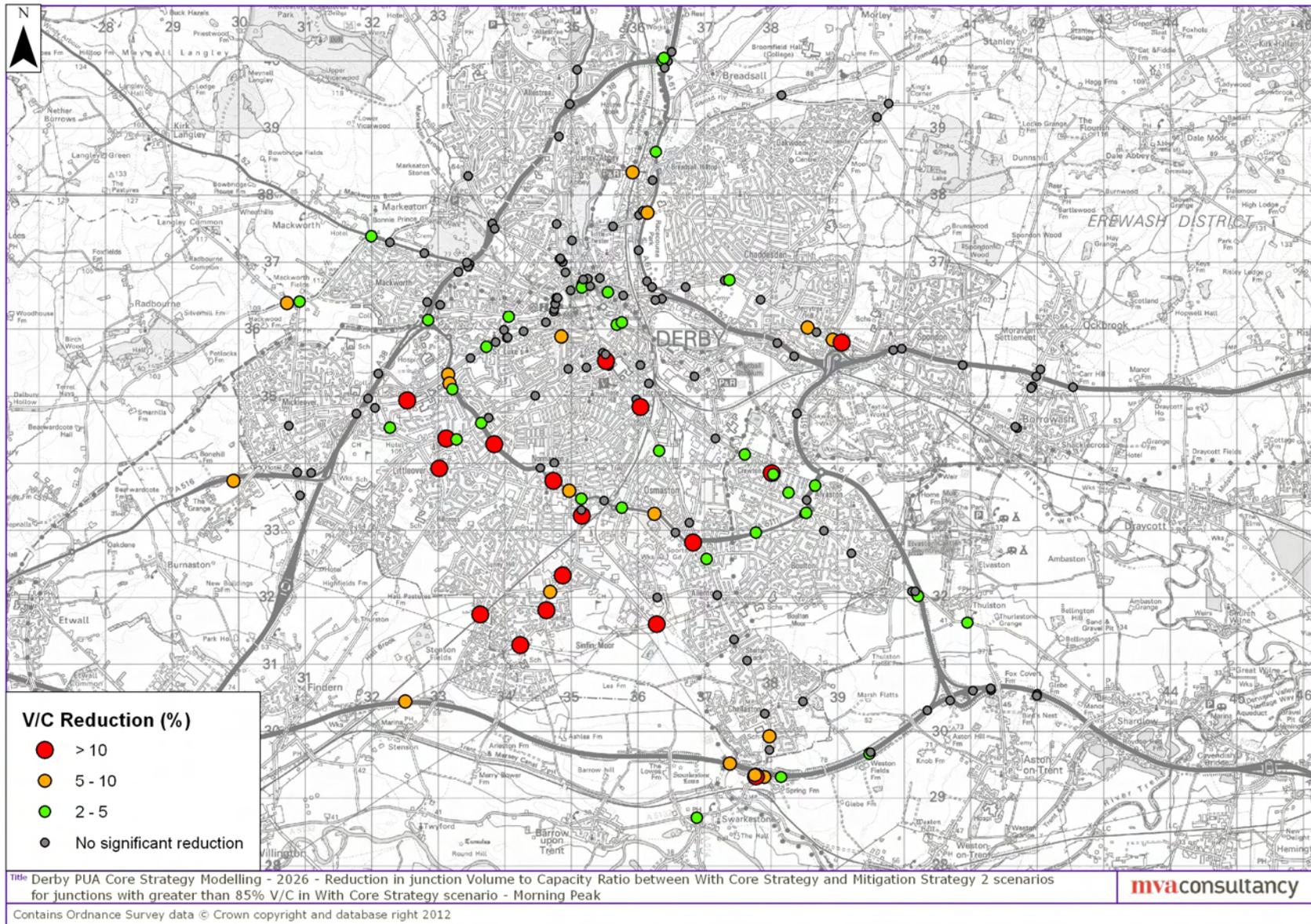


Figure 6.6 Reduction in congestion between the potential Core Strategy no mitigation scenario and Mitigation 2 for junctions with greater than 85% V/C ratio in the potential Core Strategy no mitigation scenario – PM Peak

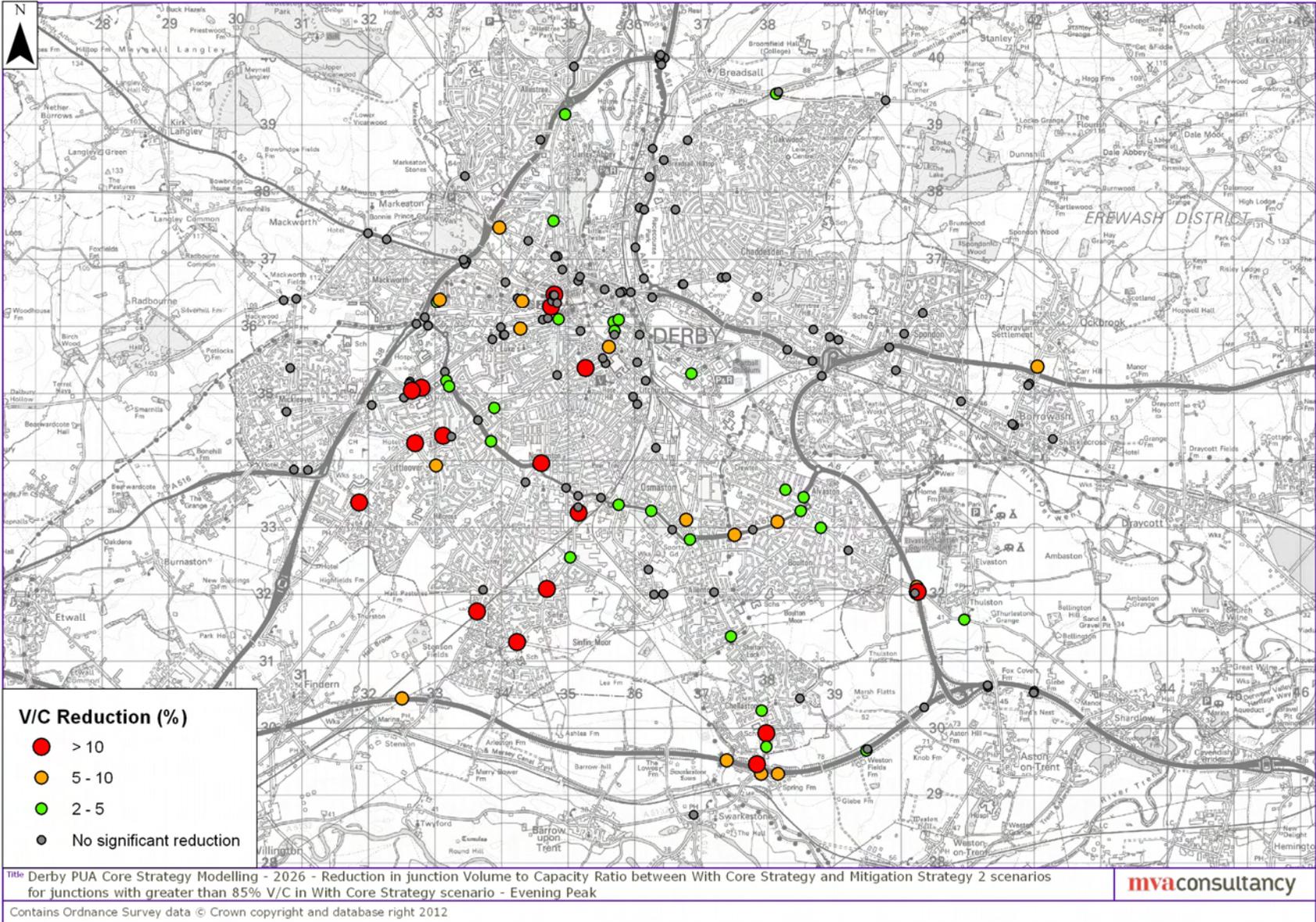


Figure 6.7 Residual Congestion Plot – AM Peak

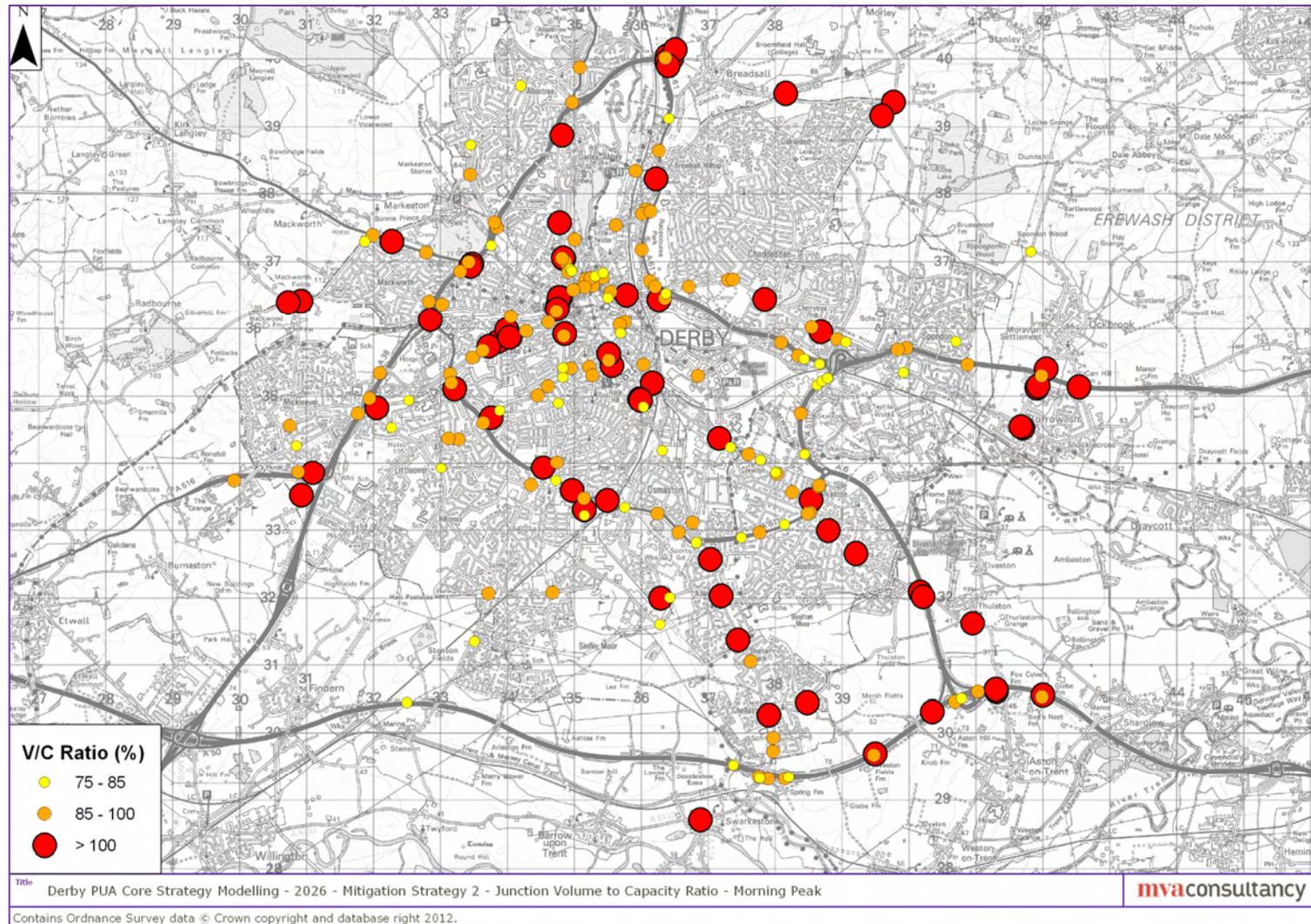
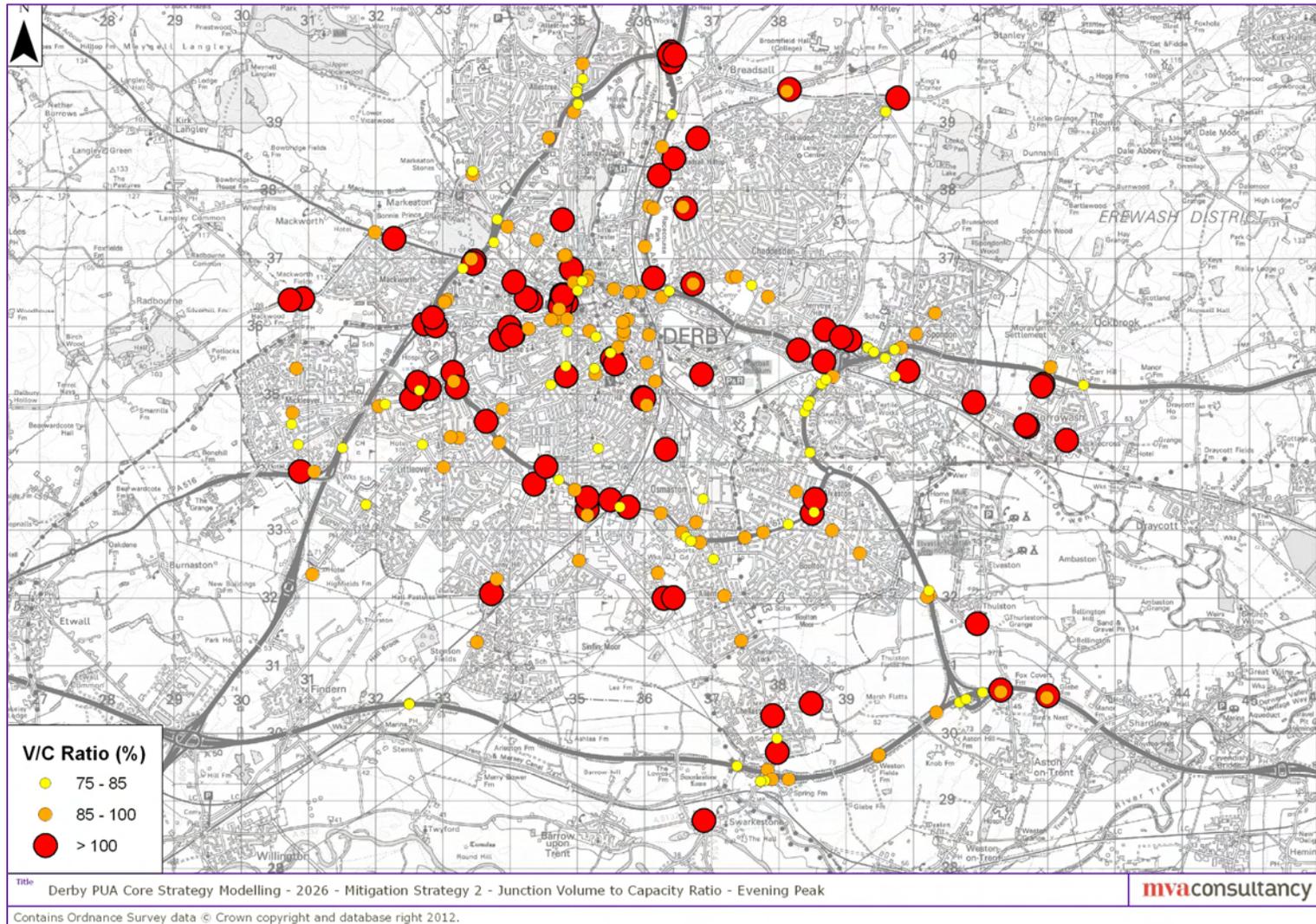


Figure 6.8 Residual Congestion Plot – PM Peak



7 Mitigation Scenario 3 – A50 Junction

7.1 Introduction

7.1.1 This chapter presents the main outputs from Mitigation Scenario 3 which consists of:

- Mitigation measures tested as part of mitigation test 1; and
- A new junction on the A50 between the A514 and A38 junctions which links directly onto Deep Dale Lane. No further improvements to the local highway network have been assumed.

7.2 Global Indicators

7.2.1 The following section presents highway indicators for the whole of the Core Strategy Area to provide a way of gauging the overall impact the potential Core Strategy sites and the impacts of Mitigation Package 3 on the full ACS area. A brief explanation of each indicator is provided below.

