

Rugby Wide Area Paramics Model

Air Quality Assessment

06/12/2017

VM175149.TN001

Introduction

- The following note presents the air quality outputs that have been extracted and processed through the PARAMICS Analysis of Instantaneous Road Emissions (AIRE) add on, related to Rugby Wide Area (RWA) modelling assessment. This note specifically presents the impact on air quality within four of the most congested areas of the RWA model network. These locations are listed below, and demonstrated in **Figure 1**:

- Dunchurch Crossroads
- Rugby Gyratory
- Leicester Road Corridor
- Hillmorton Road/Whitehall Road

Figure 1 Air Quality Assessment Locations



2. Following discussions between Rugby Borough Council (RBC), Warwickshire County Council (WCC) and Vectos Microsim (VM), it has been determined that this air quality assessment will present impacts from the following model scenarios, across the entire AM and PM modelled hours (0700-1000 and 1600-1900)
 - 2016 Baseline Scenario
 - 2031 Reference Case Scenario
 - 2031 Local Plan Scenario

3. Each of the study areas above have been reviewed on the basis that they represent the most congested parts of the model network. In each instance the junctions within the study area, along with approach links have been selected for assessment, in order that the full impact of the congestions related to each location is captured.

4. **Figures 2-5** outline the study areas considered in this assessment.

