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EXECUTIVE SUMMARY

This assessment considers the traffic implications of each of three alternative options for the design of the A28/A291 junction as provided by KCC and AMEY. The options have been tested within the VISSIM model framework used to assess the SRR previously. Only the implications in terms of traffic are considered here and are assumed to be complementary to wider options appraisal of other factors.

This assessment concludes that all options allow the benefits of the SRR to be realised, with each scenario providing performance better than the do-minimum.

Option 4B was found to provide the best overall network performance and the lowest journey times across the network. Option 1A performed least well.

The disparity in performance between Option 1A and 2B was less apparent in the PM peak; an outcome attributed to Option 2B’s removal of the S-E movement at the junction, increasing pressure on the SRR and associated junctions in the PM peak, when traffic is tidally dominant in an west to east direction.

All scenarios tested were subject to assumptions which have the potential to be very influential on the performance of the network. All scenarios, in particular Option 1A and 4B, are sensitive to the level of bus demand, arising from the extent of diversion on to the SRR (or not), the future frequency of the services and the opportunity for non-scheduled services to be afforded bus priority (e.g. school and tourist coaches). The performance of all options is likely to deteriorate if any or all of these factors are considered – however the changes are unlikely to be proportional across the options. For instance, Option 2B is likely to be least sensitive to this factor as buses are not afforded signal priority control.
Option 1A is particularly sensitive to N-S demand and any constraints that can be placed on this. The performance of the junction and the network as a whole are likely to be worse if the authority opts to facilitate all potential N-S demand rather than to artificially constrain it through limiting green-time and encouraging reassignment.

Option 2B is likely to be very sensitive, particularly in the PM peak, to any future decisions to mitigate issues at Vauxhall Road. Where such mitigation is provided, west to east traffic demand at the A28/A291 would increase in the PM peak hour, likely giving rise to greater issues at the junction and on the SRR.

Moving forward – it may be advisable to consider final sensitivity testing of a preferred option against its critically sensitive parameter to ensure that this does not substantially undermine the conclusions. For instance, should the comprehensive options appraisal determine Option 2B as preferred and it is considered the mitigation at Vauxhall Road is a strong possibility, it would be advisable to run a sensitivity test on Option 2B with mitigation at Vauxhall Road in place.

Likewise – if Option 4B is preferred ultimately, it may be advisable to consider a sensitivity test of increased bus priority demand if frequency increases are anticipated or it is felt that the priority will be afforded to all PSVs.
1.0 INTRODUCTION

1.1 This option assessment report has been prepared by C&A Consulting Engineers on behalf of Kent County Council. It sets out the methodology and results of an assessment of junction design options undertaken within the framework of the Sturry Relief Road VISSIM model, with modifications to the coding of the network at the A28/A291 junction to reflect the three preferred options. Reporting on the forecast results from the model and thus the traffic implications of the three design options are presented. All other aspects of the model to remain the same.

1.2 The work undertaken follows on from a series of earlier assessments undertaken by C&A Consulting Engineers to support the LEP business case for the Sturry Relief Road and latterly to inform the design of the link road and associated mitigation. This included initial studies on options for the A28/A291 junction, the outcome of which can be revised in the following reports:

- 16-002-001 Signalised Junction and Realigned Link Road Testing
- 16-002-002 A28-A291 Alternative Arrangement

1.3 In the intervening period; further changes have been made to the model as part of an on-going work supporting forthcoming planning application for the development proposals and to reflect further change to the KCC highway proposals. Section 2.0 of this report sets out the scope of the historical modelling and summarises the various scenarios that have been considered over this time.

1.4 Section 3.0 of this report discusses in detail the three preferred options for the proposed junction on A28 Island Road / A291 Sturry Hill which form the basis of this exercise. Following this, section 4.0 describes how it has been modelled and the process of calibration and assumptions made.
1.5 Section 5.0 details the results of this testing and, finally, section 6.0 summarises and concludes.
2.0 MODELLING SCOPE AND SUMMARY

Study Area and VISSIM Scope

2.1 The area of study identified within the scope covered the following 11 junctions, remaining consistent with earlier iterations and scenarios. The current assumptions for each junction are as follows.

- Junction 123 – Proposed Shalloak Rd Roundabout (Drawing 13-012-020)
- Junction 1 – Broad Oak Rd/Vauxhall Rd Roundabout (Existing)
- Junction 10 – A28 Sturry Rd/Vauxhall Rd/Stour Crescent Roundabout (Existing)
- Junction 126 – Proposed A28 Sturry Bypass Roundabout (Drawing 4300392-000-28)
- Junction 14 – Mill Rd/Water Lane Junction (Existing)
- Junction 13 – A28 Sturry Hill/Mill Rd/Fordwich Junction (Existing)
- Junction 8 – Proposed Sturry Hill/Island Rd Junction (Drawing 13-012-015 ‘Scenario M’; Drawing 4300392-000-30 ‘Scenario O’)
- Junction 124 – Proposed A28 Sturry Link Road Extract (Drawing 13-012-020)
- Junction 125 – Proposed Shalloak Rd Roundabout (Drawing 13-012-020)
- Junction 127 – Proposed North Access Junction (Drawing 13-012-022)
- Junction 5 – A291 Herne bay Rd/Sweechgate Junction (Existing)
2.2 The location of these junctions is shown in **Figure 1**.

