

**SHEERWATER ACCESS IMPROVEMENTS
SHEERWATER LINK ROAD**

Highways Design Report

November 2011

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Sheerwater Link Road Woking

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1.0 INTRODUCTION

- 1.1** Mayer Brown Limited has been commissioned by Woking Borough Council to prepare outline designs and junction models for the Sheerwater Access Road in addition to a potential future access into the Boundary Road Business Park.
- 1.2** Sheerwater is recognised as a Priority Place by the Surrey Strategic Partnership and in Woking Borough Council's Local Development. The area contains some 1,700 residential properties and has the largest concentration of Business Parks in the Borough. Access arrangements are an obstacle to securing investment in or full occupation of the Business Parks. The new access arrangements and enhancement of the environment of Albert Drive are considered essential to further the economic vitality of this part of the Borough.
- 1.3** Previously Mayer Brown has provided Woking Borough Council with highway and transportation advice on the provision of a link road to provide better vehicular access to Sheerwater and to improve the environment of the residential areas of Eve Road and Arnold Road. Mayer Brown has also advised the Council on alternative access arrangements for the Boundary Road Business Park.
- 1.4** The above studies resulted in an indicative scheme being prepared for Woking Borough Council's consideration, which provided a link road, an extension to Albert Drive, connecting to Sheerwater facilitating the removal of through traffic from Eve Road and Arnold Road. It is anticipated that these works would form the first stage of the works, with the potential for the future addition of a forth arm on the western side of the road, providing direct access to the Boundary Road Business Park.
- 1.5** This current report provides revised junction models based on updated traffic surveys. Topographical surveys of the area have also been carried out, allowing a more detailed road layout to be prepared. The proposed arrangements will require third party land which it is assumed will be obtained through a CPO process. Details of the scheme's land take is shown on Drawing WBCSheerwater.1/08B
- 1.6** The remainder of this report is divided into four sections:
- Existing Junction Operation and Base Traffic
 - Proposed Operation and Design Considerations
 - Capacity Analysis
 - Summary and Conclusions

- 1.7** The report demonstrates that a new link road into the Sheerwater area would be a significant benefit in terms of highways capacity, residential amenity and pedestrian and cycle infrastructure.

2.0 EXISTING JUNCTION OPERATION AND BASE TRAFFIC

Existing Junction Operation

- 2.1** Monument Road is one of the key routes into Woking from the Six Crossroads Roundabout. It leads south from the roundabout, over the canal, under the rail line and to the two mini-roundabouts that form the junctions of Monument Road / Oriental Road and Maybury Hill / College Hill.
- 2.2** Between the canal and rail bridges, Monument Road forms the major arm of junctions with Monument Way East, Eve Road, Walton Road, Arnold Road and Maybury Road. These junctions all fall within a distance of approximately 230m. Monument Road is a single-lane, two-way carriageway throughout its length.
- 2.3** In addition, there are signal controlled pedestrian crossings immediately to the south of the rail bridge, at the Arnold Road / Monument Road junction and at the Walton Road / Monument Road junction. There is an uncontrolled pedestrian crossing at the canal bridge. All signal controlled crossing are “on demand” or push button type crossings.
- 2.4** At present, Maybury Road operates on a one-way basis, with vehicles permitted to travel westbound toward the town centre only. Vehicles are permitted to turn left or right into Maybury Road from Monument Road. The junction operates on a priority basis, with Maybury Road forming the minor arm.
- 2.5** There is no room for vehicles to pass those waiting to turn right into Maybury Road. “Keep Clear” advisory markings are provided on Monument Road in an effort to minimise congestion. These markings are generally well observed.
- 2.6** Walton Road also operates on a one-way basis, with travelling eastbound towards Sheerwater only. Vehicles are permitted to turn left or right onto Monument Road, and also ahead to Eve Road. The junction is signalised, with a two-lane exit from Walton Road.
- 2.7** Arnold Road is one-way westbound, with left and right turns permitted onto Monument Road. The junction is signalised, with a two-lane exit from Arnold Road.
- 2.8** Eve Road is one-way eastbound, only left turns in are permitted. Right turning movements would block the ahead movement on Monument Road when waiting to turn. On-site observation shows that many northbound vehicles perform a U-turn at Monument Way East to turn left into Eve Road. Observations suggest that a significant level of drivers also disobey the banned right turn movement. Both of these manoeuvres have adverse implications in terms of highways safety and capacity.