Figure 2 Dunchurch Crossroads Air Quality Assessment Boundary

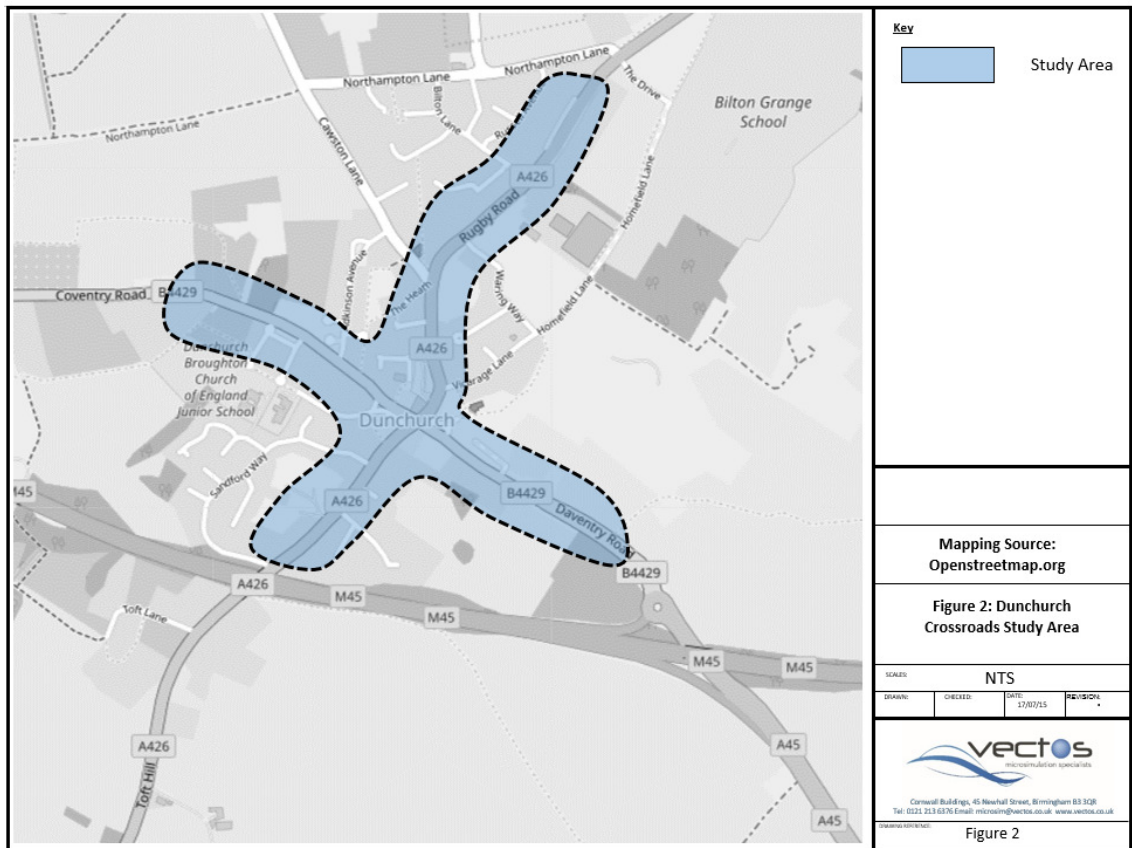


Figure 3 Rugby Gyratory Air Quality Assessment Boundary

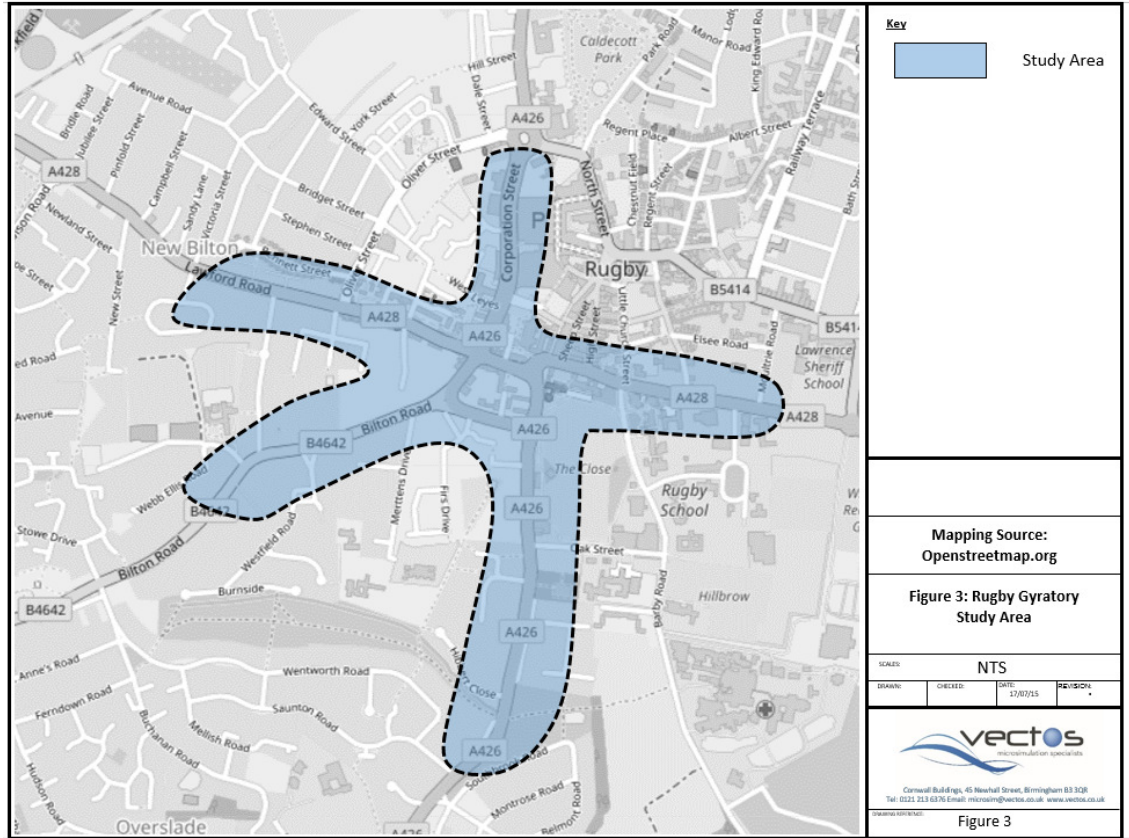


Figure 4 Leicester Road Corridor Air Quality Assessment Boundary

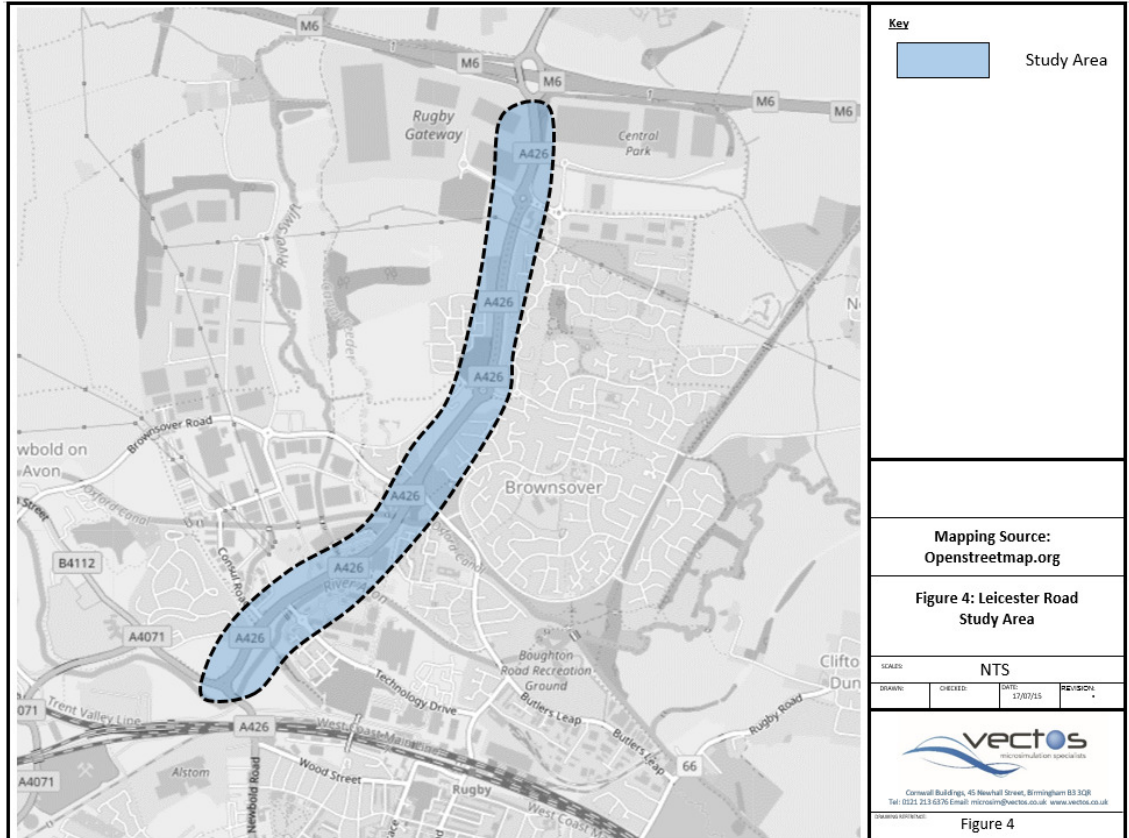
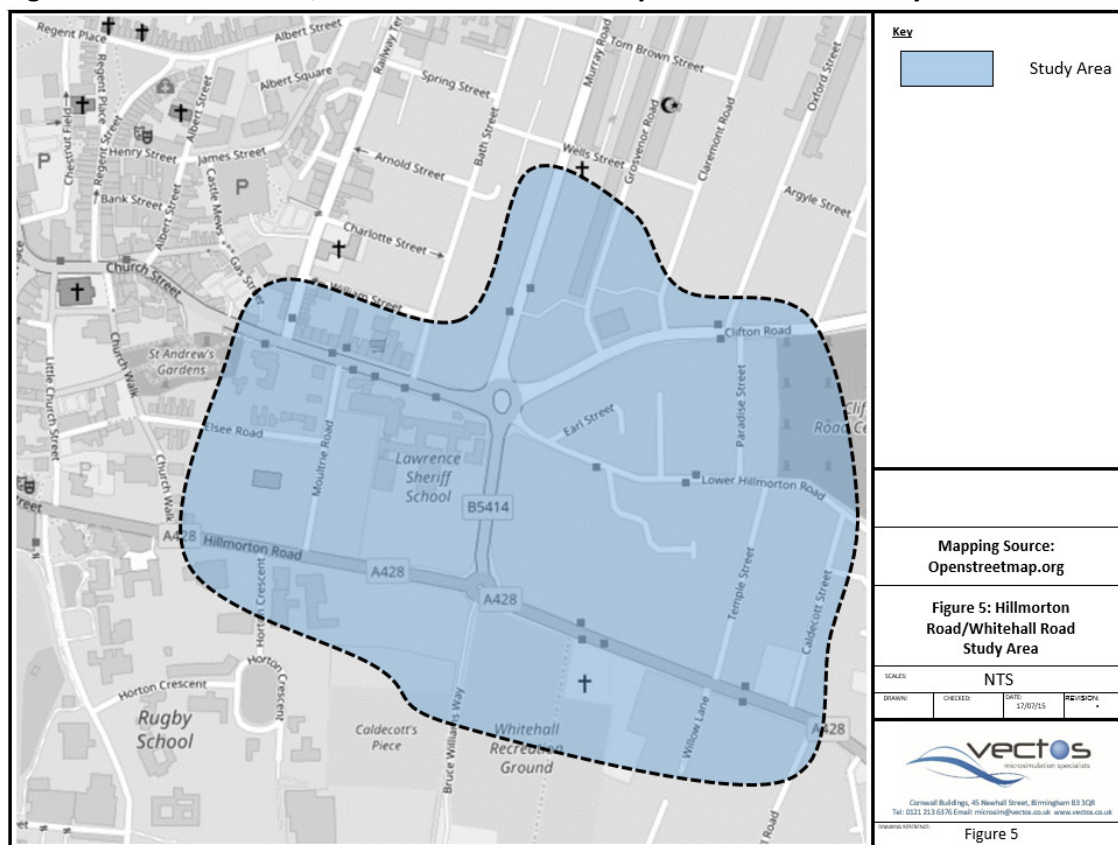


Figure 5 Hillmorton Road/Whitehall Road Air Quality Assessment Boundary



AIRE (Paramics Analysis of Instantaneous Road Emissions)

5. AIRE is an ancillary program specifically designed to process the outputs from traffic microsimulation models and calculate vehicle emissions. AIRE incorporates over 3,000 Instantaneous Emissions Modelling (IEM) tables which are used to estimate tailpipe emissions from individual simulated road vehicles. The IEM tables were derived from PHEM (Passenger car and Heavy Duty Emissions Model), which was developed by the Technical University of Graz. PHEM is a vehicle dynamics model with engine maps, enabling emissions to be output for various engine speeds and engine loads.
6. AIRE produces estimates of the oxides of nitrogen, particulate matter and total carbon that result from the combustion of fuel throughout each simulated vehicle’s journey. The estimates are produced on a simulated time step by time step basis, so the detail and quality of the resulting output emissions estimates are directly related to the adopted simulation’s fidelity and robustness.
7. The estimates produced by AIRE are for tailpipe emissions and do not include the impact of dispersion within the atmosphere, ambient factors, such as weather and temperature, or the local built environment.

