Technical Note Rev A

Subject: **Purbeck DC Local Plan Review Modelling – Phase 2: Junction Capacity Modelling**

Date: **16/10/2017**

Reference: **105700**

Glossary

From the modelling results the following definitions are taken from the Junctions 9 User Guide (2015). Junctions 9 is the software used to build, calibrate, validate and run the models. The results shown in Table 1 are summary results and represent the 'worst' values over all time segments – generally, the highest values. Note that these may come from different time segments; for example, the longest queue for a particular arm may occur during a different time segment to when the highest delay occurs, which in turn may differ between arms.

RFC - **Ratio of Flow to Capacity**: The RFC provides one output for judging the performance of the junction.

Queue: Represents the number of vehicles expected to tail back from the stop line for each arm. The summary results take the maximum queue length calculated within the whole modelled period.

Delay: This is the average time in seconds that a vehicle is calculated to wait on the arm before it can enter the junction.

LOS – Level of Service: This is based on the Delay value and the broad thresholds are defined as follows:

- A = Free flow
- B = Reasonably free flow
- C = Stable flow
- D = Approaching unstable flow
- E = Unstable flow
- F = Forced or breakdown flow

1   Introduction

1.1   Highways England has requested that the impacts of the growth options within the Purbeck Local Plan are tested on a number of junctions on the SRN, for which it has responsibility. Highways England and Purbeck District Council seeks to understand the level of change of operation and capacity at each of its junctions compared to the baseline situation.

1.2   Phase 1 has been completed which determined the trip generation of the proposed allocated developments and the likely trip distribution. Summary spreadsheets were produced showing the individual and cumulative impacts from the various developments at each of the listed junctions. It has been agreed with Highways England and Purbeck District Council that the following junctions will be assessed:

- Bere Regis Roundabout;
- Roundhouse Roundabout, and;
- Lake Gates (Wimborne).

1.3   For these junctions we have used the industry-standard modelling software 'Junctions 9' to assess operation and capacity, using the ARCADY (roundabouts) module. The models have been built using OS mapping data to provide the geometric measurements. Existing traffic survey data has been used to validate the base models of the required junctions.

1.4   We have used the industry-standard TEMPRO software to generate traffic growth rates from the base-year traffic data to the future year of 2033.

1.5   Table 1 presents the potential housing growth numbers across the whole of the District, comprising the two reference cases provided by Purbeck District Council.

Table 1: Housing growth by settlement comprising the two reference cases

SETTLEMENT	APPROXIMATE NUMBER OF HOMES	
	Alternative Option 2 3,605 homes	Alternative Option 3 3,083 homes
Wool	1,000	1,000
Lytchett Minster	650	650
Moreton Station	600	0
Wareham Town	500	500
North Wareham	205	205

SETTLEMENT	APPROXIMATE NUMBER OF HOMES	
Upton	100	100
Lytchett Matravers	90	600
Langton Matravers	40	28
Harmans Cross	20	0

1.6 Option 2 presents a reference case where development would be focused in south west Purbeck and Option 3 in north east Purbeck.

1.7 The following scenarios were used in the assessment of the Bere Regis, Roundhouse and Lake Gates roundabout junction and the represent various combinations of residential and employment development in Bere Regis.

- Scenario a = 77 homes
- Scenario d = 244 homes
- Scenario e = 0.7ha employment
- Scenario f = 1.9ha employment
- Scenario g = 0 employment

1.8 We were requested to test the maximum and minimum scenarios for all roundabouts, i.e. Alternative Option 2ea, and Alternative Option 3fd.

1.9 In addition we tested the Bere Regis roundabout for maximum housing with no employment growth – scenario 2dg.

2   Traffic Modelling Results

Bere Regis Roundabout

2.1   Future development flows have been added to the base model for the following scenarios:

- ○   Option 2 - SW Purbeck Scenario

    - ▪ Scenario a = 77 homes + Scenario e = 0.7ha employment

    - ▪ Scenario d = 244 homes + Scenario g = 0 employment

- ○   Option 3 - NE Purbeck

    - ▪ Scenario f = 1.9ha employment + Scenario d = 244 homes

2.2   Tables 1 and 2 below shows the results of these assessments. It is noted how development for employment uses can make a significant impact to the operational capacity of the Bere Regis roundabout during the AM peak.

2.3   In the AM peak the results show that with 2017 base flows the junction works close to its operational capacity. However, with 2033 base flows the junction goes well beyond the operational capacity. Arm A for instance has an RFC that is 24% higher with a 2033 base than it does with a 2017 base. The PM shows similar characteristics in the results to the AM peak.

