

URS

M1 J29A Operational Capacity Assessment

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Rev	Date	Details	Prepared by	Reviewed by	Approved by
1	11 May 2012	Draft for DCC comment	Lee Kennedy Assistant Transport Planner	Adam Hall Senior Transport Planner	David Elliott Associate
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3	05 July 2012	Draft for DCC comment	Lee Kennedy Assistant Transport Planner	Adam Hall Senior Transport Planner	David Elliott Associate

URS
Royal Court
Basil Close
Chesterfield
S41 7SL
United Kingdom

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Appendix A: Base Flows, ARCADY Outputs
Appendix B: Condition 21 Developments, ARCADY Outputs
Appendix C: Core Strategy Developments, ARCADY Outputs

1 INTRODUCTION

1.1 Overview

- 1.1.1 M1 J29A is a grade separated motorway junction at Duckmanton, located in Derbyshire. It was constructed and opened in June 2008. A major development formerly known as 'MEGZ' (Markham Employment Growth Zone) and now known as 'Markham Vale' is proposed around the motorway junction, at the site of the former Markham colliery.
- 1.1.2 Markham Vale is approximately 200 acres in size and is recognised by the Government as an Enterprise Zone; which is proposed to accommodate a mixture of office, industrial and warehousing facilities.
- 1.1.3 The site is approximately 6km East of Chesterfield, a location plan is shown below in Figure 1.
- 1.1.4 To assist with the phasing and traffic impact assessment of the Markham Vale development site a junction capacity assessment was required. A capacity assessment will be useful to inform decisions over the likely maximum traffic loads that the four existing local junctions can sustain and will provide indications of the relevant possible future mitigation requirements.
- 1.1.5 The planning application was submitted in May 2002 and permission for the development was granted in April 2005. As part of the planning permission, 'Condition 21' imposed a maximum trip generation for vehicles based upon a total development size of 265,000m². The maximum permitted is 1729 two way vehicular trips in the AM peak hour. This is fully documented in the 'Markham Employment Growth Zone Derbyshire, Trip Generation Assessment' produced by Mayer Brown, 2009 and is included in Annex A. A variation to 'Condition 21' set out by Chesterfield Borough Council on 6th April 2010 is included in Annex B at the back of this document.
- 1.1.6 The remainder of this report discusses the methodology for assessing the operational capacity that is available and then provides information on the maximum likely traffic volumes which can be supported under a variety of development conditions.
- 1.1.7 Conclusions are presented in section 4 of this report.