Results Analysis

8. Completion of the AIRE assessment on the modelled scenarios and time periods outlined in this note, has enabled a comparison of the level of the following outputs to be made at each location assessed:
- Nitrogen
 - Particulate Matter (PM10)
 - Carbon
9. The outputs have been compared between scenarios, with supporting text in the following section. Initially comparisons have been drawn between the 2016 Baseline and 2031 Reference Case results. This is then followed by a summary of the differences between the 2031 Reference Case and 2031 Local Plan results.
10. It was deemed appropriate to compare the 2031 Reference Case and 2031 Local Plan model, and not the 2016 Baseline and 2031 Local Plan model, on the basis that committed developments and external growth contained within the 2031 Reference model are consistent with those assumed within the Local Plan model.

Dunchurch Crossroads

11. Dunchurch Crossroads represents one of the most congested parts of the model network in 2016 Base model, with significant queues forming on all approaches to the crossroads in both the AM and PM peak periods.
12. The 2031 Reference Case model includes a committed scheme at the Dunchurch Crossroads, which provides additional right turn lanes on both the Rugby Road and Southam Road approaches to the junction.
13. The 2031 Local Plan model, includes both the Dunchurch proposed scheme and a further mitigation scheme in the form of the South West Relief Road, with this infrastructure being included as part of the South West Rugby development.
14. The impact on air quality at the Dunchurch Crossroads in each of these scenarios is presented in the following **Table 1** and in more detail in **Appendix A**.

Table 1 Air Quality Results for Dunchurch Crossroads

	Period	2016 Base	2031 Ref	Ref vs Base	2031 LP	LP vs Ref
Nitrogen Emissions (g)	AM	106975	92881	-13.17%	56308	-39.38%
	PM	155001	99055	-36.09%	81336	-17.89%
PM10 Emissions (g)	AM	82	56	-31.88%	43	-22.59%
	PM	86	49	-43.24%	42	-14.77%
Carbon Emissions (g)	AM	568470	424557	-25.32%	311797	-26.56%
	PM	596184	335992	-43.64%	297163	-11.56%

15. Analysis of the pollutant levels forecast within the 2016, 2031 Reference and 2031 Local Plan scenarios has been presented for the AM and PM periods within the **Table 1**. This demonstrates noticeable reductions in the levels of Nitrogen, PM10 and Carbon emissions in the 2031 Reference Case when compared to the 2016 Baseline conditions, and further reductions in emissions in the 2031 Local Plan model when compared to the 2031 Reference Case.
16. The results suggest that the inclusion of the Dunchurch scheme in the 2031 Reference Case delivers air quality benefits, particularly in the PM period with a 36% reduction in Nitrogen emissions, and around 43% reduction in PM10 and Carbon emissions.
17. When reviewing the differences between the 2031 Local Plan and 2031 Reference Case model, the 2031 Local Plan results show a further drop in emissions, with between a 23% and 39% reduction in nitrogen, PM10 and Carbon emissions in the AM period and between 12%-18% reduction in emissions in the PM period.
18. These results demonstrate that the inclusion of the Dunchurch Scheme within the modelling delivers a significant improvement at the crossroads in the 2031 Reference Case.
19. Once the South West Relief Road is included within the 2031 Local Plan model, further air quality benefits are modelled, with up to a 39% reduction in emissions in the 2031 Local Plan model when compared to 2031 Reference conditions.

Rugby Gyrotory

20. As with the Dunchurch Crossroads, the Rugby Gyrotory forms one of the most congested junctions within the modelled network. The 2031 Reference Case model forecasts significant increases in queue lengths during the AM and PM period, most noticeably on the Lawrence Sherriff Street, A426 Dunchurch Road and Bilton Road approaches.
21. Within the 2031 Local Plan model these queue increases are predicted to worsen, particularly on the Lawrence Sherriff Street entry/exit arms to the Gyrotory.
22. The associated impact on air quality at the Rugby Gyrotory, along with on the approach arms to the Gyrotory, in the AM and PM period is demonstrated within the following **Table 2** and in more detail in **Appendix B**.

Table 2 Air Quality Results for Rugby Gyrotory

	Period	2016 Base	2031 Ref	Ref vs Base	2031 LP	LP vs Ref
Nitrogen Emissions (g)	AM	258214	286789	+11.07%	355663	+24.02%
	PM	414420	506227	+22.15%	563995	+11.41%
PM10 Emissions (g)	AM	85	89	+4.49%	92	+3.28%
	PM	91	97	+6.65%	101	+4.03%
Carbon Emissions (g)	AM	575571	588060	+2.17%	739470	+25.75%
	PM	607919	724054	+19.10%	819042	+13.12%

23. Analysis of the pollutant levels forecast within the 2016, 2031 Reference and 2031 Local Plan scenarios has been presented for the AM and PM periods within the **Table 2**. This

demonstrates increases in the levels of Nitrogen, PM10 and Carbon emissions in the 2031 Reference Case when compared to the 2016 Baseline conditions, and further increases in emissions in the 2031 Local Plan model when compared to the 2031 Reference Case.

24. The results suggest that in the 2031 Reference Case, air quality reduces, particularly in the PM period with a 22% increase in Nitrogen emissions, a 7% increase in PM10 emissions and a 19% increase in Carbon emissions.
25. **Table 2** also demonstrates that the 2031 Local Plan scenario results in further reductions in air quality, when compared to the 2031 Reference Case, with Nitrogen emissions increasing by around 24% in the AM period and 11% during the PM period. Similarly PM10 emissions increase by around 3% and 4% in the AM and PM respectively whilst Carbon emissions increase by 26% in the AM and 13% in the PM.

These results demonstrate that in the 2031 Reference Case model, air quality at the Gyratory has reduced, with the most noticeable increase in emissions occurring during the PM period. The 2031 Local Plan model then demonstrates a further increase in emissions, with the most notable increase in emissions in the AM period.

Leicester Road Corridor

26. The Leicester Road corridor forms an important strategic route into and out of Rugby, and lies between Rugby town centre and the M6. The 2031 Reference Case includes a significant volume of additional trips along this corridor, as a result of the committed developments to be built close by, whilst the 2031 Local Plan further increases the number of trips along the corridor as a result of significant developments elsewhere on the network using this route to travel to and from the M6.
27. The associated impact on air quality along the entire corridor has been extracted from the modelling, and the changes in the level of emissions presented within the following **Table 3**, and in more detail in **Appendix C**.