- **Average speed** - expressed as kilometres per hour for all traffic within the highway model simulation area. Increased traffic levels should lead to more delays resulting in lower average speeds.
- **Over capacity queues** - Time spent queuing at junctions that are over capacity. As traffic levels increase we expect to see a growing number of junctions reaching capacity and the time spent queuing at these over capacity junctions increasing.
- **Total Travel Time (pcu-hrs)** – Overall travel time for all trips during the peak hours.
- **Total Travel Distance (pcu-kms)** – Overall travel distance for all trips during the peak hours.
- **Severity Index**- this indicator has been developed by MVA and takes account of the length of the roads affected by congestion, number of vehicles affected by congestion and also the level of congestion. This indicator is a number (without a unit) and gives a realistic indication of levels and severity of congestion in any particular scenario. This index only shows severity along the roads which are at, above or approaching capacity.
- **Environmental Indicators** – carbon emissions predicted from the highway model outputs.

7.2.2 Table 7.1 shows the performance of the mitigation package against the global highway indicators. It also shows the level of mitigation achieved with the mitigation package in place.

7.2.3 In terms of average speed, the mitigation package is forecast to mitigate the impacts of the development strategy by 35% across both peak hours.

7.2.4 Against the congestion indicator, the mitigation achieved by the package is 29% in the AM peak and 24% in the PM peak.

7.2.5 In the AM peak, the mitigation package is forecast to fully mitigate the impacts of the development strategy in terms of severity index. However, the mitigation is negative for the PM peak. This is due to the routing pattern in the PM peak and also due to the new junction on the A50 which draws traffic from main radials onto comparatively minor and already congested Stenson Road and other residential areas, causing more congestion overall in these areas. This statistic demonstrates that the junction on the A50 in the absence of any supporting highway infrastructure (South Derby Link Road, etc.) is likely to be unsustainable, particularly in the PM peak.

Table 7.1 Global Highway Indicators – Mitigation Scenario 3

	AM Peak			
	Reference Case	Core Strategy (no mitigation)	Mitigation Scenario 3	% Mitigated
Average Speed	38	36	37	35%
Over Capacity Queues	772	1,290	1,137	29%
Total Travel Time	14,849	16,544	15,847	41%
Total Travel Distance	566,599	594,231	580,800	49%
Severity Index	322	352	311	135%
	PM Peak			
	Reference Case	Core Strategy (no mitigation)	Mitigation Scenario 3	% Mitigated
Average Speeds	38	35	36	35%
Over Capacity Queues	837	1,448	1,299	24%
Total Travel Time	15,566	17,524	16,978	28%
Total Travel Distance	583,652	617,280	610,437	20%
Severity Index	211	258	317	-127%

7.3 Carbon Emissions Indicator

7.3.1 The impact of each of the options on greenhouse gas emissions has been measured using the MVA Environmental Appraisal software, *ENEVAL*. This software provides an indication of the main carbon dioxide equivalent emission impacts caused by road traffic on a network wide basis. The ENEVAL results for different schemes have been compared to highlight how carbon dioxide equivalent emissions change by scenario.

7.3.2 Table 7.2 provides a summary of the change in carbon dioxide equivalent values as a result of Mitigation Strategy 3.

7.3.3 The mitigation package is forecast to mitigate the environmental impacts of the development strategy by 68%.

Table 7.2 Carbon Emissions – Mitigation Scenario 3

	Reference Case	Core Strategy No Mitigation	Mitigation Scenario 3	% Mitigation
Annual CO ₂ (tonnes)	427,504	437,582	430,774	68%

7.4 General Highway Impacts

7.4.1 The following section of the report presents a series of highway plots which highlight the impact that Mitigation Package 3 has on reducing the transportation impacts of the potential Core Strategy sites. The following indicators are provided;

- **Flow Change** – Predicted changes in traffic flow levels on the highway network.
- **Volume/ Capacity plots** – these show the levels of congestion at junctions in 2026 with Mitigation Package 3 in place and also the change in congestion relative to the No Mitigation Scenario.

Flow Change

7.4.2 The levels of flow reduction on the network as a result of the Mitigation Strategy 3 are shown in Figures 7.1 and 7.2.

7.4.3 These plots show that the change in vehicle flows are widespread throughout the network, with the greatest increases in vehicle flow along the A50.

7.4.4 The mitigation package is forecast to reduce traffic flow along:

- T12 link road;
- Sections of the A5111;
- A5132; and
- Sections of A38.

7.4.5 The construction of a new junction on the A50 is forecast to significantly increase traffic along the A50 between Junction 3 and Junction 4 and through the local residential roads that lead to the junction. This is mainly a result of traffic using the proposed new junction on the A50 instead of the T12 link road.

Figure.7.1 Change in vehicle flows due to Mitigation Scenario 3 - AM Peak

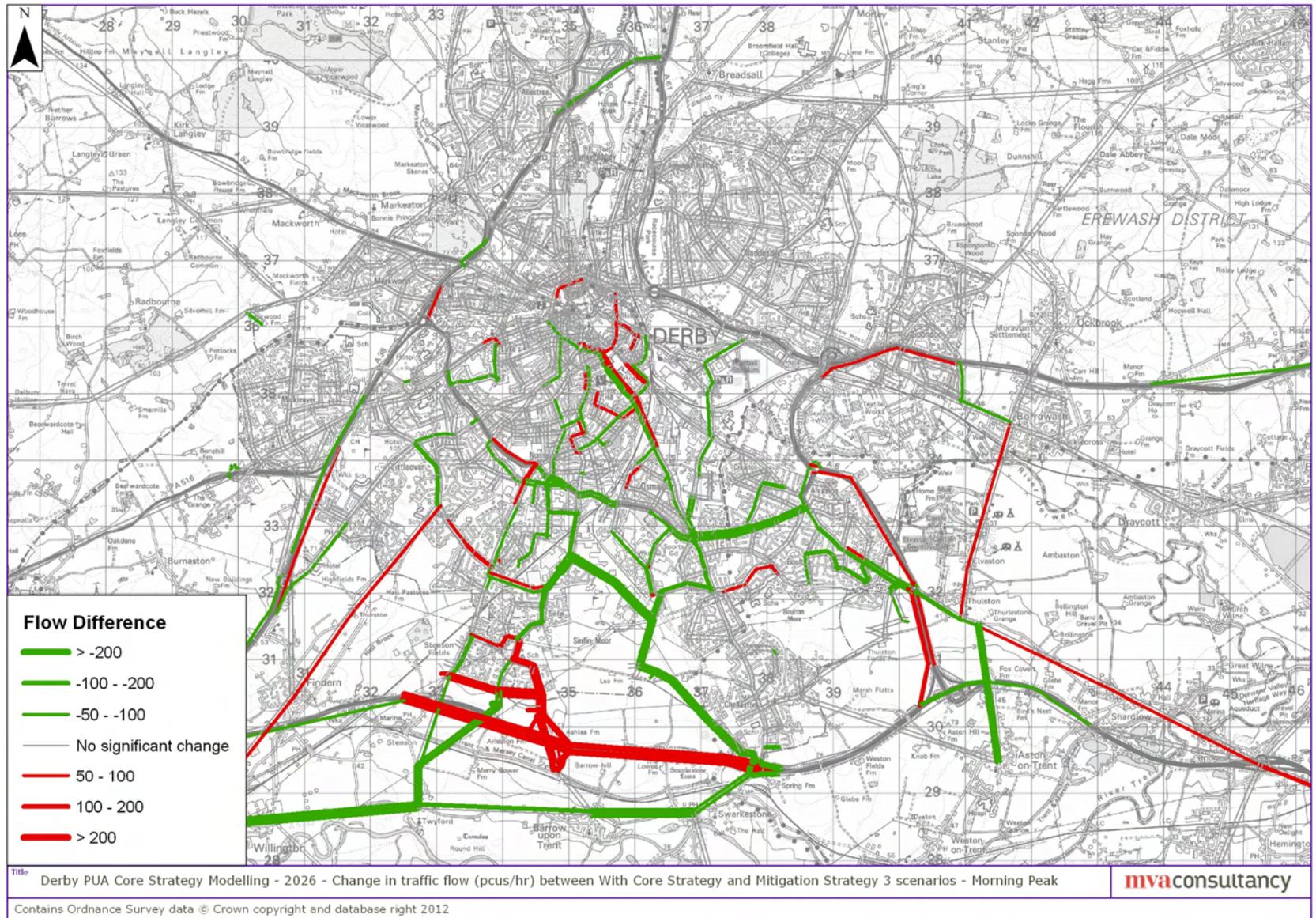
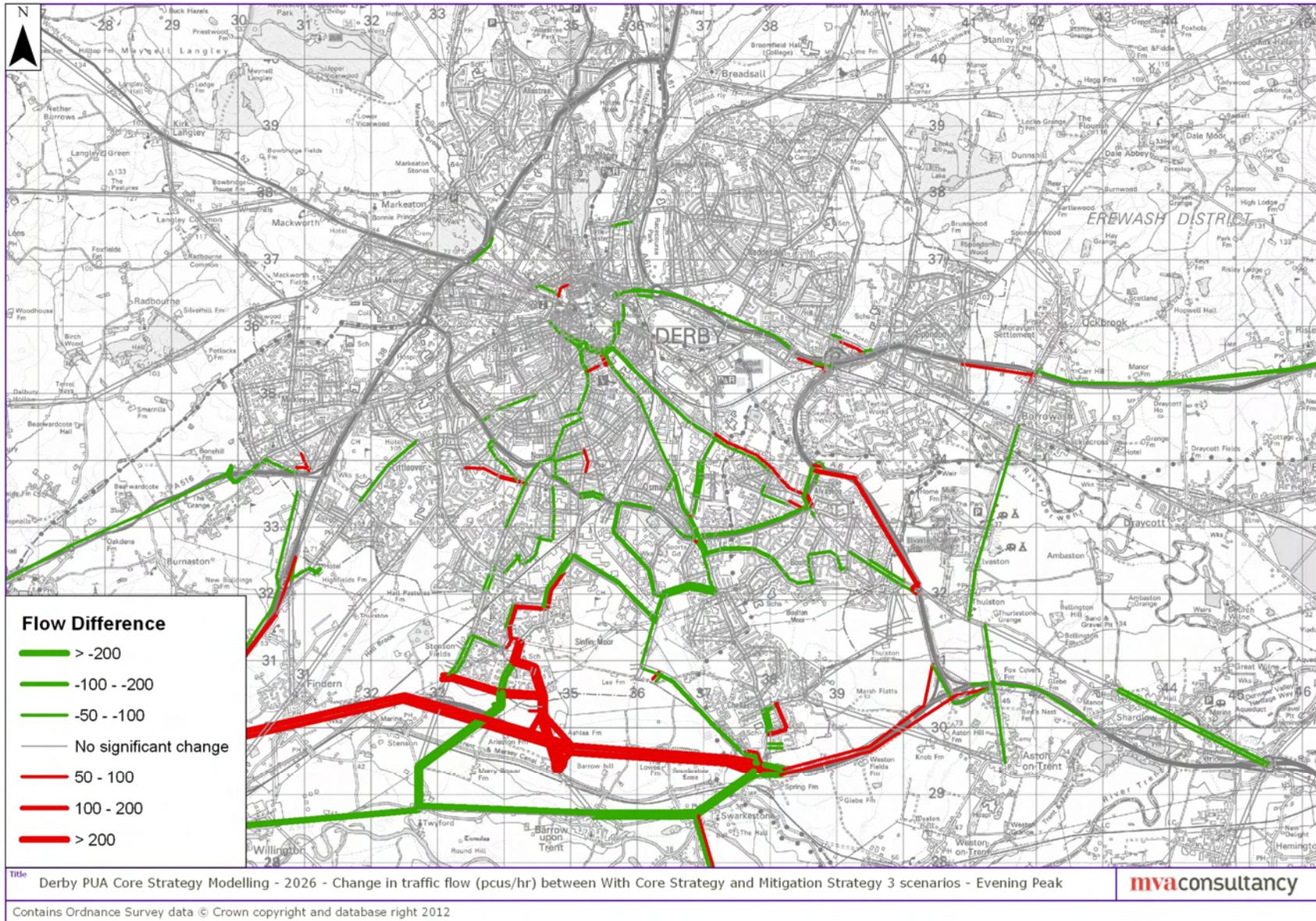


Figure.7.2 Reduction in Highway Flows due to Mitigation Scenario 3 - PM Peak



7.5 Volume / Capacity (V/C) plots

- 7.5.1 A V/C percentage of 85% is conventionally considered to be the threshold beyond that the junction approaches its effective traffic capacity. As V/C ratios increase above this level, there is an increasing likelihood of that drivers will observe perceptible increases in delays and queues at junctions which may affect their travel behaviour or routing patterns. . It will be these links/junctions which will be of most concern to the highway authorities. A V/C ratio in excess of 100% indicates that the junction is operating beyond its theoretical traffic capacity.
- 7.5.2 Figures 7.3 and 7.4 show the reduction in congestion as a result of Mitigation Package 3 at junctions which are congested in the potential Core Strategy no mitigation scenario.
- 7.5.3 The majority of junctions only receive a small reduction of less than 5% in congestion as a result of the Mitigation Scenario 3. However, the following areas have been identified as having a number of junctions with a significant reduction in congestion levels as a result of the mitigation package.
- Sinfin Lane;
 - Several junction along the A5111 Ring Road;
 - London Road; and
 - Uttoxeter New Road.
- 7.5.4 Figures 7.5 and 7.6 show the residual congestion plots for the AM and PM peaks respectively.

Figure.7.3 Reduction in congestion between the potential Core Strategy no mitigation scenario and Mitigation 3 for junctions with greater than 85% V/C ratio in the potential Core Strategy no mitigation scenario – AM Peak

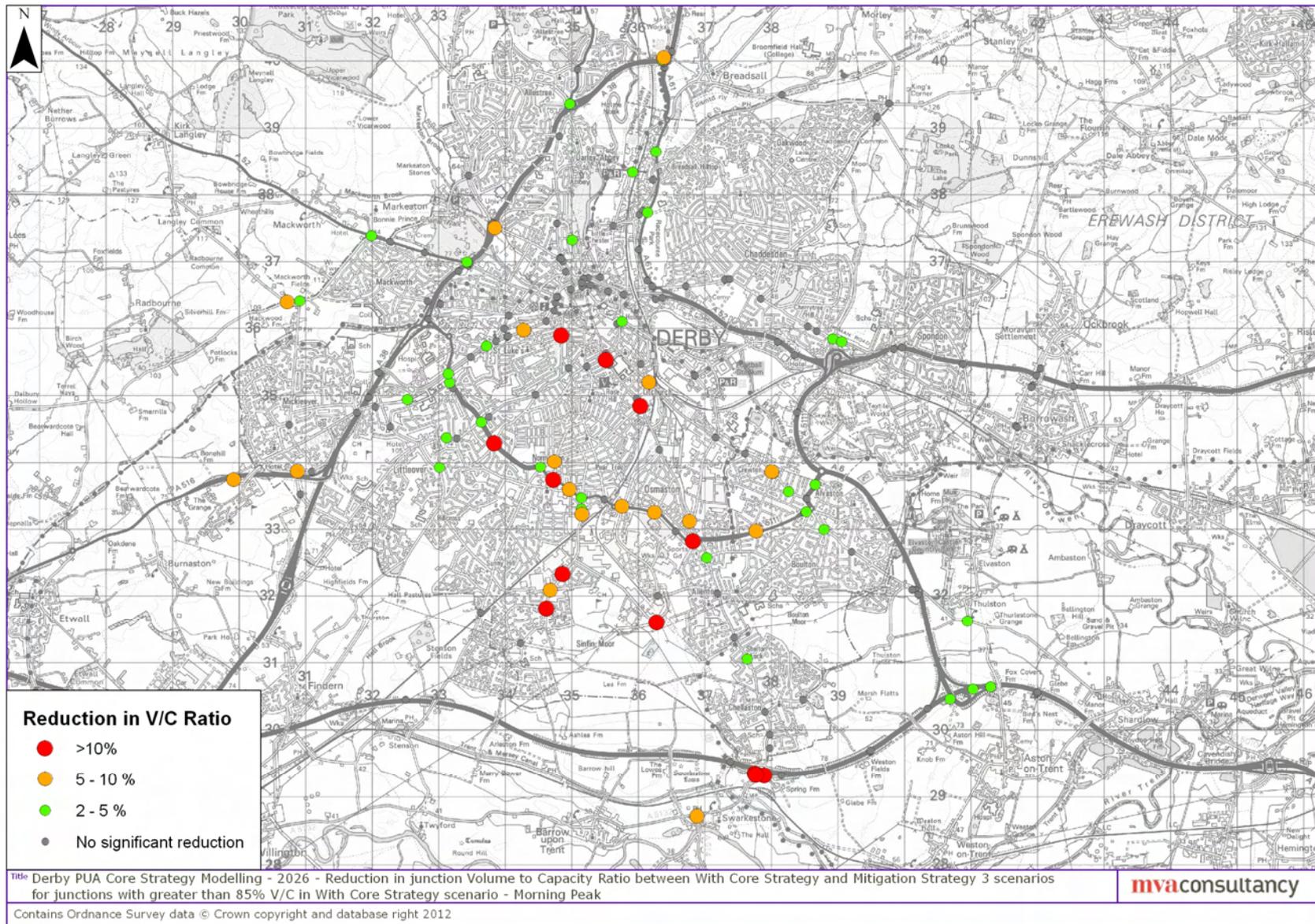


Figure.7.4 Reduction in congestion between the potential Core Strategy no mitigation scenario and Mitigation 3 for junctions with greater than 85% V/C ratio in the potential Core Strategy no mitigation scenario – PM Peak