- 2.9** Both Eve and Arnold Road are largely residential roads, with on-street parking on both sides. The residential environment is currently adversely affected by the significant volumes of traffic that each road accommodates. There is often significant queuing on Arnold Road in particular, with heavy vehicles using both roads on a regular basis. The current arrangements are not ideal for non-motorised users, particularly cyclists.
- 2.10** There are currently three bus services which operate along Eve Road and/or Arnold Road; the Peterbus 1, the 436 and the 446. These routes are shown on Figure 2.1 and will be rerouted along the new link road. Preliminary comments have been sought from the local bus operator through Surrey County Council and no “in principle” objections have been raised. Their comments are included as Appendix A.
- 2.11** Monument Way East forms the minor arm of a priority junction with Monument Road. There is a ghost island right turning facility and double “Keep Clear” markings are provided. All movements are permitted at the junction.
- 2.12** Monument Way East is a cul de sac at present, giving access to a number of commercial premises.
- 2.13** Local knowledge suggests that the existing signal junctions on Monument Road are over capacity during peak hours. Queues regularly block back to the double mini-roundabouts at the southern end of Monument Road.
- 2.14** Pedestrian flows in the area are moderate, with on-site observations indicating that the crossings are activated approximately every other cycle in peak hours.
- 2.15** On-site observations indicate cycle times of approximately 85 seconds during peak hours.
- 2.16** There are currently bus detection measures in place that give priority to buses at the signals.
- 2.17** The signal junctions also have “MOVA” installed. MOVA stands for **M**icroprocessor **O**ptimised **V**ehicle **A**ctuation. This detects approaching vehicles and queues and optimises signal timings accordingly. In off peak periods, when congestion is low, MOVA operates in a delay minimising mode but switches to a capacity maximising procedure if any approach becomes overloaded.

Base Traffic Flows

- 2.18** As set out above, as part of the previous assessment work, base traffic data was obtained from a number of sources for use in preliminary capacity assessment work.
- 2.19** In order to update this, new surveys were commissioned from K&M Traffic Surveys. These were undertaken on Tuesday 18th October from 0700-1000 and 1600-1900. These surveys covered the following junctions:
- Monument Road / Maybury Road
 - Monument Road / Walton Road / Eve Road
 - Monument Road / Arnold Road
 - Ever Road / Albert Drive / Arnold Road
 - Monument Road / Monument Way East
 - Boundary Road / Boundary Way
- 2.20** The surveys were undertaken by manual classified counts, with vehicles divided into car, HGV, bus, motorcycle and pedal cycle.
- 2.21** The full survey results are contained in Appendix B and the morning and evening 2011 weekday peak period traffic flows are illustrated at Figures 2.2 and 2.3 respectively.
- 2.22** The traffic surveys were “growthed” up to a design year of 2016 (i.e. 5 years from the date of the likely planning application). This is in line with Department for Transport *Guidance on Transport Assessment*.
- 2.23** In order to account for background traffic growth in the area, traffic growth factors were applied where appropriate.
- 2.24** As set out in DfT Transport Analysis Guidance (TAG) Unit 3.15.2, growth factors were based on the National Transport Model (NTM) factored by TEMPRO for Woking / Byfleet (main) (43UM1).
- 2.25** TEMPRO, the Trip End Model Presentation Program, allows detailed analysis of pre-processed trip-end, journey mileage, car ownership and population/workforce planning data from the National Trip End Model (NTEM). The pre-processed data is itself the output from a series of models developed and run by the ITEA division of DfT. TEMPRO can also be used to provide summaries of traffic growth using data from the National Transport Model (NTM).

2.26 This growth data is derived from:

- population forecasts based on 2008-based national forecasts released by the UK Statistics Authority
- household forecasts based on 2006-based forecasts by the Department for Communities and Local Government (CLG)
- employment forecasts, constrained to HM Treasury growth at a national level;
- car ownership forecasts that reflect recent GDP forecasts which take into account the effect of the economic downturn.

2.27 Essentially, TEMPRO factors account for planning related growth (i.e. increased housing and employment levels), with NTM covering “societal” effects such as policy, cost of running a car, etc.

2.28 An updated version of the dataset, NTEM 6.2, was released in April 2011 in draft status and was made definitive on the 19th July 2011. This new dataset was used to derive the growth factors applied.

2.29 This latest dataset has been updated as follows:

- population updated using ONS 2008-based projections;
- dwellings updated using Local Authority Annual Monitoring Reports;
- employment forecasts updated consistent with more recent GDP forecasts from the Office of Budget Responsibility. The forecasting method has also been slightly revised. The distribution of Employment and Workers by Region in the base year 2001 (and hence in all years), has been updated using Workforce Jobs and the Labour Force Survey;
- an update to the Car Purchasing Cost Index in the Car Ownership Model in line with more recent RPI data.

2.30 Growth factors were obtained using TEMPRO 6.2’s built in NTEM Growth Calculation tool. NTEM AF09 (the latest available) was used. Growth was based on that for an urban principal road serving the region.

2.31 The traffic growth factors derived are included as Appendix C. The resulting flows are shown in Figures 2.4 and 2.5.

Committed Development

2.32 There are no known significant committed developments in the immediate local area, however the use of the TEMPRO derived growth factors described above will account for generalised growth across the Woking area.