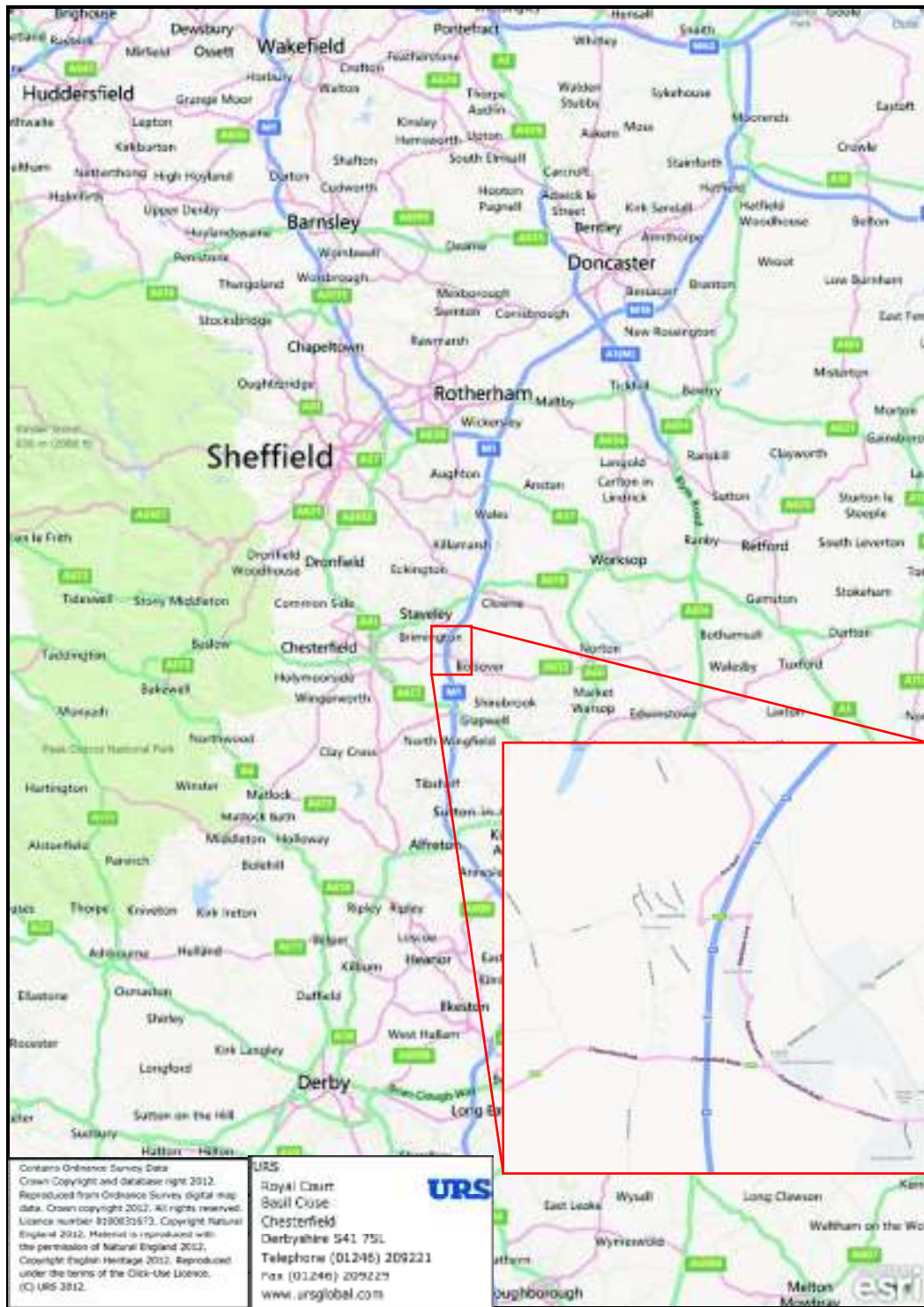


Figure 1 – Location of Markham Vale site and M1 J29A

2 METHODOLOGY

2.1 The Junctions

2.1.1 To calculate the availability of highway capacity at M1 J29A, an operational capacity assessment was undertaken.

2.1.2 The four roundabout junctions assessed are shown diagrammatically below in Figure 2 and are described in detail in Table 1.