Table 3 Air Quality Results for Leicester Road Corridor

	Period	2016 Base	2031 Ref	Ref vs Base	2031 LP	LP vs Ref
Nitrogen Emissions (g)	AM	1997490	2255170	+12.90%	2500456	10.88%
	PM	2781841	3390540	+21.88%	3933476	16.01%
PM10 Emissions (g)	AM	547	560	+2.29%	585	4.51%
	PM	549	561	+2.16%	629	12.08%
Carbon Emissions (g)	AM	3746822	4188052	+11.78%	4624240	10.42%
	PM	3469762	4152228	+19.67%	4829914	16.32%

28. Analysis of the pollutant levels forecast within the 2016, 2031 Reference and 2031 Local Plan scenarios has been presented for the AM and PM periods within the **Table 3**. This demonstrates increases in the levels of Nitrogen, PM10 and Carbon emissions in the 2031 Reference Case when compared to the 2016 Baseline conditions, and further increases in emissions in the 2031 Local Plan model when compared to the 2031 Reference Case.

29. The results suggest that in the 2031 Reference Case air quality reduces, particularly in the PM period, with a 22% increase in Nitrogen emissions and 20% increase in Carbon emissions. The results demonstrate a lower level of PM10 emission increases at around 2%. The AM emission results suggest around a 12-13% increase in Nitrogen and Carbon emissions when compared to the 2016 Baseline levels, and 2% increase in PM10 emissions.
30. Analysis of the differences in emissions between the 2031 Local Plan and 2031 Reference Case scenarios also demonstrate reductions in air quality in the 2031 Local Plan scenario, with Nitrogen emissions increasing by around 11% in the AM period and 16% during the PM period. Similarly PM10 emissions increase by around 4% and 12% in the AM and PM respectively whilst Carbon emissions increase by 10% in the AM and 16% in the PM.
31. These results demonstrate that in the 2031 Reference Case model, air quality along the corridor as a whole has reduced with the most noticeable increase in emissions occurring during the PM period.
32. The 2031 Local Plan model then demonstrates a further increase in emissions compared to the 2031 Reference Case, with the PM period demonstrating the highest level of emissions.

Hillmorton Road/Whitehall Road

33. The Hillmorton Road/Whitehall Road part of the model forms a critical route into and out of Rugby town centre, and lies between Rugby town centre and the A428 corridor and M1. The 2031 Reference Case and 2031 Local Plan models include a significant volume of additional trips along this corridor, as a result of the committed developments to be built nearby.
34. The assessment area for this section of the network includes the Hillmorton Road/Whitehall Road roundabout, and Clifton Road/Lower Hillmorton Road roundabout.
35. As part of the Rugby Strategic Transport Assessment, mitigation was included at this part of the network in the 2031 Local Plan model only, in the form of widening on the approach links and circulatory of the Hillmorton Road/Whitehall Road roundabout
36. The associated impact on air quality across this study area has been extracted from the modelling, and the changes in the level of emissions between each of the scenarios presented within the following **Table 4**, and in more detail in **Appendix D**.

Table 4 Air Quality Results for Hillmorton Road/Whitehall Road

	Period	2016 Base	2031 Ref	Ref vs Base	2031 LP	LP vs Ref
Nitrogen Emissions (g)	AM	304988	371777	+21.90%	339943	-8.56%
	PM	610849	802070	+31.30%	842870	5.09%
PM10 Emissions (g)	AM	92	100	+8.97%	90	-9.81%
	PM	119	127	+6.48%	130	2.56%
Carbon Emissions (g)	AM	606269	731820	+20.71%	687739	-6.02%
	PM	800857	1035447	+29.29%	1089945	5.26%

37. The results presented in **Table 4** demonstrate increases in the levels of Nitrogen, PM10 and Carbon emissions in the 2031 Reference Case when compared to the 2016 Baseline

conditions. The results demonstrate further increases in emissions in the 2031 Local Plan model when compared to the 2031 Reference Case model in the PM period, however, improvements in air quality are demonstrated by the Local Plan model during the AM period.

38. The results suggest that in the 2031 Reference Case air quality reduces, particularly in the PM period with a 31% increase in Nitrogen emissions and 29% increase in Carbon emissions. The AM emission results suggest around a 22% increase in Nitrogen and Carbon emissions when compared to the 2016 Baseline levels, and 9% increase in PM10 emissions.
39. When comparing the results between the 2031 Local Plan and 2031 Reference Case it is clear that the 2031 Local Plan results show air quality improvements during the AM period when compared to the 2031 Reference Case model, suggesting that the mitigation included in the Local Plan model has positive air quality benefits. Nitrogen emissions reduce by 9% in the AM period. Similarly, Carbon emissions reduce by 6% in the AM whilst PM10 emissions reduce by around 10%
40. During the PM however, the air quality benefits delivered by the mitigation are clearly offset by the additional traffic routing through this part of the network, as emissions increase in the Local Plan scenario compared to the Reference Case. A 5% increase in Nitrogen and Carbon emissions is reported, along with a 3% increase in PM10 emissions.
41. In summary the results for this part of the network demonstrate that in the 2031 Reference Case model, air quality has reduced, with the most noticeable increase in emissions occurring during the PM period.
42. The 2031 Local Plan model then demonstrates an improvement in air quality compared to the 2031 Reference Case during the AM period, and a slight worsening in the level of emissions during the PM period. The emissions during the AM period are less than those in the 2031 Reference Case AM, due to the benefits being delivered by the mitigation scheme within this part of the network.

Summary

43. This note has presented impacts on air quality at the most congested parts of the modelled Rugby network, with a specific focus on Nitrogen, Particulate Matter and Carbon emissions, using the Paramics air quality analysis add on tool, AIRE. The analysis has compared the modelled 2016 Baseline outputs with the 2031 Reference Case and the 2031 Local Plan scenario against the 2031 Reference Case.
44. The analysis has revealed that air quality improves at the Dunchurch Crossroads, by up to 43% in the 2031 Reference Case model, which is further enhanced in the 2031 Local Plan model, whereby emissions reduce by an additional 39% (during the AM period). This demonstrates the beneficial impact that the proposed Dunchurch Crossroads scheme, and delivery of the South West Relief Road has on air quality at the crossroads itself.
45. Analysis of the Rugby Gyratory, Leicester Road Corridor and the Hillmorton Road/Whitehall Road area of the model has revealed air quality reduces in the 2031 Reference Case when

compared to Baseline conditions, with increases in emissions generally highest during the PM Period.

46. In the 2031 Local Plan scenario the air quality reduces further when compared to the 2031 Reference Case, specifically at the Gyratory and along the Leicester Road corridor with around a 10%-20% increase in emissions during the AM period, and 10%-15% increase in the PM.
47. One area of improvement in air quality in the 2031 Local Plan scenario, when compared to the 2031 Reference Case, is at the Hillmorton Road/Whitehall Road study area, with the mitigation included within the model reducing emissions by around 10% during the AM period. However, during the PM period, emissions at this location do increase by around 5% when compared to the 2031 Reference Case.

