M5 Junction 14 Improvement Scheme

Consultation Report
Stroud Local Plan Review

Stroud District Council

Project Number: 60598598

September 2024

Delivering a better world

Quality information

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Table of Contents

Figures

Tables

Appendices

1. Introduction

1.1 Background

1.1.1 AECOM is appointed by Stroud District Council (SDC) to provide technical transport and development planning advice in relation to its Local Plan Review (LPR). The LPR sets out how SDC has planned for growth and development across its district up to 2040.

1.1.2 A Regulation 20 version of the LPR was submitted to the Planning Inspectorate (PINS) for Examination in Public (EiP) in 2023. During the course of the Examination, PINS has identified concerns in relation to infrastructure delivery, specifically with consideration for the improvement required to M5 Junction 12 (J12) and Junction 14 (J14) to accommodate forecast levels of traffic demand up to the end of the LPR year. PINS has agreed a pause to the EiP programme to enable SDC to provide further evidence as to the viability of funding and delivering the necessary capacity improvements for these locations.

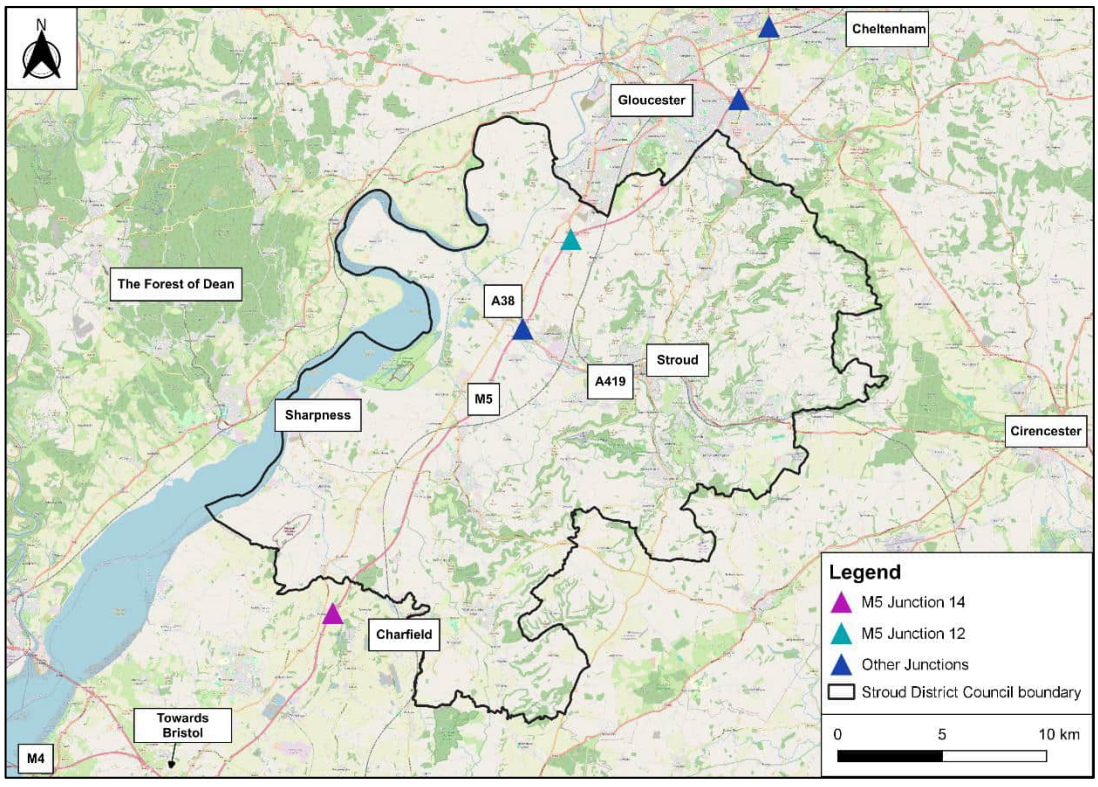
1.1.3 This report has been prepared to set out the design development, modelling, and costing exercise for J14. This report has been produced by AECOM on behalf as SDC which is the scheme sponsor for J14. A separate exercise and report has been produced for J12 on behalf of Gloucestershire County Council (GCC) which has been submitted to PINS separately. AECOM has also prepared a further report on the funding approach, which is also published as part of this consultation exercise.

1.2 Junction Location and Existing Conditions

1.2.1 M5 J14 is located adjacent to the village of Falfield within a semi-rural part of South Gloucestershire. The junction provides a highway connection between the M5 motorway and the A38 via the B4509, enabling access to the Strategic Road Network (SRN) for a number of settlements across the area in Stroud District and South Gloucestershire, including Charfield, Wooton-under-Edge, Thornbury, Sharpness and Berkeley.

1.2.2 The location and context surrounding M5 J14 is shown in **Figure 1-1**.

Figure 1-1: Location of M5 Junction 14



1.2.3 The existing junction arrangement is shown in **Figure 1-2**.The junction operates under a part-time signalised arrangement, with the traffic signals operational in the PM peak hour only. During the AM peak hour the junction operates under priority control, with priority afforded to the B4509 over the M5 on- and off-slip roads.

Figure 1-2: Existing Arrangement of M5 Junction 14

1.2.4 National Highways (NH), as the highway authority for the SRN, has advised that the existing arrangement of M5 J14 is currently at capacity and as such cannot accommodate any additional traffic demand, including that arising from the LPR. Interim improvement schemes for the junction are being promoted though various planning applications to enable development to come forward. Enhancements to the north-bound off-slip are being promoted through the development of 'Land West of Park Farm, Thornbury' (SGC Planning Application Reference: PT18/6450/O) which will extend the two-lane extent of the slip road. A further interim improvement is proposed to accommodate 750 homes at Charfield.

1.3 Stakeholder Engagement

1.3.1 The work undertaken in relation to M5 J14 has been undertaken in collaboration with key stakeholders including NH, South Gloucestershire Council (SGC), GCC, Gloucester City Council and Western Gateway which are collectively referred to as the "Transport Working Group" (TWG). SDC has met regularly with the TWG throughout the preparation and submission of the SDC LPR up to EiP and has continued to consult with respect to the design, costing and apportionment work which has been undertaken by SDC during the recent pause to the EiP.

1.4 Need for the Scheme

1.4.1 The need for, and benefit of, improving capacity at M5 J14 has been made clear through a variety of studies, including the Traffic Forecasting Report and the Traffic Forecasting Report Addendum prepared for the LPR, and various microsimulation modelling exercises undertaken by NH. The studies show that the junction will exceed capacity, with associated delay and safety implications, due to background traffic growth even without consideration for development allocated within the SDC LPR.

1.4.2 The challenges presented by capacity constraints at M5 J14 are raised in the GCC Local Transport Plan (2021-2040). Specifically, the Connecting Places Strategy for Stroud states that GCC will work *"with South Gloucestershire, Highways England and stakeholders to resolve M5 Junction 14 capacity issues".*

1.4.3 As discussed later in this report, analysis has also been undertaken by NH to understand the scale of enhancements required to ensure suitable operation of the junction in future. This shows that there are limited alternatives to delivery of major junction improvement schemes to adequately plan for growth. Smaller scale and interim schemes have been considered, but are not sufficient to fully meet the strategic needs of the region.

2. Highway Design & Modelling

2.1 Introduction

2.1.1 This section of the report outlines the preliminary design of the preferred option for M5 J14 improvements, including details as to the design optioneering process and micro-simulation modelling undertaken to confirm that the preferred scheme will operate in a safe and suitable manner up to the end of the LPR period (2040). This section also provides details as to the design and modelling of a potential improvement scheme at the A38 / B4509 junction which is an important consideration in terms of the operation of the wider M5 junction highway network.

2.2 Environmental Study

2.2.1 The highway design and optioneering process for M5 J14 has been informed by a desk-based environmental study. This has considered the environmental constraints relevant to the proposed changes to M5 J14 with consideration for impacts on landscape and visual; biodiversity and nature; cultural heritage; water resources and flood risk; ground conditions; air quality; noise and vibration; and transport and access. A copy of the study is provided at **Appendix A**.

2.2.2 The study concludes that there are a number of more detailed environmental assessments which should be undertaken during the future stages of scheme design and planning. The study also recommends consultation with a number of environmental authorities, such as Natural England in future. However, the study has not revealed any material environmental constraints or considerations which would need special consideration during this preliminary design stage.

2.3 Previous Study

2.3.1 An optioneering and microsimulation modelling exercise was undertaken on behalf of Highways England (now National Highways) in 2017 in relation to determining the scale of potential enhancements needed for a M5 J14 scheme. This has been included at **Appendix B** for reference. The study considered three options for scheme improvements, including:

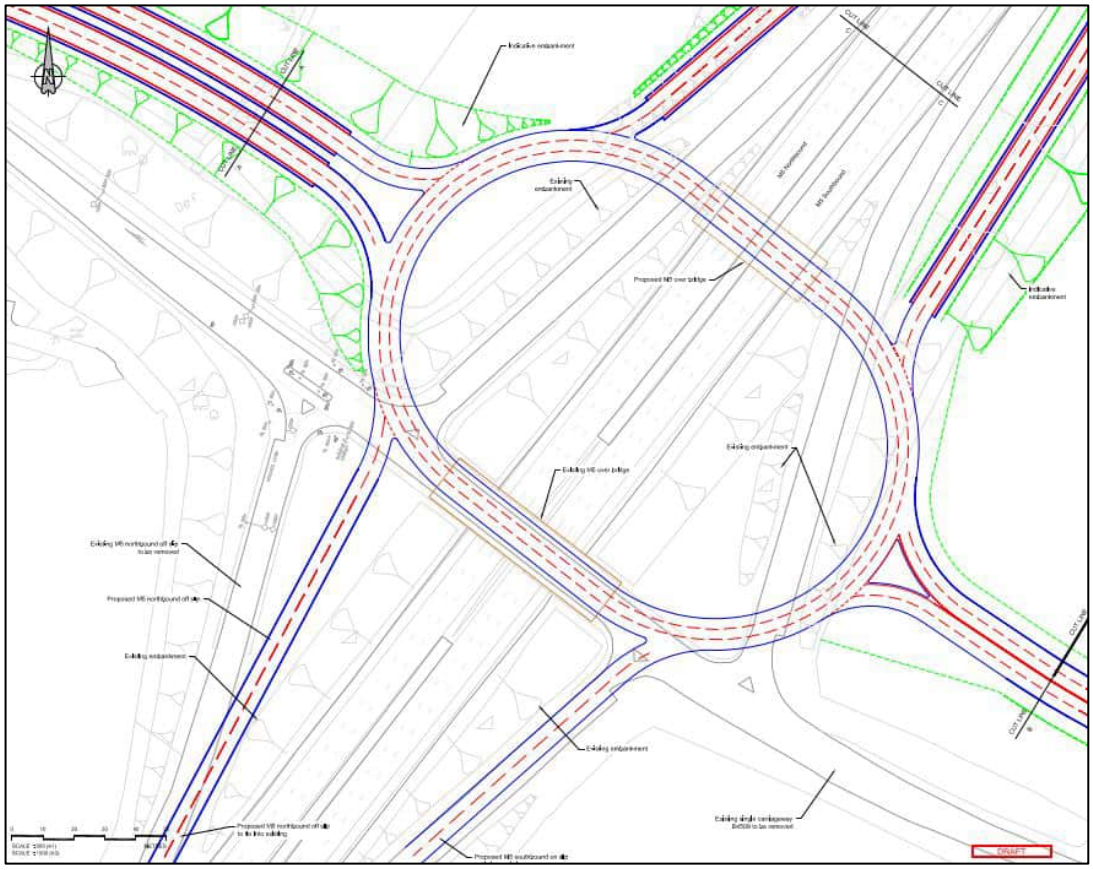
- Option 1 – a 'Dumbbell' roundabout arrangement, which would entail two roundabouts positioned either side of the motorway connecting the slip roads and B4509 arms of the junction, and a link road between the roundabouts over the M5;
- Option 2 – an enhancement to the existing junction arrangement by expanding the number of lanes on the B4509, including on the bridge over the M5 to unlock additional capacity; and
- Option 3 – a full grade-separated roundabout.

2.3.2 The conclusions of the study was a recommendation to progress with the grade-separated roundabout scheme (Option 3) as neither Option 1 nor Option 2 provided the required level of capacity. A sketch of this option, as considered at the time of the study, is shown in **Figure 2-1**.

2.3.3 The key design considerations for Option 3 included an Inscribed Circle Diameter (ICD) of approximately 130m, a three-lane circulatory carriageway and two-lane entries on all arms of the roundabout. NH has subsequently tested this arrangement using the current micro-simulation (Vissim) model for the junction, using 2040 traffic flows, and concluded that it would have capacity to accommodate future growth, subject to design development.

2.3.4 The 2017 grade-separated roundabout option has been reviewed in the development of further design options as part of this current study.

Figure 2-1: Grade-Separated Roundabout from 2017 Study



Source: CH2M, 2017

2.4 Design Optioneering

2.4.1 A further design optioneering process has been undertaken to consider various designs of a grade-separated roundabout which could be delivered for M5 J14, building on the foundations of the previous studies. The options which have been developed and considered are outlined in the following sections. It should be noted that this current design optioneering process has been proportionate, with consideration for the level of work that has taken place previously.

2.4.2 NH has confirmed that it intends to refurbish the existing bridge over the M5, with funding being sought through a separate future Road Investment Scheme (RIS) project. This means that designs which retain the existing bridge offer a significant benefit. This has been taken into consideration in terms of scheme option design and selection.

Option 1 – "Teardrop" Roundabout

2.4.3 A sketch of a potential "Teardrop" roundabout arrangement for J14 is shown in **Figure 2-2**. This approach would provide a grade-separated junction, with traffic in two directions over a single bridge positioned to the north-east of the existing bridge. This arrangement would operate similar to a standard roundabout (i.e., with the carriageways over the bridge being a circulatory, which has priority over traffic joining from the M5 slip roads and B4509). This is distinct from the "Dumbbell" roundabout considered by NH in 2017.

2.4.4 This design option has been assessed using Junctions 10, which is an industry-standard tool for modelling the capacity of priority-controlled junctions including grade-separated motorway junctions. This confirmed that this option had the potential to deliver the necessary capacity to accommodate growth up to 2040 and that associated with the LPR, although some further refinement of the approach roads would be required. However, micro-simulation modelling would be needed to take this forwards.

Figure 2-2: Sketch of a Potential "Teardrop" Roundabout Arrangement

2.4.5 The benefits of this option include a reduced land take to deliver the junction and improved safety owing to lower traffic speeds though the junction. There are also benefits in terms of the constructability of the junction in terms of the road closures and temporary traffic management works. However, following discussion with the TWG, it was agreed that this option should not be brought forward for further consideration given that it is an atypical arrangement, and would still likely incur substantial cost whilst not providing the network capacity and resilience that would be provided by a typical grade separated roundabout.

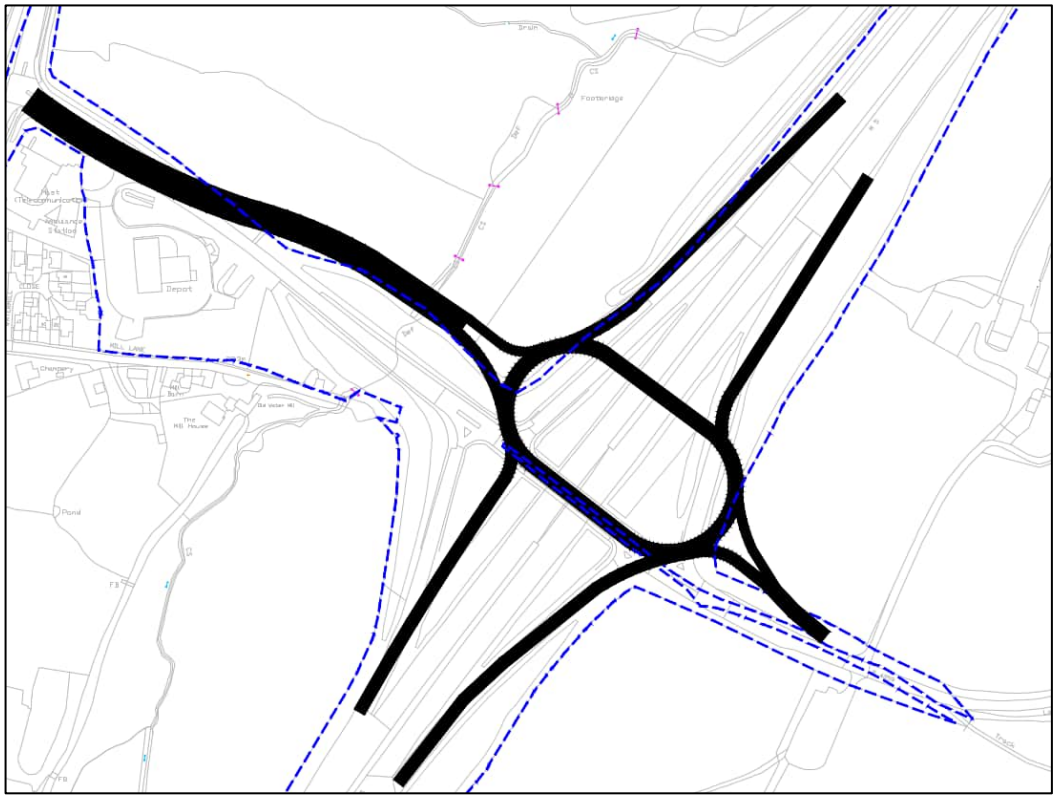
Option 2 – Additional Bridge to the North-East

2.4.6 There is an option to create a grade-separated roundabout by constructing a new bridge over the M5 carriageway to the north-east of the existing bridge, with the southern slip roads and B4509 approaches to the junction largely retained as per the existing arrangement and the northern slip roads repositioned to connect to the new bridge. A sketch of a potential layout of this arrangement is shown in **Figure 2-3**.

2.4.7 There are a number of benefits to this option compared to the alternatives which have been considered. The design only requires the construction of a single bridge which significantly improves the constructability of the scheme and reduces the impact of construction on the operation of the local and strategic highway network. However, it also does not preclude the option for NH to replace or refurbish the existing bridge if required.

2.4.8 Whilst there are some drawbacks in terms of the third-party land take required to deliver this scheme, this is not considered to be insurmountable, and is potentially reduced compared to some of the other options which have been considered, especially when accounting for elements such as earth works and the constructability of the scheme. The optioneering process has confirmed that there is no design for a grade-separated junction which completely removes the requirement for third-party land

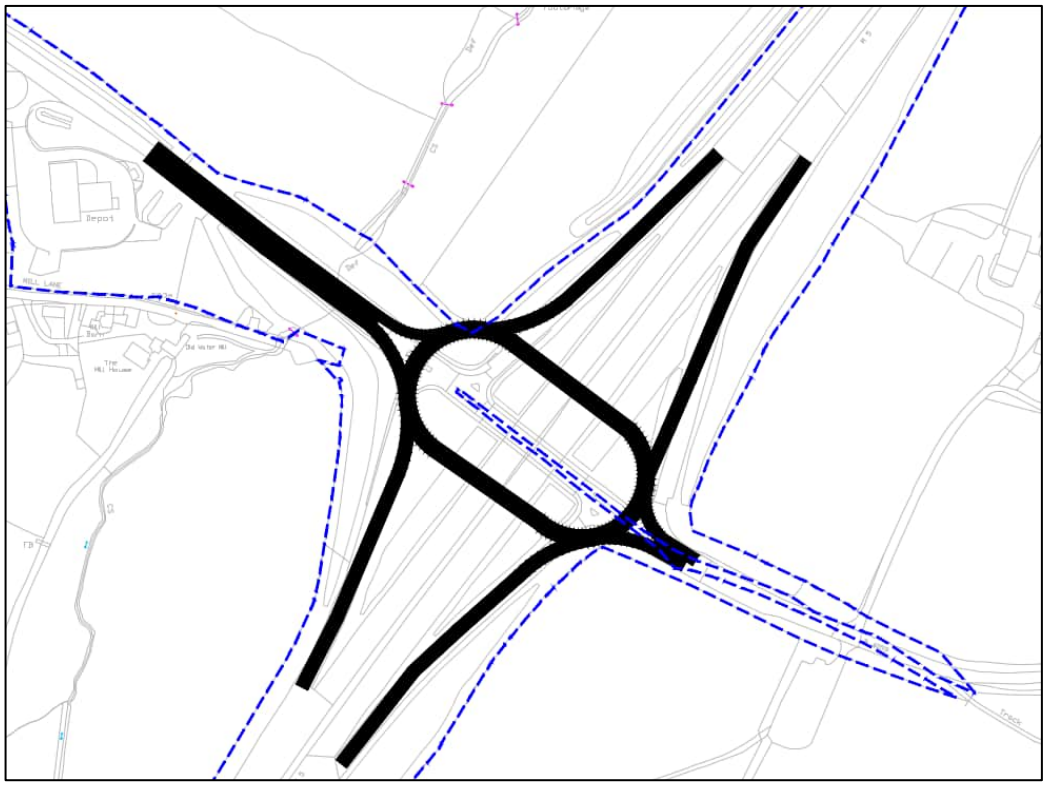
Figure 2-3: Sketch of a Potential "Additional Bridge to the North-East" Arrangement



Option 3 – New Bridges to North-East and South-West

2.4.9 There is an option to create a grade-separated roundabout by constructing two new bridges positioned to the north-east and south-west of the existing bridge over the M5 carriageway. A sketch of a potential layout of this arrangement is shown in **Figure 2-4**.

Figure 2-4: Sketch of a Potential "New Bridges to the North-East and South-West" Arrangement

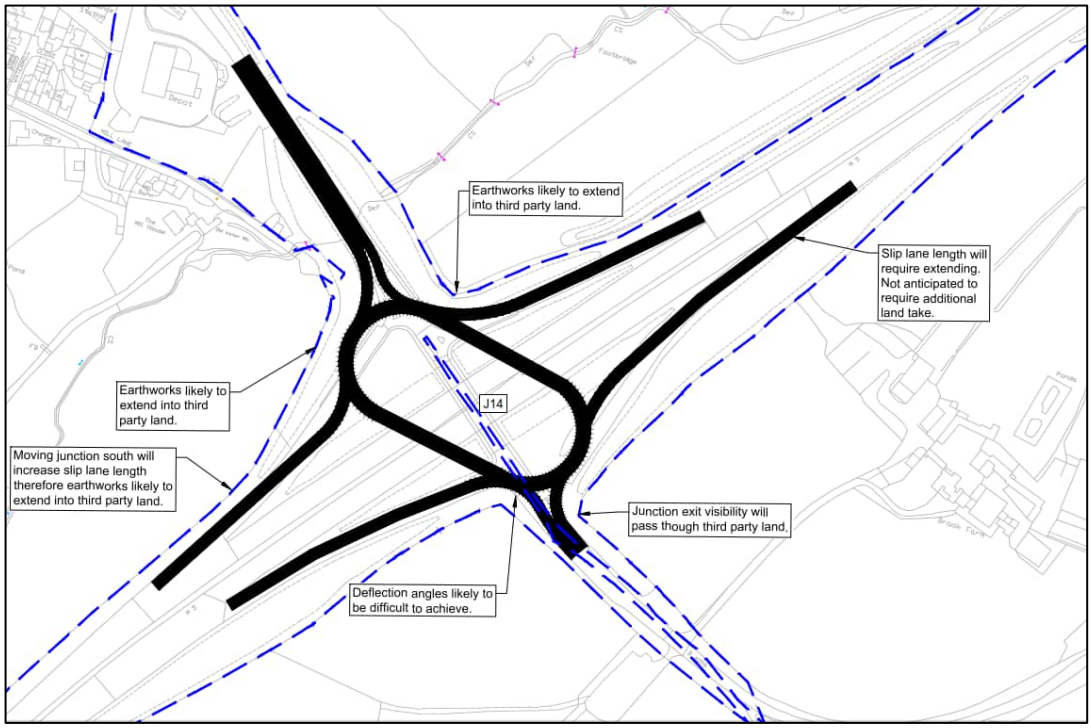


2.4.10 Under this option, there would need to be significant works to tie the slip roads into the new position of the junction compared to the existing arrangement. It would also require the delivery of two new bridges, rather than leaving the option open to retain the existing bridge. This would require significant time and cost resources to deliver, although a key benefit of the scheme is that the B4509 alignment is largely retained meaning that it could remain open for the majority of the scheme construction. However, on balance there would still need to be significant traffic management to enable construction of the slip roads, including the traffic management associated with the delivery of two new bridges over the M5. Third party land would be required both for part of the new gyratory, and for the earthworks required to deliver the scheme.