**Figure 1 - Study Area**

Changes from ‘Scenario O’ to ‘Scenario P’ and ‘Scenario Q’

2.3 The options testing conducted and summarised in report 16-002-002 gave rise to Model ‘Scenario O’. Subsequent to this, and as part of further demand scenario modelling for the Sturry and Broad Oak planning applications, KCC requested changes to some of the underlying network assumptions.
2.4 The network assumptions changes focused on the roundabout junction of the Sturry Relief Road and A28 (south of rail crossing) and the arrangement for the junction between Vauxhall Road and Broadoak Road. The former was modified to reflect KCC’s latest proposals whilst the latter was reverted to the existing arrangement, removing the proposed signalisation scheme previously included as off-site mitigation. This revised scenario, referred to as ‘Scenario P’, has subsequently been used as the basis of assessment of the Sturry Development planning application and is reported in the associated Transport Assessment. This current report looks at further refinements to the infrastructure assumptions based on alternative arrangements for the A28/A291 junction. Each of the junction options have been tested under a series of sub-scenario test, referred to more generally as Scenario Q. Table 1 on the following page provides a comparison of the most recently reported options and that now being considered in this report.
Table 1 - Scenario Comparison Table

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Description</th>
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<tr>
<td>Scenario O</td>
<td>![Scenario O Diagram]</td>
</tr>
<tr>
<td>Scenario P</td>
<td>![Scenario P Diagram]</td>
</tr>
<tr>
<td>Scenario Q</td>
<td>![Scenario Q Diagram]</td>
</tr>
</tbody>
</table>
2.5 For completeness, **Figure 2** below presents the assumed arrangement of the junction between the proposed SRR and the A28, as adopted with Scenario P and retained for this assessment (in Scenario Q).

**Figure 2 - Proposed A28 Sturry Bypass Roundabout**
3.0 PROPOSED OPTION ASSESSMENTS

3.1 This section of the report considers in more detail the three junction design options to be tested within the VISSIM model framework. The original scheme design options were provided by KCC having been prepared by AMEY on their behalf. The options tested are those requested by KCC and it is understood that the conclusions from this assessment are to feed into the broader evaluation of preferred options, which will include factors beyond traffic and network performance.

3.2 Preliminary scheme designs were provided by KCC/AMEY, which include a clear indication of the physical design of the junction. However, in order to model the junctions effectively, further assumptions have had to be made about the proposals, including assumptions on signal timing, bus prioritisation and changes to bus routing. The following sections consider first the options as presented along with any further assumptions made to allow testing and specifics of the coding in the model, followed by specific consideration of bus operation and routing through the junctions.

**Option 1A - ‘Scenario Q1A’**

*Design Assumptions*

3.3 The proposed option 1A, to be tested under Scenario Q1A, is a signalised option for A28 Island Road/ A291 Sturry Hill as shown on *Figure 3* below.
3.4 It can be seen from Figure 3 that this is a fully signal controlled option with all movement allowed except the left turn from A28 (E) to A28 (S), which is restricted to buses only.

3.5 Regarding a phasing plan, a skeleton LINSIG model of the junction has been built for staging and phasing purposes, both of which are illustrated in Figure 4 and Figure 5:
Figure 4 - Skeleton LINSIG Model phasing layout – SCQ1A

Figure 5 - Stage Sequence view - SCQ1A
3.6 As with earlier signal options, Scenario Q1A is running under VAP control within the VISSIM model with a variable cycle time. Both stage 1 and stage 2 are detector activated and stage 3 is running on fixed time. Due to higher demand southbound in the AM peak period, stage 3 runs with fixed time 9 seconds in the AM peak and 7 seconds in the PM peak period.

**Figure 6 - VAP Logical Flow – SCQ1A**

3.7 The assumed fixed time of the southbound movement is a critical factor in the operation of the junction and subsequently the traffic assignment arising through the modelling. Increases in green time on this movement were noted to increase demand (by attracting more traffic) – with a subsequent performance implication for the wider junction, including the A28. As a result, it has been assumed that this movement would be constrained to some extent – encouraging use of other routes. Conversely, an excess constraint on this green time, which is unable to accommodate the minimum demand, would give rise to excess queuing and blocking of the A28 N-E. The fixed times have been based on a series of initial assignment runs to observe the typically constrained demand for the movement – which were translated to typical fixed
green times that minimised blocking. Due to the variable nature of the assignment and the flow in to the model, blocking could not be avoided entirely.

3.8 It has been assumed for this scenario that a yellow box for conflict area would be introduced central to the junction. The yellow box has been assumed to extend across the junction and prevent traffic on N-S movements from blocking across the junction when the level crossing is called and blocking E-N movements. The box junction has been assumed to operate in the opposite direction for the model, prevent traffic from E-N that has a constrained exit from blocking traffic from N-S – although the latter is less common.

**Option 2B – ‘Scenario Q2B’**

3.9 The proposed options 2B has tested in Scenario Q2B takes the form of a priority junction between A28 Island Road/ and A291 Sturry Hill as shown on Figure 7 below.
3.10 It can be seen from Figure 7 above that this is a priority controlled option, with right-turn from A28 (S) to A28 (E) banned; along with A291 to A28 (S) banned, except for buses. In the process of recoding the junction, a local calibration of the new priority controls entry capacity using TRL Junctions software (PICADY) was undertaken as benchmark.

**Option 4B – ‘Scenario Q4B’**

3.11 Option 4B is an evolution of the previous option including in earlier iteration of the VISSIM modelling, introducing additional movements for buses, as shown on Figure 8 below.
3.12 In terms of permitted movements, this is similar to previous arrangements albeit the changes to geometry that require recoding. A further change is the provision of bus only movements A291 to A28 (S). It is assumed that the phasing will remain consistent with previous option – however, in this case the network would need to be coded for bus priority (see below).