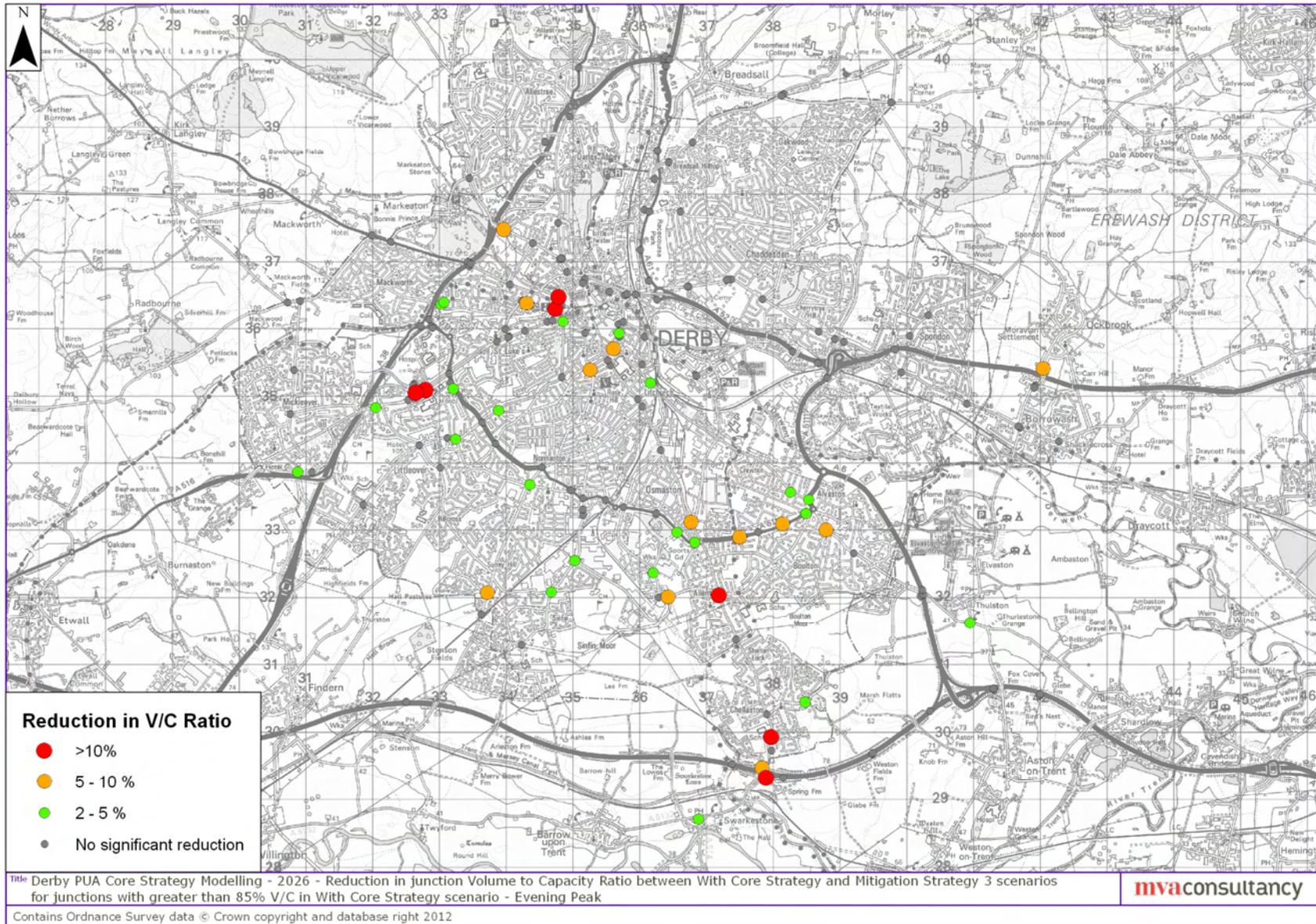


Figure 7.5 Residual Congestion Plot – AM Peak

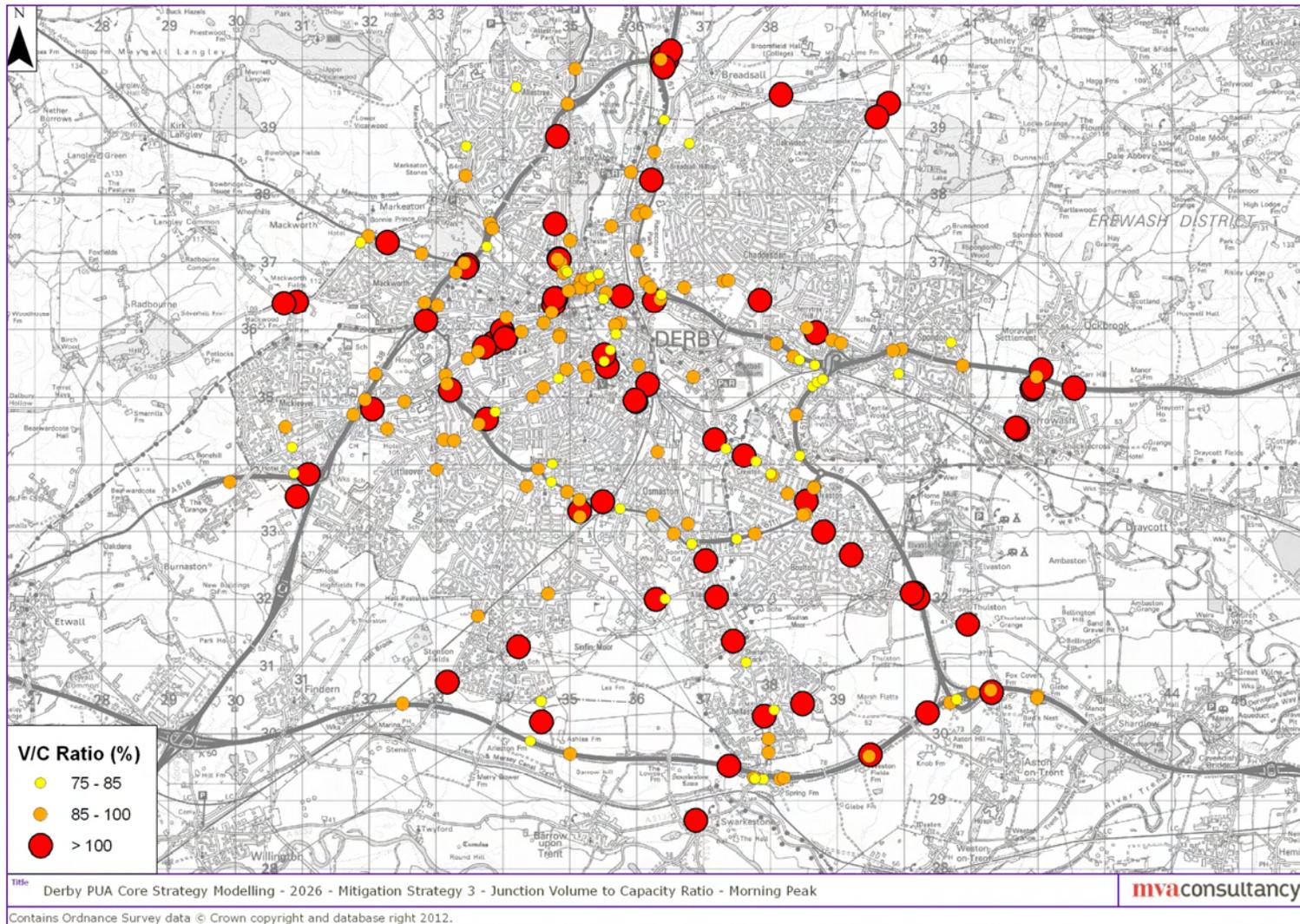
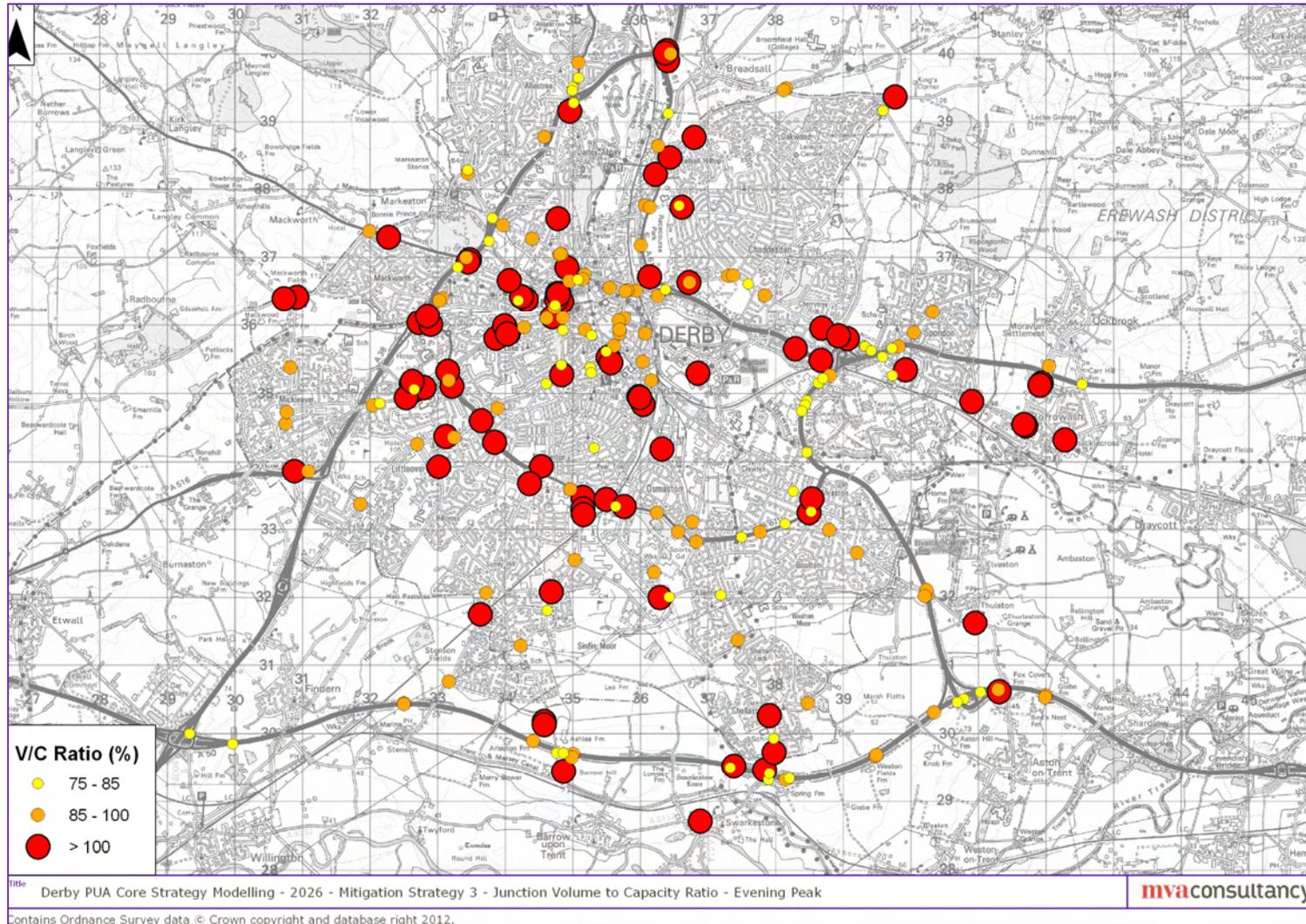


Figure 7.6 Residual Congestion Plot – PM Peak



8 Mitigation Scenario 4 – Test 2 + A50 Junction

8.1 Introduction

8.1.1 This chapter presents the main outputs from Mitigation Scenario 4 which consists of:

- Mitigation measures tested as part of mitigation test 2; and
- The new junction at the A50 as tested in scenario 3.

8.2 Global Indicators

8.2.1 The following section presents highway indicators for the whole of the Core Strategy Area to provide a way of gauging the overall impact the potential Core Strategy sites and the impacts of Mitigation Package 3 on the full ACS area. A brief explanation of each indicator is provided below.

- **Average speed** - expressed as kilometres per hour for all traffic within the highway model simulation area. Increased traffic levels should lead to more delays resulting in lower average speeds.
- **Over capacity queues** - Time spent queuing at junctions that are over capacity. As traffic levels increase we expect to see a growing number of junctions reaching capacity and the time spent queuing at these over capacity junctions increasing.
- **Total Travel Time (pcu-hrs)** – Overall travel time for all trips during the peak hours.
- **Total Travel Distance (pcu-kms)** – Overall travel distance for all trips during the peak hours.
- **Severity Index**- this indicator has been developed by MVA and takes account of the length of the roads affected by congestion, number of vehicles affected by congestion and also the level of congestion. This indicator is a number (without a unit) and gives a realistic indication of levels and severity of congestion in any particular scenario. This index only shows severity along the roads which are at, above or approaching capacity.
- **Environmental Indicators** – carbon emissions predicted from the highway model outputs.

8.2.2 Table 8.1 shows the performance of the mitigation package against the global highway indicators. It also shows the level of mitigation achieved with the mitigation package in place.

8.2.3 In terms of average speed, the mitigation package is forecast to mitigate around 48% of the impacts of the development strategy across both peak hours, and therefore the speed reduction impacts are not fully mitigated.

8.2.4 Against the congestion indicator, the mitigation achieved by the package is 42% in the AM peak and 38% in the PM peak.

8.2.5 In the AM peak, the mitigation package is forecast to fully mitigate the impacts of the development strategy in terms of severity index. However, the mitigation level is only 32% in the PM peak which is lower than Mitigation 2 which does not include the A50 junction. This is due to the levels of traffic that relocate to the area as a result of the A50 junction which reduce the effectiveness of the highway mitigation strategy in addressing the congestion issues associated with the potential Core Strategy sites.

Table 8.1 Global Highway Indicators – Mitigation Scenario 4

	AM Peak			
	Reference Case	Core Strategy (no mitigation)	Mitigation Scenario 4	% Mitigated
Average Speeds	38	36	37	48%
Over Capacity Queues	772	1,290	1,071	42%
Total Travel Time	14,849	16,544	15,720	49%
Total Travel Distance	566,599	594,231	581,210	47%
Severity Index	322	352	310	137%
	PM Peak			
	Reference Case	Core Strategy (no mitigation)	Mitigation Scenario 4	% Mitigated
Average Speeds	38	35	36	48%
Over Capacity Queues	837	1,448	1,218	38%
Total Travel Time	15,566	17,524	16,786	38%
Total Travel Distance	583,652	617,280	608,845	25%
Severity Index	211	258	243	32%

8.3 Carbon Emissions Indicator

8.3.1 The impact of each of the options on greenhouse gas emissions has been measured using the MVA Environmental Appraisal software, *ENEVAL*. This software provides an indication of the main carbon dioxide equivalent emission impacts caused by road traffic on a network wide basis. The ENEVAL results for different schemes have been compared to highlight how carbon dioxide equivalent emissions change by scenario.

8.3.2 Table 8.2 provides a summary of the change in carbon dioxide equivalent values as a result of Mitigation Strategy 4.

- 8.3.3 The mitigation package is forecast to mitigate 70% of the Carbon based environmental impacts of the development strategy.