Option 4 – "Skewed" Grade-Separated Roundabout

2.4.11 There is an option to create a grade-separated roundabout in a manner which aligns more closely with NH land ownership. A sketch of a potential layout of this arrangement is shown in **Figure 2-5.**

Figure 2-5: Potential "Skewed" Grade-Separated Roundabout



2.4.12 The benefits of this option are that, at face value, it minimises the amount of third-party land which will need to be secured to enable the construction of the scheme. However, investigation into the scheme confirmed that whilst a simple carriageway alignment could be provided within NH land, the earthworks required to construct the necessary this scheme would still require some third-party land to deliver the scheme. Significant works would be required to the slip roads, and there would be a need for an additional bridge. Furthermore, the bridge lengths would be longer than the other options, with increased costs.

2.4.13 There would therefore be limited benefit compared to some of the other options explored in terms of land take. With consideration for the intricacies required to deliver a skewed option, for example achieving the necessary entry paths, levels and bridge spans, the cost of the additional bridge, and the fact that there would remain a requirement for third party land, this option has not been considered further.

2.5 Preferred Grade-Separated Design Option

2.5.1 For the purposes of demonstrating the deliverability of a grade-separated roundabout junction M5 J14, Option 2 has been progressed to preliminary design stage, and subject to detailed micro-simulation modelling.

Preliminary Design

2.5.2 The preliminary design of the preferred grade-separated roundabout is illustrated at **Figure 2-6**. General Arrangement plans have been provided at **Appendix C**.

Figure 2-6: Preliminary Design of the Preferred Grade-Separated Roundabout

2.5.3 The scheme has been prepared in accordance with Design Manual for Roads and Bridges (DMRB) standards[1] and based on Ordnance Survey (OS) and Lidar (Light Detection and Ranging) mapping data. Key design features and considerations are as follows:

- An ICD of the roundabout to approximately 100m. This is smaller compared to the 130m considered in the 2017 scheme (as shown in **Figure 2-1**) which allows for a more compact junction arrangement. As discussed later in this report, micro-simulation modelling has confirmed that the smaller ICD will not compromise junction capacity or performance.
- Construction of a single-span bridge over the M5 to the north-east of the existing bridge. It is understood that NH intends to refurbish the existing bridge as part of a separate future Road Investment Scheme project. The proposed scheme neither precludes, nor relies upon, NH's refurbishment project.
- Realignment of the B4509 approaches to the junction to achieve the necessary entry path curvature. This will mean that some third-party land will be required to deliver the junction, however this is not considered to be a material barrier to junction delivery. Optioneering has shown that there is no option for a grade-separated roundabout which would not require any third-party land at this location.
- The B4509 West arm will be dualled in both directions to provide capacity between the M5 and A38. This will tie into an improvement scheme for the A38 / B4509 junction, which is discussed in further in **Section 2.6**.

[1] CD109 - Highway Link Design. CD116 – Geometric design of roundabouts. CD122 – Geometric design of grade separated junctions

- The southern on- and off-slip road connections have been retained as per their existing provision; however realignment will be required to achieve the necessary entry and exit path curvatures.
- The northern on- and off-slip roads will be moved northwards from their current positions to connect to the new bridge. A suitable gradient up to the new bridge deck height will be provided.
- A 1:3 gradient has been applied for earthwork slopes and a 1:2 gradient applied between the slip roads and the M5 mainline carriageway.
- The merge and diverge arrangements for the on- and off-slip roads have been confirmed based on the forecast traffic flows at J14 up to the end of the LPR (2040).

Construction and Traffic Management

2.5.4 The design of the grade-separated junction has taken constructability and traffic management implications into account. This is a crucial part of the design of any works to the SRN where the need for traffic management or road closures can have a significant impact in terms of the operation of the SRN, and therefore the costs of implementing junction improvements.

2.5.5 A potential phasing and traffic management associated with the scheme is provided illustratively at **Appendix D**, and is summarised as follows:

- Phase 1 – Off-line construction. Construction of the earthworks and carriageway sections which are not on the existing road alignment, including the B4509 West approach, B4509 East approach and the northbound off-slip road. All traffic movements at the junction remain open during this phase.
- Phase 2 – Northbound slip road closures. Construction of the on-line elements of the northbound slip roads (merge and diverge). This will require closure of these slip roads as well as Lane 1 on the M5 northbound to enable construction of the parallel merge taper. The southbound slip roads would remain open.
- Phase 3 – B4509 West tie-in. Closure of the B4509 West to construct the remaining elements of this approach to the junction.
- Phase 4 – Southbound diverge slip road closure. Construction of the southbound off-slip, which will require closure of the slip road, as well as Lane 1 of the M5 southbound. This would also involve construction of the parallel merge strip for the southbound on-slip. The Western Side of the junction would be open to traffic.
- Phase 5 – Closure of the southbound merge slip road to enable construction and tie into the junction. This would also require closure of the Lane 1 of the M5 southbound
- Phase 6 – B4409 Eastern tie-in. Closure of the B4509 East to construct the remaining elements of this approach to the junction.

2.5.6 In addition to the above, there would need to be closure of the junction and M5 mainline carriageway to install the new bridge over the M5. This could be timed so as to minimise distribution (e.g. overnight, weekend closures) and would last for a significant period of time. It is recognised that partial or full closures of the junction during construction will require significant diversions. Using the A38 this would entail use of the M5 Junction 13 at Stroud to the north and M5 Junction 16 at Bristol to the south. The precise traffic management requirements will be agreed with NH and other relevant parties as / when the scheme comes forward and will seek to minimise disruption wherever possible. The cost plan for the proposed improvements include a significant allowance for traffic management accordingly.

2.6 A38 / B4509 Junction

2.6.1 The main consideration with respect to demonstrating the soundness of the SDC LPR is considered to be the likelihood of delivering improvements to M5 J14. However, an important aspect to the future operation of the M5 J14 network is the capacity of the adjacent A38 / B4509 junction, including the extent and nature of any interactions between the junctions, for example the effects of any queues reaching back from either junction to the other, and the effect of any capacity constraint at the A38 / B4509 junction constraining the flow of traffic reaching the M5 junction and vice-versa.

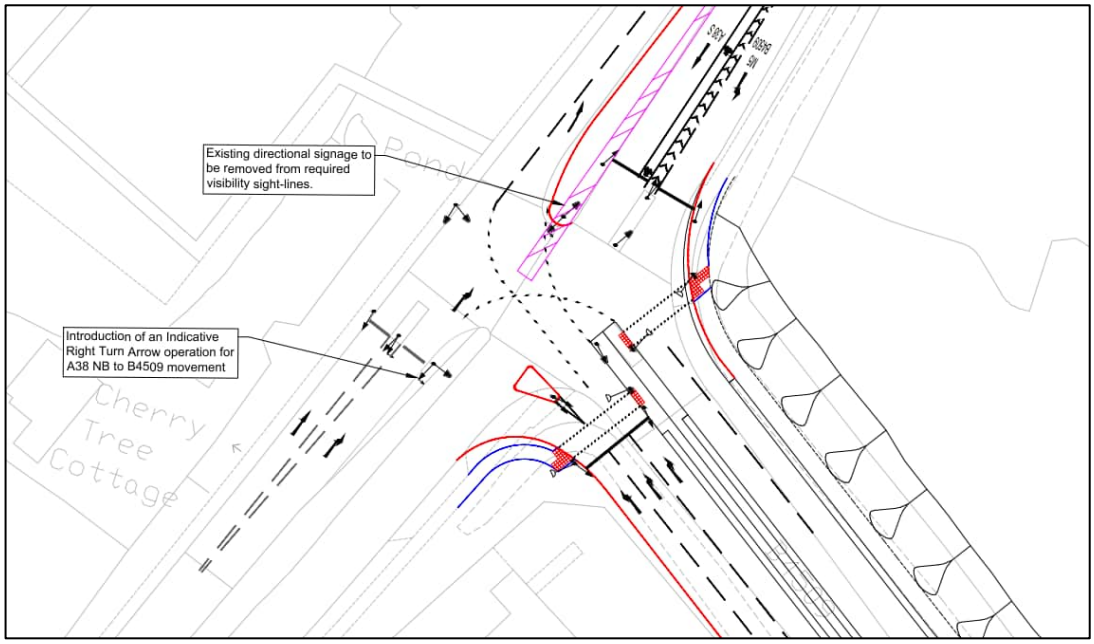
2.6.2 Micro-simulation modelling undertaken by NH suggests that enhancement will be required to the capacity of the A38 / B4509 junction to accommodate future growth. Early testing of the preferred grade-separated junction design has also confirmed that enhancement to this junction would be required.

2.6.3 Improvement at this junction has been identified within the Infrastructure Delivery Plan for the LPR, and is a known requirement of delivering the Plan. This requirement can be defined and addressed through future planning applications and is not a specific requirement of progressing the M5 J14 project. However, due to the potential interactions between the junctions, early work on the scheme has been progressed.

2.6.4 A concept design of a potential improvement to the A38 / B4509 junction has therefore been prepared to provide a holistic assessment of the M5 J14 network within the micro-simulation modelling. The option has been developed to show that there is an improvement available for the junction, although this would be subject to additional design optioneering and consultation prior to being finalised and delivered.

2.6.5 The concept design for this scheme is shown in **Figure 2-7** and included at **Appendix E**.

Figure 2-7: Concept Design for the A8 / B4509 Junction



2.6.6 The key design considerations are as follows:

- Introduction of dualling on the B4509 approach and exit from the junction. This ties into the design for J14.
- Introduction of an additional off-side flare on the B4509 on approach to the junction to enable two lanes for the right-turn movement to the A38 northbound. This necessitates the introduction of a flare on the exit for the A38 northbound.
- Extension of the flare lane on the A38 southbound to 115m. This would operate as a separate green phase.
- Introduction of an Indicative Right Turn Arrow for the A38 northbound to B4509 movement. This arrangement enables right turning traffic to 'gap accept' the opposing ahead and left turn flows from the A38 southbound, before getting a dedicated unopposed movement in the following stage. This increases the 'green-time' available for this movement, which in turn frees up additional green time and capacity for the remainder of the junction.
- Upgrade of the existing uncontrolled pedestrian crossing over the B4509 to a two-stage signalised crossing. Whilst the level of pedestrian demand for this movement is likely to be low, this upgrade has been included due to high increases in traffic flows.

2.6.7 The design has been subject to Swept Path Analysis ("Tracking") which confirms that a maximum length articulated vehicle is able to suitably navigate the proposed layout. This is to be expected given that there are relatively minor changes proposed to the junction layout, however it is understood that this is a key requirement of NH on the basis that the A38 could be used as a diversion route in the event of an M5 mainline closure.

2.7 Micro-Simulation Modelling

2.7.1 The junction improvements at M5 J14 and the A38 / B4509 junction have been assessed using micro-simulation (Vissim) modelling in order to confirm the future year performance of the scheme, including the effects of interactions within the junction network. The modelling has also been used to inform the design of the scheme through an iterative design and modelling process. Details of the Vissim model development and results are provided in a separate report which has been included at **Appendix F**.

2.7.2 The traffic flows used in the Vissim modelling have been derived from the strategic transport model (SATURN) which was used to inform the LPR. Flows have been assessed for a forecast year of 2040, which reflects the end of the LPR period. The assessment has compared a 2040 'Do Minimum' (DM) scenario and a 2040 'Do Something' (DS) scenario for the AM and PM peak hours.

- The 2040 DM scenario includes growth up to 2040, but excludes the adoption of the SDC LPR. This scenario assumes no changes to the existing M5 J14 arrangement.
- 2040 scenario includes growth in traffic up to 2040, and also includes adoption of the SDC LPR. This scenario assumes the implementation of the proposed grade-separated roundabout scheme at J14. The traffic flows for this scenario also account for the effects of induced demand at the junction (i.e. where the capacity improvements make traffic routes through the junction quicker and more reliable, which means more traffic is drawn towards the junction).

2.7.3 A summary of the key conclusions of the modelling is as follows:

- **There are forecast to be acceptable levels of queuing on the M5 off-slips.** The Vissim modelling confirms that during both peak hour periods, there are forecast to be marginally worse queues on the M5 off-slip road in the 2040 DS compared to the 2040 DM scenario, although the queues remain well within the extent of the slip road length. This means there are not forecast to be queues back to the M5 mainline carriageway, which is a key safety consideration for the operation of the junction.
- **There are forecast to be acceptable levels of queueing on the B4509 between the M5 and A38**. This means that there is suitable capacity in the junction to ensure that there are not blocking queues between M5 J14 and the A38 / B4509 junction, for example an eastbound queue on the B4509 backing up from the M5 to the A38 to the extent that vehicles cannot turn from the A38 towards the M5 (and vice-versa). This is a key consideration in the operation of the junction network.
- **There are forecast to be some higher levels of queuing and journey times on the B4509 arms in DS scenario compared to the DM scenario, especially in the AM peak hour**. This is owing to the fact that currently the B4509 is currently afforded priority through the junction (i.e. traffic on this road does not have to give way during the AM peak hour), however the introduction of priority control in the form of the grade-separated roundabout means that traffic is no longer free-flowing and as such there is an introduction of queues and increased journey times along this route.
- **All demand flows are able to pass through the junction network**. This means that the junction network (M5 J14 and A38 / B4509) has sufficient capacity to pass all demanded vehicles in the 2040 DS scenario through the model. Effectively, this means that the network operates within capacity as all vehicles can get through. This is a key consideration in terms of the capacity and operation of the junction network.

2.7.4 Overall, the micro-simulation modelling has confirmed that the proposed grade-separated roundabout will be able to accommodate the forecast level of traffic resulting from the SDC LPR, in 2040 with all Local Plan sites. The proposed scheme is therefore effective mitigation for the Plan, and the residual cumulative effect of the Plan and its mitigation is not severe in accordance with the NPPF.

3. Order of Cost Estimate

3.1 Introduction

3.1.1 This section of the report outlines the Order of Cost Estimate (OCE) undertaken for the preferred M5 J14 scheme. The OCE has been undertaken by AECOM on behalf of SDC, has been used in the forward calculations regarding funding apportionment and strategy. The OCE has been prepared to a level of detail as appropriate for the current design stage, with appropriate risks and allowances as set out in this section.

3.2 Scheme Costs

3.2.1 The cost derived for the delivery of the preferred option for a grade-separated roundabout at M5 J14, as determined from the OCE, is summarised in **Table 3-1**. The full OCE is provided at **Appendix G** for reference.

Table 3-1: Summary of OCE for M5 Junction 14 Improvement Scheme

Item	Relevant Allowance	Cost
Civil Engineering	-	£25,923,329
Traffic Management	13.9%	£3,605,117
Main Contractors Preliminaries	35.0%	£10,334,956
Main Contractors Overhead and Profit	10.0%	£3,986,340
Total Works Cost Estimate	**-**	**£43,849,743**
Design Team Fees	-	£13,154,923
Sub-Total	**-**	**£57,004,666**
Other Project Costs[2]	**-**	£6,317,667
Base Cost Estimate	**-**	**£63,176,666**
Risk Allowance	10.0%	£6,317,667
Cost Limit (excl. optimism bias)	**-**	**£69,494,332**
Optimism Bias	59.0%	£40,968,573
Cost Limit (incl. optimism bias)	**-**	**£110,462,905**

Notes: Summation Errors are due to rounding. Costs in bold are running totals.

3.3 OCE Calculations and Assumptions

3.3.1 The assumptions used in the preparation of the OCE have been subject to discussion with the TWG, and have also been compared with the methodology used by the cost consultant for the proposed scheme at M5 J12 to ensure consistency in the key assumptions and calculations. The key calculations and assumptions which have been made in the preparation of the OCE are outlined as follows:

- Benchmarking - the OCE has been benchmarked against the outturn costs of similar schemes on the Strategic Road Network (SRN). This is detailed in the Full OCE in **Appendix G**.
- Land Costs – the OCE includes an allowance of £500,000 for the obtaining land required to deliver the scheme. At this stage, the amount of land which would need to be purchased is unknown and the value of that land cannot be known until the scheme is finalised and the land negotiations are progressed. This level of allowance is considered to be a reasonable assumption for the purposes of the current exercise. It should be noted that the same allowance

[2] Including allowance for commuted sums, land fees and bond.

has been made for the scheme at J12, which will likely require a higher level of additional land to deliver a scheme.

- Traffic Management & Constructability - the OCE includes an allowance of 13.9% of the base scheme costs to account for traffic management during construction. This is based on experience and is considered to cover all of the known requirements for traffic management, including M5 closure to install the bridge as well as partial closures of the junction throughout the construction phase, and diversion requirements. Further details of the scheme construction and phasing is provided at **Appendix D**.
- Risk Contingency and Optimism Bias – the OCE includes an allowance of 10% of the base scheme costs for contingency associated with the scheme delivery risks, in addition to an allowance of 59% for optimism bias. Combined, this is approximately a 70% uplift in scheme costs to accounts for the various uncertainties associated with the early stage of scheme design.
- Commuted Sums – the OCE includes an allowance of £5 million for commuted sums payable to NH for the maintenance of the scheme for a set period of time post-opening. This is consistent with the assumption made for J12. In practice, commuted sums may not be required.
- Bond – the OCE includes an allowance of £672,000 for a contractors bond. This money is payable to NH to insure against the risk of the scheme contractor not being able to complete the necessary works to the SRN. It would be returned following delivery, and therefore the cost is an allowance for servicing the bond. This is consistent with the assumption made for J12.
- Utilities – the OCE includes an allowance of £2.25 million is included within the Civil Enginerring works cost, which equates to approximately 10% of the civils cost of the scheme. This is included as a lump sum and not an itemised allowance because at this stage, there is little evidence of utilities at M5 J14 and if there are any, they are likely to contain within the existing bridge which is likely to be retained. As such the lump sum allowance that has been included is cover localised movement or minor alteration only. The OCE includes substantial allowance for risk and contingency which would accommodate the need to mitigate any impacts on utilities if this arises through future design and construction stages.
- Design Team Fees – the OCE includes an allowance for Design Team fees. This accounts for the design, planning, project management and supervision of the scheme. This includes costs associated with regulatory processes.

3.3.2 The following elements have not been listed directly within the costs OCE for the following reasons:

- VAT – the OCE has not included an allowance for VAT.
- Inflation – the OCE has presented costs at 2024 values, and does not add additional costs inflation. Whilst it is recognised that by the time of scheme funding and delivery inflation will be applicable, at this stage of the design the construction year and the impacts of inflation in the intervening years cannot be determined. Additionally, any funding secured for the delivery of the scheme will allow for inflation at the appropriate time. As such excluding inflation from the scheme costs provides a like-for-like comparison in terms of the funding to be secured.

3.3.3 In addition to the above, it should be noted that the OCE has not included the implementation of the A38 / B4509 junction as this is a separate scheme which would be delivered separately. As noted, the need for a scheme in this location is included within the IDP.

4. Summary

4.1.1 AECOM is appointed by Stroud District Council (SDC) to provide technical transport and development planning advice in relation to its Local Plan Review (LPR). The LPR sets out how SDC has planned for growth and development across its district up to 2040. A Regulation 20 version of the LPR was submitted to the Planning Inspectorate (PINS) for Examination in Public (EiP) in 2023. PINS has agreed a pause to the EiP programme to enable SDC to provide further evidence as to the design, costing and deliverability of the necessary capacity improvements for M5 Junction 12 (J12) and Junction 14 (J14).

4.1.2 This report has been prepared to set out the design development, modelling, and costing exercise for J14. A separate exercise and report has been produced for J12 on behalf of Gloucestershire County Council (GCC) which has been submitted to PINS separately. AECOM has also prepared a further report on the funding approach, which is also published as part of this consultation exercise.

4.1.3 The work undertaken in relation to M5 J14 has been undertaken in collaboration with key stakeholders including NH, South Gloucestershire Council (SGC), GCC, Gloucester City Council and Western Gateway which are collectively referred to as the “Transport Working Group” (TWG).

4.1.4 The need for, and benefit of, improving capacity at M5 J14 has been made clear through a variety of studies undertaken by NH and SDC. The junction is forecast to exceed capacity, with associated delay and safety implications, owing to background traffic growth even without consideration for development allocated within the SDC LPR. Previous optioneering exercises have shown that there are limited alternatives to delivery of major junction improvement schemes to adequately plan for growth.

4.1.5 A number of potential grade separated roundabout designs have been considered for M5 J14. The preferred option is to construct a new bridge over the M5 carriageway to the north-east of the existing bridge for form a circulatory, with the southern M5 slip roads and B4509 approaches to the junction largely retained as per the existing arrangement with and the northern slip roads repositioned to connect to the new bridge. Some realignment of the entry path curvatures is required to meet design standards.

4.1.6 In addition to the grade-separated roundabout at J14, a design for improvement to the A38 / B4509 junction has been considered for the purposes of demonstrating that the entire local network can operate in a suitable manner and accommodate forecast levels of traffic. The improvements at this junction entail some additional lanes and a change to the operation of the traffic signals for right turning traffic from the A38 towards the M5. The scheme has been developed to show that there is an improvement available for the junction, although this would be subject to additional design optioneering and consultation prior to being finalised and delivered.

4.1.7 The junction improvements at M5 J14 and the A38 / B4509 junction have been assessed using micro-simulation (Vissim) modelling in order to confirm the future year performance of the scheme, including the effects of any interactions between the junctions. The micro-simulation modelling has confirmed that the proposed grade-separated roundabout will be able to accommodate the forecast level of traffic resulting from the SDC LPR, in 2040 with all Local Plan sites. The proposed scheme is therefore effective mitigation for the Plan, and the residual cumulative effect of the Plan and its mitigation is not severe in accordance with the NPPF.

4.1.8 An Order of Cost Estimate (OCE) has been prepared for the proposed improvements to M5 J14. This has been prepared proportionately to the stage of the scheme design, and as such includes high levels of contingency costs to account for the various uncertainties which are present at this early stage. The OCE has been benchmarked against outturn costs for other junctions on the SRN, and has been cross-referenced against the scheme costs independently calculated for J12 and has been prepared in collaboration with NH.

4.1.9 The OCE confirms that the cost of the grade-separated roundabout at M5 J14 will be in the region of£110million at 2024 prices.

Appendix A – Environmental Desk Based Study

M5 Junction 14 Environmental Constraints

To	Project number	Subject	Date
Matt Parker; David Cook	60598598	M5 Junction 14 Environmental Constraints	7 June 2024
Issued by	**Prepared by**	**Checked by**	**Approved by**
Bethany Horswell	Bethany Horswell	Anastasia Polyakova	Neil Titley

1. Introduction

A high level desk based appraisal has been undertaken to present the environmental constraints of the M5 Junction 14 Upgrade (hereafter the 'Proposed Development') and its proposed location. The appraisal identifies potential sensitivities and risks that may affect the Proposed Development's design and recommends further surveys and assessments to be undertaken.

2. Project Description and Study Area

The Proposed Development is a new grade separated junction at Junction 14 of the M5 motorway. The Proposed Development will utilise the existing bridge over the M5 and provide an additional structure to the north east. The new grade separated junction will then link to the existing roads to the east and west and provide new slip road connections to the M5.

The area of land required for the Proposed Development (hereafter referred to as the 'Site') is shown in Figure 1 as well as the Study Area which extends to 2km from the Site boundary for the purpose of this high-level appraisal.

The Study Area is characterised by agricultural land, deciduous woodland and various settlements. The main residential receptors comprise:

- the village of Falfield, located adjacent to the Site to the west;
- the village of Stone located approximately 1.3km north west;
- the village of Lower Stone located approximate 1.5km north west;
- Brook Farm and Howcroft Cottages located adjacent to the Site to the east; as well as
- the village of Tortworth located approximately 790m east.

Other receptors include Bristol North The Gables Hotel located approximately 90m north west, HMP Eastwood Park located approximately 400m south west and De Vere Tortworth Court Hotel located approximately 390m south east.

3. Environmental Constraints

3.1 Landscape and Visual

There are no National Landscapes (formally known as Areas of Outstanding Natural Beauty (AONB)) located within 2km of the Site. The Cotswolds National Landscape is located approximately 3.7km north east of the Site and longer distance views of the Proposed Development should be considered due to the topography of the Study Area.

The Study Area is covered by the following National Character Areas (NCA), as defined by Natural England 118: Bristol, Avon Valleys and Ridges[1]. The area is characterised by alternating ridges and broad valleys, with some steep, wooded slopes and open rolling farmland.