3.13 Regarding the phasing plan, a skeleton LINSIG model of the junction has been built for staging and phasing purposes shown as below Figure 9 and Figure 10:
Figure 9 - Skeleton LINSIG Model phasing layout – SCQ4B

Figure 10 - Stage Sequence view – SCQ4B
3.14 Scenario Q4B is running under VAP control with variable cycle time. Both stage 1 and stage 2 are detector activated, and stage 3 is demand dependant for Bus only. The VAP control has enabled Stage 3 to be called whenever there is a bus approaching the junction to avoid blocking back to left turning vehicles on A291 Sturry Hill Road southbound.

**Figure 10 – VAP Logical Flow – SCQ4B**

3.15 As with the other options, but more so in this case due to the bus priority assumptions, the frequency of services is key influencing factor on the performance of the junction. This is considered for all options below.
Public Transport Bus Route Assumption

3.16 Previous models assumed diversion of all ‘Triangle’ bus services on to the SRR and the retention of the ‘Thanet’ services along the A28. Each of the proposed junction arrangements tested in this assessment prompt changes to the assumptions on bus routing. These scenarios each now make allowance for bus movement between A291 and A28 (S), either as part of general traffic (Option 1A) or as bus only movements. However, in the case of Option 2B this comes with the removal of some ‘Thanet’ services.

3.17 Unless indicated otherwise, it has been assumed that the Triangle service will be split, with two buses per hour using the route through this junction and the remainder using the SRR. It should be noted that, whilst this might be a realistic assumption, Options 2B and 4B are likely to be very sensitive to higher frequency bus services, with buses potentially blocking other movements or commanding increasing proportion of green-time at the expense of other movements. It might therefore be advisable to consider sensitivity testing the tolerance of the arrangement to higher frequency services. For similar reasons, a potential critical assumption may be whether other PSVs are able to use the bus lane, rather than simply scheduled services. This might include school or tourist coaches for example. Due to a lack of data on non-scheduled PSVs and a clear indication of how such vehicles would use the routes the current assumption is that only scheduled services use the bus-only links.

3.18 As an extension to the above, there is a question of bus priority control at the junction. For this proposal, it is assumed that bus priority would be included, which would be based on a detector switching the phasing to the benefit of the bus movement upon arrival. This would be beneficial to the bus service and prevent blocking of the A291 – A28 (E) movement. However, it would be detrimental to the other movements. In a sensitivity scenario – with higher bus/PSV demand – this aggressive priority may not be preferable, with the balance of delay instead better shared.
3.19 **Table 2** below illustrates the alternations to assumptions on bus routing made for each of the options tested with Scenario Q. It should be noted that these bus routing assumptions were based on the timetabling valid at the time of the base model validation. Some changes have since taken place to routing of the existing situation which are not reflected in the models.

**Table 2 - Bus Routes Comparison Table**

<table>
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<th>Bus Service</th>
<th>Direction</th>
<th>Changes To Bus Routing (Against Base)</th>
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<td></td>
<td></td>
<td>SCNP</td>
</tr>
<tr>
<td>3</td>
<td>EB</td>
<td>None</td>
</tr>
<tr>
<td>4/4A/4X</td>
<td>WB</td>
<td>100% SRR as Figure 12</td>
</tr>
<tr>
<td>6/6A/6X</td>
<td>EB</td>
<td>100% SRR as Figure 12</td>
</tr>
<tr>
<td>7 outbound</td>
<td>EB</td>
<td>None</td>
</tr>
<tr>
<td>7 inbound</td>
<td>WB</td>
<td>None</td>
</tr>
<tr>
<td>8/8A/8X OB</td>
<td>EB</td>
<td>None</td>
</tr>
<tr>
<td>8/8A/8X IB</td>
<td>WB</td>
<td>None</td>
</tr>
<tr>
<td>9 outbound</td>
<td>EB</td>
<td>None</td>
</tr>
<tr>
<td>9 inbound</td>
<td>WB</td>
<td>None</td>
</tr>
<tr>
<td>Park &amp; Ride</td>
<td>SB</td>
<td>None</td>
</tr>
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Figure 12 - Bus Routes - through link road (Herne Bay Rd – A28 Sturry Rd)

Figure 13 - Bus Routes - through link road (Island Rd – A28 Sturry Rd)
4.0 VISSIM MODELLING & CALLIBRATION PROCESS

4.1 The modelling process, as detailed below, builds on the work completed and detailed within previous reports, including 16-002-002 Alternative arrangement and 16-002-001 Signalised junction and Realigned Link Road Testing, and the subsequent refinements.

4.2 All models were changed identically in the AM & PM scenarios although the differing lengths of the external links in AM to PM remained consistent with previous scenarios of the same time period in order to contain all demand in the modal and such that journey time could be used as a valid indicator of performance.

Proposed Sturry Hill / Island Road Junction Calibration – SCQ 2B

4.3 A geometrically accurate representation of the proposed priority junction was constructed and, in this instance, the local calibration method used to calibrate the proposed junction within VISSIM. The entering flow from A28 Island Road joining the A291 (the right turning movements) with any clearly circulating vehicle volume (the northbound movements on Sturry Hill) was calculated using PICADY output of the slope and intercept values. These were then compared to the expected vehicles numbers with the actual flow output from VISSIM model. The threshold of the expected flow to actual flow is 10%, and the requirement for the GEH statistic value is to be below 5.0.

Table 3 - Proposed Priority Junction Calibration – SCQ 2B Only

<table>
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<th>Arm</th>
<th>Name</th>
<th>PICADY</th>
<th>VISSIM</th>
<th>Diff</th>
<th>GEH</th>
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<tr>
<td></td>
<td></td>
<td>Slope</td>
<td>Intercept (Pcu/hr)</td>
<td>Qc</td>
<td>Qe</td>
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<tr>
<td>1</td>
<td>A28 Island Road RT</td>
<td>0.184</td>
<td>653</td>
<td>1000</td>
<td>469</td>
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<tr>
<td></td>
<td></td>
<td>0.184</td>
<td>653</td>
<td>800</td>
<td>506</td>
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4.4 The results above showed a 100% calibration on A28 Island Road approach (Right turn only) with two levels of flow for the GEH statistic value to be below 5.0.