2.4   Option 2 with scenarios e and e, show only marginal deterioration of junction performance in the AM in 2017 and 2033, but more notable impact in the PM peak hour. Arm A and Arm C in the PM peak shows a significant level of queuing and delay. Arm C has the additional employment traffic on this arm and the capacity results could be due to the fact that the current design geometry of the road is to serve a petrol filling station and small employment area and not the employment coming forward if Option 2 scenarios a and e are carried forward into the Local Plan.

2.5   With 2017 base flows, Option 2 with scenarios d and g (244 dwellings and no employment), the modelling shows that the roundabout generally operates within its operational capacity, with the ratio of flow to capacity (RFC) less than 1 on each arm, delays of 108 seconds and maximum queue lengths of 21 vehicles. However, using 2033 base flows Arm A which is the eastern arm of the A31, shows RFCs of 1.22 and 1.25 in the AM and PM peaks respectively. It is therefore considered that the background traffic on the network in this instance is largely responsible for the arm exceeding its operational capacity.

2.6   For Option 3 with scenarios f and d (1.9ha of employment plus 244 dwellings) the roundabout in the model operates beyond its operational capacity with RFC's of greater than 1 on most arms in the AM peak, delay of up to 960 seconds and queue lengths of 44 vehicles or approximately 264m when using 2017 baseline flows. It should be noted however, that Option 3 is where development (outside of Bere Regis) would be encouraged in the north east of the district and could affect flows along both the A31 (Arm A) and the A35 (Arms B and D) particularly as the performance of the roundabout is proportional to the level of employment in Bere Regis.

2.7   Arm C performs well above its operational capacity in the PM peak under scenario Option 3 + f + d. As with Option 2 this is understood to be due to this being the main access point to the proposed area of employment.

2.8   Overall, Option 3+Scenario f+d worsens the junction performance the most, whilst Option 2+Scenario a+e and Option 2 +Scenario d+g do not have a significant impact compared to the respective base scenario.

SYSTRA

Bere Regis Roundabout Modelling Results – AM Peak Hour

<table>
<tr><td colspan="17" align="center">Bere Regis Roundabout - AM PEAK PERIOD</td></tr>
<tr>
<th></th>
<th>Queue (Veh)</th><th>Delay (s)</th><th>RFC</th><th>LOS</th>
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</tr>
<tr>
<td></td>
<td colspan="4" align="center">2017 Baseline</td>
<td colspan="4" align="center">2017 Base+Option 2+Scenario a+e</td>
<td colspan="4" align="center">2017 Base+Option 2+Scenario d+g</td>
<td colspan="4" align="center">2017 Base+Option 3+Scenario f+d</td>
</tr>
<tr>
<td>Arm A – A31</td>
<td>11</td><td>49.07</td><td>0.94</td><td>E</td>
<td>22</td><td>88.67</td><td>1.01</td><td>F</td>
<td>15</td><td>66.69</td><td>0.97</td><td>F</td>
<td>44</td><td>158.70</td><td>1.08</td><td>F</td>
</tr>
<tr>
<td>Arm B – A35 (east arm)</td>
<td>12</td><td>54.70</td><td>0.95</td><td>F</td>
<td>22</td><td>87.74</td><td>1.01</td><td>F</td>
<td>15</td><td>63.21</td><td>0.97</td><td>F</td>
<td>43</td><td>156.13</td><td>1.08</td><td>F</td>
</tr>
<tr>
<td>Arm C – Unamed Road</td>
<td>3</td><td>96.61</td><td>0.79</td><td>F</td>
<td>5</td><td>139.01</td><td>0.92</td><td>F</td>
<td>3</td><td>108.48</td><td>0.82</td><td>F</td>
<td>10</td><td>202.5</td><td>1.03</td><td>F</td>
</tr>
<tr>
<td>Arm D – A35 (west arm)</td>
<td>4</td><td>12.68</td><td>0.78</td><td>B</td>
<td>4</td><td>15.7</td><td>0.82</td><td>C</td>
<td>4</td><td>15.09</td><td>0.82</td><td>C</td>
<td>5</td><td>17.1</td><td>0.84</td><td>C</td>
</tr>
<tr>
<td></td>
<td colspan="4" align="center">2033 Baseline</td>
<td colspan="4" align="center">2033 Base+Option 2+Scenario a+e</td>
<td colspan="4" align="center">2033 Base+Option 2+Scenario d+g</td>
<td colspan="4" align="center">2033 Base+Option 3+Scenario f+d</td>
</tr>
<tr>
<td>Arm A – A31</td>
<td>82</td><td>279.75</td><td>1.18</td><td>F</td>
<td>110</td><td>428.39</td><td>1.26</td><td>F</td>
<td>96</td><td>354.18</td><td>1.22</td><td>F</td>
<td>148</td><td>601.04</td><td>1.34</td><td>F</td>
</tr>
<tr>
<td>Arm B – A35 (east arm)</td>
<td>60</td><td>232.35</td><td>1.11</td><td>F</td>
<td>77</td><td>311.83</td><td>1.15</td><td>F</td>
<td>64</td><td>246.11</td><td>1.12</td><td>F</td>
<td>109</td><td>463.48</td><td>1.21</td><td>F</td>
</tr>
<tr>
<td>Arm C – Unamed Road</td>
<td>9</td><td>297.14</td><td>1.05</td><td>F</td>
<td>11</td><td>309.75</td><td>1.07</td><td>F</td>
<td>9</td><td>281.96</td><td>1.04</td><td>F</td>
<td>19</td><td>433.57</td><td>1.14</td><td>F</td>
</tr>
<tr>
<td>Arm D – A35 (west arm)</td>
<td>10</td><td>30.96</td><td>0.92</td><td>D</td>
<td>15</td><td>46.47</td><td>0.96</td><td>E</td>
<td>14</td><td>43.20</td><td>0.95</td><td>E</td>
<td>18</td><td>53.81</td><td>0.97</td><td>F</td>
</tr>
</table>