[1] Natural England. NCA Profile:118: Bristol, Avon Valleys and Ridges - NE400. Available at: https://publications.naturalengland.org.uk/publication/4646942

The Study Area is mainly characterised by the South Gloucestershire Landscape Character Assessment which defines eight Landscape Character Types (LCT) and 21 Landscape Character Areas (LCA). The LCT which covers the Study Area is Parkland Vale and only one LCA occurs within Parkland Vale which is 7: Falfield Vale[2]. This area is characterised by a shallow bowl comprising agricultural land and parkland, with a prominent mosaic of woodland, copses and mature trees on surrounding higher ground. The elevated topography surrounding the shallow bowl of the Falfield Vale provides extensive views across the agricultural landscape, making parts of this area sensitive to change. Dark skies are a key feature in many parts of the LCA.

Potentially sensitive visual receptors within the Study Area include residential settlements, recreational users of the landscape and people visiting places of interest for recreational or cultural reasons. There are several residential receptors within the Study Area, as noted in Section 2. It is recommended that visual screening is considered during design to help screen the Proposed Development from potential localised views.

As shown in Figure 1, there is a network of Public Rights of Way (PRoW) and recreational routes that transverse the Study Area and the Site, where views of the landscape and visual amenity is an important part of the experience. There are four PRoW, comprising 3 footpaths and one bridleway which intersect the Site. The local PRoW network is expansive, and a number of PRoW may be directly affected by the Proposed Development.

The Proposed Development should be designed to respect the surrounding character of the landscape. If artificial lighting is required, particularly at night, it should be designed in a way which considers residential receptors in close proximity to the Site to reduce the potential visual impact, as well as the impact on dark skies.

A landscape and visual appraisal is recommended to identify the predicted landscape and visual effects of the Proposed Development as well as potential mitigation measures to reduce any significant effects. Screening design should explore the opportunities to also mitigate the potential air quality and noise impacts, and contribute towards habitat connectivity.

3.2 Biodiversity and Nature Conservation

Designated Sites

There are no Special Areas of Conservation, Special Protection Areas, Local Nature Reserves, National Nature Reserves or Ramsar Sites located within 2km of the Site.

There are four Sites of Special Scientific Interest (SSSI) within 2km including (refer to Figure 1):

- Damery Road SSSI located approximately 1km north east of the Site;
- Brinkmarsh Quarry SSSI located approximately 1.1k south west;
- Slickstones Quarry Cromhall SSSI located approximately 1.9km south east; and
- Buckover Road Cutting SSSI located approximately 1.9km south west.

The Site is located within a SSSI Impact Risk Zone and therefore consultation with Natural England may be required.

There are seven Sites of Nature Conservation Interest[3] within 2km with the closest being Daniel's Wood located approximately 40m north east of the Site.

Arboriculture

There are 14 Ancient Woodlands within 2km of the Site (refer to Figure 1), with the two closest to the Site including:

- Daniel's Wood (Ancient and Semi-Natural Woodland) located approximately 40m north east of the Site; and

[2] South Gloucestershire Landscape Character Assessment. Area 7 Falfield Vale. Available at: https://beta.southglos.gov.uk/static/ca9d209995b02e4b154e03a02d7dc8f6/LCA-Section-2-Area-7.pdf
[3] South Gloucestershire Council Interactive Map. Available at: https://map.n-somerset.gov.uk/southglos.html

- Strays Grove (Ancient Replanted Woodland) located approximately 80m west of the Site.

For ancient woodlands, the design should have a buffer zone of at least 30 metres from the boundary of the woodland (known as the root protection area) to avoid root damage, unless a tree survey is carried out to identify that impacts can be avoided at closer distance. Where impacts are likely to extend beyond this distance such as the effect of air pollution from development that results in a significant increase in traffic, the design is likely to need a larger buffer zone to avoid negative impacts on ancient woodlands.

There is a veteran tree (tree ID: 179816)[4] located within the Site to the west (Grid reference: ST68539369). For veteran trees, the buffer zone should be at least 15 times larger than the diameter of the tree. The buffer zone should be 5 metres from the edge of the tree's canopy if that area is larger than 15 times the tree's diameter. This will create a minimum root protection area.

The location of Tree Preservation Orders (TPO) should be requested from South Gloucestershire Council to determine if any TPO consents are required.

A tree survey is recommended to identify preliminary information in relation to the nature and level of constraints posed by existing trees on the Site and to inform any design parameters to ensure that the potential impacts on significant trees are fully considered.

Habitats

Multiple Priority Habitats are located within 2km including deciduous woodland, coastal and floodplain grazing marsh, lowland meadows, good quality semi-improved grassland, traditional orchards and no main habitat but additional habitat exists (refer to Figure 1). Priority habitats located within the Site include:

- 'Deciduous woodland' is located within the north east of the Site; and
- 'No main habitat but additional habitat exists' is located within the east of the Site.

The land within the Study Area includes agricultural fields, hedgerows and trees, watercourses and ponds, which are home to a wide variety of fauna and flora.

Any high amenity value trees and notable habitats should be retained where possible and incorporated into the design. The design should account for a minimum 10m development buffer from watercourses and ponds where practicable.

A Preliminary Ecological Appraisal (PEA) comprising of a desk based assessment and Phase 1 Habitat Survey should be undertaken to establish the value of habitats on and around the Site and the need for any further protected species surveys and subsequent mitigations. Due to seasonality of ecological surveys these should be scheduled as soon as practicable to avoid delays to the overall programme of the Project; there may be a need for some Spring time or Summer time species surveys to inform the Project.

Biodiversity Net Gain

It is a legal requirement for new Proposed Developments under a planning application to achieve Biodiversity Net Gain (BNG) under the Environment Act 2021.

BNG should be at least 10% above existing conditions and is measured using the Defra Metric[5]. This metric reviews the type and condition of habitats present both before and after development to score the overall change for biodiversity. This requires commitment to the management of habitats within the development for the benefit of biodiversity. Where this cannot be achieved within the Site, then similar commitments would be required using off-site areas. Opportunities to achieve BNG should be developed in parallel with the Proposed Development design.

Therefore, a BNG assessment will be required as part of a planning application for the Project.

[4] Woodland Trust. Ancient Tree Inventory. Available at: https://ati.woodlandtrust.org.uk/tree-search/
[5] Natural England's Biodiversity Metric 3.1. Available at: http://publications.naturalengland.org.uk/publication/6049804846366720

3.3 Cultural Heritage

There are no World Heritage Sites, Registered Battlefields or Conservation areas located within 2km of the Site boundary.

There are three Scheduled Monuments within 2km (refer to Figure 1):

- 'Small multivallate hillfort 660m east of Whitfield Farm' located approximately 760m south east of the Site;
- 'Cross in St Leonard's churchyard' located approximately 1km north east of the Site; and
- 'Damery camp' located approximately 1.1km north east of the Site.

There are 116 Listed Buildings within 2km, consisting of one Grade I listed, two Grade II* listed and 113 Grade II listed (shown in Figure 1). The majority of these listed buildings lie within the settlements of Stone to the north west, Tortworth to the north east, Cromhall to the south east and Falfield to the west. There are also multiple listed buildings associated with De Vere Tortworth Court Hotel to the east. There are several listed buildings located adjacent to the west of the Site including Grade II listed buildings 'Falfield Mill', 'Falfield Mill House', 'Falfield War Memorial', 'Church Of St George' and 'Falfield Lodge, and Gatepiers and Railings to the front garden and on the west side of Church Avenue'.

Tortworth Court Grade II* Registered Park and Garden is located within the Study Area and overlaps with the east of the Site (refer to Figure 1). It is a national designation, and therefore the design should avoid impacting this asset. Liaison with South Gloucestershire Council's landscape officer regarding impacts on this feature is recommended early in the delivery programme.

Changes to road lighting, traffic movements (and associated vehicle lighting) as well as changes in road noise could affect the setting of listed buildings adjacent to the Site boundary.

The Study Area is certain to contain non-designated built heritage and archaeological assets which would need to be considered. Therefore, a cultural heritage desk-based assessment is recommended to determine, as far as is reasonably possible from existing records, the nature, extent and significance of the historic environment within the Study Area. Further investigations (geophysical survey, trial trenching) may be recommended based on the findings of the desk-based assessment and engagement with the local authorities and Historic England.

3.4 Water Resources and Flood Risk

There is one Main River within 2km which is Little Avon River located approximately 640m north of the Site (refer to Figure 1). A tributary of the Little Avon River (an ordinary watercourse) traverses the Site from the north to the south.

Parts of the Site are located within Flood Zones 2 and 3 within the west portion of the Site which are likely associated with the ordinary watercourse which crosses the Site as shown in Figure 1. Parts of the west and south east of the Site are also at 'high risk' and 'medium risk' of surface water flooding. Flooding from groundwater and reservoirs is unlikely in this area[6].

The groundwater vulnerability[7] in the Study Area is partially 'high risk', i.e. a high risk of surface water activities and pollutants entering groundwater bodies. There are also areas of 'medium to high risk' and 'medium risk'. Some areas to the east are also classified as having a 'soluble rock risk'.

The Site is not located within a Nitrate Vulnerable Zone, Drinking Water Safeguard Zone (for surface water or groundwater) or a Source Protection Zone.

Due to the Site being located in Flood Zone 2 and 3, as well as the Proposed Development being over 1ha, a Flood Risk Assessment will be required as part of a planning application. It is also recommended that an Outline Drainage Strategy is undertaken.

[6] UK Government Data – Flood Risk. Available at: https://www.gov.uk/check-long-term-flood-risk
[7] Defra's Multi-Agency Geographic Information for the Countryside' (MAGIC). Available at: https://magic.defra.gov.uk/MagicMap.aspx

3.5 Ground Conditions

The Site is underlain by 'Brinkmarsh Beds' (Limestone)[8] which is classified as a Secondary A aquifer and 'Brinkmarsh Beds' (Mudstone, calcareous) which is classified as a Secondary B aquifer.

There is no superficial geology recorded beneath the majority of the Site, however, 'River Terrace Deposits' (clay, silt and sand) and 'Alluvium' (Clay, silt, sand and gravel) are found in small vertical bands across the Site. These are classified as a Secondary A aquifer[9].

All four SSSI within the Study Area (as outlined in Section 3.2) are designated for geological interest.

There are no historic landfills within 2km of the Site boundary[10].

To establish potential sources of contamination, and determine if further intrusive sampling is required, it is recommended that a Phase 1 Preliminary Risk Assessment be undertaken.

3.6 Air Quality

There are no Air Quality Management Areas (AQMA)[11] within 2km of the Site with the closest being Bristol City AQMA located approximately 15.3km south west.

Due to the anticipated increase in traffic volumes, potential air quality sensitive receptors surrounding the Site which are likely to be subject to air quality impacts during construction and operation. This includes residential receptors, as identified in the Section 2 above with the closest of which are located adjacent to the west of the Site in Falfield.

Guidance from Environmental Protection UK and the Institute of Air Quality Management (IAQM)[12] suggests indicative criteria for requiring an air quality assessment, including a change in annual average daily traffic (AADT) of more than 500 Light Goods Vehicles (LGVs) or more than 100 Heavy Goods Vehicles (HGVs) at sites outside an AQMA.

An Air Quality Assessment is recommended to identify the air quality impacts of both the construction and operational phases of the Proposed Development on human health and ecological receptors.

3.7 Noise and Vibration

The Site is located in proximity to existing noise sources, including traffic on the existing road network such as the M5, A38 and B4509. There are no Noise Important Areas (NIAs)[13] within 2km of the Site. Due to the anticipated increase in traffic volumes, potential noise sensitive receptors surrounding the Site which are likely to be subject to noise during construction and operation. This includes residential receptors, as identified in the Section 2 with the closest located adjacent to the west of the Site in Falfield. The type of road surface as well as the potential use of noise barriers and earth bunds should be considered within the design.

A baseline noise survey and assessment are recommended to confirm any noise impacts of the Proposed Development, particularly during the operational phase.

3.8 Transport and Access

Junction 14 of the M5 serves a variety of settlements such as Dursley, Charfield, Falfield, Wotton-under-Edge and Thornbury. It is a diamond-type interchange that connects the M5 motorway with the B4509 road westbound which leads on to the A38. The interchange allows traffic to continue on the M5 or exit onto the B4509 eastbound.

[8] British Geological Survey – Geology Viewer. Available at: https://geologyviewer.bgs.ac.uk
[9] Defra's Multi-Agency Geographic Information for the Countryside' (MAGIC). Available at: https://magic.defra.gov.uk/MagicMap.aspx
[10] UK Government Data on Historic Landfills. Available at: https://data.gov.uk/data/map-preview
[11] Extrium – Noise and Air Quality Viewer. Available at: http://www.extrium.co.uk/noiseviewer.html
[12] Environmental Protection UK and IAQM. Guidance on land-use planning and development control: Planning for air quality 2017 v1.2. Available at: https://www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf
[13] Extrium – Noise and Air Quality Viewer. Available at: http://www.extrium.co.uk/noiseviewer.html

There are multiple PRoW[14] within 2km of the Site. PRoW which intersect the Site include:

- South Gloucestershire Footpath 16/30 within the west of the Site;
- South Gloucestershire Footpath 19/10 within the west and north of the Site;
- South Gloucestershire Footpath 1/10 within the north of the Site; and
- South Gloucestershire Bridleway 5/10 within the east of the Site.

It is recommended that the design should seek to avoid any closures or diversions of the existing PRoW.

Traffic flows are anticipated to increase and therefore transport modelling as well as a transport assessment are recommended to determine likely effects of the Proposed Development on the transport network, both during construction and operation. Furthermore, a Construction Traffic Management Plan is recommended to establish the management of construction traffic within the vicinity of the Site along the local highway network during the construction period of the works, in order to limit any potential disruptions and implications on the wider transport network.

4. Summary

The Site's main environmental constraints include potential impacts to residential receptors due to changes in air quality and noise from assumed increase in traffic volumes, flood risk, being located within a SSSI Risk Impact Zone as well as potential impacts to trees, habitats, PRoW, Registered Park and Gardens and listed buildings.

Table 1 below provides a summary of the follow-on assessments, surveys and design considerations subsequent to this review.

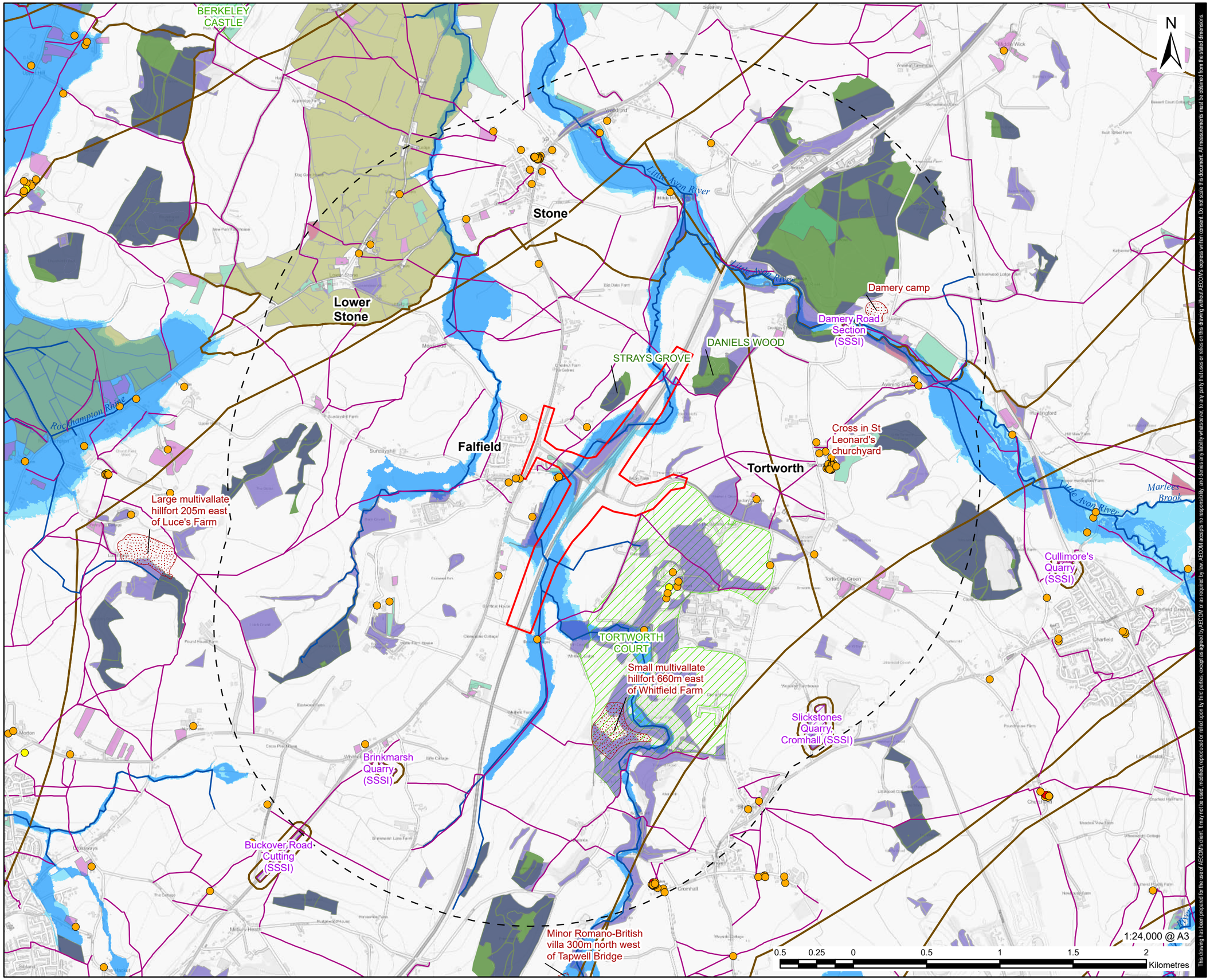
Table 1: Summary of recommendations

Environmental Constraint	Recommendations
Landscape and Visual	• Landscape and Visual Appraisal • Consideration of visual screening, including opportunities to also mitigate the potential air quality and noise impacts, and contribute towards habitat connectivity • Careful design of artificial lighting
Biodiversity and Nature Conservation	• Preliminary Ecological Appraisal including a Phase 1 Habitat Survey • Consultation with Natural England • Request the location of any TPOs from South Gloucestershire Council • Tree survey • Ancient woodland and veteran tree buffers • BNG Assessment
Cultural Heritage	• Cultural Heritage Desk Based Assessment • Liaison with South Gloucestershire Council's landscape officer regarding impacts to Tortworth Court Grade II* Registered Park and Garden
Water Resources and Flood Risk	• Flood Risk Assessment • Outline Drainage Strategy
Ground Conditions	• Phase 1 Preliminary Risk Assessment
Air Quality	• Air Quality Assessment

[14] Rowmaps – Public Rights of Way (PRoW) mapping. Available at: https://www.rowmaps.com/

Environmental Constraint	Recommendations
Noise and Vibration	• Noise Survey and Assessment • Consideration of types of road surfacing, potential use of noise barriers and earth bunds
Transport and Access	• Transport Modelling • Transport Assessment • Construction Traffic Management Plan

Figure 1: Environmental Constraints within 2km



AECOM

PROJECT

Stroud Local Plan TA M5 Junction 14

CLIENT

Stroud District Council

CONSULTANT

AECOM Limited
Midpoint, Alençon Link,
Basingstoke
RG21 7PP
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LEGEND

- Site Boundary
- 2km Study Area
- Grade I Listed Building
- Grade II Listed Building
- Grade II* Listed Building
- Main River
- Public Right of Way
- Scheduled Monument
- Registered Parks And Gardens
- Ancient Woodland
- Site of Special Scientific Interest (SSSI)
- SSSI Impact Risk Zones
- Flood Zone 3
- Flood Zone 2

Priority Habitats

- Coastal and floodplain grazing marsh
- Deciduous woodland
- Good quality semi-improved grassland
- No main habitat but additional habitats present
- Traditional orchard

NOTES

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ISSUE PURPOSE

Desk Based Study

PROJECT NUMBER

60598598

FIGURE TITLE

Environmental Constraints

FIGURE NUMBER

Figure 1

Appendix B – 2017 Design Optioneering and Modelling Study

OPTION TESTING REPORT

M5 Junction 14 VISSIM Model: Improvement Option Testing

Prepared for

Highways England

9 March 2017

1, The Square
Temple Quay
Bristol BS1 6DG

Contents

Section Page

Acronyms and Abbreviations

LMVR	Local Model Validation Report
NTEM	National Trip End Model
VPH	Vehicles Per Hour

SECTION 1

Introduction

1.1 Background

CH2M has been working with Highways England to assess the impact of future traffic growth on M5 Junction 14. This work has identified that, without intervention, the impact of forecast traffic volumes generated by local growth in housing and employment would be severe and could not be accommodated by the existing junction layout. Consequently, CH2M has been commissioned by Highways England to develop a range of potential improvement options for M5 Junction 14 and to test these using the M5 Junction 14 VISSIM model.

1.2 Purpose of Report

The purpose of this report is to identify the scale and type of junction improvement that would be necessary to accommodate anticipated future growth, although at this time there is no commitment or programme to fund or deliver the identified improvement. The report presents the results of the testing of these options under forecast traffic conditions reflecting growth from the Stroud Local Plan allocated development sites. The report also sets out the work involved in updating the VISSIM model with new traffic data collected for the study, and presents the results of the re-calibration and re-validation of the model.

1.3 Structure of Report

Following this introduction, the remainder of this report is structured as follows:

- **Section 2**: Model Update, which sets out the steps involved in updating the VISSIM model and presents the updated model calibration and validation results;
- **Section 3**: Forecast Growth, which explains the assumptions used in forecasting traffic growth at M5 Junction and the Stroud Local Plan development site assumptions employed;
- **Section 4**: Proposed Improvements, which describes the three proposed improvement options aimed at accommodating traffic growth at the interchange;
- **Section 5**: Option Testing, which explains the modelling methodology used in the testing and presents the results of the option assessment;
- **Section 6**: Summary and Conclusions, which summarises the report and provides recommendations based on the results of the option testing.

SECTION 2

Model Update

2.1 Model Background

CH2M was previously commissioned by Highways England to develop a VISSIM model of M5 Junction 14 (see Figure 2.1) in June 2016. The purpose of this modelling was to identify the point at which the impact of forecast traffic flows from planned development became severe and an improvement would be required at the interchange. The base model was completed in July 2016 with the Local Model Validation Report (LMVR), dated August 2016 (version 3), circulated and agreed by stakeholders. Full details of the model development can be found in that report.

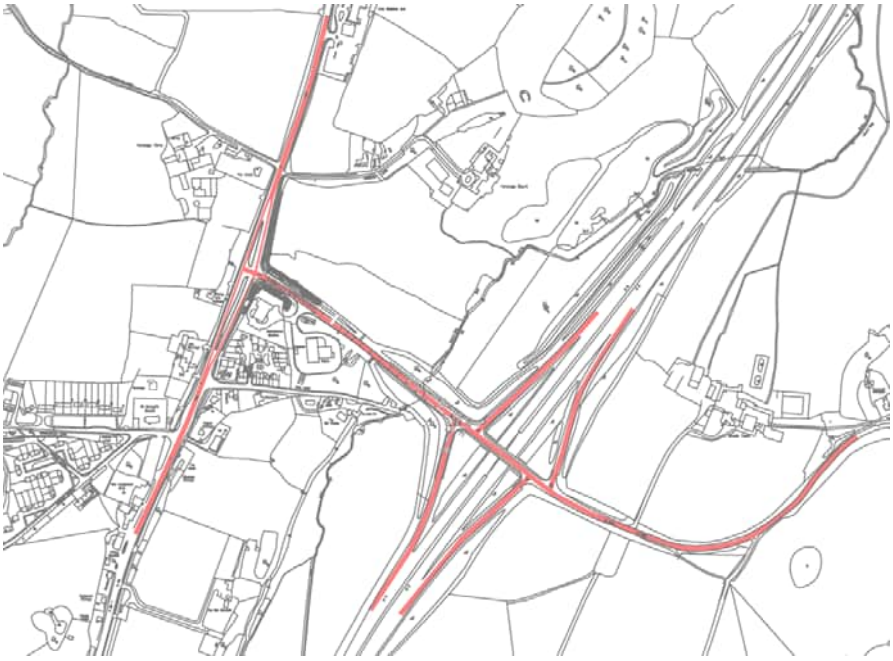


Figure 2.1: M5 Junction 14 VISSIM Model Extents

As shown in Figure 2.1, the network includes M5 Junction 14, including the intersection of the M5 off-slips and the B4509. The mainline M5 is not modelled. The network also includes the A38/B4509 signals to the west. The models have been developed to simulate traffic observed during the weekday morning peak period from 7:00 to 9:00am and weekday evening peak period from 4:00 to 6:00pm with a central hour assessment period and 30 minute warm-up and cool-down periods.