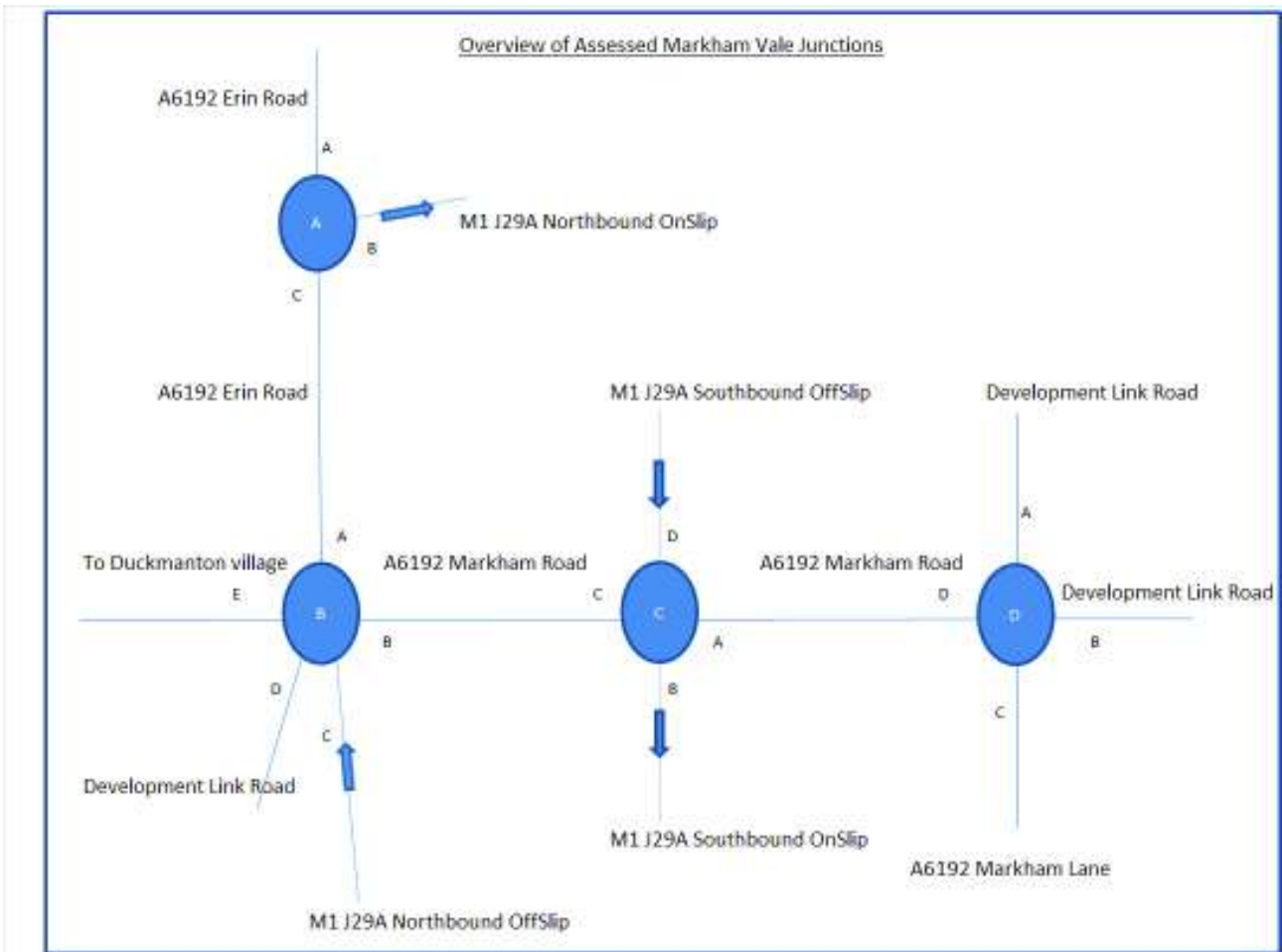


Figure 2 –Junctions assessed for capacity

TABLE 1 – M1 J29A ASSESSED JUNCTION DESCRIPTION

Roundabout	Arm	Description
A	A	A6192 Erin Road (North)
	B	M1 Northbound Onslip
	C	A6192 Erin Road (South)
B	A	A6192 Erin Road
	B	A6192 Markham Road
	C	M1 Northbound Offslip
	D	Development Link Road
	E	To Duckmanton village (Markham Road)
C	A	A6192 Markham Road (East)
	B	M1 Southbound Onslip
	C	A6192 Markham Road (West)
	D	M1 Southbound Offslip
D	A	Development Link Road (North)
	B	Development Link Road (East)
	C	A6192 Markham Lane
	D	A6192 Markham Road

2.2 Base Turning Counts

- 2.2.1 Comprehensive vehicle classified turning counts at each of the four junctions were undertaken in 2011 in the AM and PM peak period. Counts were segmented according to vehicle type and were presented in 15 minute intervals.
- 2.2.2 Some Heavy Goods Vehicle (3 axles or more) trips were identified in the count data which represented temporary site construction traffic. These trips were manually removed from the data set. These adjusted counts were then used to represent the 2011 base year traffic demands on the junctions.
- 2.2.3 The counts include development already built and occupied and this observed base year is analysed below in Section 3.1.

2.3 SATURN Highway Model

- 2.3.1 The North Derbyshire Highway Assignment Model, commissioned by Derbyshire County Council, can provide traffic flow forecasts for future year traffic demands at the junctions.
- 2.3.2 Future years (2016 and 2026) 'Core Scenario' traffic forecasts were produced. These contained trips from those development sites identified by Bolsover District Council, North East Derbyshire District Council and Chesterfield Borough Council in their emerging Core Strategy documents. The 'Core Scenario' contains all approved and planned schemes and developments and represents the growth expected by the district planning authorities:
- Committed Developments – i.e. the sites have planning permission; or:
 - Potential Developments – i.e. sites and sizes identified as Core strategic sites in the LDF submissions but do not have planning permission.
- 2.3.3 The North Derbyshire Highway Assignment Model forecast years are 2016 and 2026, i.e. the end of Derbyshire's Local Transport Plan period. The forecast includes all the currently known Core Strategy development and, therefore, it will look at a scenario that reflects the end of the core strategy horizon.
- 2.3.4 Development inbound and outbound trips at Markham Vale were calculated and assigned to the model according to the 'Condition 21' maximum permissible developments.
- 2.3.5 The new Development Link Road to the West of the M1 is assumed to be implemented and open to traffic in the 2016 model and therefore the associated rerouting of trips is fully represented. The 2016 forecast year gives a realistic future year scenario for assessing the junction's operational capacity given that the development of the Markham Vale site is unlikely to be complete before 2016.
- 2.3.6 Using the model led 2016 future year, background traffic growth including trips from committed and potential development in the adjacent local authority planning districts, was added to the 2011 base year traffic counts.