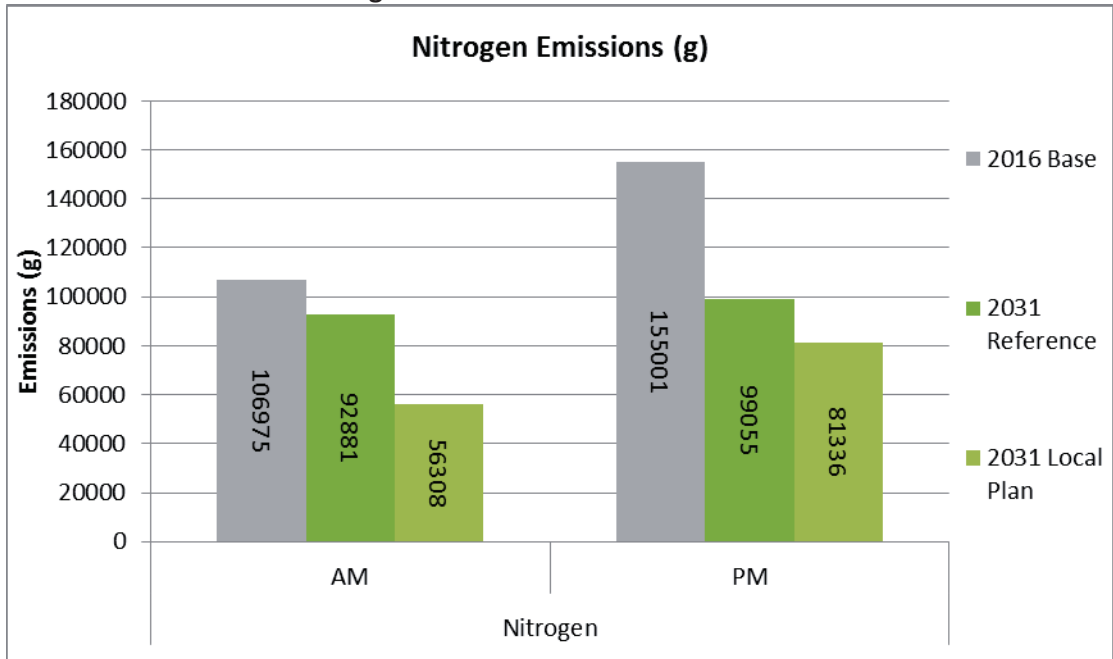
Recommendations

48. This analysis has presented results from the 2016 Rugby Wide Area Base model, along with the 2031 Reference Case and 2031 Local Plan models. The analysis has been undertaken using the Paramics air quality analysis tool AIRE.
49. Based upon the results analysed this has revealed significant increases in emissions in the future year scenarios, as the volume of trips, and congestion within the modelled network increases.
50. The results presented for the 2031 Reference Case and 2031 Local Plan scenarios, based upon the AIRE outputs, are calculated on the current day vehicle characteristics, with the predicted 2031 flows. The AIRE tool does not specifically take into account the potential for less pollutant vehicles which may become common place on the network by 2031.
51. Accordingly the results of this analysis may be considered to represent a 'worst case' scenario, on the basis that by 2031, vehicles are likely to be less polluting than current day levels, in terms of their emissions, through the development of cleaner engines and associated technology.

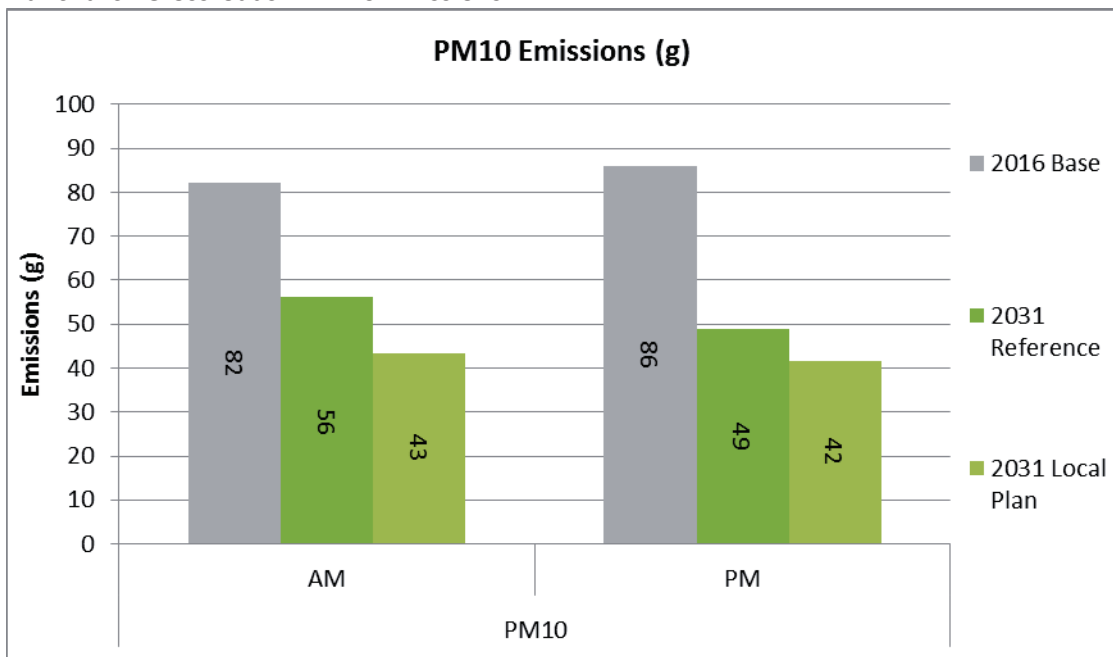
APPENDIX A

Dunchurch Crossroads Air Quality Outputs

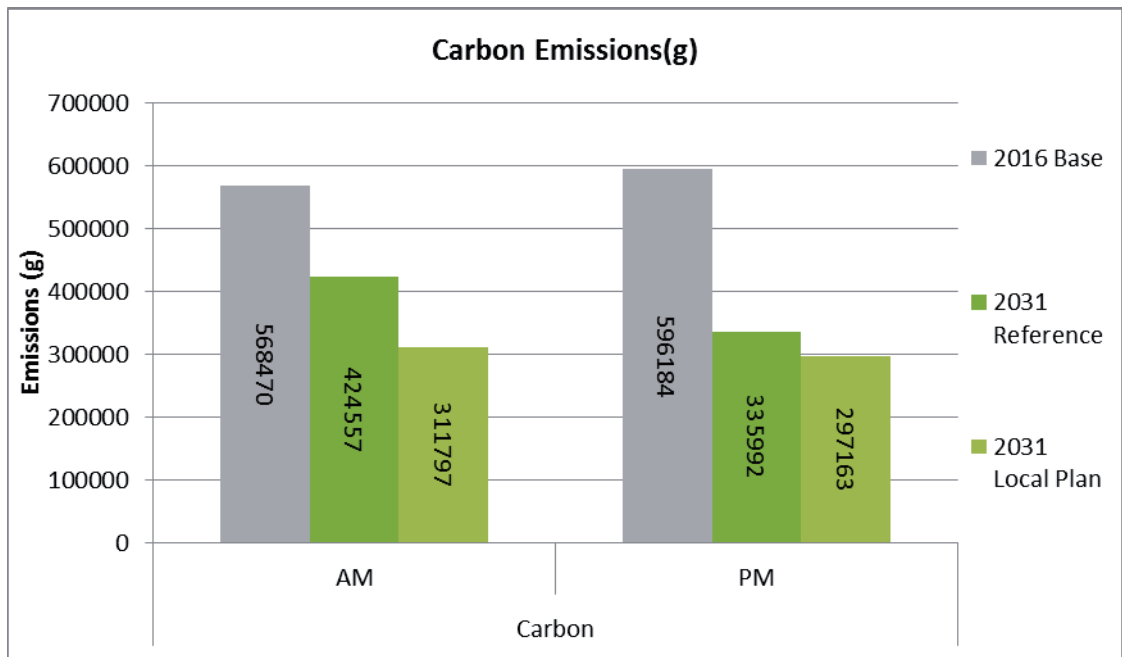
Dunchurch Crossroads – Nitrogen Emissions