Table 8.2 Carbon Emissions – Mitigation Scenario 4

	Reference Case	Core Strategy No Mitigation	Mitigation Scenario 4	% Mitigation
Annual CO ₂ (tonnes)	427,504	437,582	430,525	70%

8.4 General Highway Impacts

- 8.4.1 The following section of the report presents a series of highway plots which highlight the impact that Mitigation Package 4 has on reducing the transportation impacts of the potential Core Strategy sites. The following indicators are provided;

- **Flow Change** – Predicted changes in traffic flow levels on the highway network.
- **Volume/ Capacity plots** – these show the levels of congestion at junctions in 2026 with Mitigation Package 4 in place and also the change in congestion relative to the No Mitigation Scenario.

Flow Change

- 8.4.2 The levels of flow change on the network as a result of the Mitigation Strategy 4 are shown in Figures 8.1 and 8.2.
- 8.4.3 The combination of the new Southern Derby Link Road along with the junction at the A50 is forecast to provide relief to the southern and south-western areas of Derby by accommodating traffic from major southern radial routes and also the A50.
- 8.4.4 The mitigation package is forecast to reduce traffic flow along:
- T12 link road;
 - Wilmore Road;
 - Sinfin Lane;
 - Pastures Hill;
 - Blagreaves Lane; and
 - The A5132.
- 8.4.5 The improvements at the Stenson Road bridge, provision of South Derby Link Road and the new junction at the A50 turns Stenson Road as a more attractive radial, resulting in significant increase in traffic flow into this area using these routes.

Figure.8.1 Change in vehicle flows due to Mitigation Scenario 4 - AM Peak

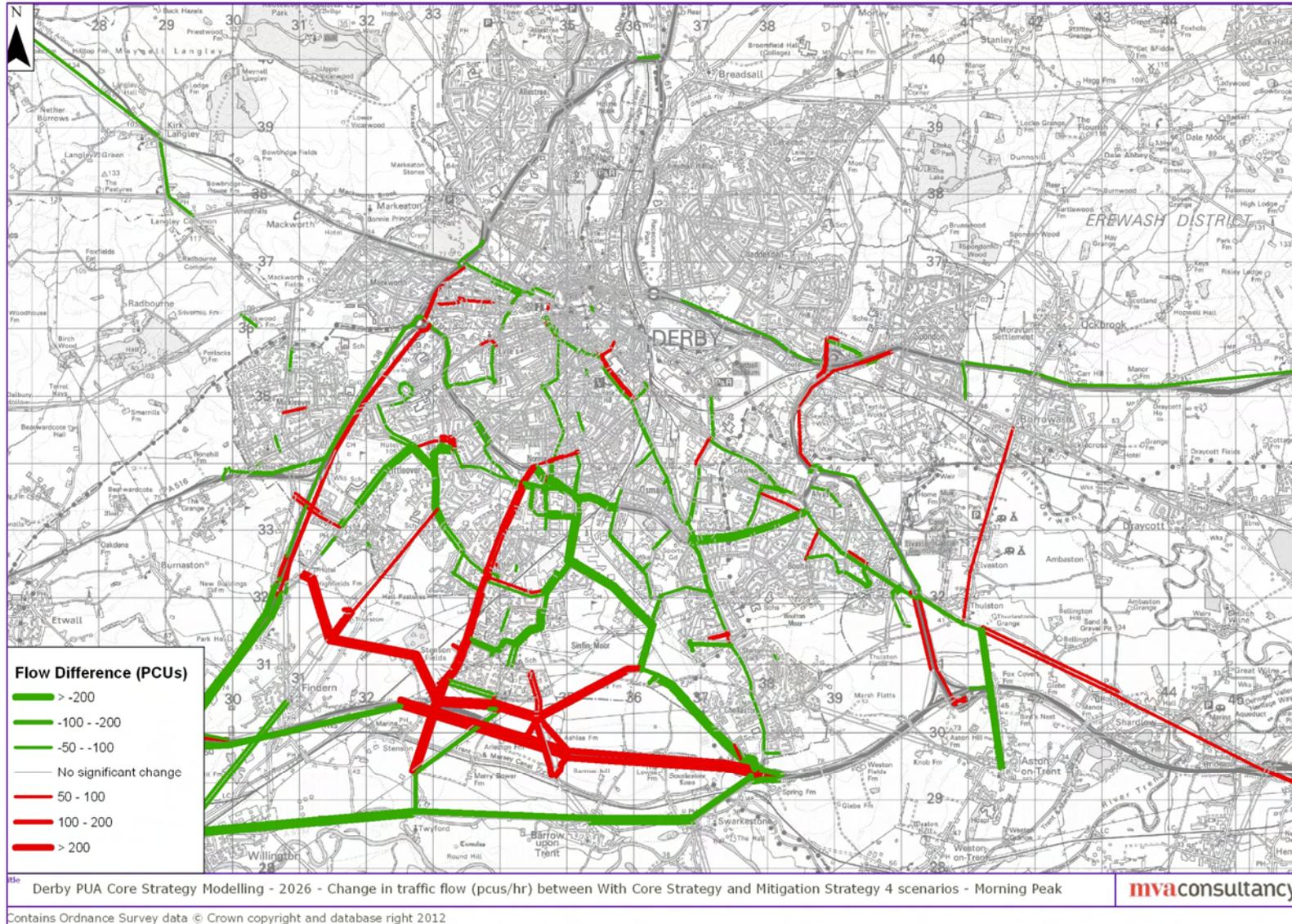
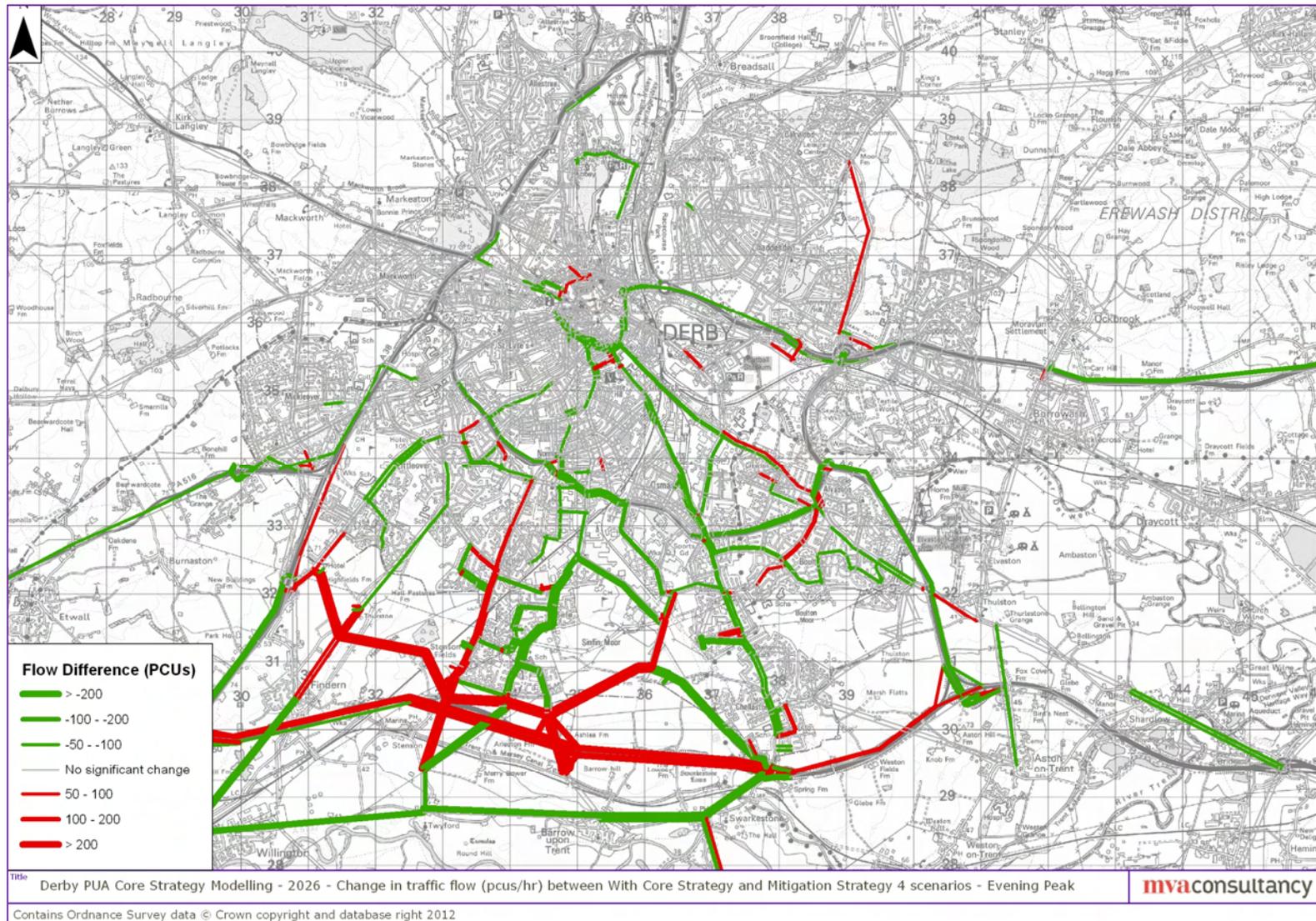


Figure.8.2 Reduction in Highway Flows due to Mitigation Scenario 4 - PM Peak



8.5 Volume / Capacity (V/C) plots

- 8.5.1 A V/C percentage of 85% is conventionally considered to be the threshold beyond that the junction approaches its effective traffic capacity. As V/C ratios increase above this level, there is an increasing likelihood of that drivers will observe perceptible increases in delays and queues at junctions which may affect their travel behaviour or routing patterns. . It will be these links/junctions which will be of most concern to the highway authorities. A V/C ratio in excess of 100% indicates that the junction is operating beyond its theoretical traffic capacity.
- 8.5.2 Figures 8.3 and 8.4 show the reduction in congestion as a result of Mitigation Package 4 at junctions which are congested in the potential Core Strategy no mitigation scenario.
- 8.5.3 The following areas have been identified as having a number of junctions with a significant reduction in congestion levels as a result of the mitigation package.
- The A514 radial route into Derby City Centre;
 - Sinfin Lane;
 - Several junction along the A5111 Ring Road;
 - London Road; and
 - Uttoxeter New Road
- 8.5.4 Figures 8.5 and 8.6 show the residual congestion plots for the AM and PM peaks respectively.

Figure 8.3 Reduction in congestion between the potential Core Strategy no mitigation and Mitigation 4 for junctions with greater than 85% V/C ratio in the potential Core Strategy no mitigation scenario – AM Peak

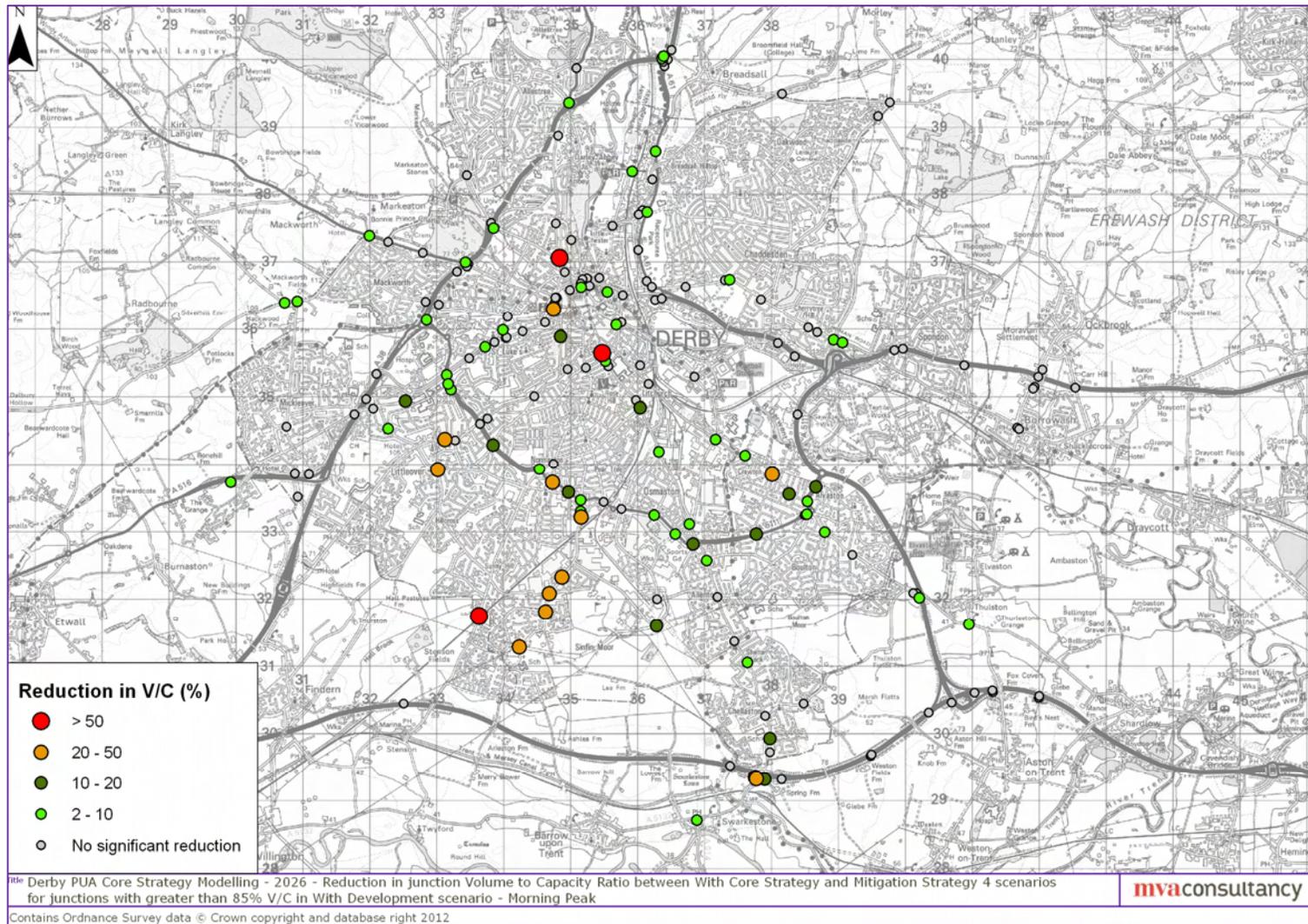


Figure 8.4 Reduction in congestion between with potential Core Strategy no mitigation and Mitigation 4 for junctions with greater than 85% V/C ratio in the potential Core Strategy no mitigation scenario – PM Peak