3.0 PROPOSED OPERATION AND DESIGN CONSIDERATIONS

- 3.1** It is proposed that Arnold Road and Eve Road be closed to motorised through traffic. The existing one-way system of Maybury Road and Walton Road would be maintained. Monument Way East would be extended east to join up with Albert Drive, creating a new link into the Sheerwater area.
- 3.2** Maybury Road would maintain its existing priority working arrangements. Walton Road would be signalised, as would the Monument Road / Monument Way East junction. The traffic signals controlling the two junctions would be linked in order to avoid excess queues forming between them.
- 3.3** It would also be possible to add a fourth arm to the Monument Road / Monument Way East junction, creating direct link to the Boundary Road Business Park.
- 3.4** It is anticipated that the existing MOVA system would be retained, optimising signal timings for on and off peak demand.
- 3.5** Bus priority measures would also be incorporated as per the existing arrangements, with buses being routed along the new Link Road.
- 3.6** As set out above, the Council has requested that this report consider two variations on the revisions to the highway layout. Firstly, consideration is to be given to the provision of the Sheerwater Link Road, to improve access to the Sheerwater Business Park area and to bypass traffic from the adjacent residential roads, Eve Road and Arnold Road. For the purposes of this assessment, this link road provision has been referred to as Phase 1.
- 3.7** The second assessment requires the consideration of a fourth arm at the new traffic signal junction which would serve the Boundary Road Business Park. This option also assumes the closure of the existing Walton Terrace and Boundary Way access to the Boundary Road Business Park, resulting in the new fourth arm becoming the only point of access to this employment area.
- 3.8** The new access to the Boundary Road business Park will result in the traffic associated with the employment uses on the park using the more appropriate highway infrastructure of Monument Road, rather than accessing via Boundary Road and Walton Road, which are predominantly fronted by residential properties.
- 3.9** This fourth arm could be constructed independently of the Sheerwater Link Road proposals, or concurrently with the Link Road proposals. For the purposes of this assessment, this link road provision has been referred to as Phase 2.

Phase 1

- 3.10** As set out above the primary objectives of this phase of the proposals are to improve access to the Sheerwater Business Park and to improve the environment along Arnold Road and Eve Road, by diverting the traffic which currently uses these routes along a new link road via the Sheerwater Business Park. The proposals also keep Walton Road open to traffic.
- 3.11** The proposals are also aimed at improving pedestrian and cycle links between the affected area and the town centre. In order provide a balance between not adversely affecting junction capacity and to provide for pedestrian desire lines a controlled crossing has been located north of the Maybury Road/Monument Road junction.
- 3.12** There is currently a high demand for ahead traffic flows from Walton Road into Eve Road and in order to cater for this demand, it has been necessary to establish a right turn lane into the proposed link road.
- 3.13** To accommodate the right turn lane, there is the requirement for third part land on both sides of the carriageway along the frontages of Monument Road.
- 3.14** The proposed layout for this arrangement is shown in Drawing WBCSheerwater.1/11 appended to this report.

Phase 2

- 3.15** Phase 2 of the proposals to be assessed introduce the provision of a fourth arm on the new Link Road/Monument Road junction which would serve the Boundary Road Business Park.
- 3.16** Under this phase, Walton Terrace and Boundary Way would be closed for traffic from Boundary Road into the Industrial Estate and the new fourth arm would provide the only access into the business park. The closures are required to avoid creating a vehicle rat-run between Boundary Road and the new Sheerwater Link Road junction.
- 3.17** The proposed layout for this arrangement is also shown in Drawing WBCSheerwater.1/11 appended to this report.

Design Considerations

3.18 In designing the highway layout Mayer Brown has taken account of the following key factors:

- highways safety
- traffic capacity
- method of signal control
- pedestrian facilities
- cycle facilities
- residential amenity of Eve Road and Arnold Road
- land take requirements

3.19 These issues are discussed in more detail below:

Highways Safety

3.20 Given the local constraints, it is important that the junctions are able to accommodate vehicle turning movements without conflicts. The junctions have therefore been subject to swept path analysis to ensure that manoeuvres can be safely accommodated. This has led to some design changes. For example, the stop line on Walton Road has been set back in order to avoid the rear of a left turning articulated vehicle swinging into the right turn lane.

Traffic Capacity

3.21 Traffic capacity has been the subject of detailed modelling. This is discussed in full in the next section of this report.

Method of Signal Control

3.22 The signal phasing and staging has been designed to maximise traffic capacity. This necessitates that on certain arms, different movements are controlled separately in order to make the most efficient use of the available green time.

3.23 It is common practice to have traffic islands between separately controlled movements on the same arm. However, due to the limited land available, this has not been possible in this instance. It would also result in excessive highways clutter.

3.24 It is therefore proposed that, where necessary, separate movements are controlled by separate signal heads. These would have arrow markings in order to clarify which movements they control.

3.25 This is a permitted method of setting out traffic signals, and is successfully in use in a number of locations in Surrey.

- 3.26** It is proposed that high mast signals be installed on the northern arm of the Monument Road / Monument way East signal junction in order to provide maximum forward visibility for vehicles arriving over the canal bridge.