Dunchurch Crossroads – PM10 Emissions



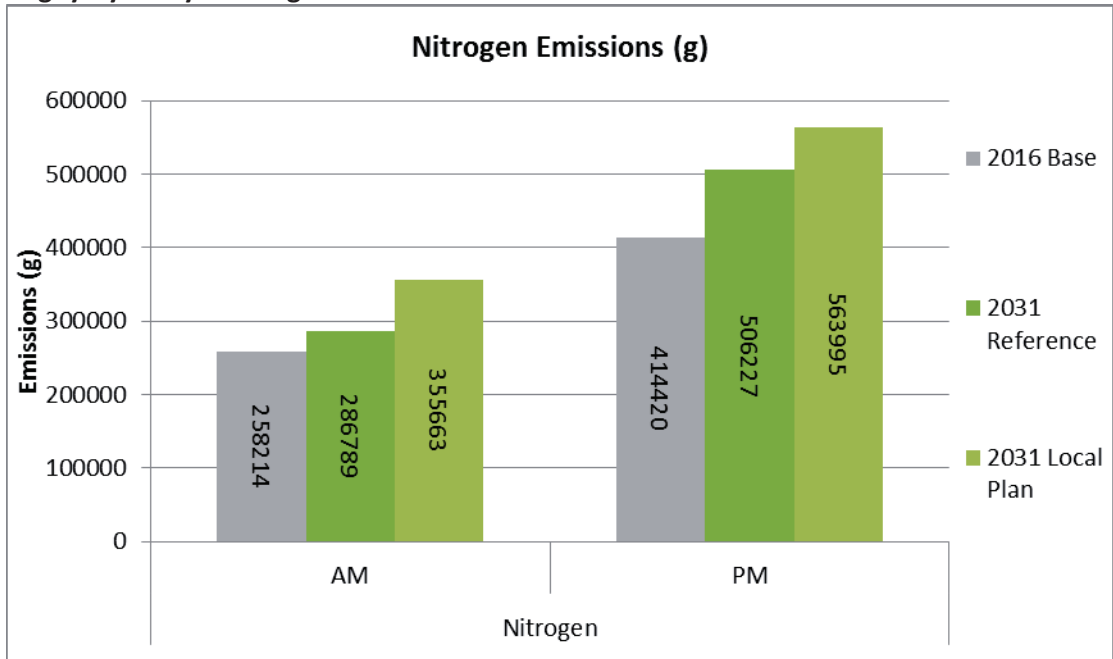
Dunchurch Crossroads – Carbon Emissions



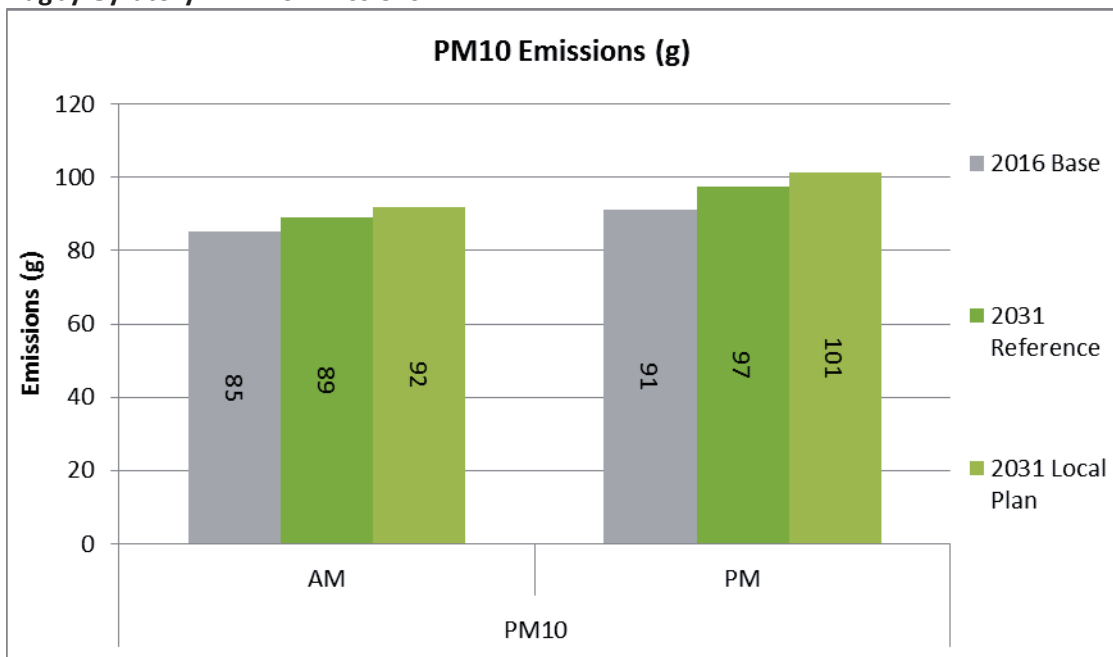
APPENDIX B

Rugby Gyratory Air Quality Outputs

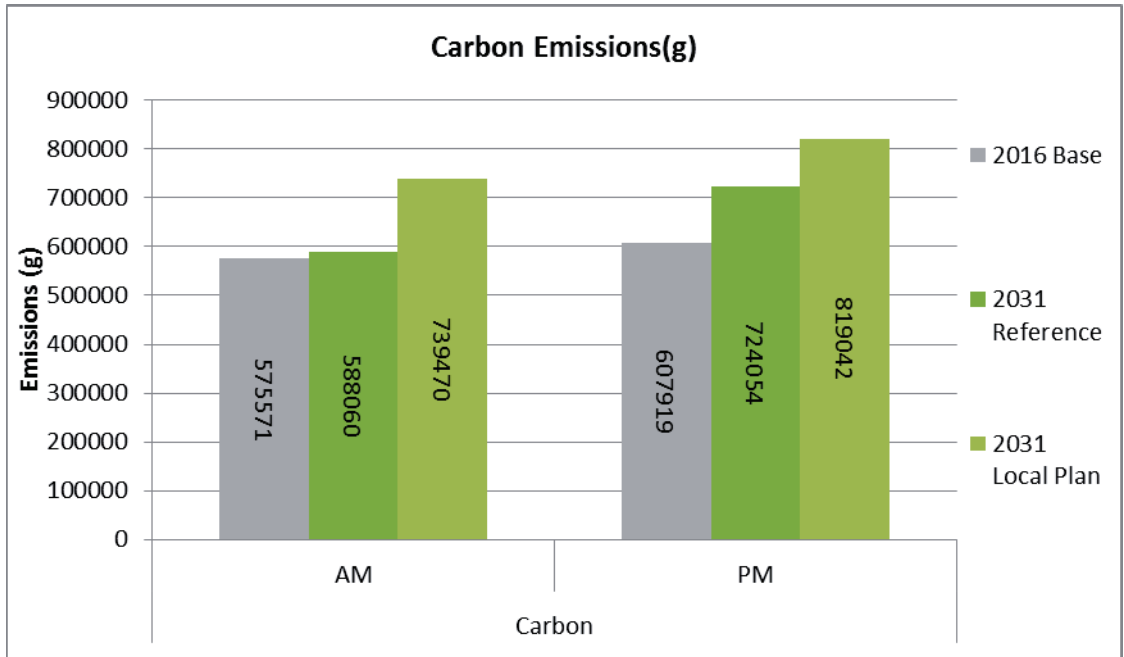
Rugby Gyratory – Nitrogen Emissions



Rugby Gyratory – PM10 Emissions



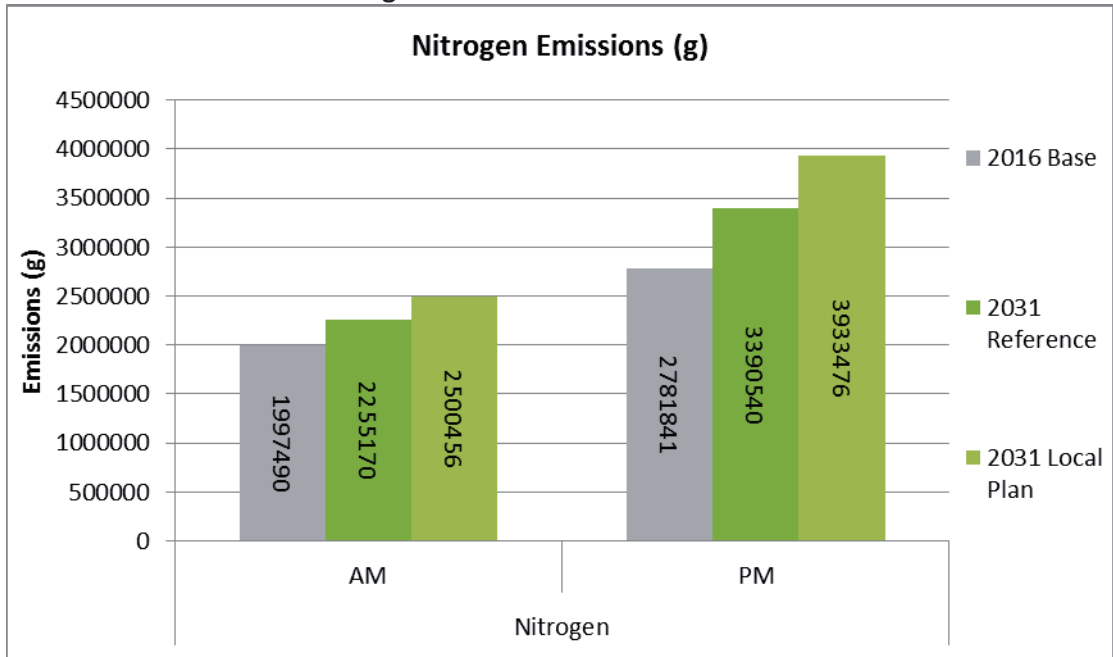
Rugby Gyratory – Carbon Emissions



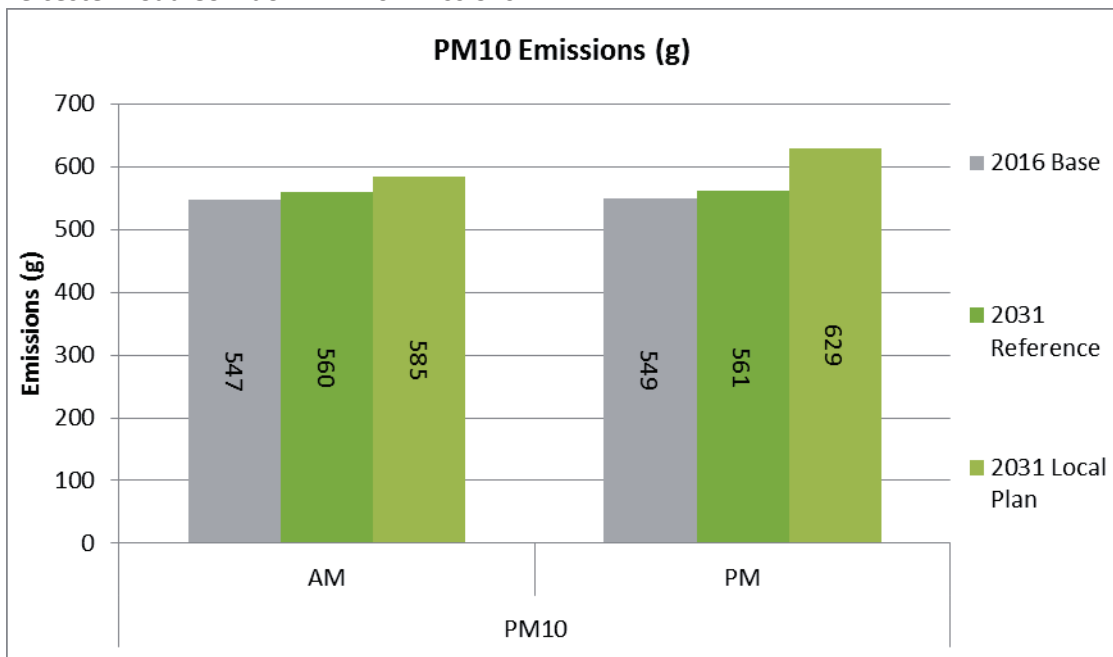
APPENDIX C

Leicester Road Corridor Air Quality Outputs