2.4 Markham Vale Trip Generation

2.4.1 Markham Vale development plots were represented by zones in the traffic model and loaded with trips for the 'Condition 21' permissible development levels in the 2026 'Core Scenario' forecasts. Adding the 2026 Markham Vale 'Condition 21' development trips to the 2016 background growth (including base counts) produced the reference demand for undertaking the junction capacity assessment of the 'Condition 21' development and is analysed below in Section 3.2. Any spare capacity in the Junction 29A analysis represents the potential for further development at Markham Vale without requiring further infrastructure improvements once all the committed 'Condition 21' developments are built out.

2.5 Markham Vale Trip Distribution

2.5.1 The Markham Vale zones are not located near to any model zones with similar land use types that could be used to determine a Markham Vale distribution and so a gravity model of Markham zones' was produced to determine distribution of trips. This trip distribution was then assigned onto the loaded highway network using the North Derbyshire Highway Assignment Model.

2.5.2 The select link analysis procedure can be used to identify the direction of trips into or out of model zones. Using the Markham Vale model zones, the following trip distributions are observed from each of the sites, in Tables 2 to 5:

TABLE 2 – MARKHAM VALE TRIP DISTRIBUTION, AM PEAK - INBOUND

Plot Number	1&2	5	6&7	8	9	13-16	Total
M1 North	47	10	99	15	20	68	259
Shuttlewood	6	3	11	2	7	8	37
Bolsover	46	12	95	14	25	78	270
M1 South	36	8	90	14	16	79	242
Calow	46	18	87	13	34	56	254
Duckmanton	6	0	20	0	0	1	27
Staveley	17	1	51	12	2	103	185
Total	205	51	453	71	103	394	1275

TABLE 3 – MARKHAM VALE TRIP DISTRIBUTION, AM PEAK - OUTBOUND

Plot Number	1&2	5	6&7	8	9	13-16	Total
M1 North	12	3	9	2	5	20	51
Shuttlewood	24	6	16	3	11	38	98
Bolsover	14	3	16	2	6	19	60
M1 South	16	3	9	2	6	26	62
Calow	25	10	19	3	18	38	112
Duckmanton	0	0	0	0	0	0	0
Staveley	14	1	13	3	1	39	70
Total	103	26	83	15	46	180	453

TABLE 4 – MARKHAM VALE TRIP DISTRIBUTION, PM PEAK - INBOUND

Plot Number	1&2	5	6&7	8	9	13-16	Total
M1 North	23	5	11	2	6	23	69
Shuttlewood	24	6	11	2	11	30	83
Bolsover	21	6	12	2	6	27	74
M1 South	16	4	8	1	5	22	55
Calow	30	8	14	2	15	32	101
Duckmanton	1	0	0	0	0	0	1
Staveley	13	3	7	2	0	38	62
Total	127	32	63	11	42	172	446

TABLE 5 – MARKHAM VALE TRIP DISTRIBUTION, PM PEAK - OUTBOUND

Plot Number	1&2	5	6&7	8	9	13-16	Total
M1 North	68	15	106	18	28	111	345
Shuttlewood	10	2	9	1	8	7	38
Bolsover	42	10	88	9	20	58	227
M1 South	52	11	81	16	14	100	274
Calow	56	21	77	9	38	35	235
Duckmanton	3	1	7	0	0	1	12
Staveley	27	3	61	14	0	113	217
Total	257	64	427	66	109	425	1349

2.5.3 The total inbound trips (shown in Table 2 and 4) and outbound trips (shown in Table 3 and 5) represent the 'Condition 21' maximum trip generation permitted.