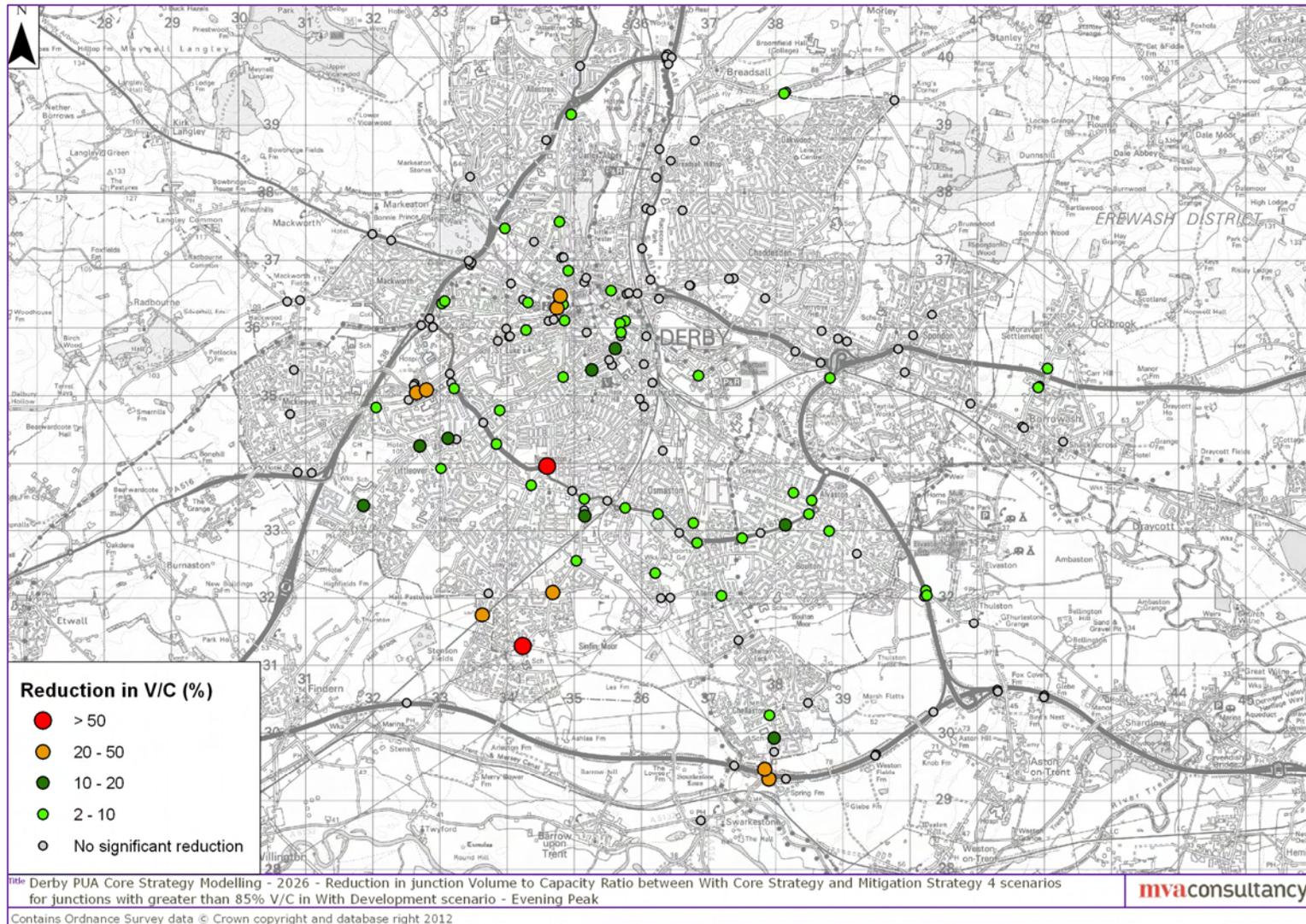


Figure 8.5 Residual Congestion Plot – AM Peak

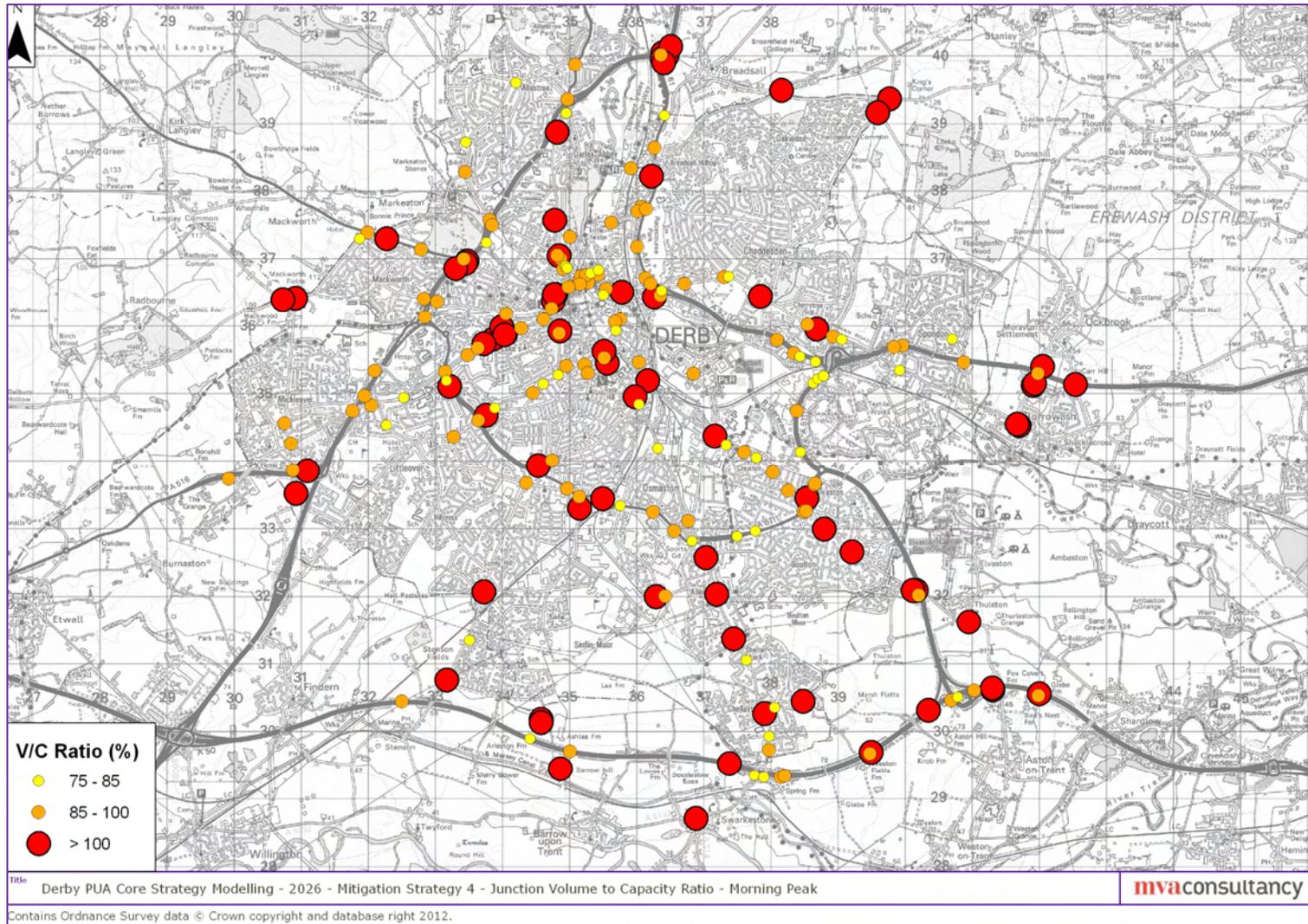
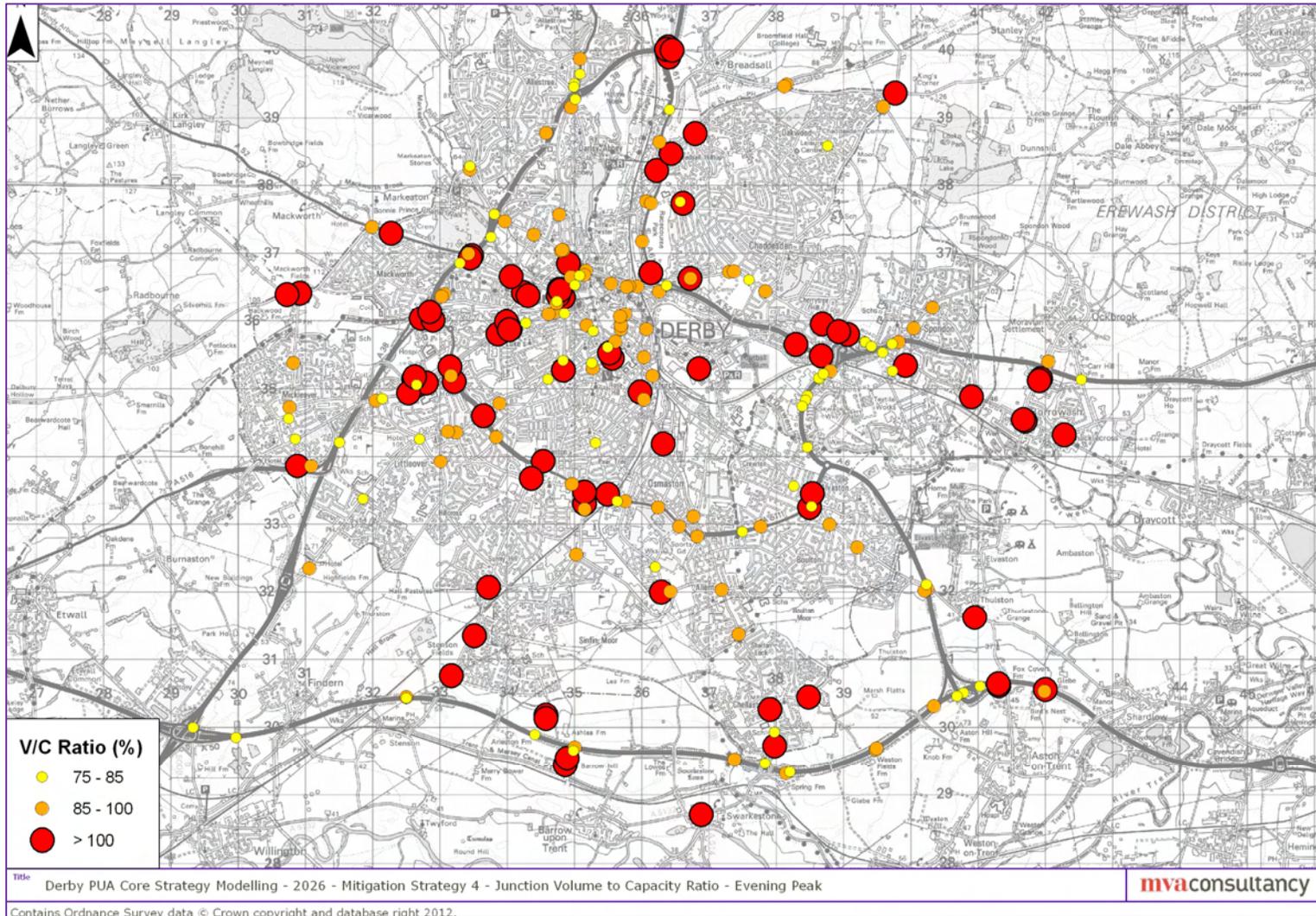


Figure 8.6 Residual Congestion Plot – PM Peak



9 Mitigation Scenario 5 – A38 Grade Separation

9.1 Introduction

9.1.1 This chapter presents the main outputs from Mitigation Scenario 5 which consists of:

- Mitigation measures tested as part of mitigation test 4; and
- Grade separation of A38 junctions with A61, A52 and A5111.

9.2 Global Indicators

9.2.1 The following section presents highway indicators for the whole of the Core Strategy Area to provide a way of gauging the overall impacts of the potential Core Strategy sites and the impacts of Mitigation Package 3 on the full ACS area. A brief explanation of each indicator is provided below.

- **Average speed** - expressed as kilometres per hour for all traffic within the highway model simulation area. Increased traffic levels should lead to more delays resulting in lower average speeds.
- **Over capacity queues** - Time spent queuing at junctions that are over capacity. As traffic levels increase we expect to see a growing number of junctions reaching capacity and the time spent queuing at these over capacity junctions increasing.
- **Total Travel Time (pcu-hrs)** – Overall travel time for all trips during the peak hours.
- **Total Travel Distance (pcu-kms)** – Overall travel distance for all trips during the peak hours.
- **Severity Index**- this indicator has been developed by MVA and takes account of the length of the roads affected by congestion, number of vehicles affected by congestion and also the level of congestion. This indicator is a number (without a unit) and gives a realistic indication of levels and severity of congestion in any particular scenario. This index only shows severity along the roads which are at, above or approaching capacity.
- **Environmental Indicators** – carbon emissions predicted from the highway model outputs.

9.2.2 Table 9.1 shows the performance of the mitigation package against the global highway indicators. It also shows the level of mitigation achieved with the mitigation package in place.

9.2.3 In terms of average speed, the mitigation package is forecast to fully mitigate the impacts of the development strategy in both peak hours.

9.2.4 Against the congestion indicator, the mitigation achieved by the package is 128% in the AM peak and 88% in the PM peak.

9.2.5 In the AM peak, the mitigation package is forecast to fully mitigate the impacts of the development strategy in terms of severity index. However, the mitigation is 14% in the PM peak. This is due to the A38 becoming more attractive route for traffic that does not have an origin or destination

within Derby and is just passing through the area, resulting in increase in traffic flow which translates into higher levels of severity index.

Table 9.1 Global Highway Indicators – Mitigation Scenario 5

	AM Peak			
	Reference Case	Core Strategy (no mitigation)	Mitigation Scenario 5	% Mitigated
Average Speeds	38	36	39	152%
Over Capacity Queues	772	1,290	628	128%
Total Travel Time	14,849	16,544	15,379	69%
Total Travel Distance	566,599	594,231	605,562	-41%
Severity Index	322	352	322	100%
	PM Peak			
	Reference Case	Core Strategy (no mitigation)	Mitigation Scenario 5	% Mitigated
Average Speeds	38	35	38	104%
Over Capacity Queues	837	1,448	910	88%
Total Travel Time	15,566	17,524	16,702	42%
Total Travel Distance	583,652	617,280	627,918	-32%
Severity Index	211	258	251	14%

9.3 Carbon Emissions Indicator

- 9.3.1 The impact of each of the options on greenhouse gas emissions has been measured using the MVA Environmental Appraisal software, *ENEVAL*. This software provides an indication of the main carbon dioxide equivalent emission impacts caused by road traffic on a network wide basis. The *ENEVAL* results for different schemes have been compared to highlight how carbon dioxide equivalent emissions change by scenario.
- 9.3.2 Table 9.2 provides a summary of the change in carbon dioxide equivalent values as a result of Mitigation Strategy 5.
- 9.3.3 The mitigation package is forecast to mitigate 75% of the Carbon related environmental impacts of the development strategy.

Table 9.2 Carbon Emissions – Mitigation Scenario 5

	Reference Case	Core Strategy No Mitigation	Mitigation Scenario 5	% Mitigation
Annual CO ₂ (tonnes)	427,504	437,582	430,034	75%

9.4 General Highway Impacts

9.4.1 The following section of the report presents a series of highway plots which highlight the impact that Mitigation Package 5 has on reducing the transportation impacts of the potential Core Strategy sites. The following indicators are provided;

- **Flow Change** – Predicted changes in traffic flow levels on the highway network.
- **Volume/ Capacity plots** – these show the levels of congestion at junctions in 2026 with Mitigation Package 3 in place and also the change in congestion relative to the No Mitigation Scenario.

Flow Change

9.4.2 The levels of flow reduction on the network as a result of the Mitigation Strategy 5 are shown in Figures 9.1 and 9.2.

9.4.3 The grade separation of the A38 junctions makes it a more attractive route for through traffic, resulting in significant increase in traffic flow.

9.4.4 The other roads forecast to have significant increases in traffic, compared to the no mitigation scenario, include:

- Stenson Road – the increase is attributed to the widening of the Railway bridge resulting in better attractiveness for travel;
- the A5111 Ring Road between Stenson Road and A38; and
- the A50 between Osmaston Road and the new junction.

9.4.5 The provision of the South Derby Link Road, like mitigation scenarios 2 and 4, provides relief to a wide area in south and south west Derby. The benefiting roads include:

- A5111 Ring Road west of Stenson Road junction;
- A514 Osmaston Road;
- Burton Road;
- Rykneld Road;
- Sinfin Lane; and

T12 Link Road.