*Dynamic Assignment*

4.5 As a dynamic assignment model, each of the AM and PM scenarios was run multiple times until a suitable level of convergence was achieved between five consecutive model runs, so that 95% of path volumes and travel times should change less than 5% between each run. This process was completed for each model run used in the validation process and between and modifications made to the model.

4.6 **Tables 4, 5, 6, 7, 8 and 9** summarise the convergence results of the final modification models as achieved. As can be seen, all criteria are within suitable limits.

Table 4 - Scenario 1A AM Convergence Table

<table>
<thead>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tr>
<td>% of Paths within 0-5% difference</td>
<td>99%</td>
<td>99%</td>
<td>99%</td>
<td>99%</td>
<td>99%</td>
<td>99%</td>
</tr>
<tr>
<td>Total travel time [h], All Vehicle Types</td>
<td>1114</td>
<td>1108</td>
<td>1116</td>
<td>1115</td>
<td>1123</td>
<td>1100</td>
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<td>% Change in Travel Time</td>
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<td>-0.5%</td>
<td>0.7%</td>
<td>0.0%</td>
<td>0.7%</td>
<td>-2.1%</td>
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Table 5 - Scenario 1A PM Convergence Table

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<th>2</th>
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<td>% of Paths within 0-5% difference</td>
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<td>99%</td>
<td>99%</td>
<td>99%</td>
<td>98%</td>
<td>99%</td>
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<tr>
<td>Total travel time [h], All Vehicle Types</td>
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<td>1195</td>
<td>1191</td>
<td>1227</td>
<td>1288</td>
<td>1261</td>
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<tr>
<td>% Change in Travel Time</td>
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<td>0.7%</td>
<td>-0.3%</td>
<td>3.0%</td>
<td>5.0%</td>
<td>-2.1%</td>
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Table 6 - Scenario 2B AM Convenience Table

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</tr>
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<tbody>
<tr>
<td>% of Paths within 0-5% difference</td>
<td>97%</td>
<td>98%</td>
<td>99%</td>
<td>98%</td>
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<td>98%</td>
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<td>Total travel time [h], All Vehicle Types</td>
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<td>1214</td>
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<td>1210</td>
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<tr>
<td>% Change in Travel Time</td>
<td>-</td>
<td>-3.0%</td>
<td>-0.8%</td>
<td>0.4%</td>
<td>-0.8%</td>
<td>0.1%</td>
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Table 7 - Scenario 2B PM Convenience Table

<table>
<thead>
<tr>
<th>Model Run</th>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of Paths within 0-5% difference</td>
<td>99%</td>
<td>99%</td>
<td>99%</td>
<td>99%</td>
<td>99%</td>
<td>99%</td>
</tr>
<tr>
<td>Total travel time [h], All Vehicle Types</td>
<td>1151</td>
<td>1157</td>
<td>1134</td>
<td>1145</td>
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<tr>
<td>% Change in Travel Time</td>
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<td>0.5%</td>
<td>-2.0%</td>
<td>1.0%</td>
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Table 8 - Scenario 4B AM Convenience Table

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<th>3</th>
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<tr>
<td>% of Paths within 0-5% difference</td>
<td>100%</td>
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<td>100%</td>
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<tr>
<td>Total travel time [h], All Vehicle Types</td>
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<td>1092</td>
<td>1081</td>
<td>1096</td>
<td>1097</td>
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<tr>
<td>% Change in Travel Time</td>
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<td>0.0%</td>
<td>-0.9%</td>
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Table 9 - Scenario 4B PM Convenience Table

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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of Paths within 0-5% difference</td>
<td>99%</td>
<td>99%</td>
<td>99%</td>
<td>99%</td>
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<td>99%</td>
</tr>
<tr>
<td>Total travel time [h], All Vehicle Types</td>
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<td>1143</td>
<td>1144</td>
<td>1136</td>
<td>1119</td>
<td>1134</td>
</tr>
<tr>
<td>% Change in Travel Time</td>
<td>-</td>
<td>-0.2%</td>
<td>0.1%</td>
<td>-0.8%</td>
<td>-1.5%</td>
<td>1.4%</td>
</tr>
</tbody>
</table>
5.0 MODELLING RESULTS

5.1 This section of the report provides the quantifiable results from the modelling of each of the scenarios – compared to the Do-minimum. This represents the objective comparison of the performance of each option. Further observational results are discussed towards the end of the section, along with some context and commentary on the sensitivity of the results.

Overall Network Performance

AM Peak Period

5.2 Table 10 below summarises the overall network performance of the three preferred options for ‘Scenario Q’ in the AM Peak Period.

Table 10 - Comparison Results Table AM Peak Period

<table>
<thead>
<tr>
<th>Network Performance</th>
<th>Scenario</th>
<th>Do Min</th>
<th>SCQ1A</th>
<th>SCQ2B</th>
<th>SCQ4B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Delay Per Vehicle (s)</td>
<td>570</td>
<td>418</td>
<td>343</td>
<td>311</td>
<td></td>
</tr>
<tr>
<td>Average Speed (mph)</td>
<td>10</td>
<td>13</td>
<td>15</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

5.3 The results show that within the three preferred options, Scenario Q4B operates with the highest performance for AM peak period and Scenario Q1B the worst – albeit considerably better still than the Do-Minimum.