Bere Regis Roundabout Modelling Results – PM Peak Hour

	Queue (Veh)	Delay (s)	RFC	LOS	Queue (Veh)	Delay (s)	RFC	LOS	Queue (Veh)	Delay (s)	RFC	LOS	Queue (Veh)	Delay (s)	RFC	LOS
Bere Regis Roundabout - PM PEAK PERIOD																
	2017 Baseline				**2017 Base+Option 2+Scenario a+e**				**2017 Base+Option 2+Scenario d+g**				**2017 Base+Option 3+Scenario f+d**			
Arm A – A31	14	63.51	0.96	F	27	112.82	1.03	F	21	90.81	1.01	F	41	160.85	1.08	F
Arm B – A35 (east arm)	8	33.91	0.91	D	14	54.86	0.96	F	12	47.07	0.95	E	13	52.08	0.96	F
Arm C – Unamed Road	2	75.27	0.71	F	16	324.75	1.20	F	3	106.61	0.80	F	59	959.9	1.64	F
Arm D – A35 (west arm)	5	15.54	0.84	C	6	19.62	0.87	C	6	17.68	0.86	C	8	24.72	0.90	C
	2033 Baseline				**2033 Base+Option 2+Scenario a+e**				**2033 Base+Option 2+Scenario d+g**				**2033 Base+Option 3+Scenario f+d**			
Arm A – A31	88	346.66	1.21	F	110	484.50	1.27	F	103	438.29	1.25	F	136	596.4	1.31	F
Arm B – A35 (east arm)	38	121.93	1.05	F	59	185.60	1.10	F	52	158.33	1.08	F	56	170.54	1.09	F
Arm C – Unamed Road	10	312.53	1.09	F	42	1178.01	1.51	F	11	344.81	1.11	F	119	2450.32	2.02	F
Arm D – A35 (west arm)	22	59.06	0.99	F	31	78.18	1.01	F	28	71.94	1.01	F	43	104.8	1.04	F

Roundhouse Roundabout

2.9   Future development flows have been added to the base model for the following scenarios:

⭕   Option 2 - SW Purbeck

▪ Scenario a = 77 homes + Scenario e = 0.7ha employment

⭕   Option 3 - NE Purbeck Scenario

▪ f = 1.9ha employment + Scenario d = 244 homes

2.10   Generally, with 2017 base flows input into the model, the Roundhouse Roundabout operates at capacity at present and performs above operational capacity under all scenarios, with Option 3 f + d scenario performing worst. Of particular note is Arm C, the A350 southern arm in the Option 3 f + d scenario which includes 1.9ha of employment land and provision for 244 homes. This arm provides a key link between Purbeck and Poole and Bournemouth but also provides access to and from some larger towns to the north including Blandford Forum and Shaftsbury. Commuter traffic between these towns is likely to traverse the Roundhouse Roundabout at peak hours. However, again, it should be noted that Option 3 allocates most of the development in the north east of the district including Lytchett Matravers located to the south of this junction.