Pedestrian and Cycle Facilities

- 3.27** Signal controlled pedestrian facilities will be provided at both signal controlled junctions. Due to the proposed staging of the junctions and the limited possibilities for staggered pedestrian islands, these will largely take place on an “all red” stage.
- 3.28** At the Walton Road junction, the crossing immediately to the south will become a toucan crossing, with eastbound cyclists on Walton Road being brought onto the southern footway, then crossing Monument Road before heading down Eve Road
- 3.29** A separate signal controlled toucan crossing will be maintained between Arnold Road and Maybury Road.
- 3.30** This will allow westbound cyclists to come down Arnold Road, across the toucan and onto the existing cycle route along Maybury Road.
- 3.31** With the removal of through traffic from Eve and Arnold Road, it is anticipated that these will become important pedestrian and cycle routes.

Residential Amenity of Eve Road and Arnold Road

- 3.32** Clearly the removal of through traffic on these two roads will have a significant benefit for existing residents. It will require both roads to revert to two-way working, with turning facilities provided as close to their western ends as practical.
- 3.33** The existing on-street parking arrangements will have to be revised, through the use of Traffic Regulation Orders (TROs), to permit two-way working. If parking were permitted along the full length of both sides of the roads, then they would be too narrow to permit two vehicles to pass. However, due to the low residual volumes of traffic, it is anticipated that it will be possible to maintain much of the existing parking, with passing places provided as necessary. It is also necessary to introduce turning heads on each road to allow vehicles to turn around and exit the roads in a forward gear. The turning arrangements have been designed to accommodate a large refuse vehicle.

Land Take Requirements

- 3.34** The existing highways boundaries are too narrow to permit the full changes required to Monument Road. It is therefore necessary for additional land to be obtained, presumably through a CPO process, to accommodate the proposed scheme.
- 3.35** No buildings will be affected and land take has been minimised wherever possible.

4.0 CAPACITY ANALYSIS

4.1 This section considers the implications of the proposed road schemes on the capacity of the adjacent highway network.

4.2 The following scenarios have been assessed in relation to capacity:

- Existing highway layout
- Phase 1 - Proposed Sheerwater Link Road
- Phase 2 - Proposed Sheerwater Link Road, with access to Boundary Road Business Park

4.3 The operation of the proposed layouts has been modelled using the JCT Consultancy's LINSIG V3 software; a well recognised method of testing signal junctions. The program also allows the modelling of give-way junctions and allows small networks of junctions to be examined. The software compares actual demand flows to the junction's theoretical capacity and gives a measure of Degree of Saturation expressed in percent.

4.4 In addition, the program gives an overall measure of the junctions' performance, Percentage Reserve Capacity (PRC). The PRC is calculated from the maximum degree of saturation on a link controlled by the Stage Stream and is a measure of how much additional traffic could pass through a junction controlled by the Stage Stream whilst maintaining a maximum degree of saturation of 90% on all links. A PRC of 0% therefore means that each link of the junction is operating with a 10% of its capacity unused. A junction with a PRC of down to -10% would thus still be operating within theoretical capacity. The lower the PRC value, the worse the network is operating.

4.5 Normal practice when assessing a junction's or network's capacity would be to take on-site traffic flow and queue measurements to assess the capacity and saturation flows of individual lanes. The modelling would then be validated against observed conditions at the junction.

4.6 However, in this instance, it is considered that this approach would not be appropriate. The reasoning behind this is that the proposed changes will be extensive, and will create a new road layout. Clearly it is not possible to make the necessary observations of a road that does not yet exist.

4.7 It is therefore important that a consistent method of calculating capacities is applied across all three scenarios. Individual lane capacities have thus been calculated using the methodologies set out in TRL Research Report 67, based dimensions taken from the various road layout drawings appended to this report.

4.8 These calculations are performed within the LINSIG program, with the dimensions input when constructing the model.

4.9 For all modelling, peak hour traffic flows were derived from the survey data. The traffic flows were converted into Passenger Car Units (PCUs), allowing the model to take account of the level of larger vehicles on the network. The PCU conversion factors recommended by TRL in Research Report 67 were used as outline below:

Vehicle	PCU Factor
Light Vehicles	1
HGVs	2.3
Buses	2
Motorcycles	0.4
Pedal Cycles	0.2

Table 4.1: TRL RR67 PCU Conversion Factors

4.10 Due to the number of links involved in the models, the full results are not reproduced in the text. However, summary tables are provided alongside the discussion of the individual models.

Existing Highway Layout

4.11 The modelling of the existing highway layout has been based on signal programming forms provided by Surrey County Council (Works Order Number 470779089, Last Modified 20/02/08, Issue 1.0.1). These are included in Appendix D and set out the existing phases, phase delays, stages and intergreens.

4.12 Rather than attempt to replicate existing conditions, the aim of the base model was to create a set of results that would form a reasonable basis for comparison against the future layouts. As set out above, it was therefore essential that lane capacities and signal timing were derived using the same methodology.

4.13 Lane capacities were derived from RR67 calculations within LINSIG.

4.14 Signal timings were based on the 85 second cycle time observed on-street during peak hours. The LINSIG models were optimised for capacity, with the staging “double cycled” to replicate the effect of the all red pedestrian phase being called approximately every other cycle.