2.2 New Traffic Data

The VISSIM model was developed using the best available traffic data at the time, namely a combination of MOVA Assessment Log lane flows (19th May 2016), TRADS (Monday to Thursday average from Mat 2013 and September 2014) and Automatic Traffic Counter (ATC) data (5th May 2016). To provide a check on the previous model and provide new data for a model update in conjunction with the improvement scheme testing, a full 12 hour Manual Classified Turning Count (MCC) between 7:00am and 7:00pm was carried out by Tracsis at the interchange on the 17th November 2016.

The new MCC was used to update the VISSIM model origin-destination patterns and volumes in the trip matrices, as well as the 15 minute in-flow profiles to derive the 15 minute matrices. The count was also used to update the modelled split between light and heavy vehicles. Consistency checks with turning count data at the A38/B4509 signals showed a reasonable match. However, where there were discrepancies, the turning movements at the A38/B4509 signals were adjusted to harmonise with the traffic volumes from the November 2016 survey at M5 Junction 14.

2.3 Model Calibration

The global model parameters and calibration adjustments from the previous M5 Junction 14 VISSIM model were largely retained with only some minor tweaking of the gap acceptance values carried out in order to match throughput as indicated by the new November 2016 MCC. The models were then run for 10 seed runs with observed and modelled turning movements compared for each hour to confirm satisfactory model calibration.

As before, the GEH statistic has been adopted as the main indicator of the extent to which modelled flows match the corresponding observed values with a GEH of five or less indicating a good fit. Additionally, the DMRB flow criteria of being within 100 vehicles per hour (vph) for flows under 700 vph, or being within 15 per cent if greater than 700vph has been assessed.

Table 2.1 summarises the results of the turning count calibration checks for the AM and PM peak hours. The full results can be found in Tables A1 to A4 in **Appendix A**. The results indicate a good level of fit in both modelled peak periods with all movements meeting both GEH and DMRB flow criteria.

Table 2.1: Turning Count Calibration/Goodness of Fit Summary

Period	Total Turns	Counts GEH<5	Count DMRB Flow
AM (7:00-8:00am)	16	100%	100%
AM (8:00-9:00am)	16	100%	100%
PM (4:00-5:00pm)	16	100%	100%
PM (5:00-6:00pm)	16	100%	100%

2.4 Model Validation

As before, mean travel times from the Highways Analyst database have been used to assess the overall robustness of the models and ensure that typical operational conditions within the modelled network are being simulated accurately. An update to the Highways Analyst database meant that travel time data for the whole of 2015 was now available. This was extracted with the data filtered for Tuesday to Thursday term time only for the critical hours at the site, namely 7:30-8:30am and 4:30-5:30pm. This combination of newer information and change in the time period filtering of the Highway Analyst travel time data meant that observed travel times were different from those used in the original model.

Travel time validation has been carried out for the M5 off-slips at Junction 14 in isolation as well as a range of routes criss-crossing the model network. The travel time route sections in VISSIM have been configured to match the travel time sections available in the Highways Analyst database. Typically, the routes seek to cover circa 500 metres of the external approaches to the model network. The routes used are shown in **Appendix B**.

Acceptability criteria set out by Transport for London (TfL) in their latest micro-simulation best-practice guidelines recommend that average modelled travel times be within 15 per cent of the corresponding observed values on 85 per cent of routes. Further guidance provided in the Design Manual for Road &

Bridges (DMRB) suggests a suitable overall fit to have been achieved once 85 per cent of routes validate to within 15 per cent or one minute (if higher).

Model validation has been undertaken using 10 simulation seed runs. The travel time validation results can be seen in Tables 2.2 to 2.3. The results show that both AM and PM peak hour models validate to both DMRB and TfL acceptability criteria in every hour modelled with every route meeting DMRB criteria. These validation results demonstrate that the models are replicating typical operational conditions within the modelled network. Together with the calibration results, the validation checks confirm that the model is fit for purpose of testing propose improvement options at M5 Junction 14.

Table 2.2: Travel Time (seconds) Validation Results, AM Peak Hour (7:30-8:30am)

Route	Obs	Mod	Diff	Diff%	DMRB
Route 1 – M5 s/b off-slip;	21	17	-4	-20%	YES
Route 2 – M5 n/b off-slip;	37	41	4	11%	YES
Route 3 – A38 (N) to M5 (S);	180	206	26	14%	YES
Route 4 – A38 (S) to M5 (N);	152	124	-28	-18%	YES
Route 5 – B4509 (E) to M5 (N);	120	106	-14	-12%	YES
Route 6 – M5 (N) to A38 (S);	89	84	-5	-5%	YES
Route 7 – B4509 (E) to A38 (N);	154	141	-13	-8%	YES
Route 8 – M5 (S) to B4509 (E);	162	150	-12	-7%	YES
Route 9 – A38 (N) to A38 (S), and	75	66	-9	-12%	YES
Route 10 – A38 (S) to A38 (N)	56	54	-2	-4%	YES
% Passing					**100%**

Table 2.3: Travel Time (seconds) Validation Results, PM Peak Hour (4:30-5:30pm)

Route	Obs	Mod	Diff	Diff%	DMRB
Route 1 – M5 s/b off-slip;	39	40	1	3%	YES
Route 2 – M5 n/b off-slip;	50	36	-14	-28%	YES
Route 3 – A38 (N) to M5 (S);	136	128	-8	-6%	YES
Route 4 – A38 (S) to M5 (N);	133	119	-14	-10%	YES
Route 5 – B4509 (E) to M5 (N);	127	131	4	3%	YES
Route 6 – M5 (N) to A38 (S);	101	102	1	1%	YES
Route 7 – B4509 (E) to A38 (N);	191	179	-12	-6%	YES
Route 8 – M5 (S) to B4509 (E);	79	82	3	4%	YES
Route 9 – A38 (N) to A38 (S), and	68	66	-2	-2%	YES
Route 10 – A38 (S) to A38 (N)	51	55	4	8%	YES
% Passing					**100%**

SECTION 3

Forecast Growth

3.1 Background Growth

The forecast year for the option testing is 2017 plus full Stroud Local Plan growth. Background growth to this year has been applied through the application of TEMPRO growth factors. TEMPRO derives its forecasts from the National Trip End Model (NTEM) which is based on household and employment projections from published sources with these assumptions subjected to further consultation with local planning authorities and subsequent revision, as appropriate. At the time of writing, the NTEM datasets used in TEMPRO are dated 2011 and, in view of this, it can be assumed that any plan allocations prior to 2011 are included, but any plan allocations, such as those within the Stroud Local Plan, are not.

In order to maintain consistency and ensure a robust assessment, the same TEMPRO growth as that used in the previous trigger point modelling work has been assumed at M5 Junction 14. This used growth between 2015 and 2017 for the Stroud District Council and South Gloucestershire Council areas with the Production and Attraction growth factors for each averaged to establish unadjusted growth factors for the AM and PM peak periods. The resulting growth factors were **1.0121** in the AM and **1.0159** in the PM. WebTAG advises that TEMPRO growth should be subjected to income and fuel price adjustments with the relevant factors given in WebTAG Table M 4.2.1. Following the application of these adjustments the background traffic growth assumed is **1.034** in the AM and **1.038** in the PM.

3.2 Stroud Local Plan Sites

Table 3.1 lists the Stroud Local Plan sites considered in this study that are expected to result in growth in traffic at M5 Junction 14.

Table 3.1: Stroud Local Plan Sites Affecting M5 Junction 14

Allocated Sites	Plan Allocation	Planning Status
Hunts Grove Extension (Phase2)	750 dwellings	Planning Permission Granted
Quedgeley Business Park East	13 ha employment	Live planning application
North East of Draycott, Cam	12.5 ha employment plus 450 dwellings.	Live planning application – 10.7 ha employment and 450 dwellings
Sharpness	17 ha employment plus 300 dwellings	No planning application submitted
Stroud Valleys	450 dwellings	No planning application submitted
Land West of Stonehouse	10 ha employment plus 1350 housing	Planning Permission Granted

Note: The Local Plan also makes reference to a 'Windfall' site of 750 dwellings and a 'Council Housing Site' of 150 dwellings. No information is given on these proposals, and their location is not known. It has therefore not been possible to take account of these sites within the modelling undertaken.

3.2.1 Previous Atkins Work

Atkins considered developments impacting on M5 J14 in the Stroud District Council - Local Development Plan Draft Transport Impact Assessment. This work used generic trip rates for all development sites, and made assumptions on gross floor areas for employment sites. Trip distribution and assignment was identified by adopting a variety of methods, including using 2001 journey to work data, visual inspection

of the network and the use of a gravity model. Since planning applications for many of these site have now been submitted, it is possible to use the latest land use mix and revise trips rates and distribution using information contained in the relevant Transport Assessment accompanying planning application submissions. Similarly, the distribution and assignment can now be updated using 2011 journey to work data.

3.2.2 Traffic Generation

Trip generation for the Stroud Local Plan allocations has been based on trip rates provided within the Transport Assessment for each site and agreed with Highways England. For sites with no current Transport Assessment, such as the Sharpness and Stroud Valley sites, trip rates utilised by Atkins from the Stroud Local Plan work have been adopted. Since most of the Transport Assessments focused on the typical AM and PM peak hours (8:00-9:00am and 5:00-6:00pm) TRICS was also used to estimate traffic generation in the 'warm-up' hour preceding these periods, using a trip rate profile for the same land use classifications. The resulting traffic generation used for each site is summarised in Table 3.2.

Table 3.2: Stroud Local Plan Sites Traffic Generation

Site	**7-8am**		**8-9am**		**4-5pm**		**5-6pm**	
	Arr	Dep	Arr	Dep	Arr	Dep	Arr	Dep
Hunts Grove Extension	39	177	68	308	235	105	285	128
Quedgeley Business Park East	232	64	440	103	70	415	71	430
North East of Draycott, Cam	195	164	326	270	153	290	175	306
Sharpness Docks	61	75	89	125	78	80	92	86
Stroud Valleys	27	94	47	162	104	60	126	72
Land West of Stonehouse	197	330	392	600	463	403	556	453

3.2.3 Traffic Distribution

To consider the impact of all sites on the junction, 2011 journey to/from work Census information has been used to distribute the new trips to and from various destinations and origins. This was applied to developments using the distribution for the relevant 2011 Census Middle Layer Supper Output Area (MSOA). Trips were then assigned to the network based on the site location and the most logical route to and from their destination/origin.

3.2.4 Growth at M5 Junction 14

Appendix C contains four traffic flow diagrams for each modelled showing the resulting estimated increase in traffic flow at M5 Junction 14 and the nearby A38/B4509 signals associated with the Stroud Local Plan sites. The diagrams show that the growth in traffic at M5 Junction 14 is relatively well distributed across the modelled network and that the increases are not generally significant with maximum increases of circa 60 vehicles per hour (vph) in any one direction. The greatest increases in entry flows to the network are on the A38 (north) and B4509 arms.

SECTION 4

Proposed Improvements

4.1 General Approach

The main constraint at M5 Junction 14 is the single narrow over-bridge with a current width available for only three lanes across the deck. As agreed with Highways England as part of the study brief, banned or restricted movements cannot form part of the proposed scheme. Additionally it was assumed in the development of the design options that the improvement works are permitted to include:

- New or widened bridge structures over the M5 mainline; and
- Land outside the highway boundary, as well as third party land

To identify an appropriate scale of improvement to accommodate forecast growth, a first option was devised seeking to leave the over-bridge unchanged (Option 1 – see below). The second option considered widening of the existing deck to provide four lanes (Option 2), and the third and final option provided an entirely new structure in addition to the existing over-bridge (Option 3).

The resulting three proposed option layout designs are feasibility/preliminary design in nature, so consider the following:

- New highway alignment and standard;
- The revised position of kerb-lines and new traffic islands;
- Proposed road markings; and
- Any potential Departures from Standard.

The proposed improvement scheme drawings, however, do not show or include consideration of the following potential design issues:

- Revised street lighting layouts;
- Relocated positions of gullies and connections;
- Changes to up-right signs and new sign-face details;
- Traffic signal detection and allied ducting/chambers; and
- Consideration of services and buried utilities.

4.2 Improvement Options

4.2.1 Option 1

The proposed layout of Option 1 is shown in Drawing Number 679475.ST.16.14.05-OP1-01 in **Appendix D**. It involves the replacement of the existing intersection arrangement at the top of both sets of slip roads with roundabouts to create a standard dumb-bell arrangement. The creation of the roundabouts would mean that the bridge structure could be left unchanged, although this option would require some realignment of the slip roads, as well as use of land potentially outside of the highway boundary.

The proposed layout maintains two lanes on each approach, including the short flared section on the over-bridge and maintaining of the existing two-lane flared section on the B4509 approaches matching the geometry provided under the current arrangement. Whilst not shown on the layout drawing, each lane would be allocated to each turning movement, so, for instance, lane one of the M5 northbound off-

slip would be for the left turn to the B4509 westbound while lane two would be for the right turn to the B4509 eastbound.

4.2.2 Option 2

The proposed layout of Option 2 is shown in Drawing Number 679475.ST.16.14.05-OP2-01 in **Appendix D**. This option involves works to the existing over-bridge to provide four lane across the bridge deck. It retains the existing intersection arrangement with the extra width used to create long right turning lanes for traffic turning onto the M5 on-slips. This improvement in the storage capacity of these right turns could mean that it may be possible to run the B4509 entry arms concurrently making the operation of the traffic signals more efficient than is currently the case.

To maximise the operational flexibility of the signals under the new layout, the MOVA operation was revised to reflect a dual stream arrangement with each intersection operating independently of the other. IN loops were also introduced on the new longer right turn lanes as well as queue detection to prevent right turn queue lengths from becoming critical and impeding other movements. With these potential enhancements, the traffic signals were also assumed to be restored to 'full time' including full operation during the morning peak period.

4.2.3 Option 3

The proposed layout of Option 3 is shown in Drawing Number 679475.ST.16.14.05-OP3-01 to 04 in **Appendix D**. This option involves extensive works including the introduction of a new structure and significant realignment of the approaches to M5 Junction 14 in order to provide a full junction interchange arrangement over two bridges. At present, it is envisaged that the interchange would remain fully uncontrolled but clearly there would be scope in future to introduce full, or partial, signal control in order to better manage queue lengths on the M5 slip roads.

The introduction of a full junction would require realignment of the B4509 approaches to the interchange most notably on the westbound approach. This realignment would require the acquisition of a large amount of third party land. The realignment of the B4509 eastbound approach would provide the opportunity to upgrade this section from its current single carriageway to a full dual carriageway (D2AP) between the A38 and M5 Junction 14. This would enhance approach capacity to both M5 Junction 14 itself, as well as the B4509 approach to the A38 signals.

SECTION 5

Option Testing

5.1 Methodology

As noted, the assessment of the proposed improvement options has been carried out under forecast 2017 traffic volumes plus growth associated with the full Stroud Local Plan allocated sites. To provide a basis for comparison the existing M5 Junction 14 layout under these growth conditions was run to provide a Do-Nothing scenario. The proposed options were then coded into the network using this scenario as a starting point. The scenarios were each ran for 10 seed runs in order to smooth the impact of the randomisation of the model.

The previous Atkins work at M5 Junction 14 used LinSig which simple mathematical approach to modelling lends itself to the production of capacity outputs such as Degrees of Saturation (Dos) and Practical Reserved Capacity (PRC) that provide a concise measure of whether a junction is operating within or over capacity. Similar performance measures are not readily available from VISSIM. Instead, the model was configured to output network performance statistics, travel times and maximum queue lengths which collectively provide a picture of the overall operational forecast conditions.

Critically, an important measure of whether the proposed options are functioning satisfactorily are the maximum queue lengths on the M5 off-slip arms approaching the interchange. DMRB Volume 6 section 2 TD 22/06 paragraph 2.41 states that *"Drivers leaving the mainline should have sufficient time to react and brake safely before the end of any queues. The designer must be ensure that the downstream section and junctions do not cause queues that approach the back of the diverge nose."*.

Measurement of the distance between the give-way/stop lines on the off-slip arms at M5 Junction 14 and the nosing of the diverge provides a distance of 290 metres between these points on the northbound off-slip and 300 metres on the southbound off-slip. Queue lengths exceeding these distances on the slip road would suggest a failure of the junction, or a given option, to cope with traffic and raise a serious road safety hazard by causing slow moving or static traffic on the slip road close to the M5 mainline.

5.2 Assessment Results

5.2.1 Network Performance

Table 5.1 compares network performance outputs for the AM peak hour. The results clearly show that Option 3 performs the best, although Option 1 also provides a notable improvement in network operational conditions compared with the Do-Nothing scenario. Option 2, on the other hand, results in a fairly large deterioration in network conditions compared to the Do-Nothing scenario.

Table 5.1: M5 Junction 14 Network Performance Comparison, AM (7:30-8:30am)

Scenario	Avg Delay (s)	Avg Spd (mph)	Tot Trvl Time	Trips Complete
Do-Nothing	142	14	851874	3394
Option 1	88	18	697909	3512
Option 2	245	10	1242999	3262
Option 3	24	28	459027	3579

Table 5.2 compares the network performance statistics for the PM peak hour. The results highlight that this period the network is much less congested compared to the AM peak hour. All options provide an improvement in network conditions relative to the Do-Nothing scenario, although the benefits of Option 2 are marginal. Options 1 and 3 provide notable improvement in network operation, over the Do-Nothing scenario, with Option 3 performing marginally better than Option 1.

Table 5.2: M5 Junction 14 Network Performance Comparison, PM (4:30-5:30pm)

Scenario	Avg Delay (s)	Avg Spd (mph)	Tot Trvl Time	Trips Complete
Do-Nothing	46	25	464788	3185
Option 1	24	28	421238	3180
Option 2	42	26	471222	3183
Option 3	20	30	406057	3182

5.2.2 Travel Times

Figures 5.1 compares travel times (in seconds) for the Do-Nothing and three options for the four approaches to M5 Junction 14, as well as the B4509 between M5 Junction 14 and the A38/B4509 signals for the AM peak hour. The results show notable reduction in travel times with Option 3 on the northbound off-slip and B4509 eastbound approaches. Option 1 yields similar benefits but also appears to increase delays on the B4509 westbound approach compared to the Do-Nothing scenario. Option 2 increases travel times on the B4509 westbound approach but does provide benefits on the northbound off-slip.

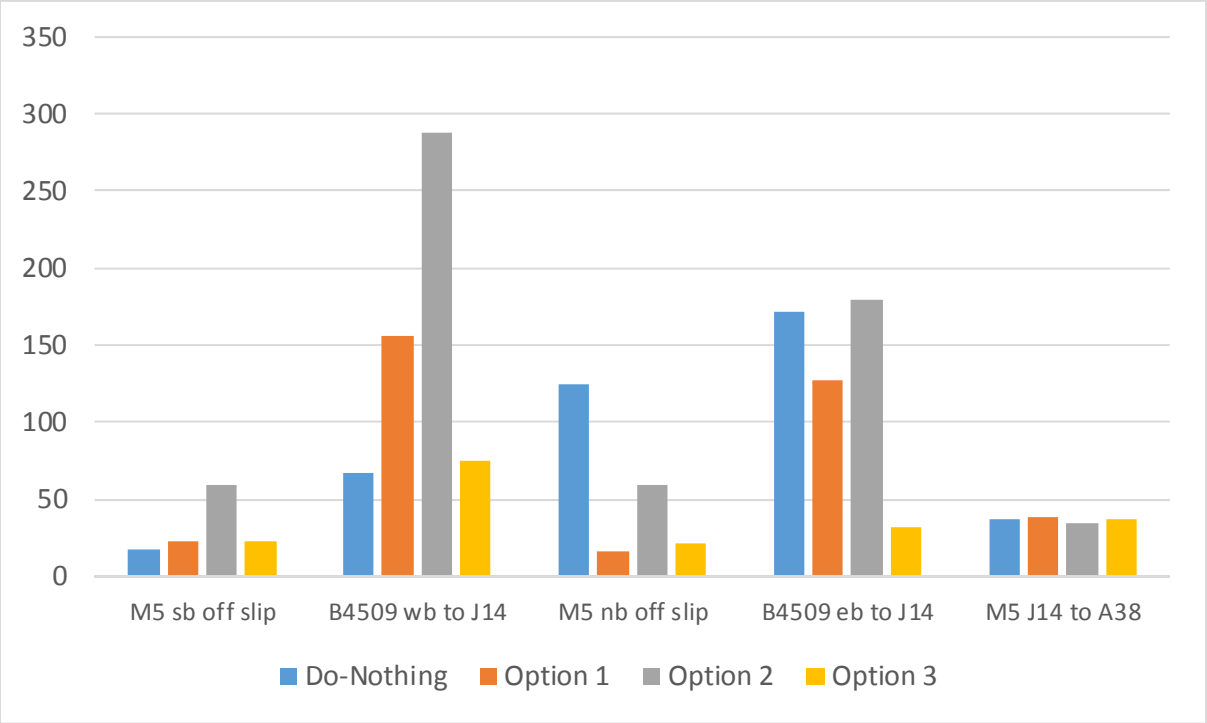


Figure 5.1: Travel Time (s) Comparison, AM Peak Hour (7:30-8:30am)

Figures 4.2 compares travel times on the same routes for the PM peak hour. During this period, Options 1 and 3 provide similar benefits with similar lower travel times on every approach to M5 Junction 14 than in the Do-Nothing scenario. Option 2 also provide benefits across all approaches to the interchange, although the reductions in travel time are much less than those provided by Option 1 and 3. Travel times on the route from M5 Junction 14 to the A38 signals are largely comparable across each of the scenarios modelled.

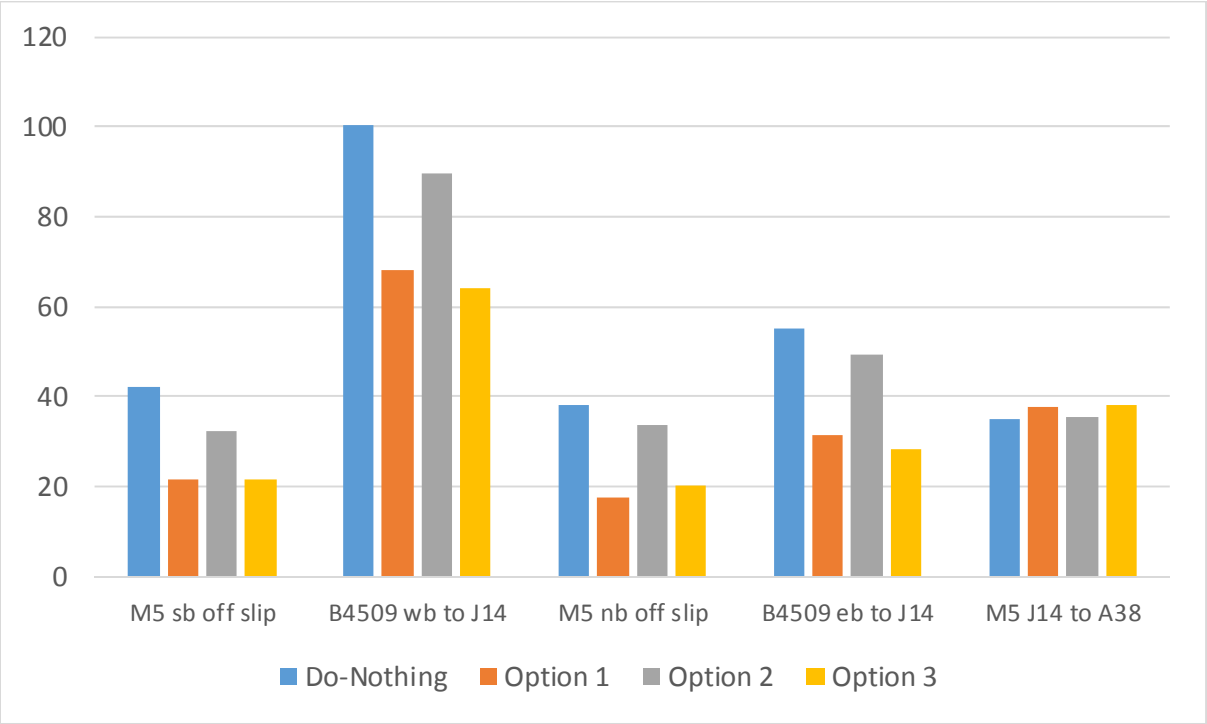


Figure 5.2: Travel Time (s) Comparison, PM Peak Hour (4:30-5:30pm)

5.2.3 Queue Lengths

Appendix E contains graphs comparing the maximum queue lengths in metres on each arm of M5 Junction 14 and A38/B4509 junction under the Do-Nothing and three scheme options. The values shown are the modelled maximum recorded queue within each five minute time segment. The results reflect the findings from the network performance and travel time results in that Option 3 provides the greatest benefits in terms of reduced queuing at the interchange. Option 1 also provides benefits but increases queuing on the B4509 westbound approach to M5 Junction 14. Option 2 significantly increases queuing on most approaches during the AM peak, including the southbound off-slip.