PM Peak Period

5.4 Table 11 below summarises the overall network performance of the option test results for ‘Scenario Q’ in the PM Peak Period.
Table 11 - Comparison Results Table PM Peak Period

<table>
<thead>
<tr>
<th>Network Performance</th>
<th>Do Min</th>
<th>SCQ1A</th>
<th>SCQ2B</th>
<th>SCQ4B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Delay Per Vehicle (s)</td>
<td>559</td>
<td>480</td>
<td>452</td>
<td>404</td>
</tr>
<tr>
<td>Average Speed (mph)</td>
<td>11</td>
<td>11</td>
<td>12</td>
<td>13</td>
</tr>
</tbody>
</table>

5.2 The results show that within the three preferred options, Scenario Q4B operates with the highest performance for PM peak period.

Journey Time

5.5 A journey time evaluation was carried out between the three preferred options in ‘Scenario Q’ to evaluate the different impacts of the proposed Sturry Hill and Island Road junction to the network journey time.
5.6 **Table 12** below summarises the travel time results for all options in 'Scenario Q' in the AM Peak Period.

**Table 12 - Comparison Results Table - Travel Time AM**

<table>
<thead>
<tr>
<th>Travel Time Scenario</th>
<th>AM Scenarios</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Do Min</td>
</tr>
<tr>
<td>ANPR002-003</td>
<td>814</td>
</tr>
<tr>
<td>ANPR004-001</td>
<td>164</td>
</tr>
<tr>
<td>ANPR004-009</td>
<td>276</td>
</tr>
<tr>
<td>ANPR010-003</td>
<td>321</td>
</tr>
<tr>
<td>ANPR012-001</td>
<td>450</td>
</tr>
<tr>
<td>ANPR002-011</td>
<td>557</td>
</tr>
<tr>
<td>ANPR008-011</td>
<td>109</td>
</tr>
<tr>
<td>ANPR012-007</td>
<td>144</td>
</tr>
<tr>
<td>ANPR002-009</td>
<td>719</td>
</tr>
<tr>
<td>ANPR010-001</td>
<td>440</td>
</tr>
</tbody>
</table>

5.7 The results indicate that SCQ4B has the shortest journey time spent across the network, with SCQ1A typically the longest in the AM peak period.

**PM Peak Period**

5.8 **Table 13** below summarises the travel time results for results for all options in 'Scenario Q' in the PM Peak Period.
Table 13 - Comparison Results Table - Travel Time PM

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Do Min</th>
<th>SCQ1A</th>
<th>SCQ2B</th>
<th>SCQ4B</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANPR002-003</td>
<td>639</td>
<td>235</td>
<td>145</td>
<td>145</td>
</tr>
<tr>
<td>ANPR004-001</td>
<td>138</td>
<td>166</td>
<td>170</td>
<td>149</td>
</tr>
<tr>
<td>ANPR004-009</td>
<td>258</td>
<td>388</td>
<td>254</td>
<td>245</td>
</tr>
<tr>
<td>ANPR010-003</td>
<td>314</td>
<td>343</td>
<td>367</td>
<td>334</td>
</tr>
<tr>
<td>ANPR012-001</td>
<td>573</td>
<td>433</td>
<td>600</td>
<td>445</td>
</tr>
<tr>
<td>ANPR002-011</td>
<td>585</td>
<td>356</td>
<td>405</td>
<td>377</td>
</tr>
<tr>
<td>ANPR008-011</td>
<td>112</td>
<td>200</td>
<td>177</td>
<td>104</td>
</tr>
<tr>
<td>ANPR012-007</td>
<td>297</td>
<td>364</td>
<td>359</td>
<td>322</td>
</tr>
<tr>
<td>ANPR002-009</td>
<td>739</td>
<td>389</td>
<td>375</td>
<td>376</td>
</tr>
<tr>
<td>ANPR010-001</td>
<td>495</td>
<td>353</td>
<td>392</td>
<td>374</td>
</tr>
</tbody>
</table>

5.9 The results indicate that SCQ4B has the shortest journey time spent across the network. In this period, the performance benefits of SCQ2B over SCQ1A are less apparent. In fact, SCQ2B has notably longer journey times on a number of routes.

VISSIM Link Flow

AM Peak Period

5.10 A VISSIM Link Flow evaluation is also carried out in order to identify the differences in terms of network performance and longer journey time comparing the different junction designs on A28 Island Road/ A291 Sturry Hill. Table 14 below summarises the total junction link flow for AM peak period.
Table 14 - Total Junction Link Flow - AM

<table>
<thead>
<tr>
<th>Junction No.</th>
<th>Junction Name</th>
<th>AM</th>
<th>1A</th>
<th>2B</th>
<th>4B</th>
</tr>
</thead>
<tbody>
<tr>
<td>123</td>
<td>Proposed Shalloak Rd Priority Junction</td>
<td></td>
<td>1573</td>
<td>1628</td>
<td>1564</td>
</tr>
<tr>
<td>1</td>
<td>Proposed Broad Oak Rd/Vauxhall Rd Signalised Junction</td>
<td></td>
<td>1997</td>
<td>2197</td>
<td>2140</td>
</tr>
<tr>
<td>10</td>
<td>A28 Sturry Rd/Vauxhall Rd/Stour Crescent Roundabout</td>
<td></td>
<td>2953</td>
<td>2744</td>
<td>2894</td>
</tr>
<tr>
<td>126</td>
<td>Proposed A28 Sturry Bypass Roundabout</td>
<td></td>
<td>2063</td>
<td>2094</td>
<td>2184</td>
</tr>
<tr>
<td>14</td>
<td>Mill Rd/Water Lane Junction</td>
<td></td>
<td>568</td>
<td>960</td>
<td>1023</td>
</tr>
<tr>
<td>13</td>
<td>A28 Sturry Hill/Mill Rd/Fordwich Junction</td>
<td></td>
<td>346</td>
<td>964</td>
<td>1120</td>
</tr>
<tr>
<td>8</td>
<td>Proposed Sturry Hill/Island Rd Junction</td>
<td></td>
<td>1544</td>
<td>1899</td>
<td>1931</td>
</tr>
<tr>
<td>124</td>
<td>Proposed A28 Sturry Link Road Extract</td>
<td></td>
<td>2630</td>
<td>2504</td>
<td>2312</td>
</tr>
<tr>
<td>125</td>
<td>Proposed Shalloak Rd Roundabout</td>
<td></td>
<td>2993</td>
<td>2726</td>
<td>2623</td>
</tr>
<tr>
<td>127</td>
<td>Proposed North Access Junction</td>
<td></td>
<td>1454</td>
<td>1464</td>
<td>1476</td>
</tr>
<tr>
<td>5</td>
<td>A291 Herne bay Rd/Sweechgate Junction</td>
<td></td>
<td>1593</td>
<td>1667</td>
<td>1653</td>
</tr>
</tbody>
</table>