- 4.15** One limitation of LINSIG is that it does not directly account for the effect of “blocking back” between adjacent junctions. This is regularly observed on Monument Road, with the queuing between the existing signals preventing additional vehicles reaching the next stop line. In LINSIG, no direct account is taken of this, so the model assumes that traffic can keep entering the area between the signals, no matter how much space is available.
- 4.16** In order to account for this, the Optimiser Queue Constraints function has been applied to the two internal links between the stop lines on Monument Road. After experimentation with various values, a Degree of Saturation Weighting of 15% per Excess PCU has been applied to force the model to prioritise the minimisation of queues on these internal links. The Excess Queue Limits have been set at approximately three quarters of the available space (as recommended in the LINSIG 3 User Guide).
- 4.17** In the model, the right turn into Eve Road is permitted for a limited number of vehicles. Although this is a prohibited movement, it is regularly abused, and it is important that this effect is realistically accounted for.
- 4.18** With regards to the traffic flows incorporated in the model, LINSIG derives its traffic flows from an overall Origin – Destination (OD) matrix for the whole network rather than individual junction counts. For example, a vehicle might enter the model at the Boundary Way Business Park (Zone I) and then head towards Monument Way East (Zone B). Without expensive and time consuming plate matching video surveys, it is not possible to be certain about exactly what paths vehicles take through the network.
- 4.19** However, LINSIG incorporates a “Matrix Estimation” function. This allows individual junction counts to be input. In addition, certain values in the OD matrices can be “locked” to maximise accuracy. For example, it is known how many vehicles that originate from Monument Road (N) (Zone A) enter Monument way East (Zone B) and vice versa. This would be a locked value, as it can be directly quantified from the surveys.
- 4.20** “Internal zones” were added on ever Road and Arnold Road to account for the fact that some trips may start or finish in these areas due to the residential properties.
- 4.21** With this data input, the matrix estimation process is started and then progressively refined to achieve a good “fit” to the observed turning counts. This is done by deriving a “GEH statistic” for each movement.

- 4.22** The GEH or Geoffrey E. Havers (GLC transport planner who invented the statistic in the 1970s) Statistic. The GEH statistic measures a combination of relative and absolute error between a traffic count and a modelled flow and is commonly used to test the goodness of fit of modelled flows to observed counts.
- 4.23** The value of GEH indicates how 'different' the Count and modelled flow would generally be regarded by a traffic engineer. GEH levels in practical terms are:
- A $GEH < 1$ indicates an excellent match between Count and modelled flow.
 - A $GEH < 5$ is generally acceptable in a larger network but should be checked in a smaller network to see if improvements can be made.
 - A $GEH > 5$ and < 10 would be unacceptable in a small network but may be acceptable in a larger network if carefully checked and the difference explained.
 - A $GEH > 10$ would rarely be acceptable and indicates something is wrong somewhere. The most likely cause is poorly matching and inconsistent counts.
- 4.24** The criteria usually used for the overall acceptability of larger network validation are 85% of Counts being matched with $GEH < 5$. More rigid criterion may be applied to smaller, more densely counted networks.
- 4.25** In this case, GEH values of below 1 were achieved throughout the network, indicating an excellent match between the modelled and recorded traffic flows.

4.26 The results of the modelling are included as Appendix E of this report. Summary tables are provided below of the key Arnold Road / Monument Road and Walton Road / Monument Road / Eve Road junctions alongside overall network statistics:

	AM Peak		PM Peak	
	Deg Sat (%)	MMQ (pcu)	Deg Sat (%)	MMQ (pcu)
J1: MONUMENT ROAD / MONUMENT ROAD EAST	31.1	-	32.8	-
J2: EVE ROAD / MONUMENT ROAD / WALTON ROAD	131.9	-	97.1	-
Walton Road Ahead Left	131.9	64.9	82.0	9.5
Walton Road Right	71.4	6.8	97.1	15.5
Monument Road (N) Left Ahead	73.7	15.0	64.7	12.1
Monument Road (S) Right Ahead	90.6	18.6	86.7	17.5
J3: ARNOLD ROAD / MONUMENT ROAD	130.0	-	119.9	-
Monument Road (S) Ahead	54.2	10.5	53.2	9.6
Arnold Road Left Right	130.0	70.7	119.9	61.8
Monument Road (N) Ahead	42.6	6.2	60.7	14.2
J4: MAYBURY ROAD / MONUMENT ROAD / MAYBURY ROAD	96.6	-	121.1	-
J5: EVE ROAD / ARNOLD ROAD / ALBERT DRIVE	25.3	-	24.7	-
J6: BOUNDARY ROAD / BOUNDARY WAY	16.7	-	16.5	-
J7: WALTON TERRACE / MONUMENT WAY WEST	13.7	-	10.4	-
J8: WALTON ROAD / BOUNDARY ROAD	41.5	-	31.6	-
PRC Over Signalled Lanes (%)	-46.5		-34.6	
PRC (%) Over All Lanes	-46.5		-34.6	
CTotal Delay for Signalled Lanes (pcuHr)	157.07		190.54	
Total Delay Over All Lanes (pcuHr)	158.95		192.26	