2.6 Core Strategy Traffic Analysis

2.6.1 A final test of 'Core Strategy Development' used the 'Condition 21' Markham Vale trip numbers and routing. This test used a reference demand that includes:

- additional background traffic growth from the National Transport Model (NTM) growth forecasts;
- 'committed' and 'potential' development throughout the North Derbyshire model area, excluding Markham Vale developments identified in the Local Development Plan; and
- 'Condition 21' maximum permissible development

2.6.2 The 'Core Strategy Development' test is the 2026 forecast model output and is the final analysis presented in Section 3.3 below

2.6.3 Figure 3 details the processes used to assess the capacity of Junction 29A.

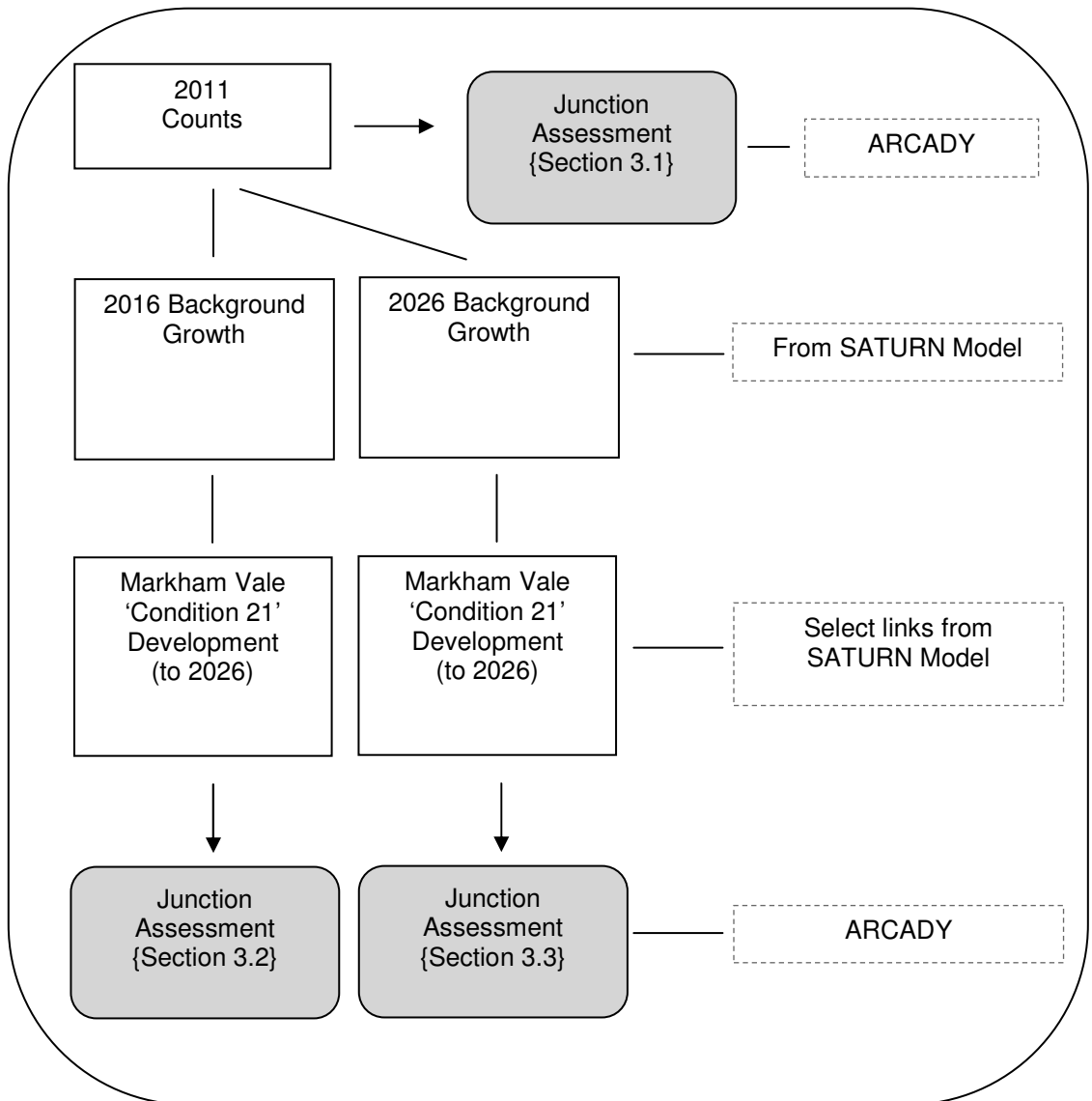


Figure 3 – Junction Demand Traffic Flow Derivation

2.7 ARCADY Analysis

- 2.7.1 The demand traffic flows were entered into an ARCADY analysis, with the junction arms as described above in Table 1 and illustrated in Figure 2. ARCADY analyses were undertaken for both the AM and PM peak hours.
- 2.7.2 HGV proportions were calculated for each arm of each junction based on the base count information, traffic model proportions to the forecast year and development traffic proportions.
- 2.7.3 Junction geometry was measured, using OS CAD data, and the parameters are documented within the ARCADY analysis outputs contained at the Appendices (see Volume 2 of this report).
- 2.7.4 The ODTAB option was selected for all ARCADY analyses undertaken for this junction capacity assessment.
- 2.7.5 The aim of the capacity assessment was to:
- Test the roundabouts against the 2011 base flows including existing development
 - Test the analysis against the 'Condition 21' development levels
 - Test the analysis against the 'Core Strategy Development' flows and 'Condition 21' Markham development levels
- 2.7.6 The ratio of flow to capacity (RFC) is a useful indicator of a roundabouts operational performance. The DMRB gives the following guidance¹:
- “The RFC is an indicator of the likely performance of a junction under a future year traffic loading. It should be calculated or computed for each trial design. Due to the site to site variation mentioned in paragraph 5.2 there is a standard error of prediction of the entry capacity by the formula of + or - 15% for any site. Thus if any entry RFC ratio of about 85% occurs queuing will theoretically be avoided in the chosen design year peak hour in 5 out of 6 cases”