Figure 9.1 Reduction in Highway Flows due to Mitigation Scenario 5 - AM Peak

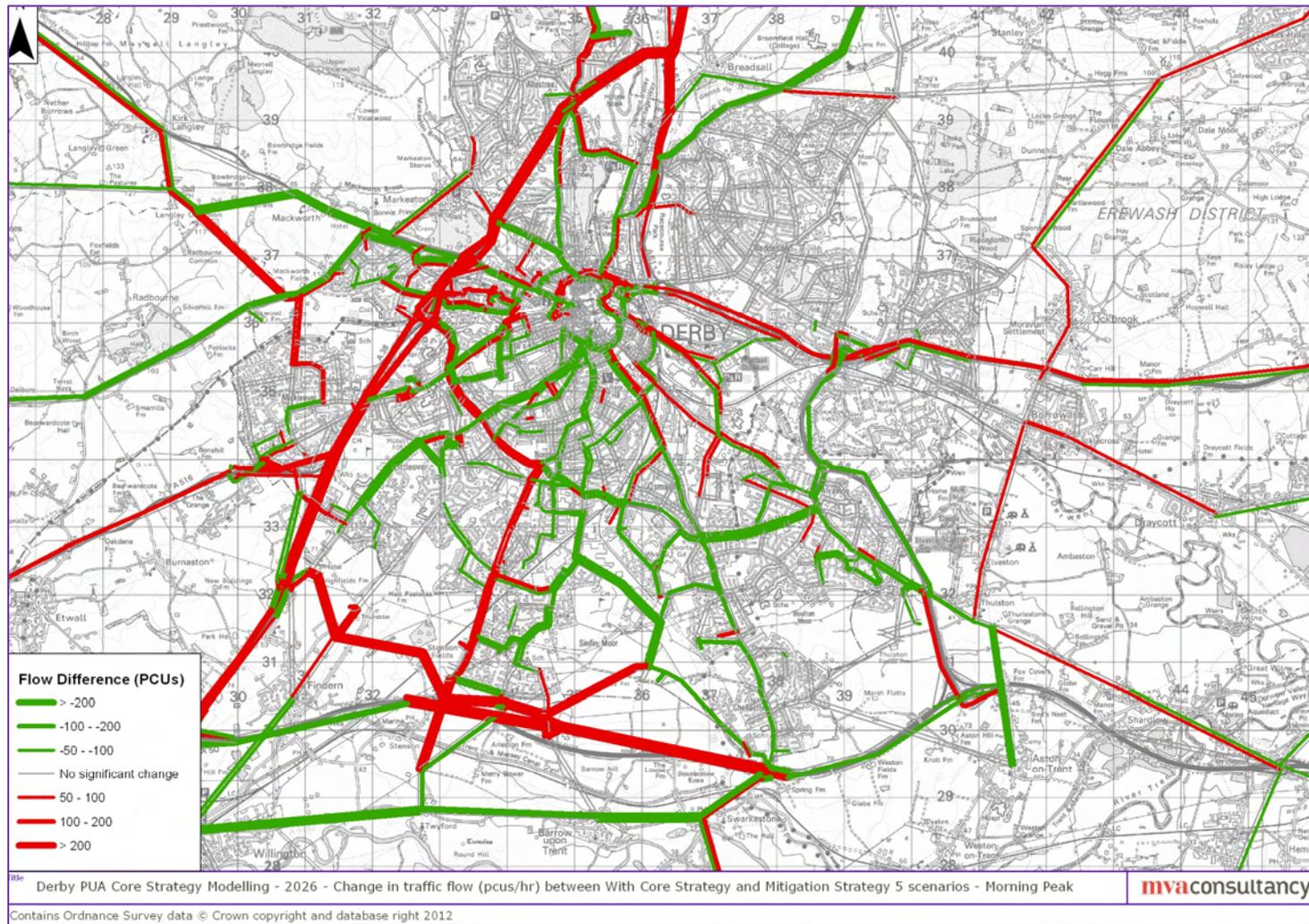
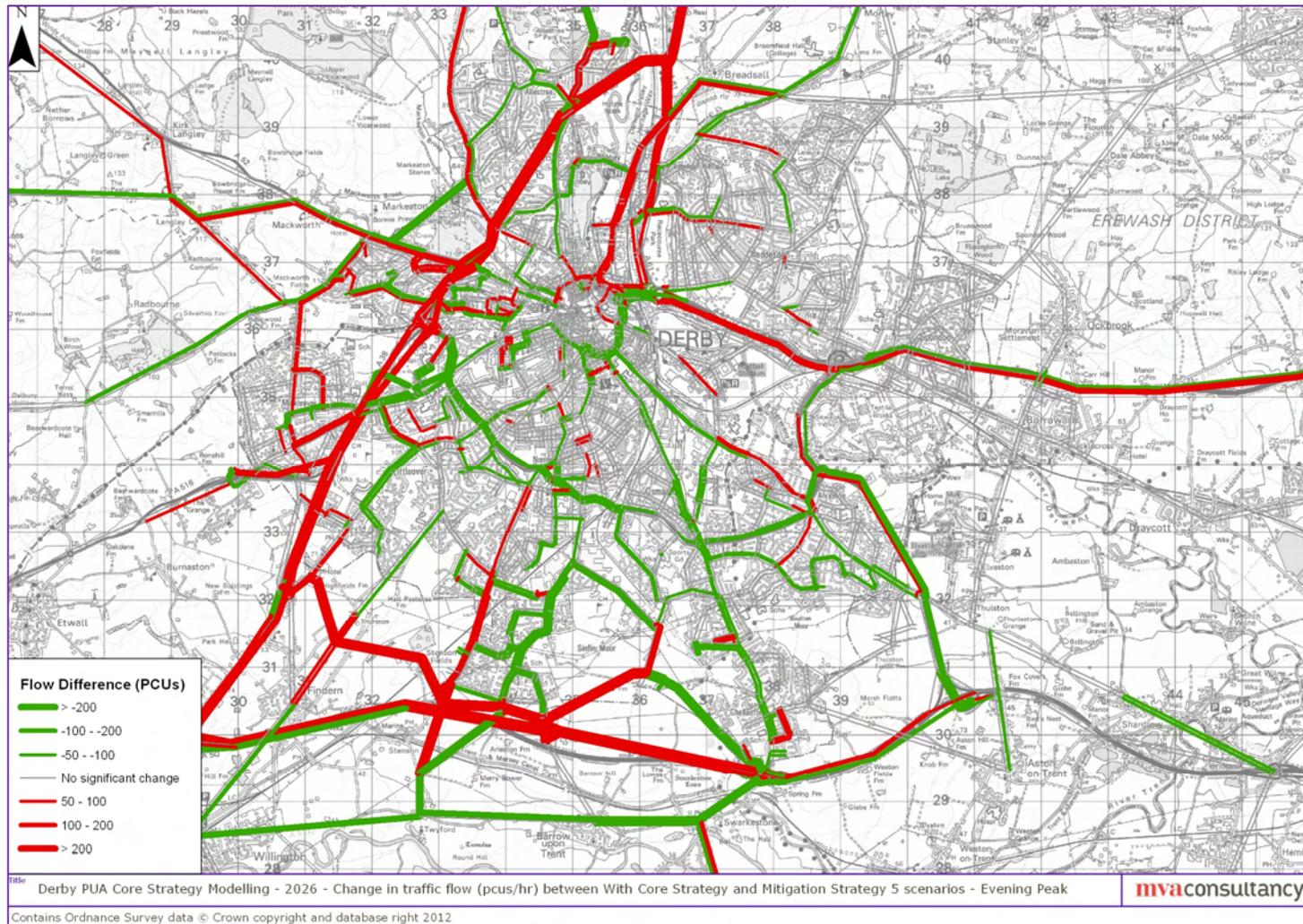


Figure 9.2 Reduction in Highway Flows due to Mitigation Scenario 5 - PM Peak



9.5 Volume / Capacity (V/C) plots

- 9.5.1 A V/C percentage of 85% is conventionally considered to be the threshold beyond that the junction approaches its effective traffic capacity. As V/C ratios increase above this level, there is an increasing likelihood of that drivers will observe perceptible increases in delays and queues at junctions which may affect their travel behaviour or routing patterns. It will be these links/junctions which will be of most concern to the highway authorities. A V/C ratio in excess of 100% indicates that the junction is operating beyond its theoretical traffic capacity.
- 9.5.2 Figures 9.3 and 9.4 show the reduction in congestion as a result of Mitigation Package 5 at junctions which are congested in the potential Core Strategy no mitigation scenario.
- 9.5.3 The A38 grade separation, alongwith other mitigation measures, provides congestion relief to a wide area within and around Derby. The main roads/areas benefitting from this relief include:
- Derby City Centre;
 - The 'grade-separated' junctions along the A38;
 - Uttoxeter New Road;
 - Burton Road;
 - Sinfin Lane;
 - Osmaston Road;
 - London Road; and
 - Various junctions along the A5111 Ring Road.
- 9.5.4 Figures 9.5 and 9.6 show the residual congestion plots for the AM and PM peaks respectively.

Figure 9.3 Reduction in congestion between with potential Core Strategy no mitigation and Mitigation 5 for junctions with greater than 85% V/C ratio in the potential Core Strategy no mitigation scenario – AM Peak

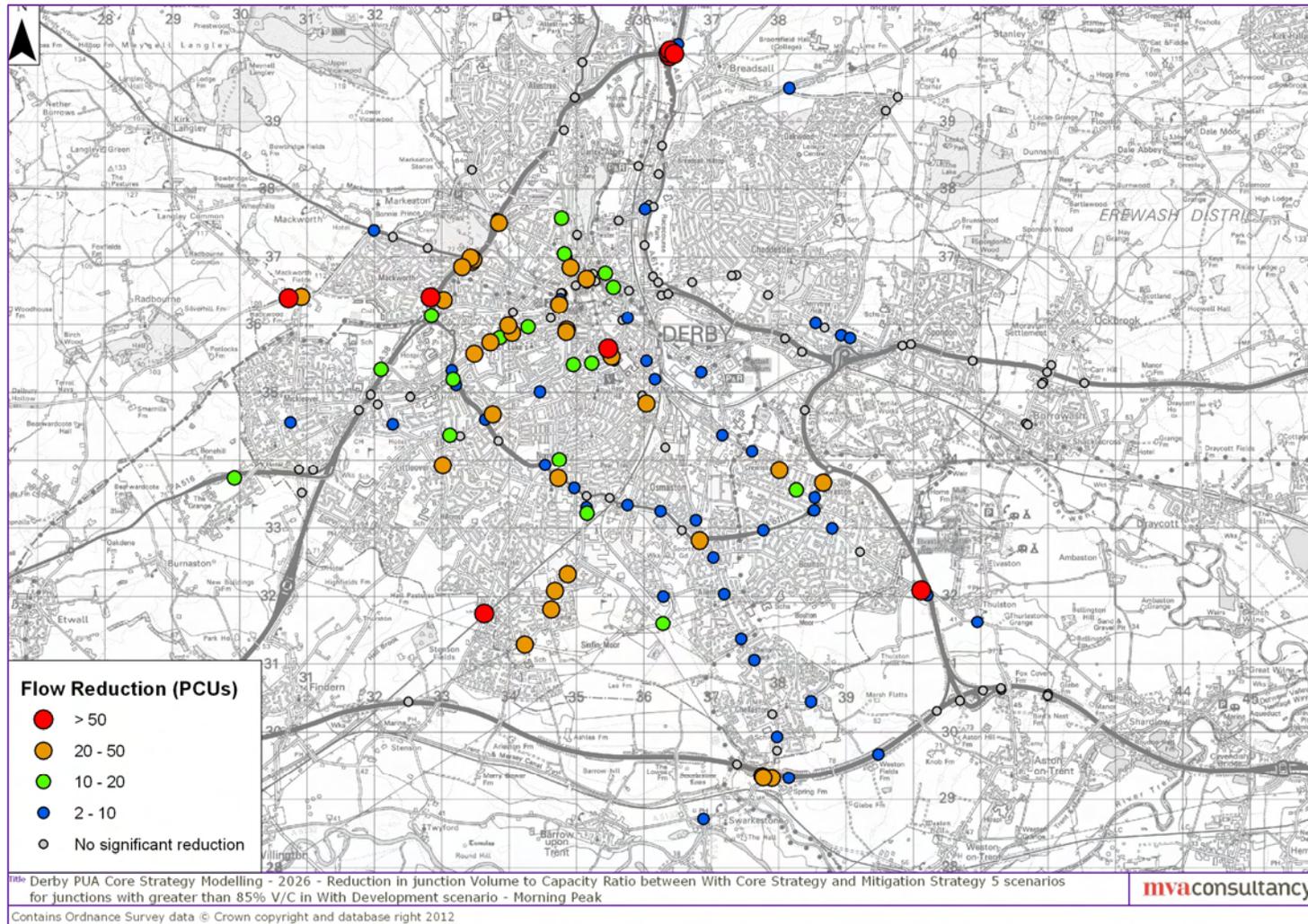


Figure 9.4 Reduction in congestion between with potential Core Strategy no mitigation and Mitigation 5 for junctions with greater than 85% V/C ratio in the potential Core Strategy no mitigation scenario – PM Peak