Table 4.2: 2011 Baseline Modelling Results

	AM Peak		PM Peak	
	Deg Sat (%)	MMQ (pcu)	Deg Sat (%)	MMQ (pcu)
J1: MONUMENT ROAD / MONUMENT ROAD EAST	31.4	-	33.4	-
J2: EVE ROAD / MONUMENT ROAD / WALTON ROAD	146.5	-	103.5	-
Walton Road Ahead Left	146.5	84.1	87.2	10.7
Walton Road Right	79.7	7.4	103.5	22.3
Monument Road (N) Left Ahead	74.3	15.5	66.0	12.1
Monument Road (S) Right Ahead	91.6	18.9	59.6	17.8
J3: ARNOLD ROAD / MONUMENT ROAD	143.0	-	128.3	-
Monument Road (S) Ahead	54.8	10.8	54.2	9.6
Arnold Road Left Right	143.0	91.7	128.3	81.0
Monument Road (N) Ahead	43.3	6.2	61.1	16.0
J4: MAYBURY ROAD / MONUMENT ROAD / MAYBURY ROAD	95.6	-	120.8	-
J5: EVE ROAD / ARNOLD ROAD / ALBERT DRIVE	25.1	-	25.5	-
J6: BOUNDARY ROAD / BOUNDARY WAY	17.3	-	17.0	-
J7: WALTON TERRACE / MONUMENT WAY WEST	14.2	-	10.7	-
J8: WALTON ROAD / BOUNDARY ROAD	43.0	-	32.7	-
C1 PRC Over Signalled Lanes (%)	-62.7		-42.6	
C2 PRC Over Signalled Lanes (%)	-62.7		-42.6	
PRC (%) Over All Lanes	197.38		217.04	
C1 Total Delay for Signalled Lanes (pcuHr)	199.35		218.84	
C2 Total Delay for Signalled Lanes (pcuHr)				
Total Delay Over All Lanes (pcuHr)				

Table 4.3: 2016 Baseline Modelling Results

4.27 The tables show that the network is currently operating well over capacity. This results in significant queues and delays on the local highway network.

Phase 1 Modelling

- 4.28** In order to provide comparable results, a similar modelling procedure has been followed when assessing the proposed Phase 1 road layout.
- 4.29** Lane capacities have been derived using RR67 calculations.
- 4.30** The existing 85 second cycle time has been retained. As for the base model, the stages have been “double cycled” to simulate the effect of the all red pedestrian phase being activated every other cycle.
- 4.31** Traffic flows have been derived from the OD matrices obtained in the base model. The values have been transposed as necessary to suit the new zone layout.
- 4.32** The Optimiser Queue Constraints function has again been applied to the two internal links between the stop lines on Monument Road. For consistency a Degree of Saturation Weighting of 15% per Excess PCU has been applied to force the model to prioritise the minimisation of queues on these internal links. The Excess Queue Limits have been set at approximately three quarters of the available space (as recommended in the LINSIG 3 User Guide).
- 4.33** At present, the two existing sets of signals are controlled by a single controller, with fixed timings offsetting the two junctions. For the new arrangement, two separate controllers have been used to control the two junctions, allowing the software the maximum flexibility to offset timings as necessary to minimise queuing between the two sets of signals
- 4.34** As set out above, the left and right turns from Walton Road and Monument Way East will be separately controlled to maximise capacity. The proposed phasing and staging diagrams are included within the LINSIG modelling outputs.

- 4.35** The results of the modelling are included as Appendix F of this report. Summary tables are provided below of the key Arnold Road / Monument Road and Walton Road / Monument Road / Eve Road junctions alongside overall network statistics:

	AM Peak		PM Peak	
	Deg Sat (%)	MMQ (pcu)	Deg Sat (%)	MMQ (pcu)
J1: MONUMENT ROAD / MONUMENT WAY EAST	70.2	-	56.5	-
Monument Road (N) Left Ahead	70.2	10.7	56.5	10.5
Monument Road (S) Ahead Right	57.4	12.3	48.8	8.3
Sheerwater Link Road Right Left	53.6	6.7	55.4	7.4
J2: MONUMENT ROAD / WALTON ROAD	71.8	-	86.8	-
Walton Road Left	57.9	7.9	56.0	8.6
Walton Road Right	71.8	5.9	86.8	13.2
Monument Road (N) Ahead	54.6	8.4	65.6	6.1
Monument Road (S) Ahead	71.3	11.5	47.9	7.8
J3: MAYBURY ROAD / MONUMENT ROAD / MAYBURY HILL	62.1	-	71.7	-
J4: WALTON ROAD / BOUNDARY ROAD	41.4	-	31.6	-
J5: MONUMENT WAY EAST ESTATE	34.0	-	33.6	-
J6: ARNOLD ROAD / EVE ROAD AREA	29.8	-	25.1	-
J7: WALTON TERRACE / MONUMENT WAY WEST	13.7	-	10.4	-
J8: WALTON ROAD / BOUNDARY ROAD	16.7	-	16.5	-
C1 PRC Over Signalled Lanes (%)	28.3		59.3	
C2 PRC Over Signalled Lanes (%)	25.3		3.7	
PRC (%) Over All Lanes	25.3		3.7	
C1 Total Delay for Signalled Lanes (pcuHr)	8.44		7.76	
C2 Total Delay for Signalled Lanes (pcuHr)	11.46		13.34	
Total Delay Over All Lanes (pcuHr)	22.94		24.41	