2.11   With 2033 base flows input into the model, the situation identified in the 2017 scenarios is exacerbated with a RFC on arm C over 25% beyond the operational capacity in the AM peak and 28% in the PM peak. Also of note in the 2033 scenarios are arm A and C, these are the north and south A350 links respectively. However, as with the Bere Regis junction, capacity issues with arms A and C are noted to be related to background traffic growth and not necessarily related to the additional development that the local plan could provide for.

2.12   Overall, Option 3+Scenario f+d worsens the junction performance the most, but Option 2+Scenario a+e still does have an impact compared to the respective base scenario, particularly on arms A, B and C.

Roundhouse Roundabout Modelling Results – AM Peak Hour

	Queue (Veh)	Delay (s)	RFC	LOS	Queue (Veh)	Delay (s)	RFC	LOS	Queue (Veh)	Delay (s)	RFC	LOS
Roundhouse Roundabout - AM PEAK PERIOD												
	2017 Baseline				**2017 Base+Option 2+Scenario a+e**				**2017 Base+Option 3+Scenario f+d**			
Arm A – A350 (north arm)	30	147.66	1.06	F	41	199.38	1.11	F	46	227.43	1.12	F
Arm B – A31 (east arm)	9	32.51	0.91	D	11	38.62	0.93	E	12	44.39	0.95	E
Arm C – A350 (south arm)	14	101.62	0.99	F	47	265.37	1.16	F	80	475.74	1.29	F
Arm D – Unamed Road / Access	0	0	0.00	A	0	0.00	0.00	A	0	0.00	0.00	A
Arm E – A31 (west arm)	15	91.83	0.99	F	19	116.51	1.02	F	18	108.37	1.00	F
	2033 Baseline				**2033 Base+Option 2+Scenario a+e**				**2033 Base+Option 3+Scenario f+d**			
Arm A – A350 (north arm)	96	530.13	1.25	F	114	635.87	1.29	F	123	687.83	1.31	F
Arm B – A31 (east arm)	48	134.93	1.06	F	58	157.71	1.08	F	65	175.03	1.10	F
Arm C – A350 (south arm)	67	480.37	1.25	F	128	843.82	1.41	F	182	1218.45	1.54	F
Arm D – Unamed Road / Access	0	0.00	0.00	A	0	0.00	0.00	A	0	0.00	0.00	A
Arm E – A31 (west arm)	54	320.90	1.15	F	60	362.36	1.17	F	59	341.04	1.16	F

Roundhouse Roundabout Modelling Results – PM Peak Hour

	Queue (Veh)	Delay (s)	RFC	LOS	Queue (Veh)	Delay (s)	RFC	LOS	Queue (Veh)	Delay (s)	RFC	LOS
Roundhouse Roundabout - PM PEAK PERIOD												
	2017 Baseline				**2017 Base+Option 2+Scenario a+e**				**2017 Base+Option 3+Scenario f+d**			
Arm A – A350 (north arm)	23	127.54	1.04	F	33	174.79	1.08	F	43	234.73	1.13	F
Arm B – A31 (east arm)	8	28.54	0.90	D	20	64.55	0.99	F	30	90.68	1.02	F
Arm C – A350 (south arm)	15	106.34	1.00	F	30	179.44	1.09	F	43	240.5	1.14	F
Arm D – Unamed Road / Access	0	0.00	0.00	A	0	0.00	0.00	A	0	0.00	0.00	A
Arm E – A31 (west arm)	15	75.31	0.98	F	19	90.41	1.00	F	26	117.37	1.03	F
	2033 Baseline				**2033 Base+Option 2+Scenario a+e**				**2033 Base+Option 3+Scenario f+d**			
Arm A – A350 (north arm)	77	470.89	1.23	F	95	583.03	1.27	F	111	676.29	1.31	F
Arm B – A31 (east arm)	40	114.82	1.04	F	86	246.44	1.13	F	106	321.59	1.16	F
Arm C – A350 (south arm)	74	513.42	1.28	F	90	626.55	1.29	F	109	728.36	1.33	F
Arm D – Unamed Road / Access	0	0.00	0.00	A	0	0.00	0.00	A	0	0.00	0.00	A
Arm E – A31 (west arm)	62	276.83	1.14	F	71	322.11	1.16	F	85	398.11	1.19	F