During the previous Stroud Local Plan growth impact assessment work the critical issue at M5 Junction 14 was the extent of queue lengths on the M5 northbound off-slip during the AM peak period. The modelling showed that this queue would exceed the storage capacity of the slip road at 50 to 75 per cent of Stroud Local Plan growth. Figure 5.3 reproduced from **Appendix E** compares the maximum queue length profile throughout the morning peak period under the Do-Nothing and three proposed improvement options. It shows that all of the proposed improvement options for M5 Junction 14, in particular Options 1 and 3, are effective at mitigating excessive queuing on the M5 northbound off-slip.

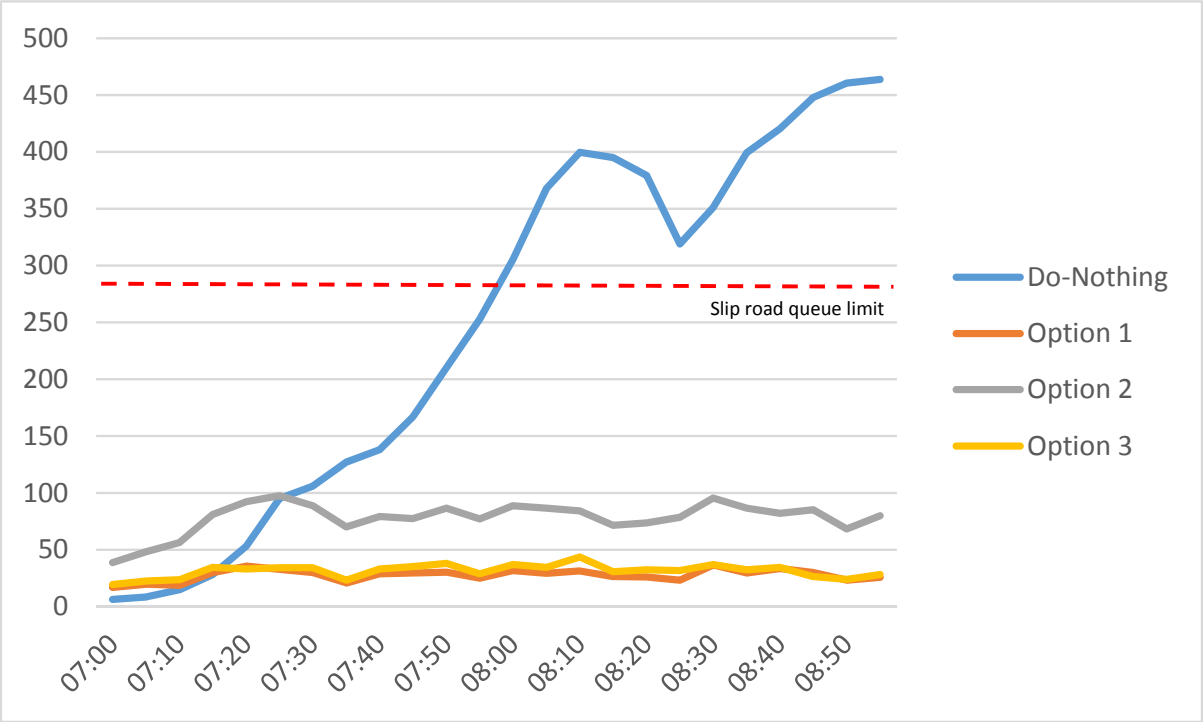


Figure 5.3: M5 Northbound Off-Slip, Max Queue Length (m) Profile Comparison, AM Peak Period

Queue lengths at the A38/B4509 signals during the AM peak period are influenced by the extent of queuing on the B4509 eastbound approach to M5 Junction 14. Consequently, there is extensive queuing at these signals under the Do-Nothing scenario and Option 2, as congestion on the eastbound bridge deck propagate upstream and results in exit impedance at the A38/B4509 signals. This issue is mitigated partly by Option 1 and resolved completely by Option 3. During the PM peak period, queue lengths at this intersection are comparable across all of the scenarios modelled.

SECTION 6

Summary and Conclusions

6.1 Summary

This report has presented the results of VISSIM microscopic traffic modelling of a series of potential improvement scheme options for M5 Junction 14. Previous modelling work has identified that the current intersection will be over-capacity at 50 to 75 per cent of traffic growth associated with Stroud Local Plan development sites. This over-capacity situation during the AM peak period is expected to result in queue lengths on the M5 northbound off-slip exceeding the storage capacity of the slip road with queues extending onto the mainline M5 carriageway.

The assessment has been carried out using the M5 Junction 14 VISSIM model. This model has been updated using recent MCC turning count data collected in November 2016. The model has been recalibrated to turning flows from this survey and revalidated to Highway Analyst mean travel times from 2015 (Tuesday to Thursday, term-time only). The calibration and validation checks meet and exceed the required acceptability criteria and demonstrate that the model is fit for purpose of assessing improvement options for M5 Junction 14.

Three improvement options has been devised with potentially increasing cost and land implications as follows:

- **Option 1**: replacement of the intersection arrangement at the top of both slip road with roundabout and the creation of a dumb-bell layout;
- **Option 2**: widening of the existing over-bridge deck to four lanes to provide longer right turning lanes and potentially enable the two intersection to operate independently and more efficiently;
- **Option 3**: construction of a new M5 over-bridge to create a full interchange with realignment of the B4509 approaches.

The modelling assessment indicates that Option 1 provides benefits over the current arrangement in terms of general operational conditions and mitigates the impact that forecast traffic growth will have on queue lengths on the northbound off-slip during the AM peak. However, it is also expected to lead to notable increases in queuing and delay on the B4509 westbound approach to M5 Junction 14. There may be design enhancements to resolve this impact, although any solutions are severely constrained by the existing narrow over-bridge. Its capacity to accommodate any further growth may also be limited.

Whilst it provides some benefits during the PM peak period, Option 2 results in significant increases in congestion at the interchange during the AM. It appears that the proposed increases in the length of the right turn lanes on the over-bridge are not sufficient to accommodate the forecast demand for these movements. The proximity of the two sets of signals means that 'hard' linking of the signals, as at present, is inefficient because of the amount of lost time to inter-green time and phase delays, and that with soft linking, as tested in Option 2, it is hard to guarantee sufficiently good coordination.

Not surprisingly, Option 3 provides significant benefits over the current arrangement. The modelling shows that it is capable of mitigating excessive queuing during the AM peak on the M5 northbound off-slip whilst providing comparable operational conditions, or better, on other approaches to the interchange. Additionally, the improvement in the operation of M5 Junction 14 under this option does not have any detrimental impact on the operation of the A38/B4509 signals. Rather, this option ensures the sound operation of these signals through resolving forecast exit blocking from M5 Junction 14.

6.2 Conclusions

Whilst Option 1 offers some improvement over the present layout, it simply relocates most of the forecast congestion from one arm of the B4509 and the northbound off-slip and concentrates it on another arm of the B4509 to the east. This is unlikely to be acceptable to the local highway authority or indeed users of the interchange. The modelling assessment also indicates that this option is unlikely to have much spare capacity for further traffic growth. The proposed layout also has limited opportunities for further enhancement without works to widen over the existing over-bridge. The introduction of traffic signal control would also be difficult because of the small size of the roundabouts.

Based on the modelling work presented in this report, it is clear that, all else being equal, Option 3 provides the only long-term solution to traffic growth at M5 Junction 14. It is the only option that provides benefits over the current arrangement whilst appearing to have spare capacity to accommodate further traffic growth beyond that associated with the Stroud Local Plan, such as that from unallocated windfall sites. This option also has significant potential for further enhancement, as required, such as the introduction of full or partial signal control, or minor works to widen entries to the roundabout. However, it is acknowledged that this option will be expensive and difficult to deliver because of the need for a new motorway structure and large areas of third party land required.

Appendix A
Turning Count Calibration Results

Table A1: Turning Count Calibration Results, AM Peak (7:00-8:00am)

From	To	Obs	Mod	Diff	Diff%	GEH	DMRB	
							Flow	GEH
M5 Junction 19								
M5 N	B4509 E	318	310	-8	-3%	0.45	YES	YES
	B4509 W	162	157	-5	-3%	0.40	YES	YES
B4509 E	M5 S	486	474	-12	-2%	0.55	YES	YES
	B4509 W	172	167	-5	-3%	0.38	YES	YES
	M5 N	351	350	-1	0%	0.05	YES	YES
M5 S	B4509 W	264	257	-7	-3%	0.43	YES	YES
	B4509 E	271	255	-16	-6%	0.99	YES	YES
B4509 W	M5 N	176	169	-7	-4%	0.53	YES	YES
	B4509 E	177	168	-9	-5%	0.69	YES	YES
	M5 S	463	452	-11	-2%	0.51	YES	YES
A38/B4509 Junction								
A38 N	B4509	491	493	2	0%	0.09	YES	YES
	A38 S	262	255	-7	-3%	0.44	YES	YES
B4509	A38 S	359	322	-37	-10%	2.01	YES	YES
	A38 N	283	253	-30	-11%	1.83	YES	YES
A38 S	A38 N	129	125	-4	-3%	0.35	YES	YES
	B4509	336	324	-12	-4%	0.66	YES	YES

Table A2: Turning Count Calibration Results, AM Peak (8:00-9:00am)

From	To	Obs	Mod	Diff	Diff%	GEH	DMRB	
							Flow	GEH
M5 Junction 19								
M5 N	B4509 E	242	241	-1	0%	0.06	YES	YES
	B4509 W	156	156	0	0%	0.00	YES	YES
B4509 E	M5 S	435	437	2	0%	0.10	YES	YES
	B4509 W	258	260	2	1%	0.12	YES	YES
	M5 N	347	350	3	1%	0.16	YES	YES
M5 S	B4509 W	264	266	2	1%	0.12	YES	YES
	B4509 E	222	230	8	4%	0.53	YES	YES
B4509 W	M5 N	145	147	2	1%	0.17	YES	YES
	B4509 E	190	197	7	4%	0.50	YES	YES
	M5 S	473	488	15	3%	0.68	YES	YES
A38/B4509 Junction								
A38 N	B4509	431	471	40	9%	1.88	YES	YES
	A38 S	222	223	1	0%	0.07	YES	YES
B4509	A38 S	346	392	46	13%	2.39	YES	YES
	A38 N	253	289	36	14%	2.19	YES	YES
A38 S	A38 N	141	142	1	1%	0.08	YES	YES
	B4509	321	347	26	8%	1.42	YES	YES

Table A3: Turning Count Calibration Results, PM Peak (4:00-5:00pm)

From	To	Obs	Mod	Diff	Diff%	GEH	DMRB	
							Flow	GEH
M5 Junction 19								
M5 N	B4509 E	306	304	-2	-1%	0.11	YES	YES
	B4509 W	132	127	-5	-4%	0.44	YES	YES
B4509 E	M5 S	208	208	0	0%	0.00	YES	YES
	B4509 W	190	192	2	1%	0.14	YES	YES
	M5 N	264	255	-9	-3%	0.56	YES	YES
M5 S	B4509 W	332	335	3	1%	0.16	YES	YES
	B4509 E	285	290	5	2%	0.29	YES	YES
B4509 W	M5 N	141	137	-4	-3%	0.34	YES	YES
	B4509 E	200	192	-8	-4%	0.57	YES	YES
	M5 S	231	221	-10	-4%	0.67	YES	YES
A38/B4509 Junction								
A38 N	B4509	284	281	-3	-1%	0.18	YES	YES
	A38 S	180	178	-2	-1%	0.15	YES	YES
B4509	A38 S	285	282	-3	-1%	0.18	YES	YES
	A38 N	369	362	-7	-2%	0.37	YES	YES
A38 S	A38 N	283	278	-5	-2%	0.30	YES	YES
	B4509	288	282	-6	-2%	0.36	YES	YES

Table A4: Turning Count Calibration Results, PM Peak (5:00-6:00pm)

From	To	Obs	Mod	Diff	Diff%	GEH	DMRB	
							Flow	GEH
M5 Junction 19								
M5 N	B4509 E	306	306	0	0%	0.00	YES	YES
	B4509 W	187	186	-1	-1%	0.07	YES	YES
B4509 E	M5 S	197	197	0	0%	0.00	YES	YES
	B4509 W	166	165	-1	-1%	0.08	YES	YES
	M5 N	203	209	6	3%	0.42	YES	YES
M5 S	B4509 W	367	373	6	2%	0.31	YES	YES
	B4509 E	337	340	3	1%	0.16	YES	YES
B4509 W	M5 N	198	201	3	2%	0.21	YES	YES
	B4509 E	274	276	2	1%	0.12	YES	YES
	M5 S	164	170	6	4%	0.46	YES	YES
A38/B4509 Junction								
A38 N	B4509	347	352	5	1%	0.27	YES	YES
	A38 S	124	126	2	2%	0.18	YES	YES
B4509	A38 S	289	290	1	0%	0.06	YES	YES
	A38 N	431	435	4	1%	0.19	YES	YES
A38 S	A38 N	216	220	4	2%	0.27	YES	YES
	B4509	289	295	6	2%	0.35	YES	YES

Appendix B
Travel Time Validation Routes

Figure B1: Travel Time Validation Route 1, M5 Southbound Off-Slip

Figure B2: Travel Time Validation Route 2, M5 Northbound Off-Slip

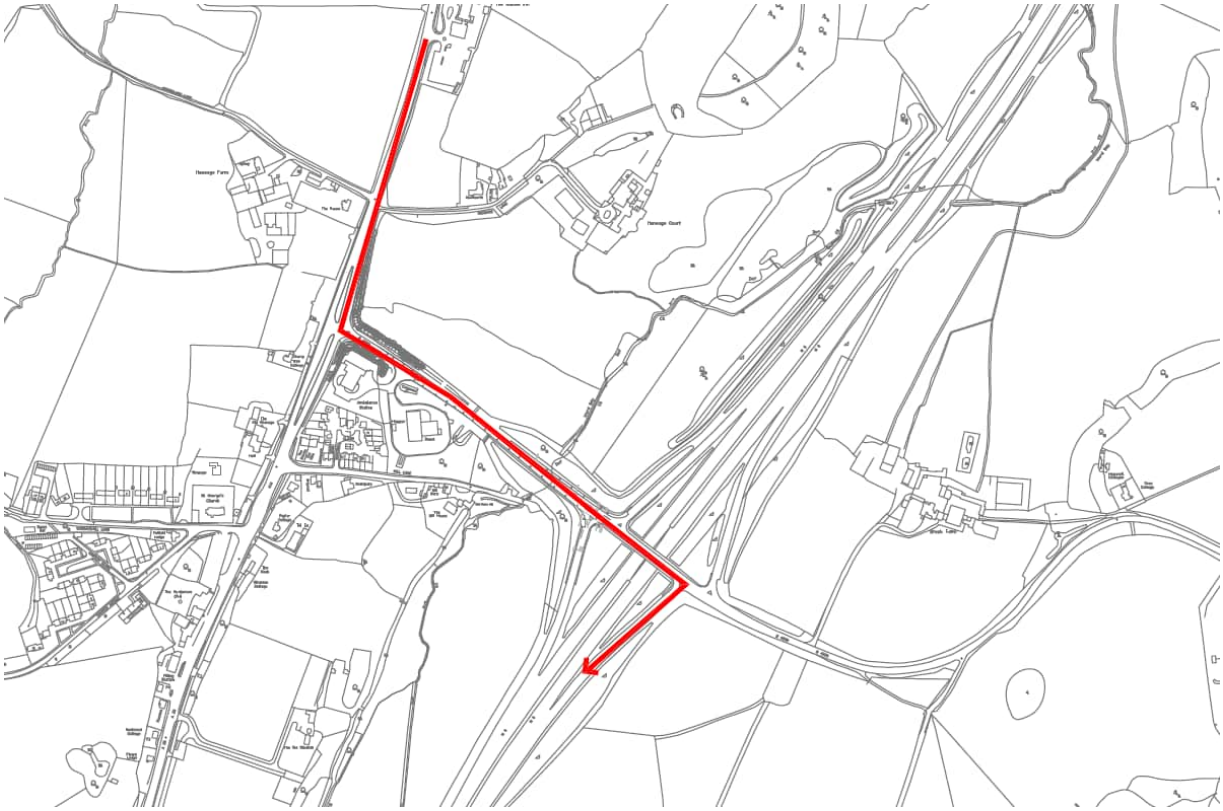


Figure B3: Travel Time Validation Route 3, A38 (North) to M5 (South)

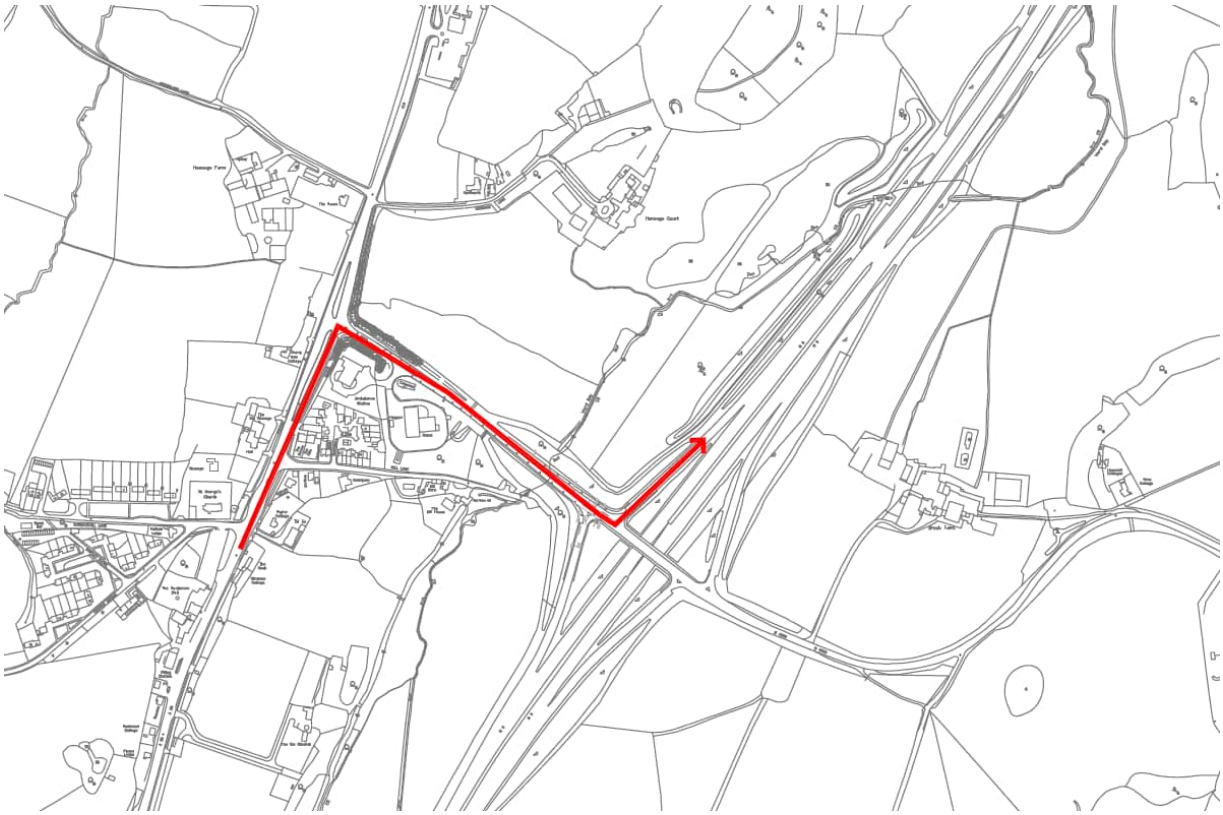


Figure B4: Travel Time Validation Route 4, A38 (South) to M5 (North)

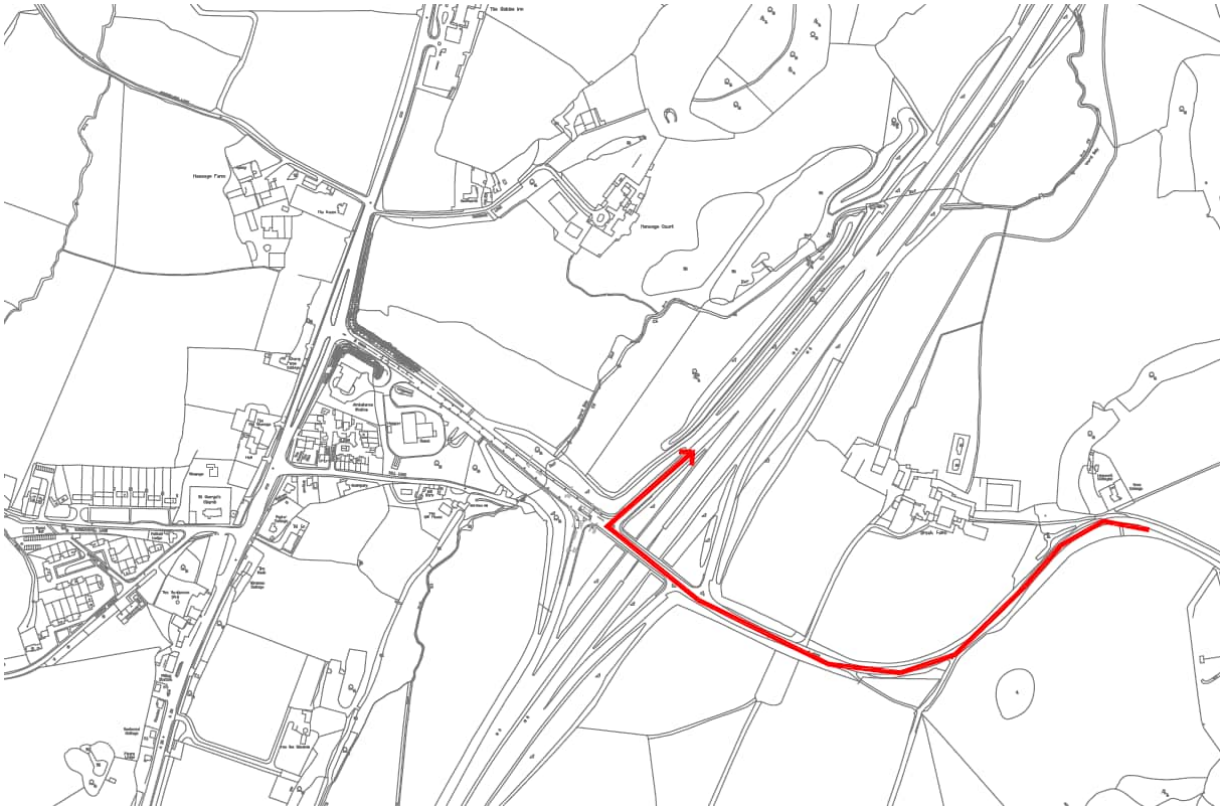


Figure B5: Travel Time Validation Route 5, B4509 (East) to M5 (North)

Figure B6: Travel Time Validation Route 6, M5 (North) to A38 (South)

Figure B7: Travel Time Validation Route 7, B4509 (East) to A38 (North)

Figure B8: Travel Time Validation Route 8, M5 (South) to B4509 (East)

Figure B9: Travel Time Validation Route 9, A38 (North) to A38 (South)

Figure B10: Travel Time Validation Route 10, A38 (South) to A38 (North)

Appendix C
Stroud Local Plan Traffic Growth

Figure C1: M5 Junction 14, Stroud Local Plan Traffic Growth (7:00-8:00am)