5.11 **Figure 15, Figure 16 and Figure 17** below showed the detail link flow information for the modelling network in AM Peak period for ‘Scenario Q1A’, ‘Scenario Q2B’ and ‘Scenario Q4B’ respectively.
Figure 15 - Scenario Q1A Link Flow - AM
Figure 16 - Scenario Q2B Link Flow - AM
Figure 17 - Scenario Q4B Link flow - AM
**PM Peak Period**

5.12 Table 15 below summarises the total junction link flow for PM peak period.

<table>
<thead>
<tr>
<th>Junction No.</th>
<th>Junction Name</th>
<th>1A</th>
<th>2B</th>
<th>4B</th>
</tr>
</thead>
<tbody>
<tr>
<td>123</td>
<td>Proposed Shalloak Rd Priority Junction</td>
<td>1114</td>
<td>995</td>
<td>908</td>
</tr>
<tr>
<td>1</td>
<td>Proposed Broad Oak Rd/Vauxhall Rd Signalised Junction</td>
<td>1554</td>
<td>1771</td>
<td>1659</td>
</tr>
<tr>
<td>10</td>
<td>A28 Sturry Rd/ Vauxhall Rd/ Stour Crescent Roundabout</td>
<td>2864</td>
<td>2900</td>
<td>2775</td>
</tr>
<tr>
<td>126</td>
<td>Proposed A28 Sturry Bypass Roundabout</td>
<td>2023</td>
<td>2173</td>
<td>2021</td>
</tr>
<tr>
<td>14</td>
<td>Mill Rd/Water Lane Junction</td>
<td>874</td>
<td>1022</td>
<td>858</td>
</tr>
<tr>
<td>13</td>
<td>A28 Sturry Hill/Mill Rd/Fordwich Junction</td>
<td>717</td>
<td>997</td>
<td>1018</td>
</tr>
<tr>
<td>8</td>
<td>Proposed Sturry Hill/Island Rd Junction</td>
<td>1552</td>
<td>1839</td>
<td>1688</td>
</tr>
<tr>
<td>124</td>
<td>Proposed A28 Sturry Link Extract</td>
<td>2300</td>
<td>2421</td>
<td>2139</td>
</tr>
<tr>
<td>125</td>
<td>Proposed Shalloak Rd Roundabout</td>
<td>2145</td>
<td>1888</td>
<td>2002</td>
</tr>
<tr>
<td>127</td>
<td>Proposed North Access Junction</td>
<td>1477</td>
<td>1587</td>
<td>1409</td>
</tr>
<tr>
<td>5</td>
<td>A291 Herne bay Rd/Sweechgate Junction</td>
<td>1694</td>
<td>1886</td>
<td>1731</td>
</tr>
</tbody>
</table>
5.13 **Figure 18, Figure 19 and Figure 20** below showed the detail link flow information for the modelling network in PM Peak period for ‘Scenario Q1A’, ‘Scenario Q2B’ and ‘Scenario Q4B’ respectively.
Figure 18 - Scenario Q1A Link Flow - PM
Figure 19 - Scenario Q2B Link Flow - PM
Figure 20 - Scenario Q4B link flow - PM
VISSIM Modelling Observations

5.14 To further understand the outcomes of the modelling exercise, a series of observations of the modelling running were carried out to examine and investigate the results above. These observations focused mainly on Junction A28 Island Road/ A291 Sturry Hill, but also considered the wider network where appropriate. They seek to explain, where possible, the results noted above and the sensitivity of these to changes in assumptions.

General Observations for All Scenarios

5.15 When considering the results of these modelling scenarios, it is important to note that limitations in the overall model framework can have differing implications on performance of each option.

5.16 Particular caution should be applied in comparing the results of the PM Peak models. Earlier modelling identified the constraints inherent in the network preventing the full benefits of the SRR being demonstrated in the PM peak. Of particular concern was the ‘bottle neck’ of the Vauxhall Road junctions. In the future year scenarios under the PM peak scenario, when the tidal nature of traffic flow is west to east, traffic is sufficiently constrained at these junctions so as to generate excess queuing, essentially holding back traffic from entering the wider network. This issue was in part resolved through the proposed introduction of mitigation at Vauxhall Road and Broadoak Road. Whilst this is understood to still be a possible solution it has been removed from the current model scenarios under instructions from KCC.

5.17 This issue is less apparent in the AM peak, when the tidal flow is east to west and the busier flow of traffic hits the A28/A291 junction first.