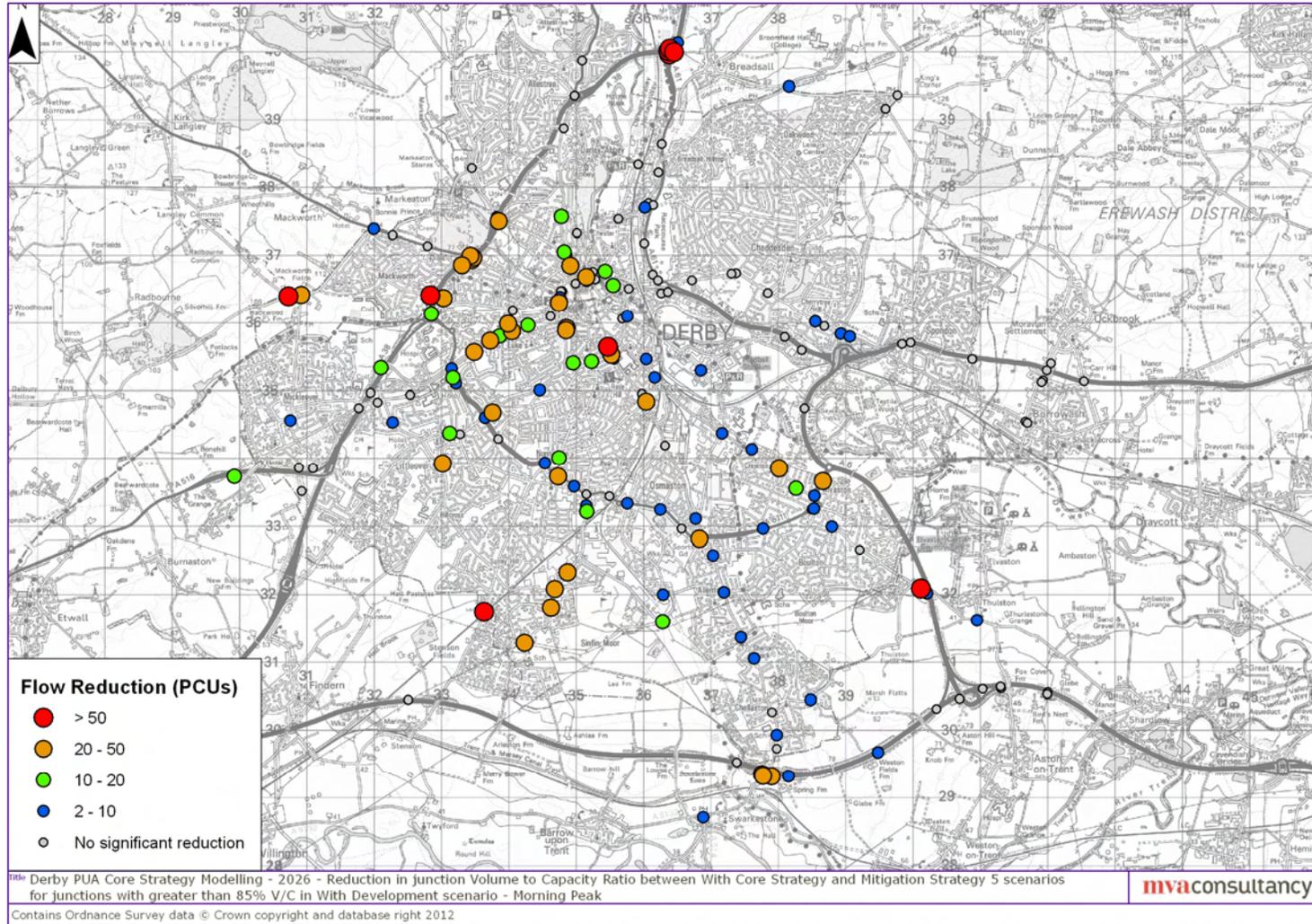


Figure 9.5 Residual Congestion Plot – AM Peak

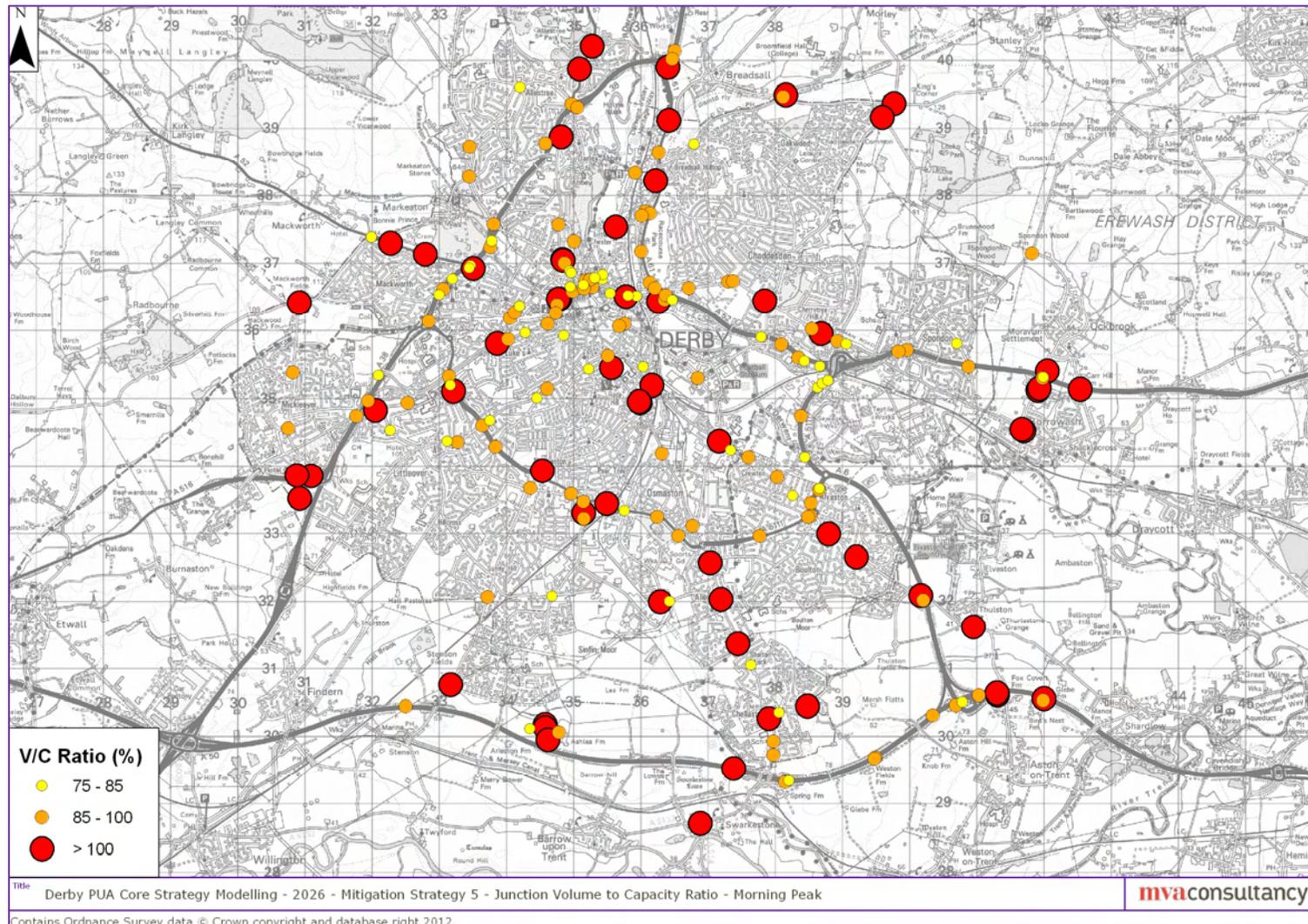
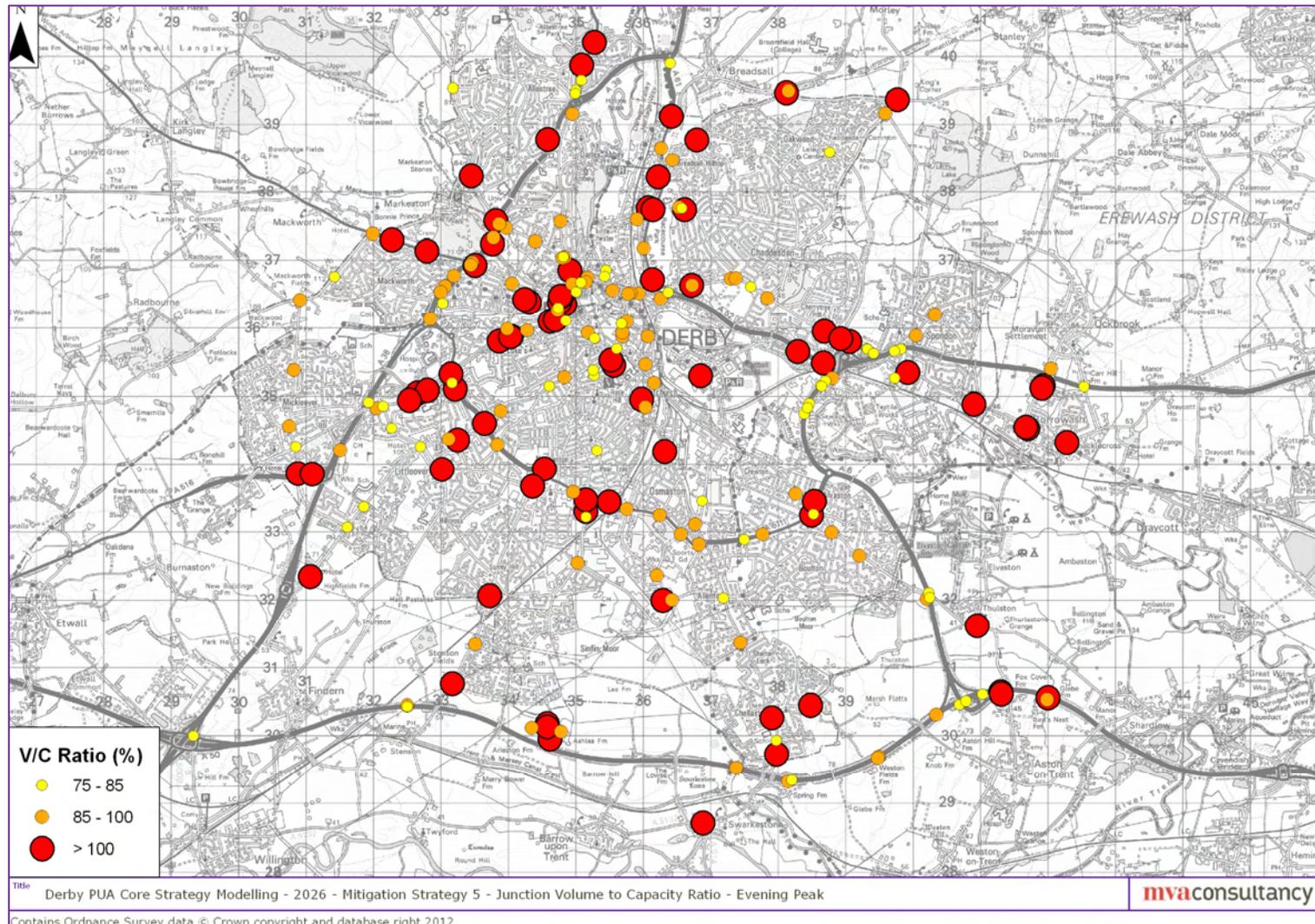


Figure 9.6 Residual Congestion Plot – PM Peak



9.6 Impact of A38 Grade Separation

9.6.1 Figures 9.7 and 9.8 show the flow difference plots for Mitigation Test 5 compared with Mitigation Test 4, thus showing the impact of the A38 grade separation on the highway network in and around Derby.

9.6.2 During the AM peak, the grade separation of the A38 junctions is forecast to increase traffic along the following roads:

- The A38;
- The A61;
- Sections of the A5111 Ring Road;
- The new South Derby Link Road; and
- The A50.

9.6.3 During the PM peak, the roads forecast to witness increase in traffic (as a result of the grade separation) include the A38, the A50 and the A61 as the reduction in congestion along this section of the A38 draws longer distance traffic to the route utilising these main roads. The most significant rerouting is from the M1 to the A38. This has been discussed in section 9.7.

9.6.4 The following roads are forecast to witness significant reduction in flow in the AM peak as a result of the grade separation of A38 junctions:

- A52 east of A38;
- Radbourne Lane;
- Rykneld Road;
- Burton Road;
- T12 Link Road;
- Sections of A5111 Ring Road east of Stenson Road junction;
- Wilmore Road; and
- Grampian Way.

9.6.5 In the PM peak, the following roads are expected to see decrease in traffic:

- A5111 Ring Road;
- Sections of Inner Ring Road;
- T12 Link Road;
- Wilmore Road;
- A5132; and
- Uttoxeter New Road.

9.6.6 The impact of the grade separation is more wide-spread in the AM peak than the PM peak.

Figure 9.7 AM Peak Flow Difference Profile – Mitigation Test 5 compared to Mitigation Test 4

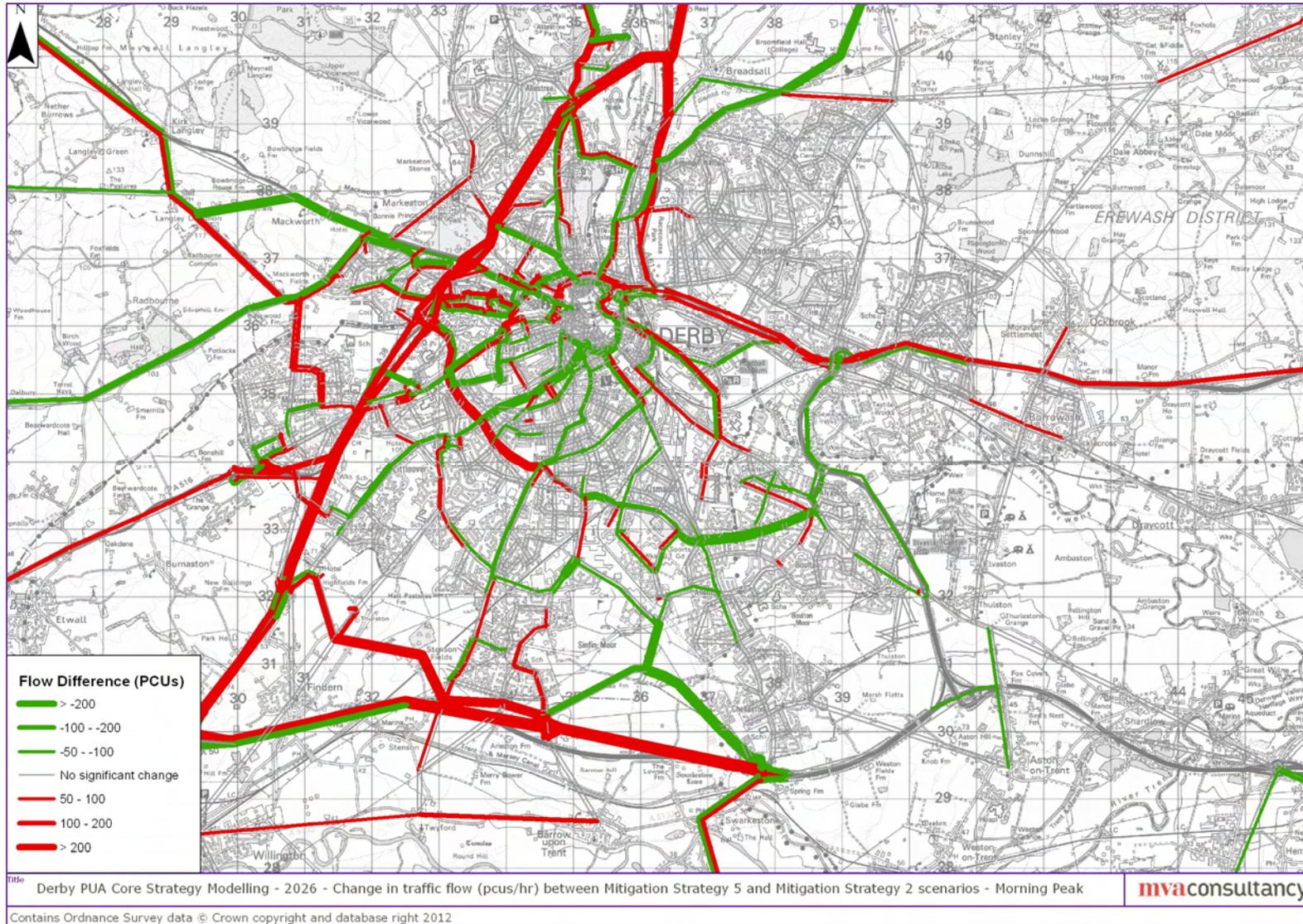
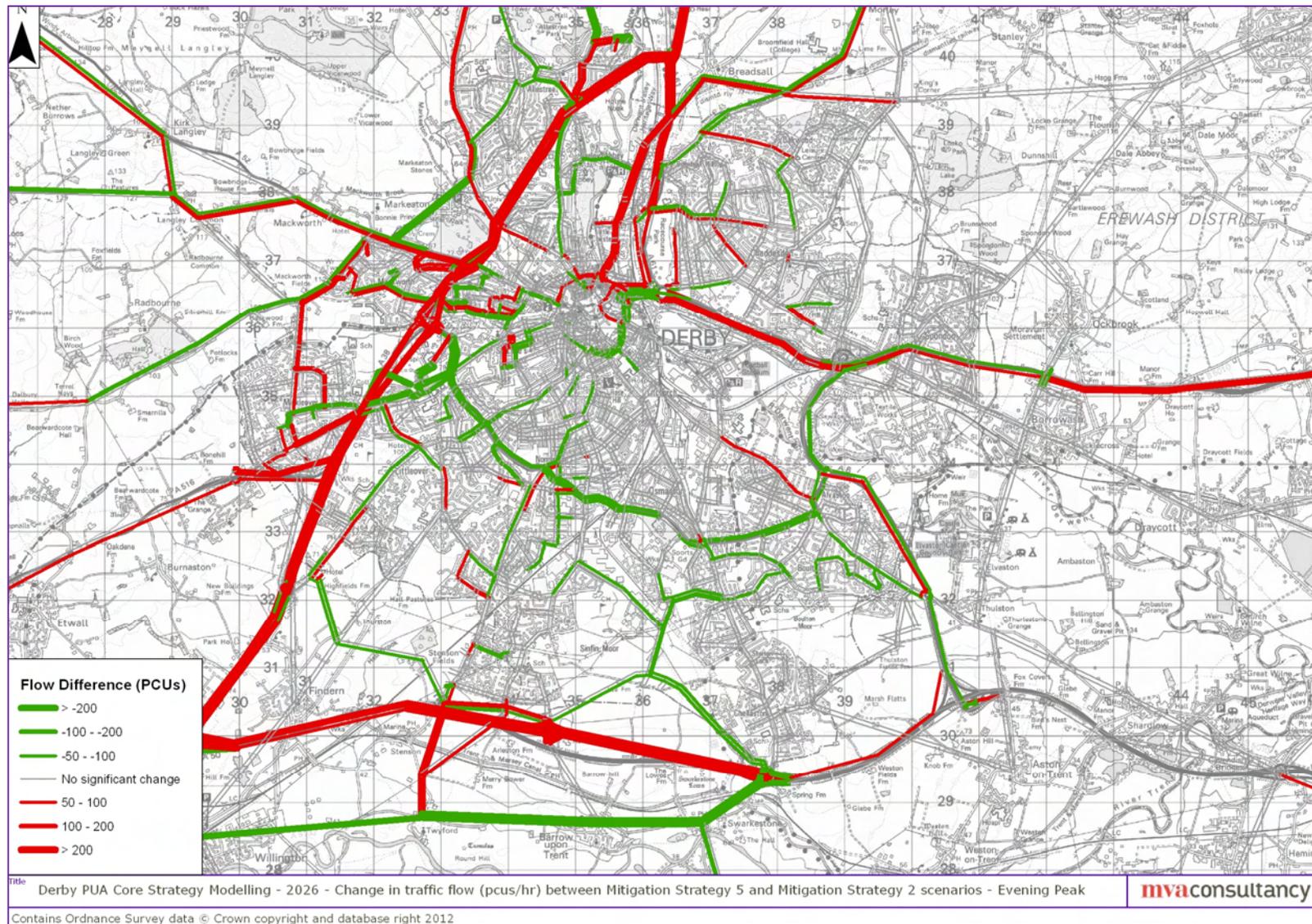