Lake Gates Roundabout

2.13 Future development flows have been added to the base model for the following scenarios:

- Option 2 - SW Purbeck
  - Scenario a = 77 homes + Scenario e = 0.7ha employment

- Option 3 - NE Purbeck Scenario
  - f = 1.9ha employment + Scenario d = 244 homes

2.14 Using 2017 base flows, generally arms A to C perform near to operational capacity with RFCs at or around 1 for all scenarios. Of note is Arm D, the western arm of the A31 which shows maximum RFCs of 1.13, queues of 58 vehicles and a delay of 207 seconds during the AM peak under Option 3 scenario f and d (highest combination of employment and residential). The A31 provides a strategic east-west link between Dorchester, Poole, Bournemouth, Southampton and Portsmouth and could be a reason for this arm showing capacity issues.

2.15 With 2033 base flows input into the model all arms exceed operational capacity. Following from the results shown with 2017 base flows, as expected arm D is the worst performing. However, it should be noted that based on the existing situation and the observed survey (2017) flows arm D exceed operational capacity. Therefore, any development traffic will only worsen this capacity issue. It can be suggested that arms A and B only show capacity issues in the 2033 scenarios and these could also therefore be a consequence of background traffic growth. However, arm D in the AM peak and arms C and D in the PM peak exceed their capacities in the 2017 with development scenarios.

2.16 Overall, there is little difference in the impact at this junction from either Option 2+Scenario a+e or Option 3+Scenario f+d.

SYSTRA

Lake Gates Roundabout Modelling Results – AM Peak Hour

	Queue (Veh)	Delay (s)	RFC	LOS	Queue (Veh)	Delay (s)	RFC	LOS	Queue (Veh)	Delay (s)	RFC	LOS
Lake Gates Roundabout - AM PEAK PERIOD												
	2017 Baseline				**2017 Base+Option 2+Scenario a+e**				**2017 Base+Option 3+Scenario f+d**			
Arm A – B3078	9	48.60	0.93	E	10	55.26	0.94	F	11	57.81	0.95	F
Arm B – A31 (east arm)	8	30.28	0.90	D	10	35.52	0.92	E	10	38.67	0.93	E
Arm C – Wimborne Road	11	52.78	0.94	F	13	62.41	0.96	F	15	70.06	0.98	F
Arm D – A31 (west arm)	26	106.84	1.03	F	50	182.04	1.11	F	58	207.72	1.13	F
	2033 Baseline				**2033 Base+Option 2+Scenario a+e**				**2033 Base+Option 3+Scenario f+d**			
Arm A – B3078	42	171.36	1.08	F	46	186.04	1.09	F	47	192.8	1.10	F
Arm B – A31 (east arm)	55	154.50	1.08	F	64	175.57	1.10	F	68	190.11	1.11	F
Arm C – Wimborne Road	73	317.39	1.17	F	77	344.1	1.18	F	81	366.56	1.19	F
Arm D – A31 (west arm)	94	429.25	1.21	F	137	610.35	1.28	F	152	667.05	1.30	F

Lake Gates Roundabout Modelling Results – PM Peak Hour

Lake Gates Roundabout - PM PEAK PERIOD											
	Queue (Veh)	Delay (s)	RFC	LOS	Queue (Veh)	Delay (s)	RFC	LOS	Queue (Veh)	Delay (s)	RFC	LOS
	2017 Baseline				2017 Base+Option 2+Scenario a+e				2017 Base+Option 3+Scenario f+d			
Arm A – B3078	8	34.23	0.91	D	11	44.1	0.94	E	13	49.4	0.95	E
Arm B – A31 (east arm)	7	24.22	0.89	C	13	42.29	0.95	E	16	50.37	0.97	F
Arm C – Wimborne Road	10	59.82	0.94	F	24	123.88	1.04	F	30	149.65	1.07	F
Arm D – A31 (west arm)	30	122.71	1.05	F	39	150.27	1.07	F	44	166.24	1.08	F
	2033 Baseline				2033 Base+Option 2+Scenario a+e				2033 Base+Option 3+Scenario f+d			
Arm A – B3078	44	135.15	1.06	F	58	172.29	1.09	F	63	189.10	1.10	F
Arm B – A31 (east arm)	55	141.11	1.08	F	85	229.55	1.13	F	94	260.25	1.15	F
Arm C – Wimborne Road	63	335.64	1.18	F	84	490.93	1.24	F	92	541.64	1.26	F
Arm D – A31 (west arm)	98	457.42	1.22	F	112	498.04	1.23	F	123	533.21	1.25	F