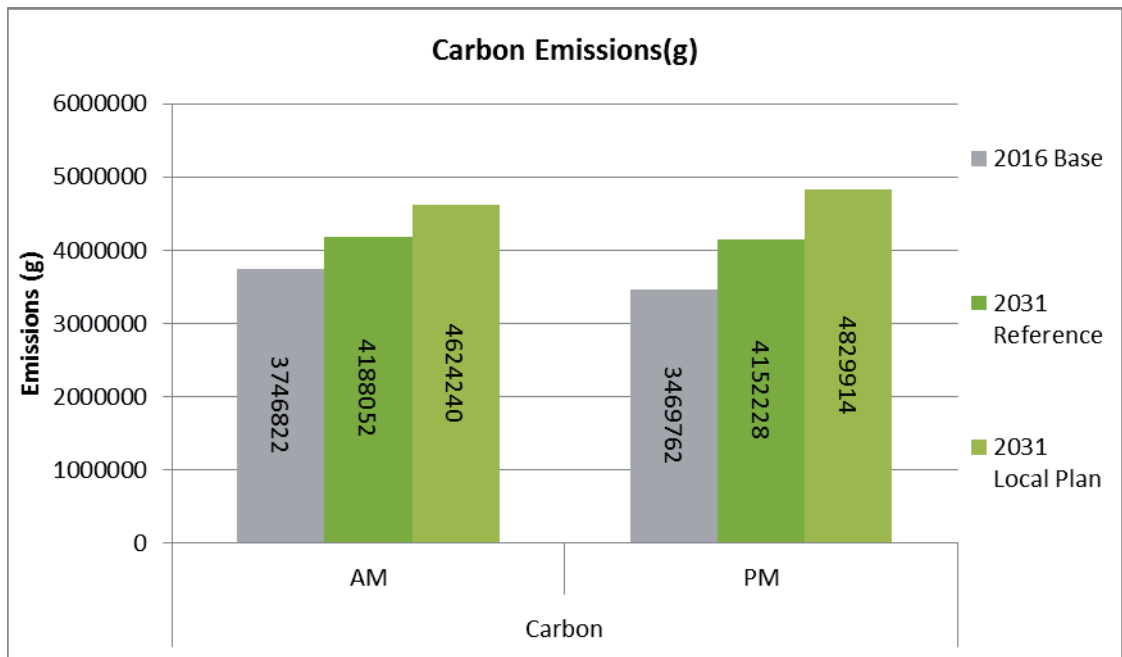
Leicester Road Corridor – Nitrogen Emissions



Leicester Road Corridor – PM10 Emissions



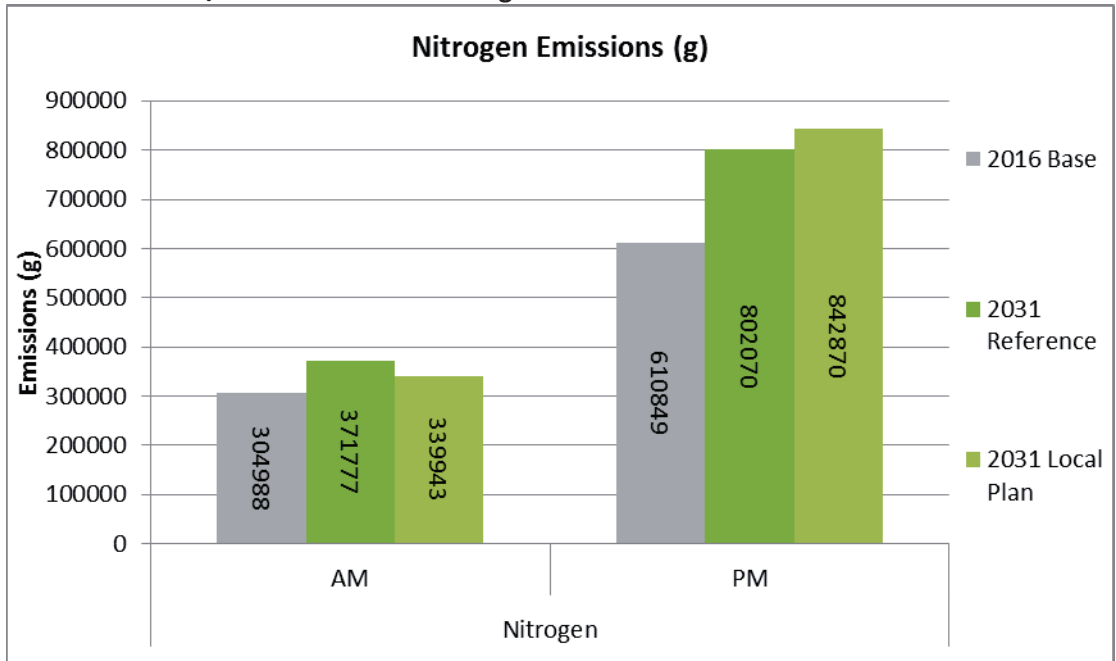
Leicester Road Corridor – Carbon Emissions



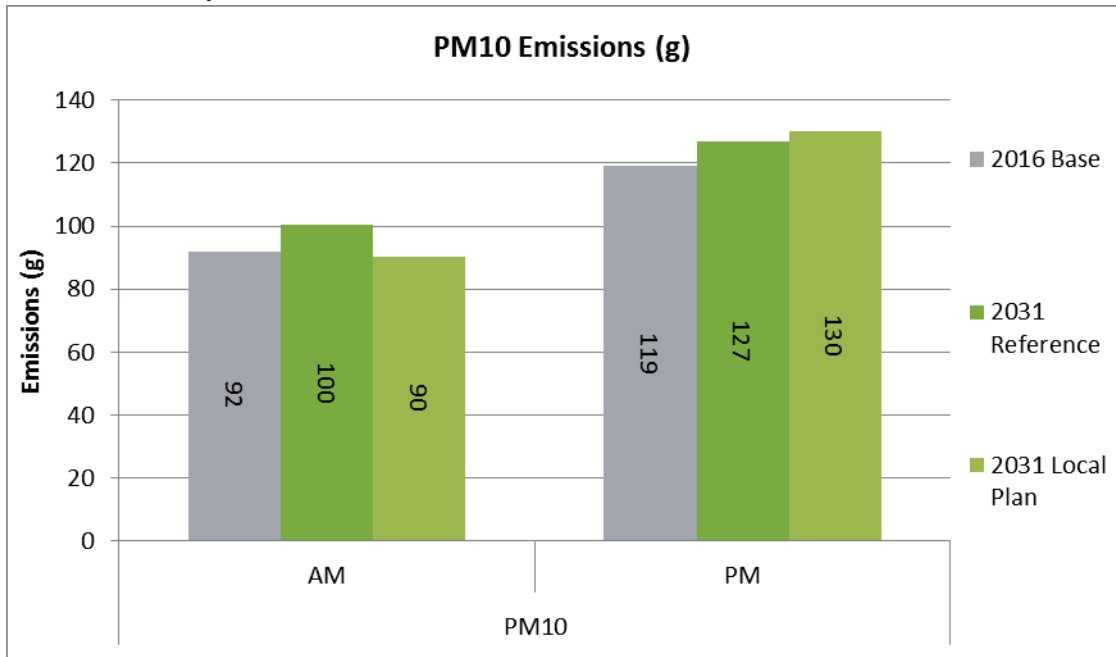
APPENDIX D

Hillmorton Road/Whitehall Road Air Quality Outputs

Hillmorton Road/Whitehall Road – Nitrogen Emissions



Hillmorton Road/Whitehall Road – PM10 Emissions



Hillmorton Road/Whitehall Road – Carbon Emissions