5.18 In the PM peak, the A28/A291 junction is subjected to constrained demand with the traffic held to the west of Vauxhall Road. This is of course representative of what is proposed and in this regard would be considered
reasonable. The analysis does not however forecast the scenario where traffic issues are addressed (in part or full) at Vauxhall Road and greater demand is able to reach the A28/A291 junction in the PM peak hour.

5.19 Because of the differing banned movements of the options, this constraint will be represented differently in each of the options tested. For example, Option 2B bans movement from the south to east at the junction. The implications of this ban, which forces all eastbound traffic to use the SRR and not A28, are likely to be less apparent in the current constrained PM peak model than they would be in a scenario where the constraint was lifted.

5.20 The following paragraphs provide comment on the specific options.

Scenario Q1A

5.21 A significant limitation of Option 1A is the introduction of the additional conflicting movement from north to south. This require the introduction of a complete extra stage in the signal timing – with the resultant increase in intergreen time during stage changes. The net impact is significant reductions in green time that can be allocated to the A28 Island Road, which in the AM Peak is subject to notable demand.

5.22 In a more general sense – the need for more stages with more opposing movements introduces greater delay.

5.23 For AM peak period, the impact from lost green and blocking back for southbound has put pressure on Junction 124 – the proposed A28 Sturry Link Road roundabout – and further blocking back to Junction 5 – A291/ Sweechgate junction.

5.24 During PM Peak period, focusing on A28 Island Road/ A291 Sturry Hill junction, Scenario Q1A operates with restricted entry capacity from A28 Sturry
Hill road rather than Island road due to the demand change and the lost green time for a third stage.

5.25 The design of a left turn flare and go-ahead movement on A291 Sturry Hill North arm gives rise to occasions where the dominant left turning traffic is blocked by traffic waiting to progress ahead, introducing effectively wasted green time for left turning movement. This is an issue for AM peak period predominately with the higher demand for southbound movement.

5.26 It is noted that this issue is exacerbated due to the fixed time of the level crossing, and the lack of a link to VAP activated A28/A291 junction in the model such that occasionally, southbound traffic is stopped by the level crossing despite the green stage afforded to it.

5.27 It should be noted that the model has adopted a fixed green time for the southbound movement which is intended to be a balance between constraint and suitable provision. More green time afforded to the N-S movement here would minimise the incidents of blocking the N-E movement, but it would do so at the expense of green time for the other movements, particular E-N. Providing more green time could also attract more demand, exacerbating the issue. Care would need to be taken in the implementation of an Option 1A based design to ensure the balance between providing for the demand of the N-S and not prejudicing the overall performance of other approaches.

5.28 To mitigate some of these issues with Option 1A, whilst retaining the N-S movement, additional queue storage on the northern arm would be required.

Scenario Q2B

5.29 During AM Peak period, Scenario Q2B operates well when consideration is given to the A28 Island Road/ A291 Sturry Hill junction itself. Much of this performance is gained from the banned southbound movement.
from A291 Sturry Hill and banned right turn for A28 northbound traffic. The overall speed within the network is similar to the existing situation with an average of 15mph.

5.30 During PM Peak period, Scenario Q2B operates well focusing on A28 Island Road/ A291 Sturry Hill junction, again due to banned southbound movement for A291 Sturry Hill and banned right turn for A28 northbound traffic. The diverted traffic from these banned movements does however put pressure on the wider network. During PM peak period, queues formed on proposed A28 Sturry Link Road roundabout (J124) as the Option 2B design forces all west-east traffic to use this route, with no option to use the A28. The delays incurred were arguably not severe, but certainly worse than other scenarios. However, it is important to note the caveat set out previously about the constrained nature of demand in the PM peak model. In the event that off-site mitigation at Vauxhall Road was introduced, the limitation of Option 2B and the delays on the SRR would be more profound.

**Scenario Q4B**

5.31 Scenario Q4B - a signal controlled with left turn only for A291 southbound traffic with provision of dedicated turning lanes on A28 westbound approach provision of bus gateway on A291 southbound for junction A28 Island Road/ A291 Sturry Hill. This design is very similar to the previous study in 16-002 A28-a291 Alternatives arrangement. The bus priority gateway is the main difference. With a 50% bus diverted to the new produced link road assumption, considering bus priority and prevent blocking of the A291-A28 (E0 movement, a demand dependant detector has been introduced with the VISSIM modelling, switching the phase to the benefit of the bus movement upon arrival). (Detail in section 3)

5.32 During AM Peak period, Scenario Q4B operates well focusing on A28 Island Road/ A291 Sturry Hill junction and entire network. The average speed
is 15mph and the movement across the network after dynamic assignment in the model area is well balanced.

5.33 During PM Peak period, Scenario Q4B operates well focusing on A28 Island Road/ A291 Sturry Hill junction. The average speed is also 15mph.

Sensitivity of Results

5.34 In considering the results set out in this report, it is important that the sensitivity of the model to the assumptions made is considered.

5.35 Options 1A and 4B are likely to be very sensitive to alternative assumptions on bus routing and frequency. Both operate bus priority measures that afford priority at the expense of other movements. Option 4B in particular does so at the expense of the critical E-N movement in the AM peak. Increases in bus frequency and/or use of the bus lane by large number of non-scheduled services would be likely to have a material impact on the performance of junction and the wider network.

5.36 Option 2B is likely to be less sensitive to additional bus movements, as these would not immediately trigger loss of green time for other arms. However, the lack of bus priority, with increased demand, could give rise to more frequent occurrences of buses blocking the N-E movement.

5.37 Further sensitivity testing could be undertaken on the scenarios to ascertain the impact of changes to bus routing and frequencies. This could seek to ascertain whether such changes would change the conclusions of this assessment.