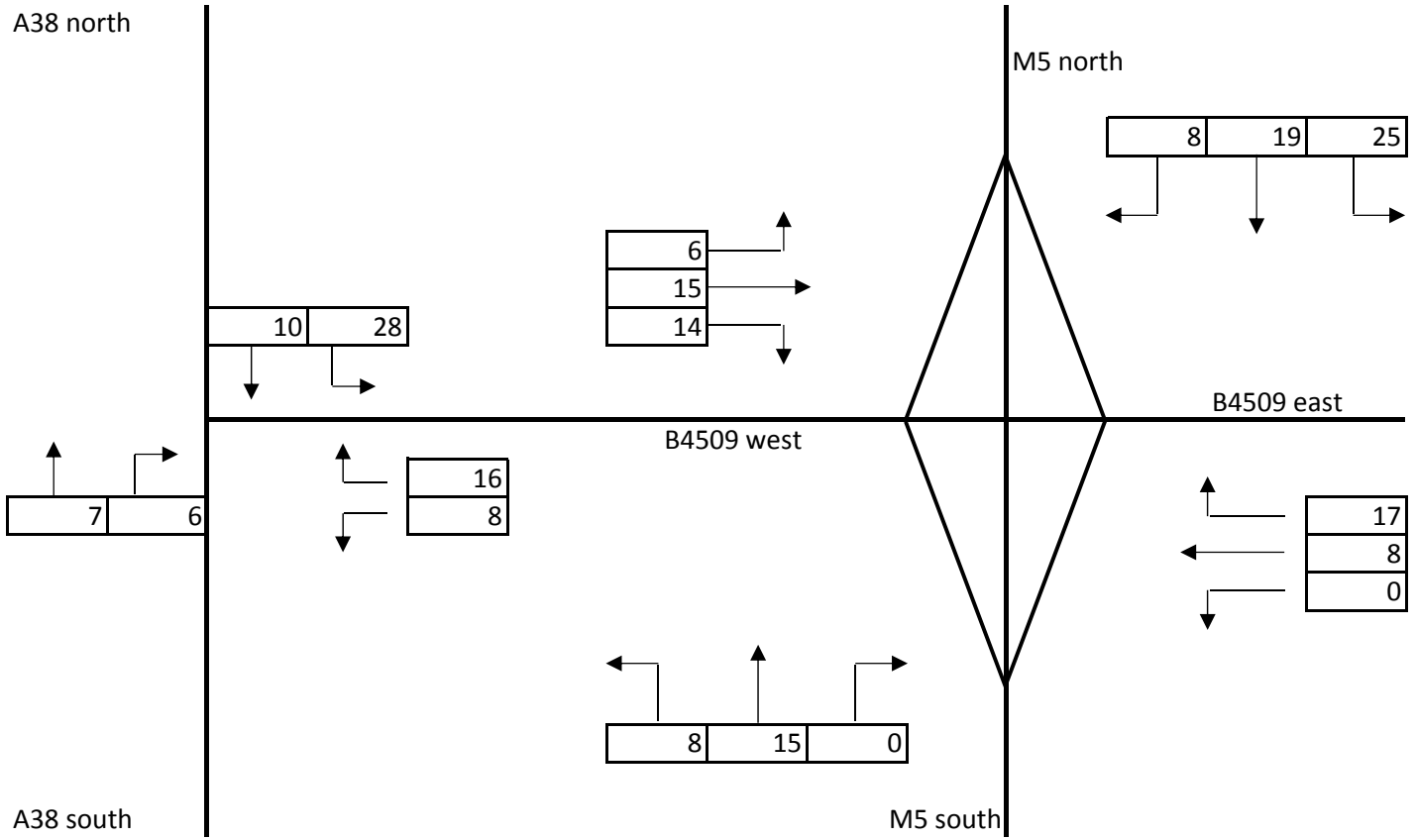


Figure C2: M5 Junction 14, Stroud Local Plan Traffic Growth (8:00-9:00am)

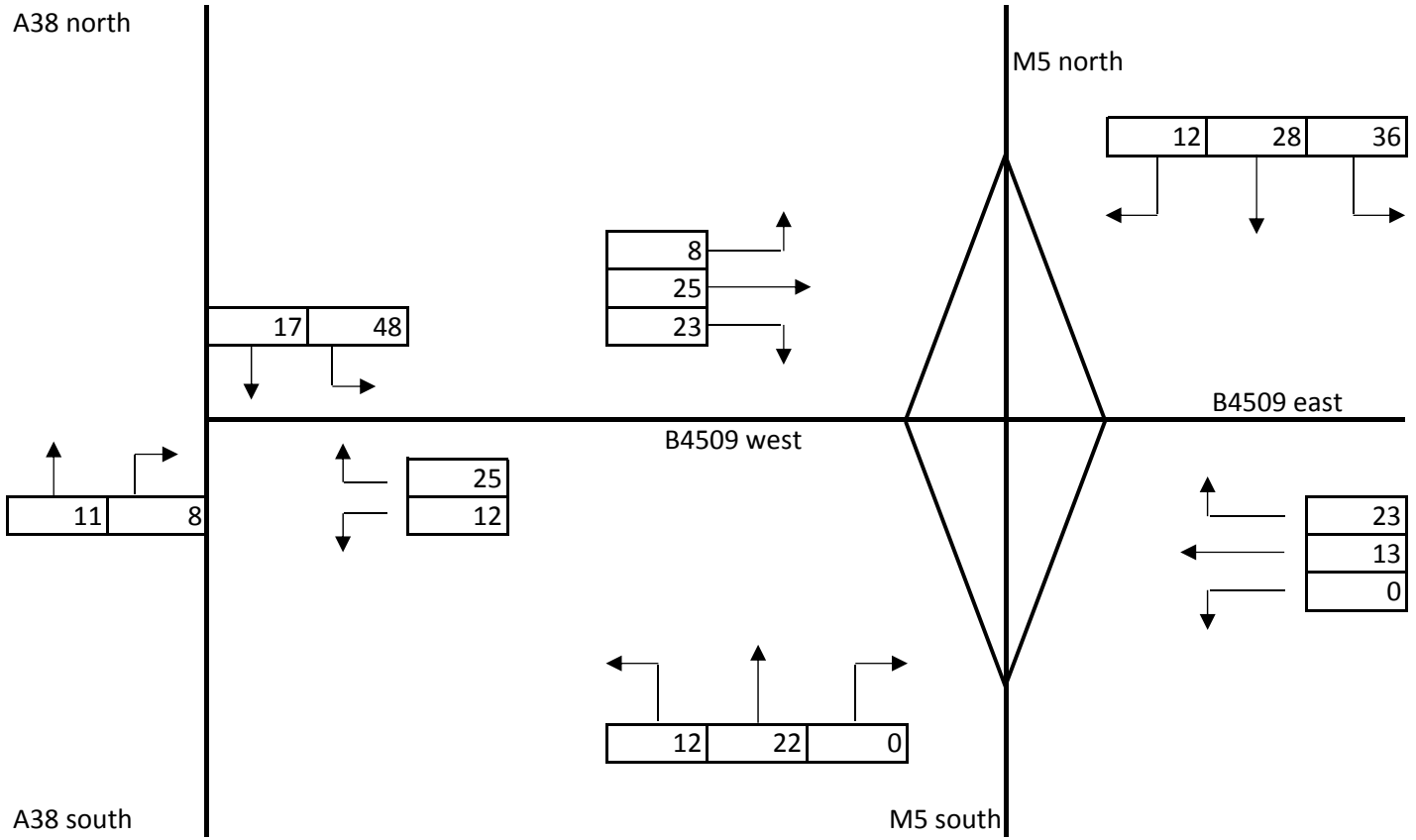


Figure C3: M5 Junction 14, Stroud Local Plan Traffic Growth (4:00-5:00pm)

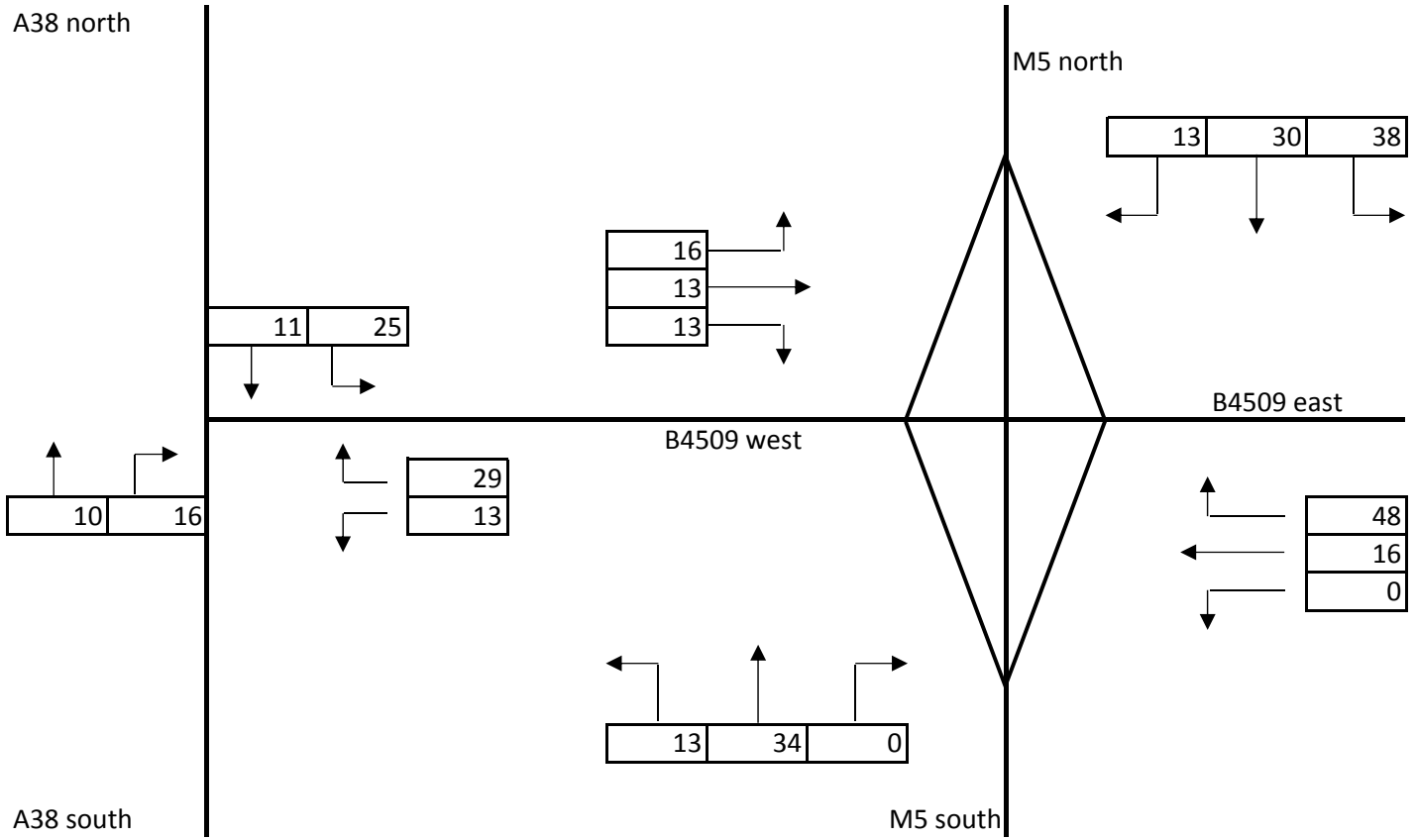
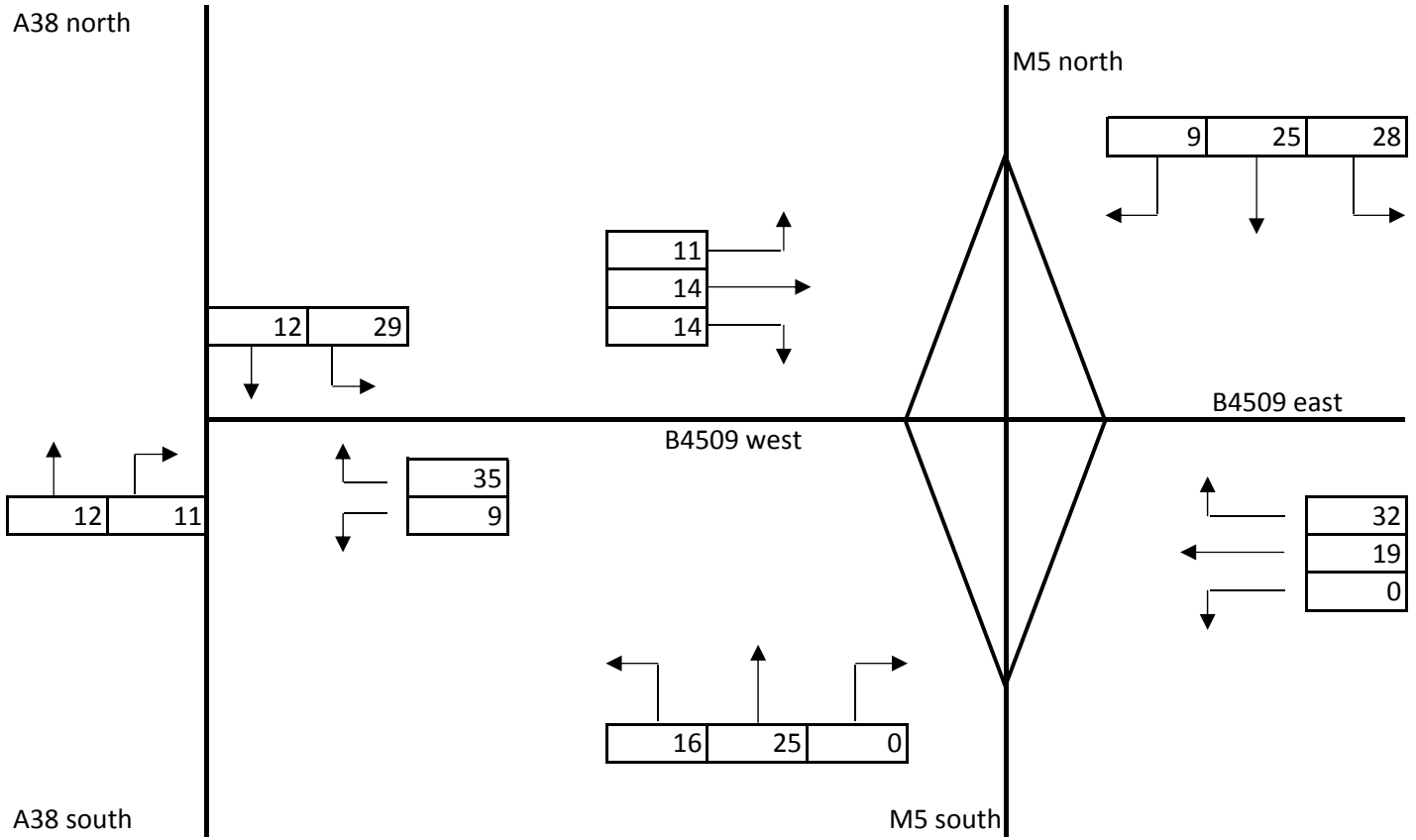
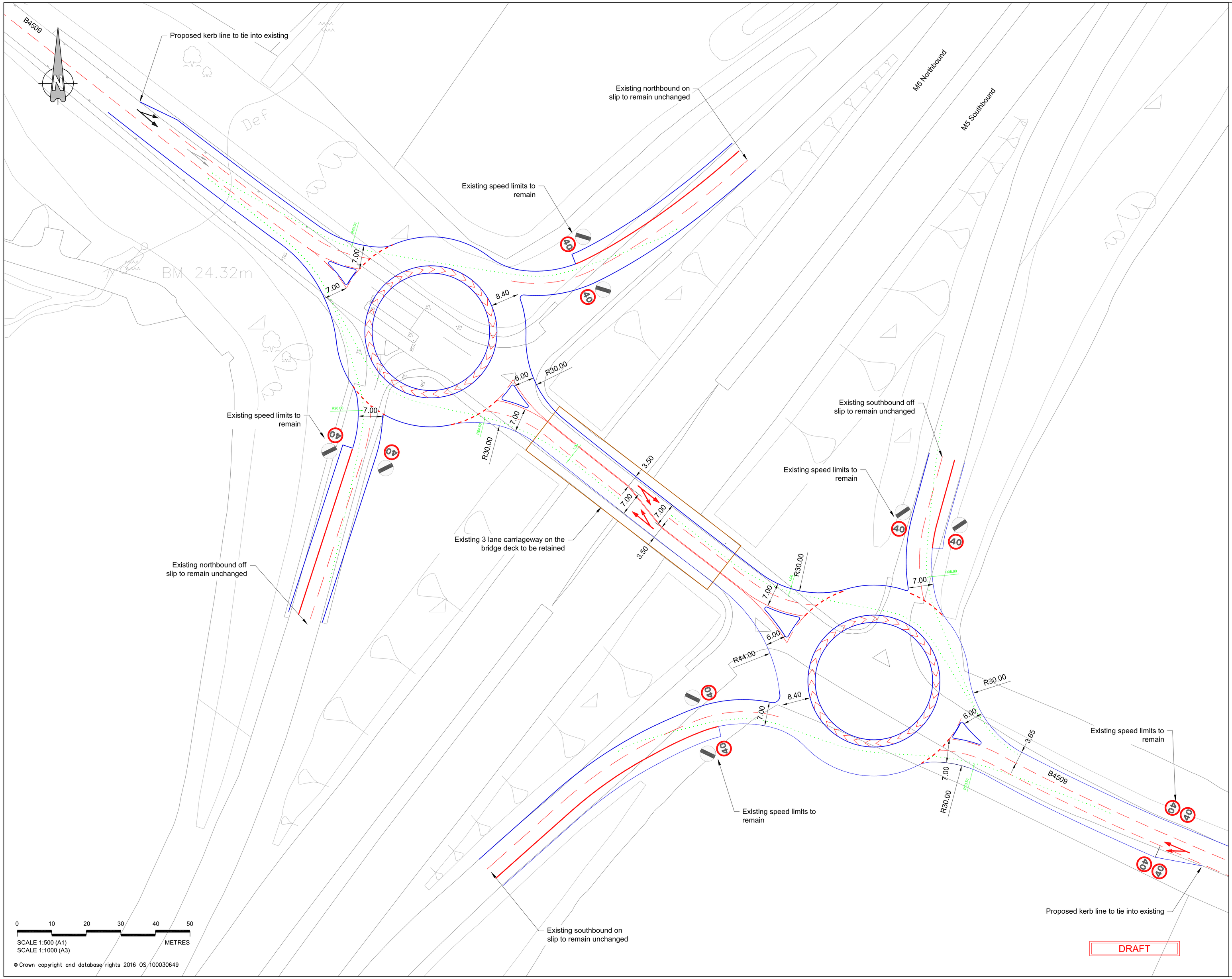


Figure C4: M5 Junction 14, Stroud Local Plan Traffic Growth (5:00-6:00pm)



Appendix D
M5 Junction 14 Improvement Options



DO NOT SCALE. This drawing is to be read in conjunction with all relevant Architects, Engineers and Specialist Manufacturer's drawings and specifications. If in doubt please consult the Engineer.

Notes:

1. All dimensions are in metres unless noted otherwise.

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CH2M
1 The Square Temple Quay Bristol BS1 6DG
Tel +44 (0)117 910 2580 Fax +44 (0)117 910 2581
www.ch2m.com

Project

M5 J14 CONCEPT

Drawing

M5 J14
DUMB-BELL ROUNDABOUT
OPTION 1

Drawn by: ADS	Date: 24/11/2016
Checked by: LT	Date: 06/12/2016
Approved by: LT	Date: 06/12/2016

Drawing No. 679475.ST.16.14.05-OP1-01

Revision -

Drawing Scale: 1:500 @ A1

Drawing file path & name - C:\Users\ewlead\Projects\679475.ST.16.14.05 M4 J14 Concept and Modelling TEMP\90 AutoCAD\ 679475.ST.16.14.05-OP1-01 Rev 0.dwg

DO NOT SCALE. This drawing is to be read in conjunction with all relevant Architects, Engineers and Specialist Manufacturer's drawings and specifications. If in doubt please consult the Engineer.

Notes:

1. All dimensions are in metres unless noted otherwise.

Proposed kerb line to tie into existing
B4509
70.00
2.00
6.00
R10.00
Existing speed limits to remain
R10.00
3.40
1.60
6.00
R5.00
Existing northbound on slip to remain unchanged
Existing embankment
M5 Northbound
M5 Southbound
Existing embankment
Approximate location of M5 over bridge
Existing southbound off slip to remain unchanged
Existing northbound off slip to remain unchanged
Existing 3 lane carriageway on the bridge deck to be widened to 4 lanes, with approx. 1m clearance to the bridge parapet
1.00
86.00
1.00
1.60
6.00
3.40
R5.00
R7.00
Existing embankment
6.00
2.00
50.00
6.00
50.00
Existing southbound on slip to remain unchanged
Proposed kerb line to tie into existing

0 10 20 30 40 50
METRES
SCALE 1:500 (A1)
SCALE 1:1000 (A3)

DRAFT

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Project

M5 J14 CONCEPT

Drawing

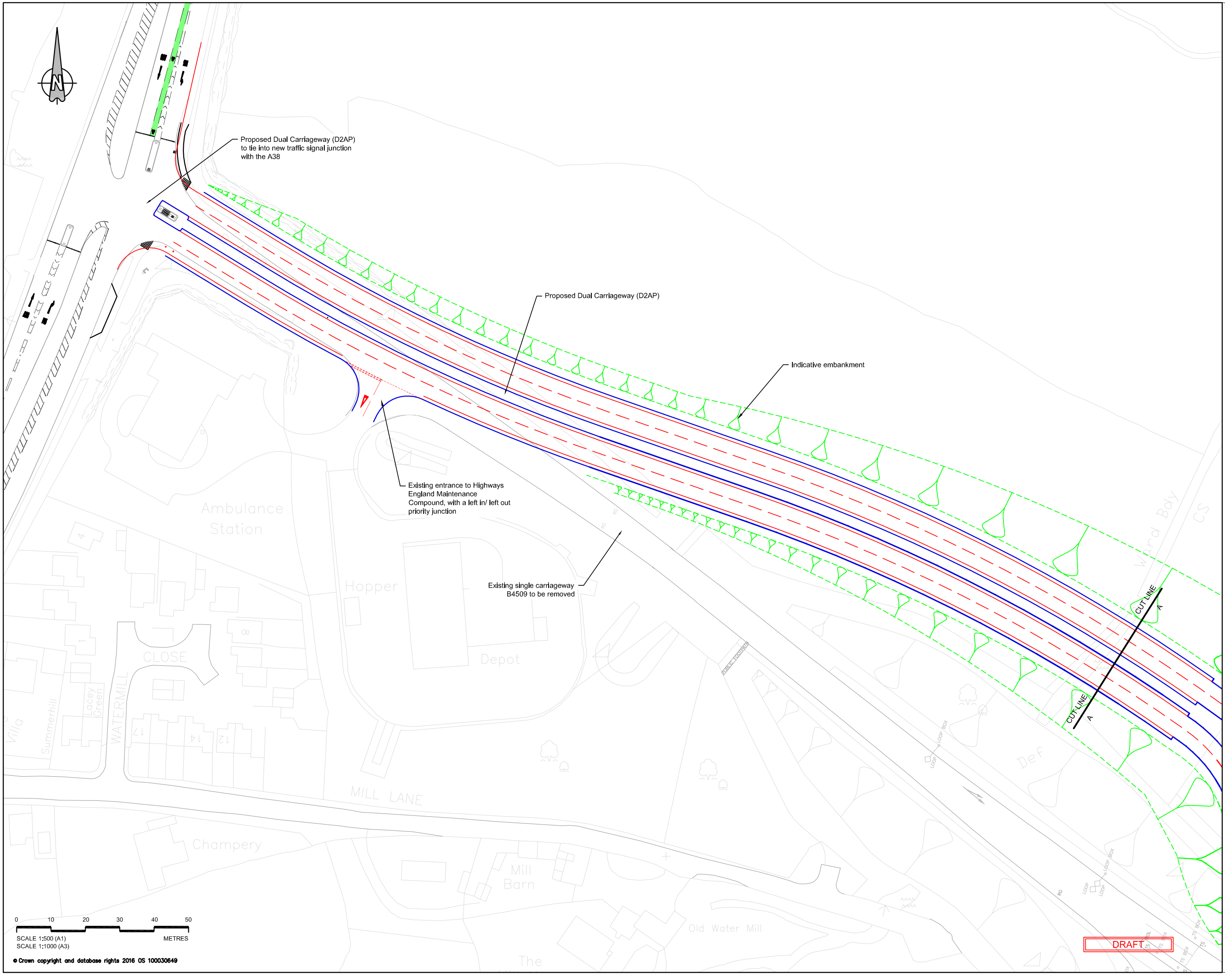
M5 J14
TRAFFIC SIGNAL JUNCTION
OPTION 2

Drawn by: ADS	Date: 24/11/2016
Checked by: LT	Date: 06/12/2016
Approved by: LT	Date: 06/12/2016