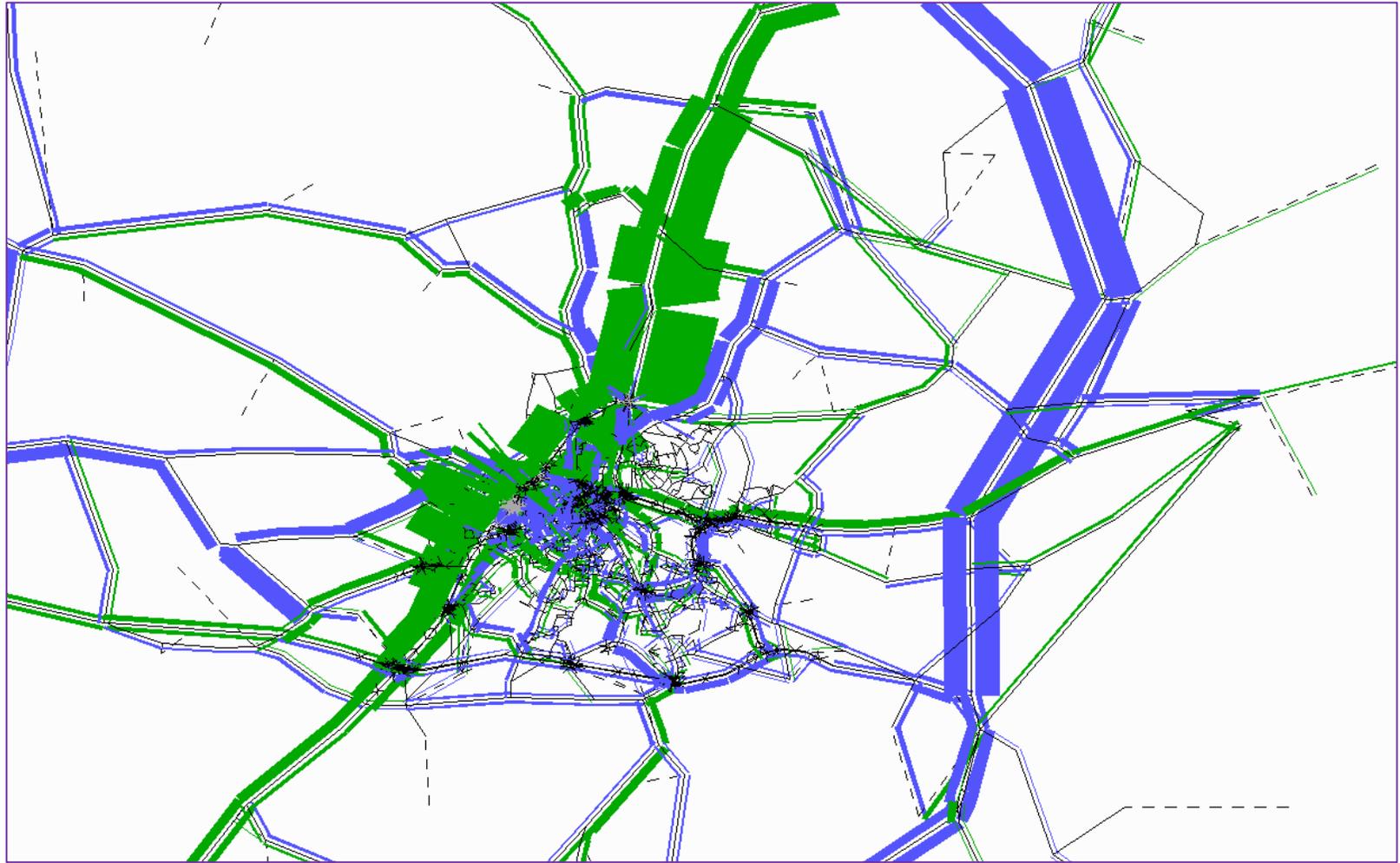
Figure 9.8 PM Peak Flow Difference Profile – Mitigation Test 5 compared to Mitigation Test 4



9.7 Strategic Impact of A38 Grade Separation

- 9.7.1 Figure 9.9 is a SATURN plot showing the strategic impact of the A38 grade separation in terms of change in traffic flow on a strategic level. A reduction in traffic has been shown in blue whereas an increase has been shown in green.
- 9.7.2 The grade separation of A38 junctions is forecast to make the A38 a more attractive route, resulting in a significant diversion of strategic traffic from the M1 onto the A38.

Figure 9.9 Strategic Impact of the A38 Grade Separation



10 Conclusions and Recommendations

10.1 Summary of Results

10.1.1 This study has provided:

- A traffic impact assessment of potential DUA Core Strategy; and
- an appraisal of the identified mitigation packages in terms of their effectiveness in reducing congestion and carbon emissions.

10.1.2 The performance indicators utilised to monitor congestion include:

- Over Capacity Queues (pcu-hrs);
- Average Speeds (km/h); and
- Severity Index.

10.1.3 Table 10.1 shows a summary of the modelling outputs in terms of the performance of each mitigation package against these global indicators. These modelling results are discussed further in the following sections of this report.

10.1.4 In terms of congestion, mitigation package 5 is forecast to be the best performing package as it includes all mitigation schemes included in the other packages and the grade separation of A38 junctions, providing congestion relief to a wide area in and around Derby.

10.1.5 However, in terms of severity index, mitigation package 2 outperforms other packages. This package tends to provide local mitigation to the areas directly affected by the implementation of the potential Core Strategy sites and does not result in a significant level of additional traffic being attracted to the area.

10.1.6 The inclusion of the A50 junction or the A38 improvements has a much wider impact which causes major diversions of traffic to these routes from the wider Strategic Road Network. These additional flows negate the pure site mitigation impacts of the scheme and result in non Core Strategy related impacts on the local highway network. As a result they are less effective in mitigating the impacts of the potential Core Strategy sites.

Table 10.1 Summary of the Performance of Mitigation Packages

	Performance Indicator		Reference Case	No Mitigation	Mitigation Test 1	Mitigation Test 2	Mitigation Test 3	Mitigation Test 4	Mitigation Test 5
AM Peak	Over Capacity Queues	Value	772	1,290	1,120	1,063	1,137	1,071	628
		Percent Mitigated	-	-	33%	44%	29%	42%	128%
	Average Speed	Value	38	36	37	37	37	37	39
		Percent Mitigated	-	-	30%	39%	35%	48%	152%
	Severity Index	Value	322	352	345	267	311	310	322
		Percent Mitigated	-	-	25%	281%	135%	137%	100%
PM Peak	Over Capacity Queues	Value	837	1,448	1,323	1,193	1,299	1,218	910
		Percent Mitigated	-	-	21%	42%	24%	38%	88%
	Average Speed	Value	38	35	36	36	36	36	38
		Percent Mitigated	-	-	17%	30%	35%	48%	104%
	Severity Index	Value	211	258	252	180	317	243	251
		Percent Mitigated	-	-	33%	168%	-127%	32%	14%
Carbon Emissions Annual CO₂ (tonnes)	Value	427,504	437,582	431,197	430,910	430,774	430,525	430,034	
	Percent Mitigated	-	-	63%	66%	68%	70%	75%	

10.2 Reference Case

- 10.2.1 The 2026 Reference Case has been based on the TEMPRO growth forecasts for non-residential land use and the background growth resulting from the changes in economic circumstances of existing residents. The residential land use assumes all committed developments but no growth associated with the potential Core Strategy sites.
- 10.2.2 From 2006 to 2026, in the absence of potential Core Strategy sites, the highway peak hour traffic is forecast to grow by around 23%.

10.3 No Mitigation Scenario

- 10.3.1 The potential Core Strategy envisages development of more than 11,000 houses in and around Derby City.
- 10.3.2 The predicted key impacts of the potential Core Strategy are as follows:
- 70% increase in congestion from Reference Case;
 - 6% - 7% reduction in average speeds;
 - 2-3% increase in carbon emissions.

10.4 Mitigation Package 1

- 10.4.1 Mitigation Package 1 includes smarter choices initiatives to encourage travel by non-car modes and enhancements to public transport in the vicinity of the development sites. The key impacts of this initial mitigation package in addressing the impacts of the potential Core Strategy sites are identified below:
- 1% - 6% increase in public transport mode share for the development sites;
 - Reduction of 8% - 10% in peak hour highway trips associated with the development sites;
 - 28% mitigation in terms of congestion;
 - 19% mitigation in terms of severity index; and
 - 63% mitigation of the CO₂ emissions.
- 10.4.2 The majority of the junctions only receive a small reduction in congestion as a result of the Smarter Choices mitigation, less than 5%. However, the following areas have been identified as having a number of junctions with a significant reduction in congestion levels as a result of the mitigation package.
- The A514 radial route into Derby City Centre;
 - The A516 Uttoxeter New Road; and
 - Along the Connecting Derby scheme.

- 10.4.3 The public transport mitigation measures have the greatest impact for the Evans of Leeds site and the Boulton Moor/Thulston Fields sites. The Boulton Moor/Thulston Fields sites are accessed by a new 15 minute service which significantly enhances the accessibility to public transport from this area. These sites (Boulton Moor and Thulston Fields) also benefit from bus priority along London Road.
- 10.4.4 The Newhouse Farm and Wragley Way/Stenson Fields sites do not benefit greatly from the public transport mitigation with limited usage of the new service accessing Newhouse Farm.
- 10.4.5 In terms of 'slow modes' the greatest impact of the smarter choices measures is associated with Newhouse Farm and Boulton Moor/ Thulston Fields due to the improved accessibility to the facilities in the adjacent areas of Mickleover and Chellaston. It should be noted that these are also some of the highest generating sites and therefore the potential for change is greater.

10.5 Mitigation Package 2

- 10.5.1 Mitigation Package 2 includes, in addition to the measures included in package 1, a new South Derby Link Road (running parallel to the A50 through the development sites, joining Rykneld Road with the T12 Link Road), two-way working of Stenson Road railway bridge and a new railway station near Stenson Road. The key findings from the modelling work can be seen below:
- Significant patronage at the new railway station;
 - 43% mitigation in terms of congestion;
 - 225% mitigation in terms of severity index; and
 - 66% mitigation of the CO₂ emissions.
- 10.5.2 The mitigation package is forecast to reduce traffic flows through the local residential areas and along the following main routes:
- A50;
 - Osmaston Road;
 - London Road;
 - Sections of A5111; and
 - T12 Link Road.
- 10.5.3 Vehicles are transferring to the new South Derby Link Road that is part of Mitigation Strategy 2. This is easing pressure on the local highway network, however there is predicted to be increases in vehicle flow along:
- Stenson Road;
 - A5132; and
 - Sections of the A38.

10.5.4 There are a number of junctions within the residential areas to the south of the Ring Road that have been identified as having a significant change in congestion levels as a result of the mitigation package. Some of the specific routes include:

- Sinfin Lane;
- Uttoxeter New Road;
- Several junctions along the A5111; and
- the A514/A50 junction.

10.6 Mitigation Package 3

10.6.1 Mitigation Package 3 comprised of mitigation package 1 plus a new junction on the A50 connecting to Deep Dale Lane. The key findings can be seen below:

- 26% mitigation in terms of congestion;
- 135% mitigation in terms of severity index in the AM peak;
- The severity index mitigation in the PM peak is negative; and
- 68% mitigation of the CO₂ emissions.

10.6.2 The proposed A50 junction is forecast to reduce traffic flow along:

- T12 link road;
- Sections of the A5111;
- A5132; and
- Sections of A38.

10.6.3 However, the construction of a new junction on the A50 is forecast to significantly increase traffic along the A50 between Junction 3 and Junction 4 and on the residential routes leading to the new junction. This is mainly a result of traffic using the proposed new junction on the A50 instead of the T12 link road.

10.6.4 The following areas have been identified as having a number of junctions with a significant reduction in congestion levels as a result of the mitigation package.

- Sinfin Lane;
- Several junction along the A5111 Ring Road;
- London Road; and
- Uttoxeter New Road.

10.6.5 The new junction on the A50 draws traffic from main radials onto comparatively minor and already congested Stenson Road and other residential areas, causing more congestion overall in these areas. This demonstrates that the junction on the A50 in the absence of any supporting highway infrastructure (South Derby Link Road, etc.) is likely to be unsustainable, particularly in the PM peak.

10.7 Mitigation Package 4

10.7.1 Mitigation Package 4 is a combination of mitigation packages 2 and 3. The key results from this scenario are provided below:

- 40% mitigation in terms of congestion;
- 137% mitigation in terms of severity index in the AM peak;
- The severity index mitigation in the PM peak is 32%; and
- 70% mitigation of the CO₂ emissions.

10.7.2 The combination of the two mitigation packages, significantly increases the highway capacity in the area. However, its impact in terms of reducing local congestion is relatively limited as these schemes induce traffic into the area which negates the potential capacity benefits of the package.

10.8 Mitigation Package 5

10.8.1 Mitigation Package 5 includes all elements of mitigation package 4 plus the grade separation of A38 junctions with A61, A52 and A5111. The key results from this scenario are provided below:

- 108% mitigation in terms of congestion;
- 100% mitigation in terms of severity index in the AM peak;
- The severity index mitigation in the PM peak is 14%; and
- 75% mitigation of the CO₂ emissions.

10.8.2 The implementation of the A38 grade separation schemes has much wider effects than the more localised impacts of the potential Core Strategy sites. The modelling suggests that the removal of these capacity constraints on the A38 Trunk Road route, result in this route providing a viable alternative for through traffic between the West Midlands and the North with significant extraction from the M42/M1 corridor.

10.9 Recommendations

10.9.1 The recommended approach to the mitigation of the final Core Strategy scenario will be dependant on the sites that are included in the final strategy. However, this initial appraisal suggests that a mitigation strategy should include the following measures:

- The implementation of Smarter Choices and travel planning measures for all sites.
- The provision of around four buses per hour linking the sites to the city centre and other local retail and employment facilities.
- Direct and safe pedestrian cycle routes connecting the sites to public transport routes and local employment and retail facilities.
- The provision of the South Derby Link Road.

10.9.2 Schemes that have the potential to provide benefits include the park and ride sites and the rail station, however, we recommend that a more detailed study is undertaken to specifically consider the business cases for these elements of the package to ensure that they are financially viable.

10.9.3 It is also recommended that further investigation into the detailed impacts of the South Derby Link Road and also the proposed A50 junction (if this is taken forward) are undertaken to establish whether these schemes are deliverable in terms of their impacts on the wider network, land requirements, costs and physical layout constraints.

MVA Consultancy 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.mvaconsultancy.com

Abu Dhabi

AS Business Centre, Suite 201, Al Ain Road, Umm al Nar, P.O. Box 129865, Abu Dhabi, UAE
T: +971 2 510 2402 F: +971 2 510 2403

Birmingham

Second Floor, 37a Waterloo Street
Birmingham B2 5TJ United Kingdom
T: +44 (0)121 233 7680 F: +44 (0)121 233 7681

Dublin

First Floor, 12/13 Exchange Place
Custom House Docks, IFSC, Dublin 1, Ireland
T: +353 (0)1 542 6000 F: +353 (0)1 542 6001

Edinburgh

Second Floor, Prospect House, 5 Thistle Street,
Edinburgh EH2 1DF United Kingdom
T: +44 (0)131 220 6966 F: +44 (0)131 220 6087

Glasgow

Seventh Floor, 78 St Vincent Street
Glasgow G2 5UB United Kingdom
T: +44 (0)141 225 4400 F: +44 (0)141 225 4401

London

Second Floor, 17 Hanover Square
London W1S 1HU United Kingdom
T: +44 (0)20 7529 6500 F: +44 (0)20 7529 6556

Lyon

11, rue de la République, 69001 Lyon, France
T: +33 (0)4 72 10 29 29 F: +33 (0)4 72 10 29 28

Manchester

25th Floor, City Tower, Piccadilly Plaza
Manchester M1 4BT United Kingdom
T: +44 (0)161 236 0282 F: +44 (0)161 236 0095

Marseille

76, rue de la République, 13002 Marseille, France
T: +33 (0)4 91 37 35 15 F: +33 (0)4 91 91 90 14

Paris

12-14, rue Jules César, 75012 Paris, France
T: +33 (0)1 53 17 36 00 F: +33 (0)1 53 17 36 01

Woking

Dukes Court, Duke Street, Woking
Surrey GU21 5BH United Kingdom
T: +44 (0)1483 728051 F: +44 (0)1483 755207

Email: info@mvaconsultancy.com

Offices also in

Bangkok, Beijing, Hong Kong, Shenzhen and Singapore

mvaconsultancy