5.38 Option 1A is very sensitive to the demand for N-S movement. The demand itself is also sensitive to the green time allowed on the movement. Accordingly, increases in the green time, which may be deemed necessary to
accommodate demand, could attract further demand to the detriment of the wider operation of the network.

5.39 A sensitivity test could introduce variable demand timing of this arm, with the models VAP control increase time to allow for demand. This could reduce the incidents of blocking but also reduce performance on other approaches.

5.40 Finally, all options are subject to the limitations of the model with regards to assumptions on wider mitigation (particularly Vauxhall Road/Broad Oak). A series of sensitivity tests could be conducted introducing potential mitigation in such locations to ascertain whether the additional demand released by this would change the conclusions of the report. This last sensitivity test may be particularly relevant if the final preferred junction configuration is Option 2B and future mitigation of Vauxhall Road/Broad Oak is deemed likely.
6.0 SUMMARY

6.1 Comparing the proposed three preferred option designs on Sturry Hill and Island Road junction, the above results show a similar performance within the AM peak period, and significantly worse performance in the PM peak period.

6.2 It is considered that SCQ4B and SCQ2B perform better than SCQ1A in terms of network performance and journey time. SCQ1A has the worst results within the three options.

6.3 Looking into SCQ2B and SCQ4B scenarios further, it can be seen that they are performing similar in the AM Peak period but different in the PM peak period. The reason behind it could be that due to the banned right turn for A28 northbound traffic on SCQ2B, more traffic has to be reassigned to the network and travel through the link road. Additionally, the restriction in entry capacity on Broad Oak Rd/ Vauxhall Road junction has limited the ability to make a fair comparison between these two scenarios.

6.4 Further test including test Scenario Q2B and Scenario Q4B with signalised junction Broad Oak Road/ Vauxhall Road is proposed.
DRAWINGS
Railway boundary fence added MIM MIM 18.10.16

File ref - p:\d - projects\co04300392 - a28 sturry link rd\102.drawings\01. working\000 non contract\4300392-000-28.dwg

Project Name
Rev
Drawing No
Scale :
Original Drawing Size :
Drawing Title
Dimensions :A1
As constructed
For construction
Date:
Client
Revision details
Design:
Appd:
Rev
Drawn:
Chkd:
For tender
For comment
Chkd Appd
05 October 2016

A28 Sturry Link Road, Canterbury
Scheme Design - Option 2
General Arrangement
A28 Sturry Road to North of Railway

SCALE  1 : 1000

TYPICAL SECTION WITH BUS LANE (looking North)

SCALE  1 : 1000

Notes
Earthworks slopes amended to 1 in 2.5
Pier 1 moved to Ch.212.5

SCALE  1 : 50

LONG SECTION
OPTION 1
Signal controlled signalised left turn for A29 southbound traffic.

OPTION 2
Signal controlled signalised left turn for A29 southbound traffic and left turn only for A28 westbound traffic, with bus lane to Sturry Station forecourt incorporating bus interchange facility, in wider forecourt.

OPTION 3
As existing (no movement restrictions) with carriageway widening to provide dedicated turning lanes or A28 westbound approach.

OPTION 4
Signal controlled signalised right turn for A29 southbound traffic with provision of dedicated turning lanes on A28 westbound approach.

OPTION 1A
Signal controlled signalised left turn for all other A28 westbound traffic, with turning exemption for buses.

OPTION 2A
Signal controlled signalised left turn for all other A28 westbound traffic and left turn only for A28 southbound traffic, with bus lane to Sturry Station forecourt incorporating bus interchange facility, in wider forecourt.

OPTION 2B
Signal controlled signalised left turn for A28 southbound traffic and left turn only for A28 northbound traffic with provision of dedicated turning lanes on A28 southbound approach.

EXISTING
Signal controlled signalised right turn for A29 southbound traffic with provision of dedicated turning lanes on A28 southbound approach.

OPTION 4A
Signal controlled signalised left turn for A29 southbound traffic with provision of dedicated turning lanes on A28 westbound approach.

OPTION 4B
Signal controlled signalised left turn for A29 southbound traffic with provision of dedicated turning lanes on A28 westbound approach.

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Notes
Average Queue (m)

Not to Scale
Not all Roads and Routes are Shown

SCQ1A - AM Peak Hour (0800-0900)
2031 Average Queue

16-002
Jun-17
Average Queue (m)

Not to Scale
Not all Roads and Routes are Shown

SCQ4B - AM Peak Hour (0800-0900)
2031 Average Queue

Jun-17
<table>
<thead>
<tr>
<th>Location</th>
<th>Average Queue (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fordwich Road</td>
<td>11</td>
</tr>
<tr>
<td>Vauxhall Road</td>
<td>14</td>
</tr>
<tr>
<td>Island Rd</td>
<td>8</td>
</tr>
<tr>
<td>Sturry Hill</td>
<td>5</td>
</tr>
<tr>
<td>Sweechgate</td>
<td>12</td>
</tr>
<tr>
<td>A291 Herne Bay Road</td>
<td>12</td>
</tr>
<tr>
<td>Shalloak Road</td>
<td>0.2</td>
</tr>
<tr>
<td>A291</td>
<td>4.5</td>
</tr>
<tr>
<td>A28</td>
<td>1.2</td>
</tr>
</tbody>
</table>

**Notes:**
- Average Queue (m)
- Not to Scale
- Not all Roads and Routes are Shown

**Source:**
- SCQ4B - PM Peak Hour (1700-1800)
- 2031 Average Queue
- Jun-17
Not to Scale
Not all Roads and Routes are Shown

SCQ2B - PM Peak Hour (1700-1800)
2031 Maximum Queue

Notes
Maximum Queue (m)

Land at Sturry / Broad Oak

16-002
Jun-17

Consulting Engineers Ltd