Drawing No.	Revision
679475.ST.16.14.05-OP2-01	-

Drawing Scale: 1:500 @ A1

Drawing file path & name : C:\Users\ewkod\Projects\679475.ST.16.14.05 M4 J14 Concept and Modelling TEMP\90 AutoCAD\ 679475.ST.16.14.05-OP2-01 Rev 0.dwg



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Project

M5 J14 CONCEPT

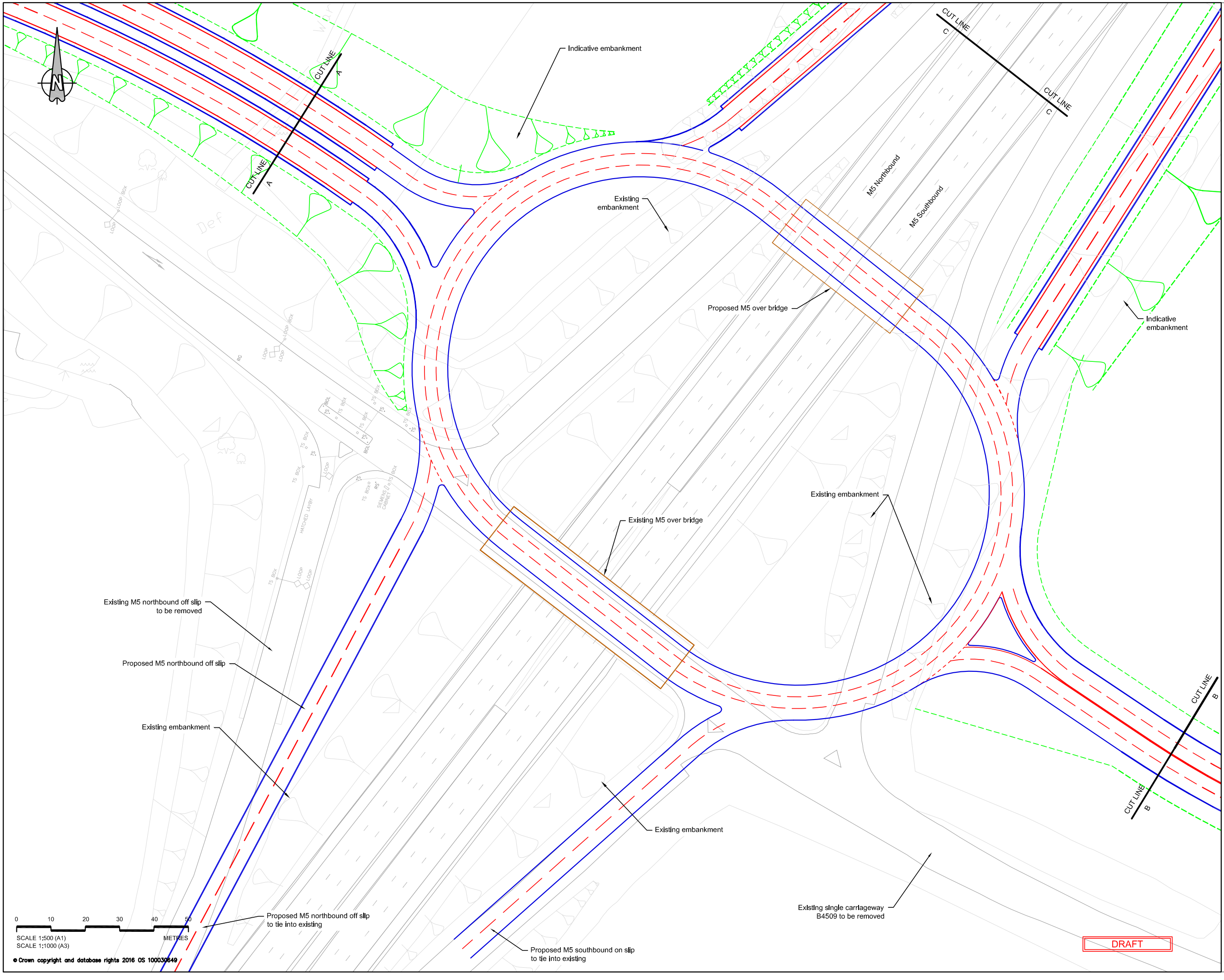
Drawing

M5 J14 GRADE SEPARATED JUNCTION OPTION 3

Drawn by: ADS	Date: 24/11/2016
Checked by: LT	Date: 06/12/2016
Approved by: LT	Date: 06/12/2016

Drawing No.	Revision
679475.ST.16.14.05-OP3-01	-

Drawing Scale: 1:500 @ A1



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Notes:

1. All dimensions are in metres unless noted otherwise.

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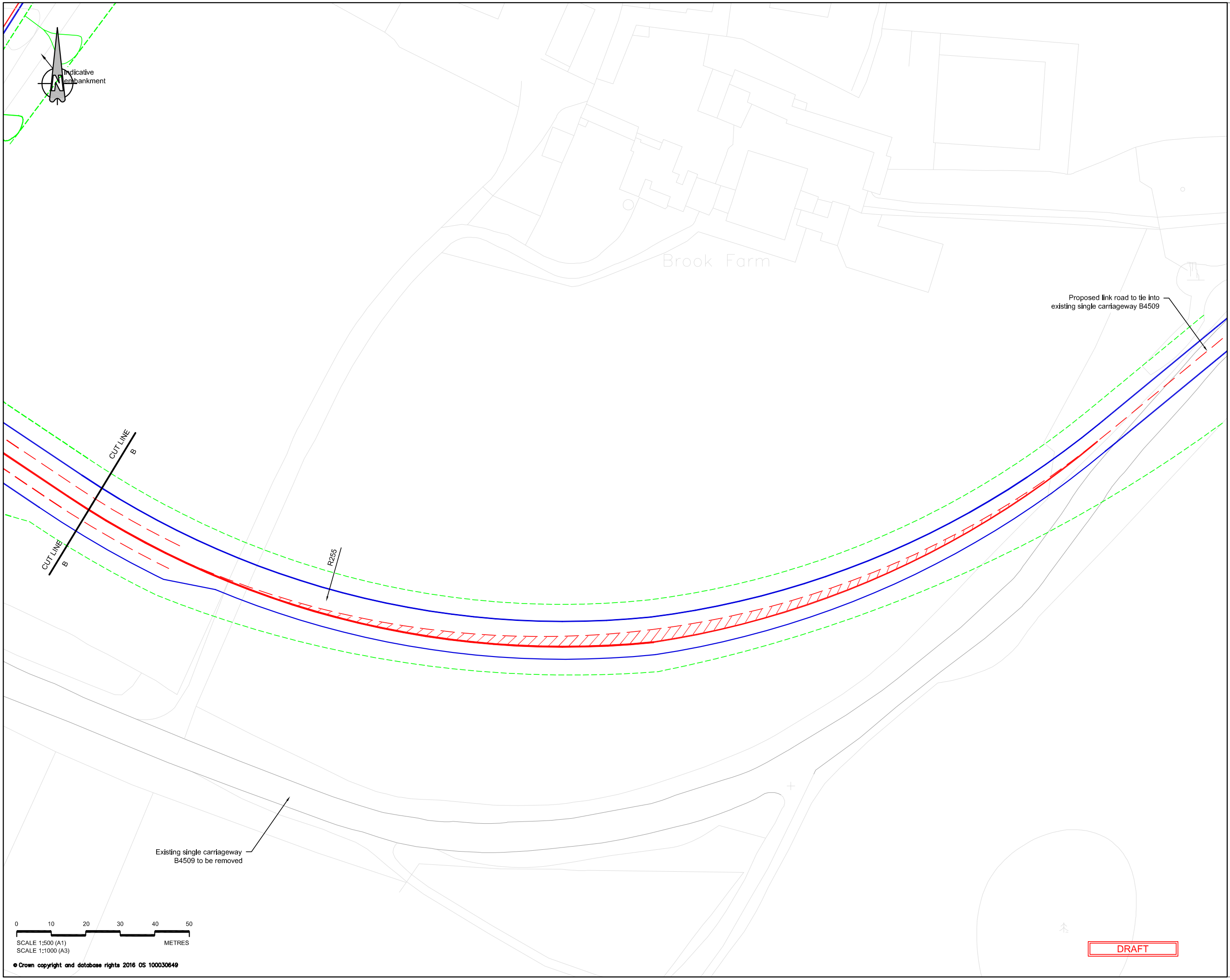
M5 J14 CONCEPT

Drawing

M5 J14
GRADE SEPARATED JUNCTION
OPTION 3

Drawn by: ADS	Date: 24/11/2016	
Checked by: LT	Date: 06/12/2016	
Approved by: LT	Date: 06/12/2016	
Drawing No. 679475.ST.16.14.05-OP3-02	Revision -	

Drawing Scale: 1:500 @ A1



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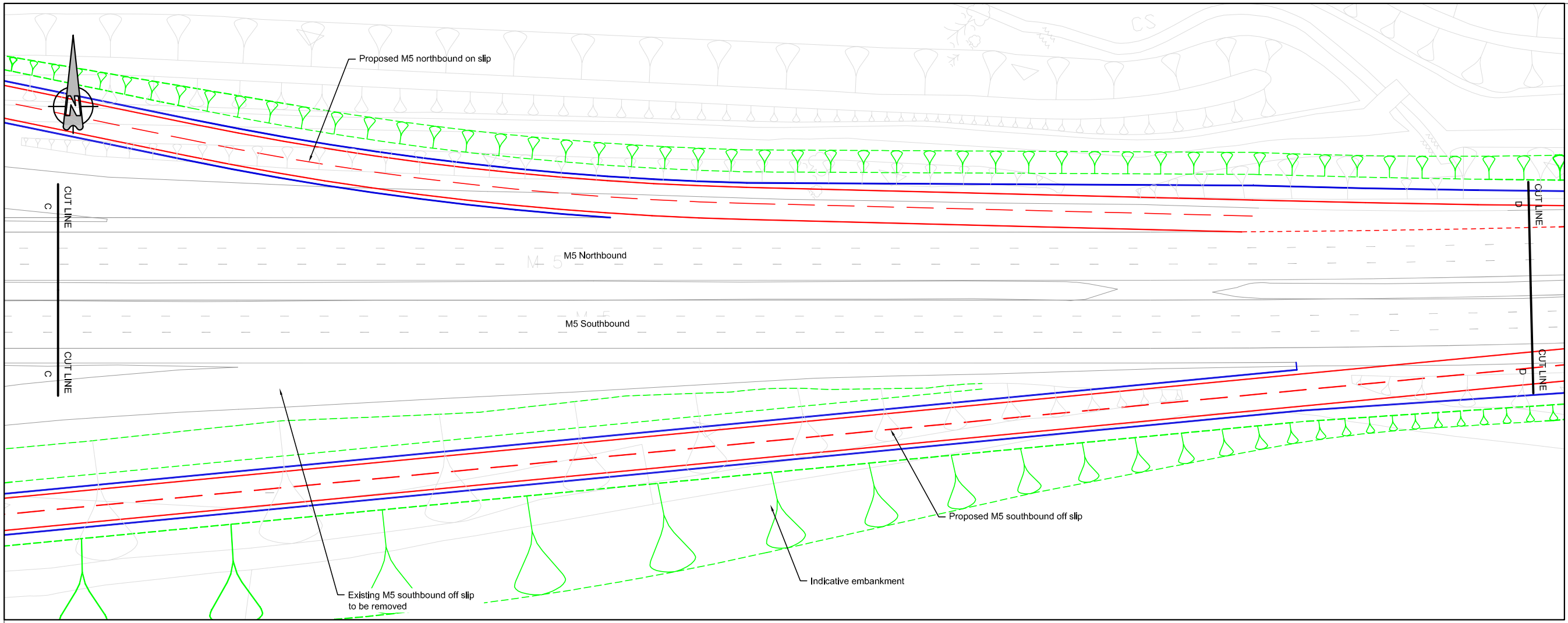
M5 J14 CONCEPT

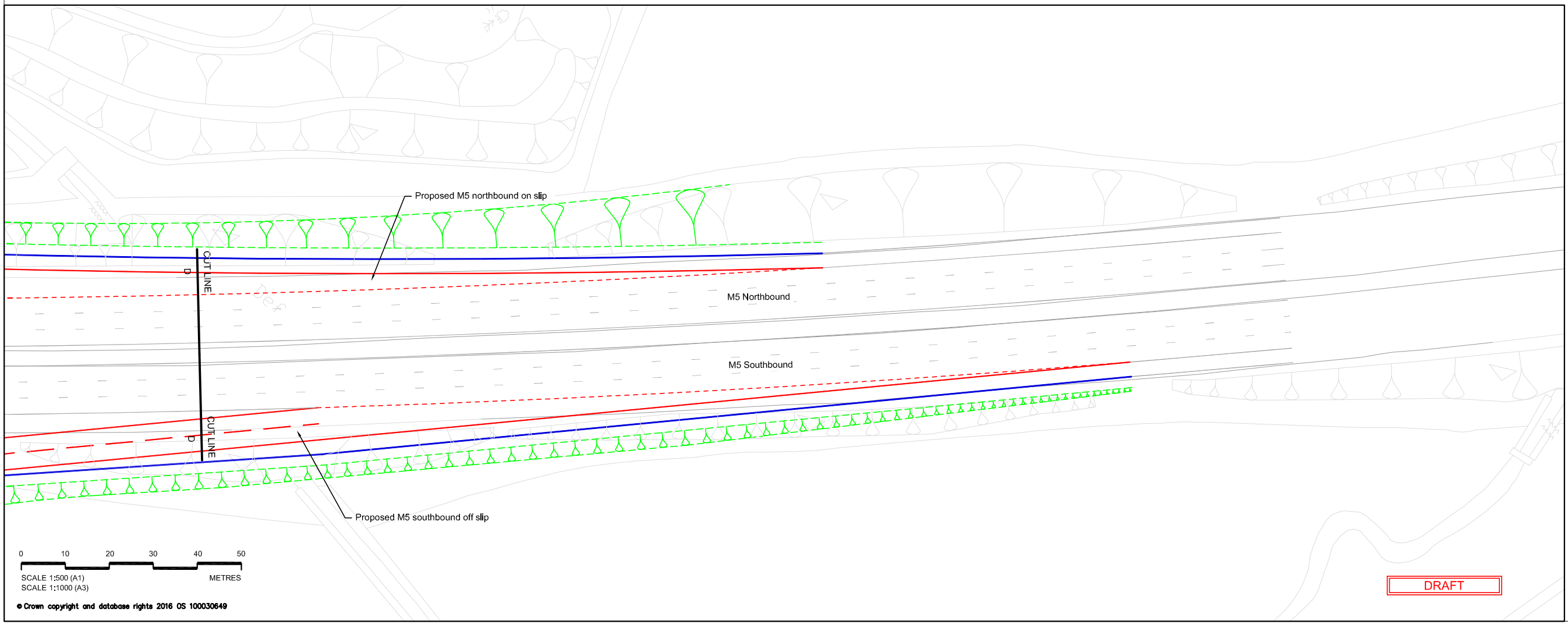
Drawing

M5 J14
GRADE SEPARATED JUNCTION
OPTION 3

Drawn by: ADS	Date: 24/11/2016
Checked by: LT	Date: 06/12/2016
Approved by: LT	Date: 06/12/2016
Drawing No. 679475.ST.16.14.05-OP3-03	Revision -

Drawing Scale: 1:500 @ A1





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Notes:

1. All dimensions are in metres unless noted otherwise.

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M5 J14 CONCEPT

Drawing

M5 J14
GRADE SEPARATED JUNCTION
OPTION 3

Drawn by: ADS	Date: 24/11/2016
Checked by: LT	Date: 06/12/2016
Approved by: LT	Date: 06/12/2016

Drawing No.	Revision
679475.ST.16.14.05-OP3-04	-

Drawing Scale: 1:500 @ A1

Appendix E
Forecast Queue Length Profiles

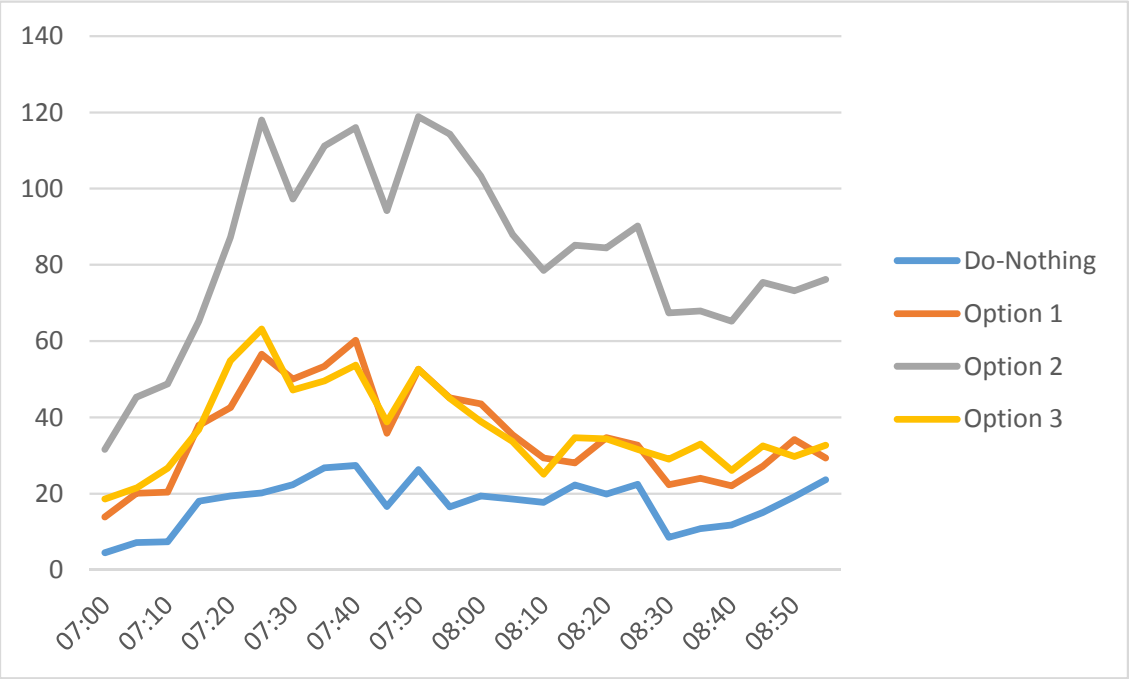


Figure E1: Max Queue Length (m) Comparison, M5 Junction 14, M5 Southbound Off-Slip, AM

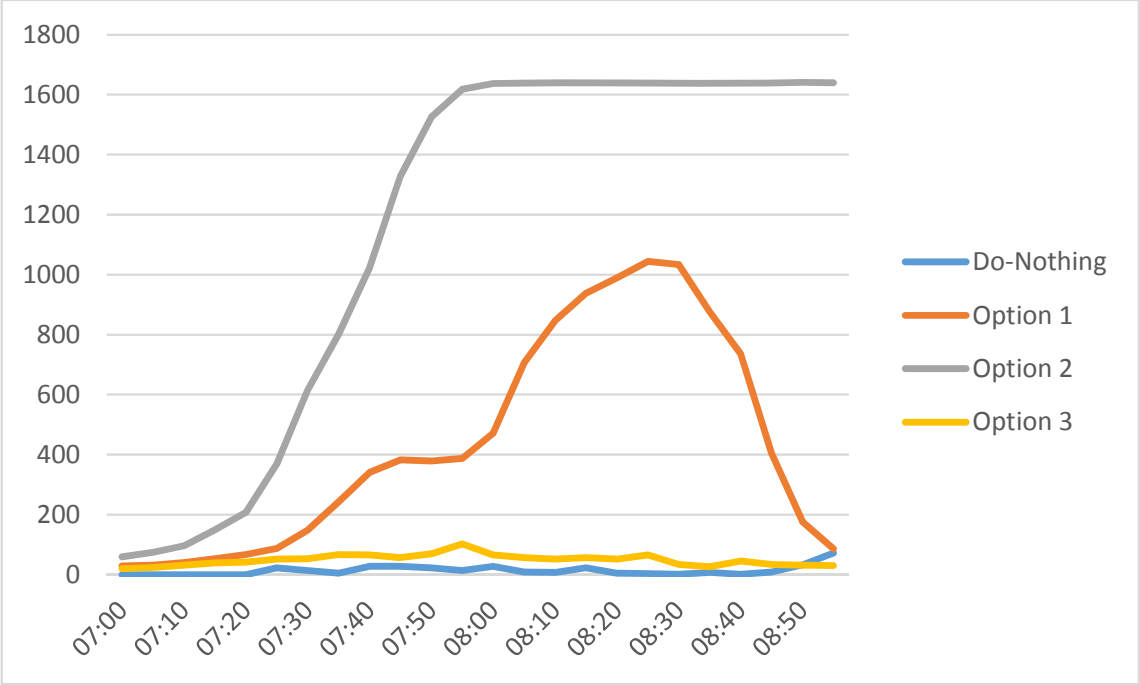


Figure E2: Max Queue Length (m) Comparison, M5 Junction 14, B4509 Westbound, AM

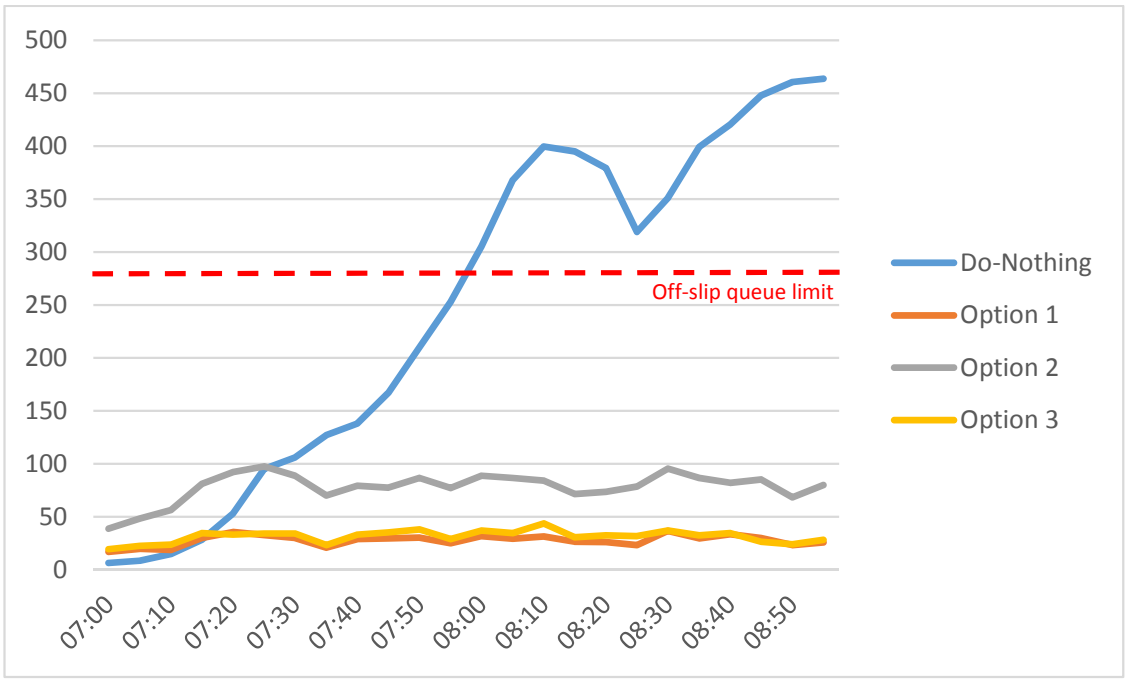


Figure E3: Max Queue Length (m) Comparison, M5 Junction 14, M5 Northbound Off-Slip, AM