Table 4.4: 2011 Phase 1 Modelling Results

	AM Peak		PM Peak	
	Deg Sat (%)	MMQ (pcu)	Deg Sat (%)	MMQ (pcu)
J1: MONUMENT ROAD / MONUMENT WAY EAST	74.0	-	71.2	-
Monument Road (N) Left Ahead	74.0	11.5	71.2	11.1
Monument Road (S) Ahead Right	60.3	12.4	49.6	10.4
Sheerwater Link Road Right Left	55.1	7.4	59.2	6.8
J2: MONUMENT ROAD / WALTON ROAD	74.4	-	94.9	-
Walton Road Left	60.5	8.4	42.9	6.3
Walton Road Right	74.4	6.3	94.9	16.1
Monument Road (N) Ahead	56.7	8.5	66.5	9.1
Monument Road (S) Ahead	72.6	11.9	66.9	10.4
J3: MAYBURY ROAD / MONUMENT ROAD / MAYBURY HILL	64.8	-	74.5	-
J4: WALTON ROAD / BOUNDARY ROAD	42.9	-	32.7	-
J5: MONUMENT WAY EAST ESTATE	35.2	-	35.3	-
J6: ARNOLD ROAD / EVE ROAD AREA	30.9	-	26.0	-
J7: WALTON TERRACE / MONUMENT WAY WEST	14.2	-	10.7	-
J8: WALTON ROAD / BOUNDARY ROAD	17.3	-	17.0	-
C1 PRC Over Signalled Lanes (%)	21.6		26.4	
C2 PRC Over Signalled Lanes (%)	21.0		-5.4	
PRC (%) Over All Lanes	21.0		-5.4	
C1 Total Delay for Signalled Lanes (pcuHr)	9.36		8.77	
C2 Total Delay for Signalled Lanes (pcuHr)	12.09		16.78	
Total Delay Over All Lanes (pcuHr)	24.73		29.20	

Table 4.5: 2016 Phase 1 Modelling Results

- 4.36** The tables show that the proposals will significantly improve the operation of this section of the highway network. The network remains marginally over-capacity, but queuing is greatly reduced.

- 4.37** The Phase 1 proposals would not only significantly improve pedestrian and cycle facilities, residential amenity and access to the Sheerwater area, but also result in improvements to the operation of the local highway network.

Phase 2 Modelling

- 4.38** The Phase 1 model was extended via the addition of a fourth arm on the Monument Way East / Monument Road junction, to examine the effect of providing a direct access to the Boundary Way Business Park
- 4.39** All aspects of the Phase 1 model were retained, with the traffic flows altered to suit the new zone layout.
- 4.40** The proposed phasing and staging diagrams are included within the LINSIG modelling outputs.
- 4.41** The results of the modelling are included as Appendix G of this report. Summary tables are provided below of the key Arnold Road / Monument Road and Walton Road / Monument Road / Eve Road junctions alongside overall network statistics:

	AM Peak		PM Peak	
	Deg Sat (%)	MMQ (pcu)	Deg Sat (%)	MMQ (pcu)
J1: MONUMENT ROAD / MONUMENT WAY EAST	85.3	-	69.5	-
Monument Road (N) Left Ahead Right	73.5	14.9	63.5	12.3
Monument Road (S) Ahead Right Left	78.9	11.8	69.5	9.7
Sheerwater Link Road Right Left Ahead	65.4	8.7	65.9	9.5
Boundary Way Estate Left Ahead Right	85.3	8.7	61.6	7.9
J2: MONUMENT ROAD / WALTON ROAD	67.4	-	83.8	-
Walton Road Left	65.0	10.1	59.8	9.8
Walton Road Right	64.9	5.2	83.8	10.7
Monument Road (N) Ahead	52.9	7.1	64.9	6.9
Monument Road (S) Ahead	67.4	10.8	48.5	8.4
J3: MAYBURY ROAD / MONUMENT ROAD / MAYBURY HILL	67.6	-	83.1	-
J4: WALTON ROAD / BOUNDARY ROAD	47.5	-	34.6	-
J5: MONUMENT WAY EAST ESTATE	34.0	-	34.0	-
J6: ARNOLD ROAD / EVE ROAD AREA	29.9	-	26.6	-
C1 PRC Over Signalled Lanes (%)	5.5		29.4	
C2 PRC Over Signalled Lanes (%)	33.4		7.4	
PRC (%) Over All Lanes	5.5		7.4	
C1 Total Delay for Signalled Lanes (pcuHr)	16.98		15.40	
C2 Total Delay for Signalled Lanes (pcuHr)	11.15		12.17	
Total Delay Over All Lanes (pcuHr)	31.45		32.90	