- 2.7.7 Based on this guidance, any junction arm was considered to be over capacity when the RFC value from the ARCADY outputs exceeded a target value of 0.85 in either time period.
- 2.7.8 The results of the ARCADY analyses at each of the four roundabouts are presented in the following section.

¹ Reference: DRMB, Volume 6, Section 2, TA 23/81, Para 6.2

3 JUNCTION OPERATIONAL ASSESSMENT

3.1 Base Flows

3.1.1 Base flows were taken from the 2011 traffic flow counts. This test does not include any traffic growth assumptions. Existing Markham Vale development built and occupied by 2011, is included in this assessment. The site occupation plan is included in Annex C. The summary RFC statistics are provided below in Table 6 for the AM and PM peak hour separately.

TABLE 6 – M1 J29A JUNCTION RFC-BASE			
Roundabout	Approach	RFC AM	RFC PM
A	A	0.124	0.106
	B	Outbound	Outbound
	C	0.257	0.231
B	A	0.162	0.140
	B	0.182	0.190
	C	0.119	0.134
	D	0.000	0.000
	E	0.141	0.097
C	A	0.249	0.192
	B	Outbound	Outbound
	C	0.277	0.187
	D	0.118	0.161
D	A	0.000	0.000
	B	0.000	0.000
	C	0.243	0.198
	D	0.265	0.218

3.1.2 All approaches to all junctions operate below the target RFC of 0.85 in the 2011 base year scenario. This is consistent with the conditions currently observed on the ground.

3.1.3 Full ARCADY outputs for this scenario are provided in Appendix A (see Volume 2 of this report).

3.2 Condition 21 Developments

- 3.2.1 As part of the planning process, Markham Vale has been granted permission based upon the condition that trip generations do not exceed specified levels. Each development site within Markham Vale has consented land uses which each generate their own rates of trip generation, the land uses are a combination of; B1, B2 and B8. From this data the number of vehicles entering and leaving each Markham Vale development site was calculated and assigned to the model (as described in sections 2.4 & 2.5 above).
- 3.2.2 The modelled flows across all Markham Vale development sites is 1729 vehicular trips in the AM peak hour and 1794 vehicular trips in the PM peak hour. These are based on total Gross Floor Areas (GFA) of 25,000m² of B1, 60,000m² of B2 and 180,000m² of B8. The flows represent the total two way flows both into and out of all Markham Vale development sites in each time period.
- 3.2.3 The RFC statistics for the 'Condition 21' developments' trip demands assigned to each of the four roundabouts are provided below in Table 7.