Table 4.6: 2011 Phase 2 Modelling Results

	AM Peak		PM Peak	
	Deg Sat (%)	MMQ (pcu)	Deg Sat (%)	MMQ (pcu)
J1: MONUMENT ROAD / MONUMENT WAY EAST	88.4	-	72.2	-
Monument Road (N) Left Ahead Right	69.4	14.6	64.8	12.2
Monument Road (S) Ahead Right Left	81.4	11.8	72.2	9.3
Sheerwater Link Road Right Left Ahead	73.8	10.5	67.5	10.6
Boundary Way Estate Left Ahead Right	88.4	9.4	66.6	8.4
J2: MONUMENT ROAD / WALTON ROAD	69.7	-	89.1	-
Walton Road Left	69.7	10.2	62.6	10.9
Walton Road Right	65.1	5.3	89.1	12.9
Monument Road (N) Ahead	55.3	8.2	66.6	7.3
Monument Road (S) Ahead	66.5	10.8	49.5	8.0
J3: MAYBURY ROAD / MONUMENT ROAD / MAYBURY HILL	70.6	-	86.5	-
J4: WALTON ROAD / BOUNDARY ROAD	49.4	-	35.9	-
J5: MONUMENT WAY EAST ESTATE	35.2	-	35.8	-
J6: ARNOLD ROAD / EVE ROAD AREA	30.9	-	27.5	-
C1 PRC Over Signalled Lanes (%)	1.8		24.7	
C2 PRC Over Signalled Lanes (%)	29.1		1.0	
PRC (%) Over All Lanes	1.8		1.0	
C1 Total Delay for Signalled Lanes (pcuHr)	18.38		15.99	
C2 Total Delay for Signalled Lanes (pcuHr)	11.96		14.17	
Total Delay Over All Lanes (pcuHr)	34.00		36.11	

Table 4.7: 2016 Phase 2 Modelling Results

- 4.42** The tables show that, when compared to the Phase 1 option, the addition of the forth arm to the junction would further improve the overall capacity of the network and reduce queuing.

5.0 SUMMARY AND CONCLUSIONS

5.1 Mayer Brown Limited has been commissioned by Woking Borough Council to prepare outline designs and junction models for the Sheerwater Access Road in addition to a potential future access into the Boundary Road Business Park.

5.2 Sheerwater is recognised as a Priority Place by the Surrey Strategic Partnership and in Woking Borough Council's Local Development. The area contains some 1,700 residential properties and has the largest concentration of Business Parks in the Borough. Access arrangements are an obstacle to securing investment in or full occupation of the Business Parks. The new access arrangements and enhancement of the environment of Albert Drive are considered essential to further the economic vitality of this part of the Borough.

5.3 The proposals are considered in two phase:

- Phase1:
 - creation of the Sheerwater Link Road via the extension of Monument Way East to the east, joining with Albert Drive
 - widening on Monument Road
 - signalisation of the Monument Road / Monument Way East (Sheerwater Link Road) junction
 - closure of Arnold Road and Eve Road to vehicular through traffic
 - provision of turning heads and parking restriction revisions on Arnold Road and Eve Road
 - creation of signalised pedestrian / cycle crossings across Monument Road leading to / from quiet routes along Arnold Road and Eve Road
- Phase2:
 - above works, plus addition of fourth arm to Monument Road / Monument Way East (Sheerwater Link Road) junction giving direct access to the Boundary Road Business Park

5.4 The operation of both phases is considered against that of the existing road layout for the current year and a design year of 2016. The traffic flows used are taken from Surveys carried out in October 2011.

5.5 This report demonstrates that:

- the existing layout of the local highway network is operating significantly over its theoretical capacity, leading to congestion and excess queuing
- both Phase 1 and Phase 2 would require additional land outside the existing highway boundary
- Phase 1 would continue to operate over theoretical capacity, but would offer significant performance improvements over the existing layout
- the Phase 1 proposals would offer significant benefits to residents of Eve Road and Arnold Road
- there are clear benefits to the Sheerwater area through improved vehicular access
- pedestrian and cycle links between the Sheerwater area and the town centre would be significantly improved
- the Phase 2 proposals would further benefit the capacity of the network
- Phase 2 would reduce HGV traffic on Maybury Road and provide direct access to the Boundary Way Business Park

APPENDIX A
Initial Bus Operator Comments

APPENDIX B
Traffic Survey Data

APPENDIX C

Growth Factors

APPENDIX D
Signal Programming Forms

APPENDIX E

Base LINSIG Modelling

APPENDIX F
Phase 1 LINSIG Modelling

APPENDIX G
Phase 2 LINSIG Modelling