TABLE 7 – M1 J29A JUNCTION RFC-CONDITION 21			
Roundabout	Approach	RFC AM	RFC PM
A	A	0.259	0.332
	B	Outbound	Outbound
	C	0.565	0.588
B	A	0.477	0.429
	B	0.467	0.475
	C	0.487	0.629
	D	0.448	0.579
	E	0.287	0.142
C	A	0.186	0.323
	B	Outbound	Outbound
	C	0.471	0.375
	D	0.619	0.846
D	A	0.021	0.043
	B	0.010	0.027
	C	0.089	0.167
	D	0.350	0.089

- 3.2.4 In both the AM Peak and PM Peak all four roundabouts operate below the 0.85 RFC target value. No junction causes concern and delays would not be expected on any approach arm under typical conditions.
- 3.2.5 Given that ‘Condition 21’ sets the upper limit for development trip generations at Markham Vale and all junctions under this scenario operate below the 0.85 RFC target value, the development location split is acceptable and the allocation of developments to plots does not need to be optimised further to improve junction operation or development capacity.
- 3.2.6 The full ARCADY outputs for this scenario are provided in Appendix B (in Volume 2 of this report).

3.3 Core Strategy Developments

3.3.1 The 'Core Strategy Developments' assessments include; Markham Vale developments, background growth, and 'Committed' and 'Potential' schemes which have been identified by the local planning districts; Chesterfield, North East Derbyshire and Bolsover, in their uncertainty logs (see section 2.6 above).

3.3.2 The AM and PM turning movements are taken directly from the 2026 North Derbyshire Highway Assignment Model. Markham Vale developments are as the 'Condition 21' arrangements. The ARCADY analysis is presented below in Table 8.

TABLE 8 – M1 J29A JUNCTION RFC-CORE STRAT.			
Roundabout	Approach	RFC AM	RFC PM
A	A	0.705	0.656
	B	Outbound	Outbound
	C	0.996	1.027
B	A	0.847	0.604
	B	0.506	0.484
	C	1.248	1.189
	D	0.682	1.025
	E	0.364	0.133
C	A	0.824	1.063
	B	Outbound	Outbound
	C	0.843	0.601
	D	1.295	1.070
D	A	0.024	0.058
	B	0.011	0.036
	C	0.411	0.613
	D	0.542	0.524

- 3.3.3 Under this scenario the RFC at three of the four junctions are above the 0.85 RFC target value on at least one arm. This implies that queuing will form at several locations at M1 J29A in the 'Core Strategy' scenario. Full ARCADY outputs for this scenario are provided in Appendix C.
- 3.3.4 It may be possible to make capacity enhancing modifications to these junctions. Potential mitigation options could include:
- enlarging the Eastern roundabout (C) via entry width widening to the M1 SB off-slip (approach D) to ensure queuing does not extend back to the M1 mainline and entry width widening to the A6192 westbound (approach A);
 - full or partial signalisation of the western roundabout (B), particularly the northbound off-slip (approach C), to ensure queuing does not extend back to the motorway main line; and
 - enlarging the North-western roundabout (A) via entry width widening to Erin Road northbound (approach C) and provision of a two-to-one merge on the M1 On-Slip (exit B).
- 3.3.5 The above options would require further analysis and design work to confirm their feasibility and extent.

4 CONCLUSIONS

- 4.1.1 An operational capacity assessment was undertaken at M1 J29A roundabouts using a combination of 2011 traffic counts, outputs from the North Derbyshire SATURN traffic model, and development trip assumptions from model routing predictions. ARCADY was used for the analysis of operational capacity of each of the four existing roundabout junctions.
- 4.1.2 In the base year all junctions perform within their capacity ability, as expected given observed conditions.
- 4.1.3 A junction assessment of Junction 29A with the 'Condition 21' Development scenario combined with traffic forecasts to 2016, identified that all junctions operate within their capacity ability.
- 4.1.4 A 'Core Strategy' analysis was undertaken which includes all identified likely development to the year 2026. Three junctions were identified as lacking sufficient capacity to meet forecast demands and would need some mitigation works to reduce the impact of queues and delays.
- 4.1.5 Any proposed mitigation measures would require further analysis in order to determine their feasibility.