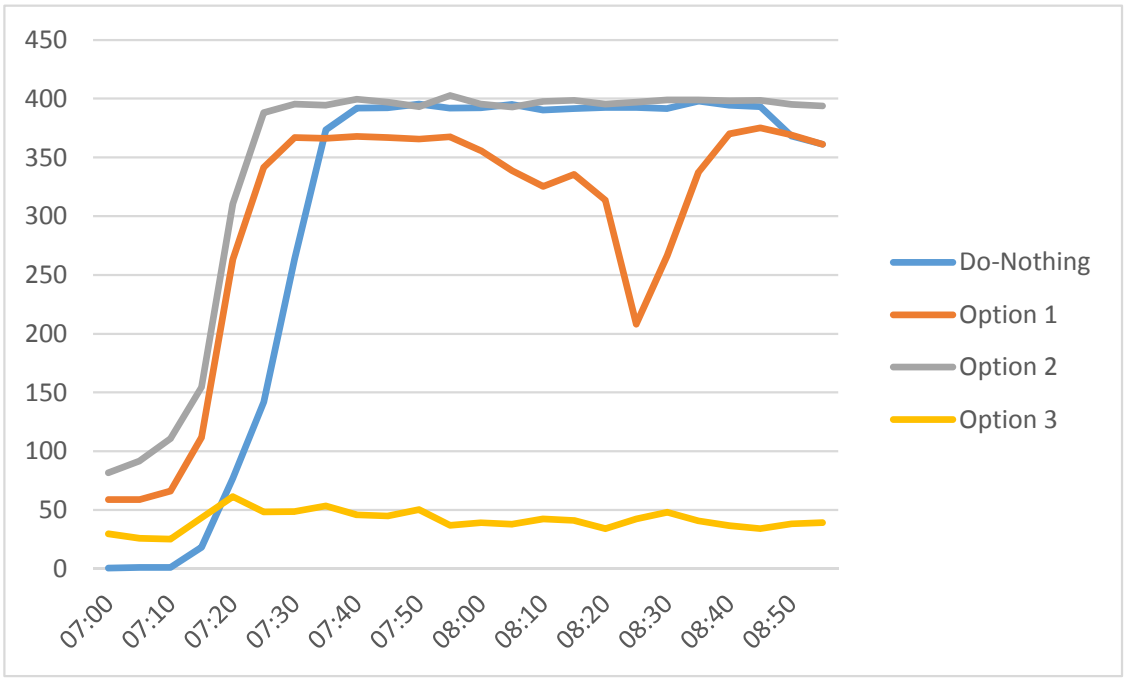


Figure E4: Max Queue Length (m) Comparison, M5 Junction 14, B4509 Eastbound, AM

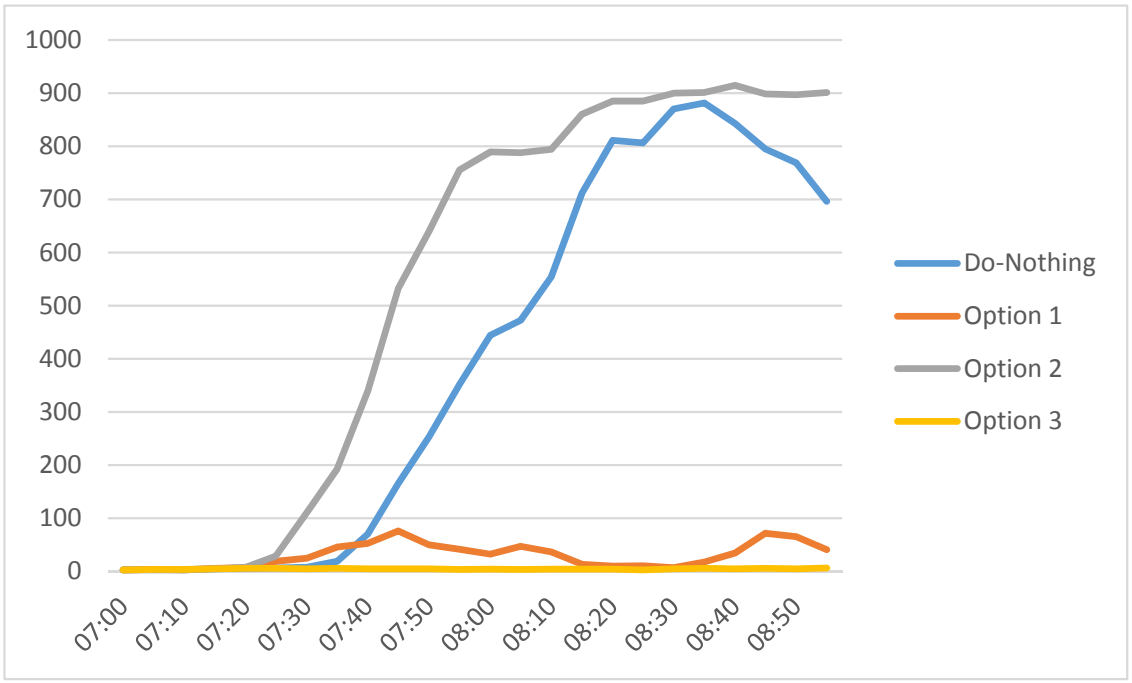


Figure E5: Max Queue Length (m) Comparison, A38/B4509, A38 s/b Left Turn, AM

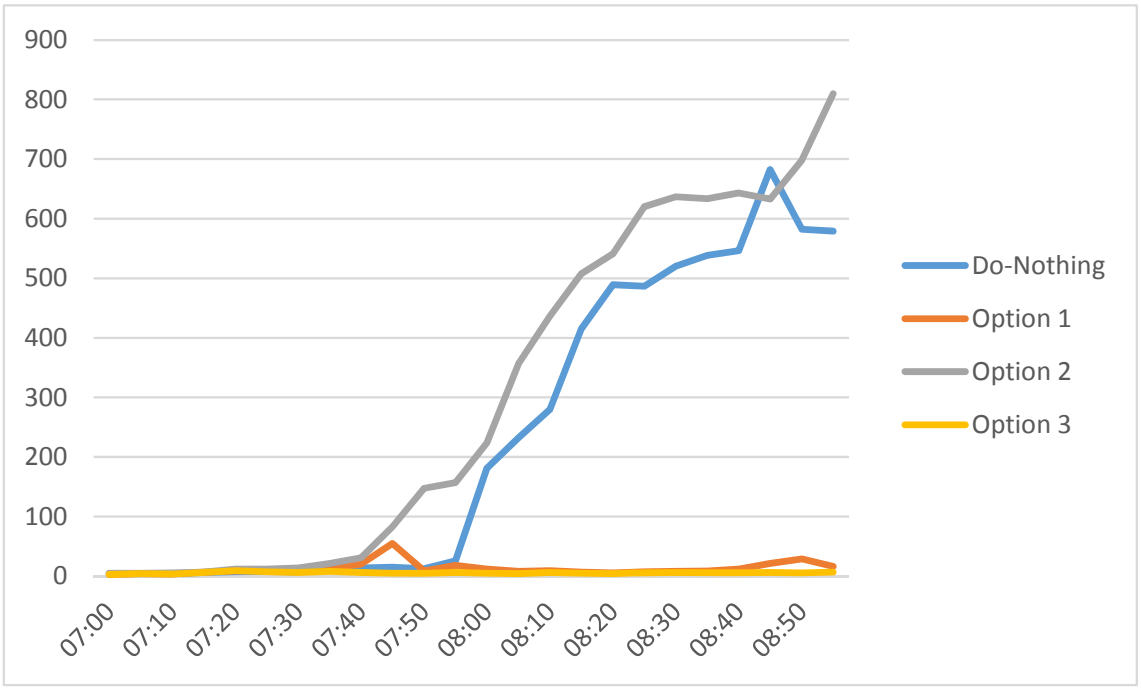


Figure E6: Max Queue Length (m) Comparison, A38/B4509, A38 s/b Ahead, AM

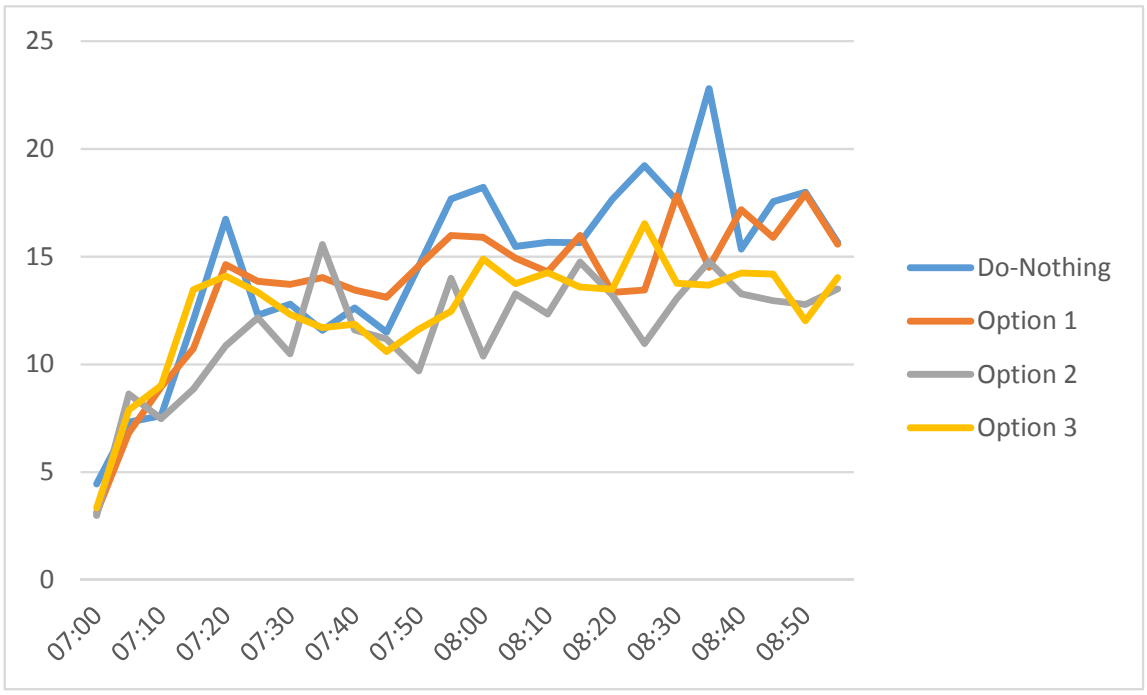


Figure E7: Max Queue Length (m) Comparison, A38/B4509, B4509 Approach, AM

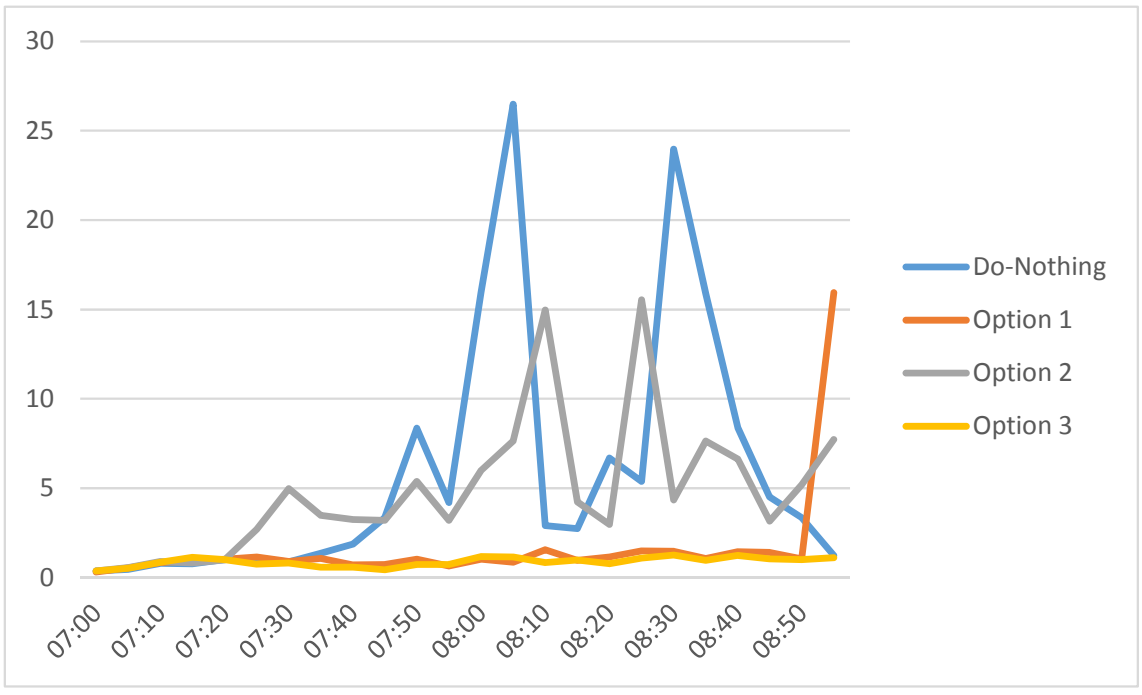


Figure E8: Max Queue Length (m) Comparison, A38/B4509, A38 n/b Ahead, AM

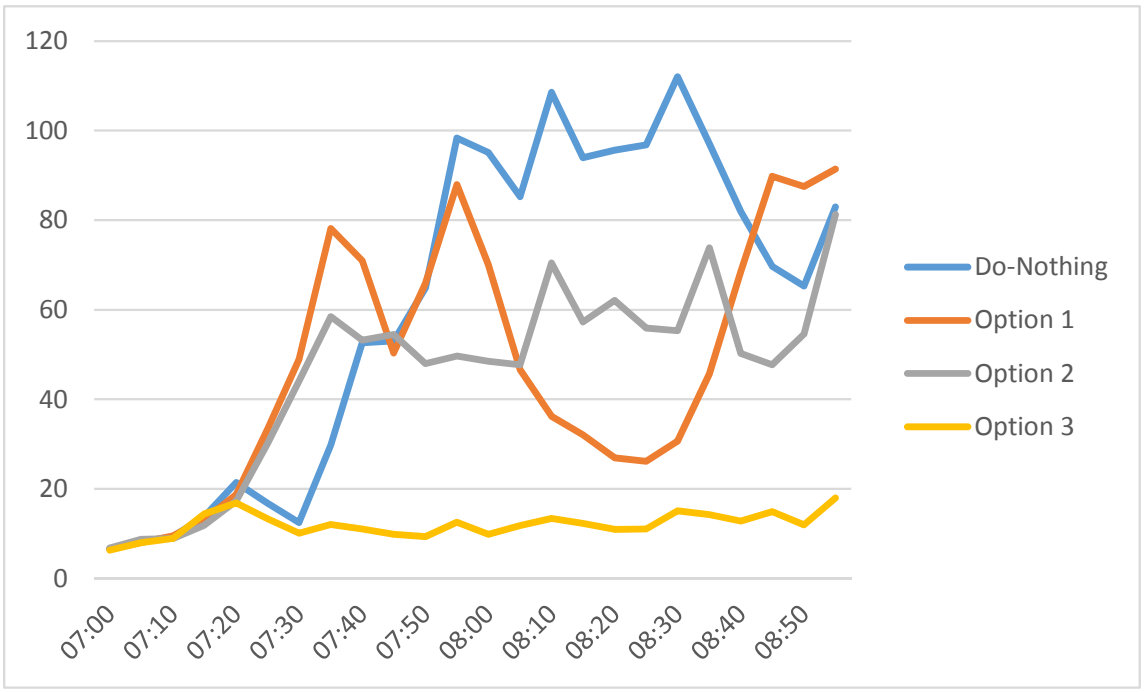


Figure E9: Max Queue Length (m) Comparison, A38/B4509, A38 n/b Right Turn, AM

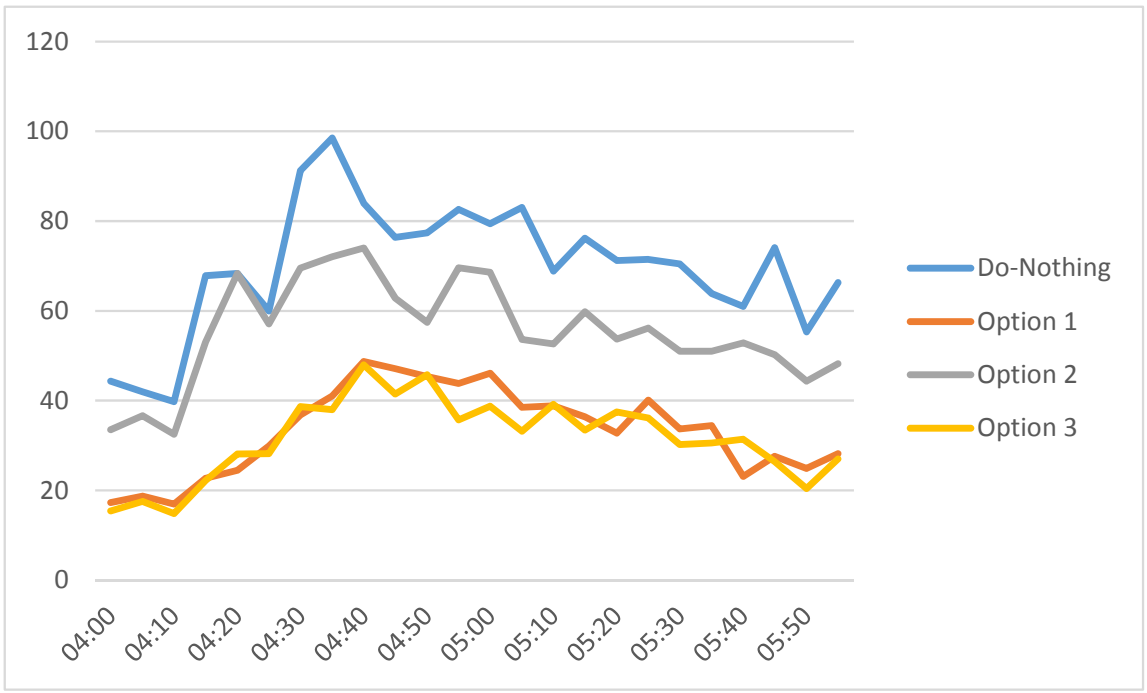


Figure E10: Max Queue Length (m) Comparison, M5 Junction 14, M5 Southbound Off-Slip, PM

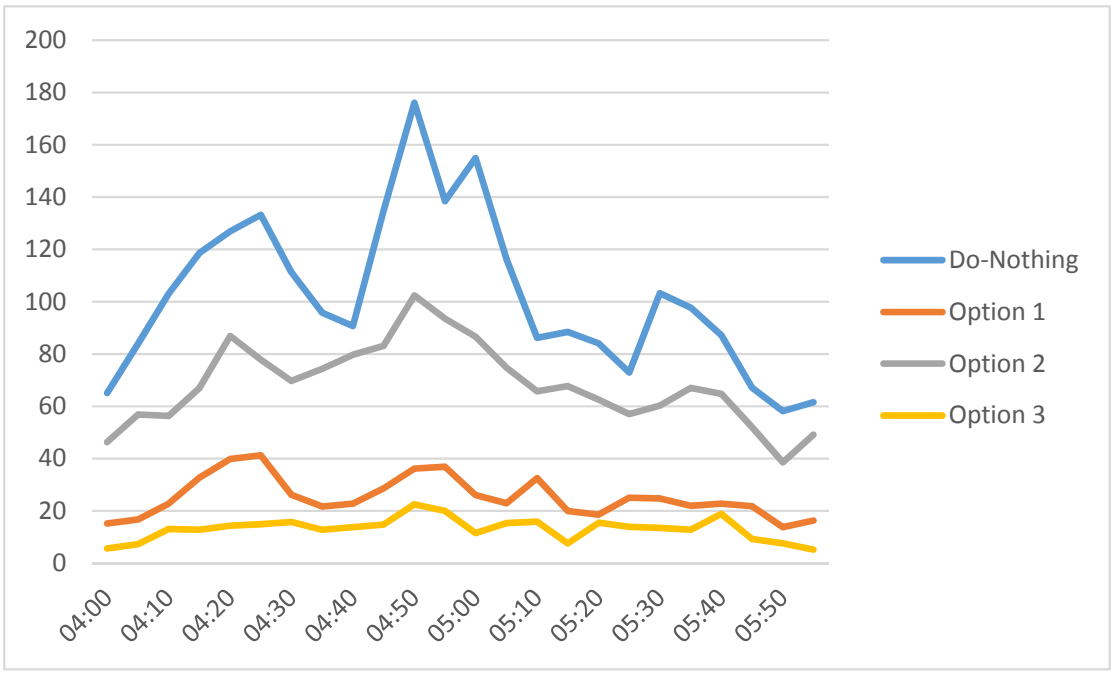


Figure E11: Max Queue Length (m) Comparison, M5 Junction 14, B4509 Westbound, PM

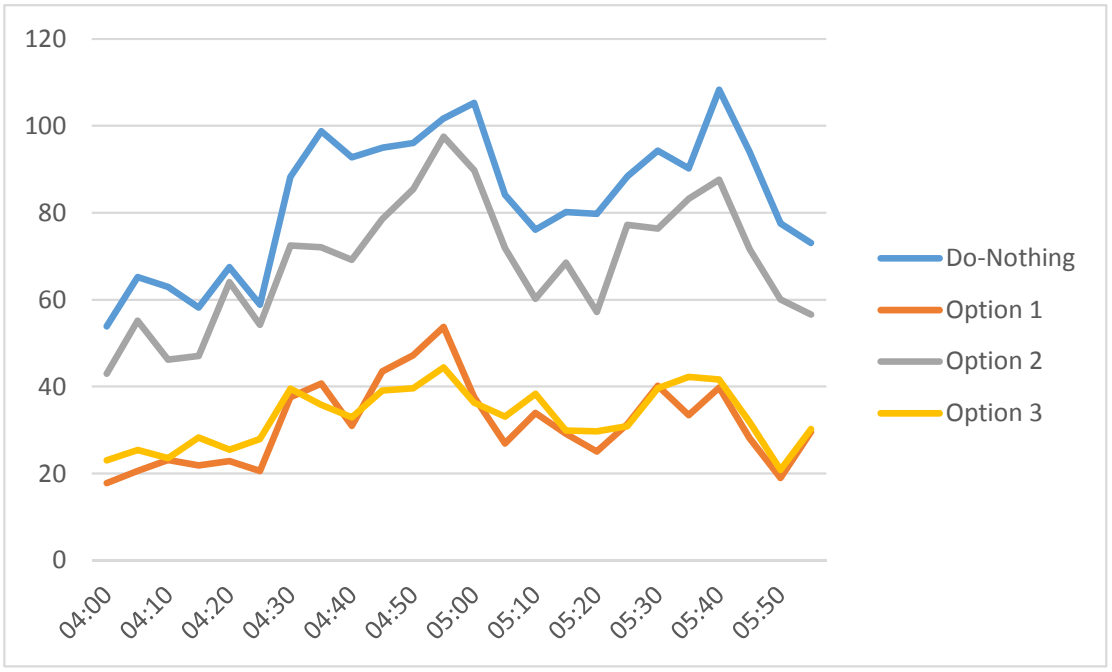


Figure E12: Max Queue Length (m) Comparison, M5 Junction 14, M5 Northbound Off-Slip, PM

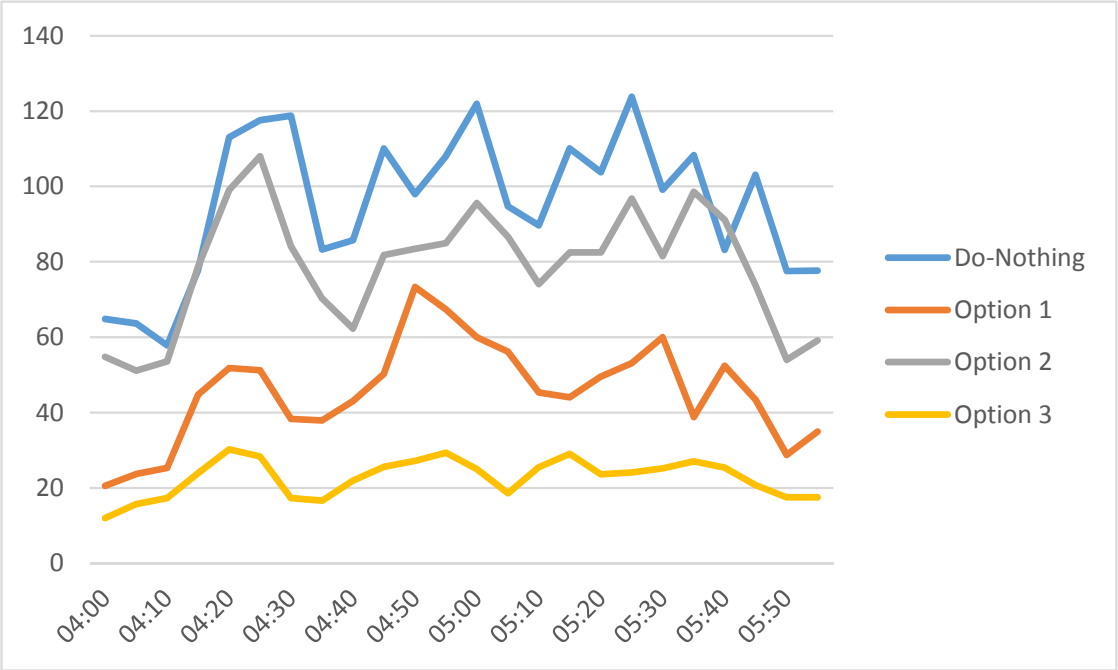


Figure E13: Max Queue Length (m) Comparison, M5 Junction 14, B4509 Eastbound, PM

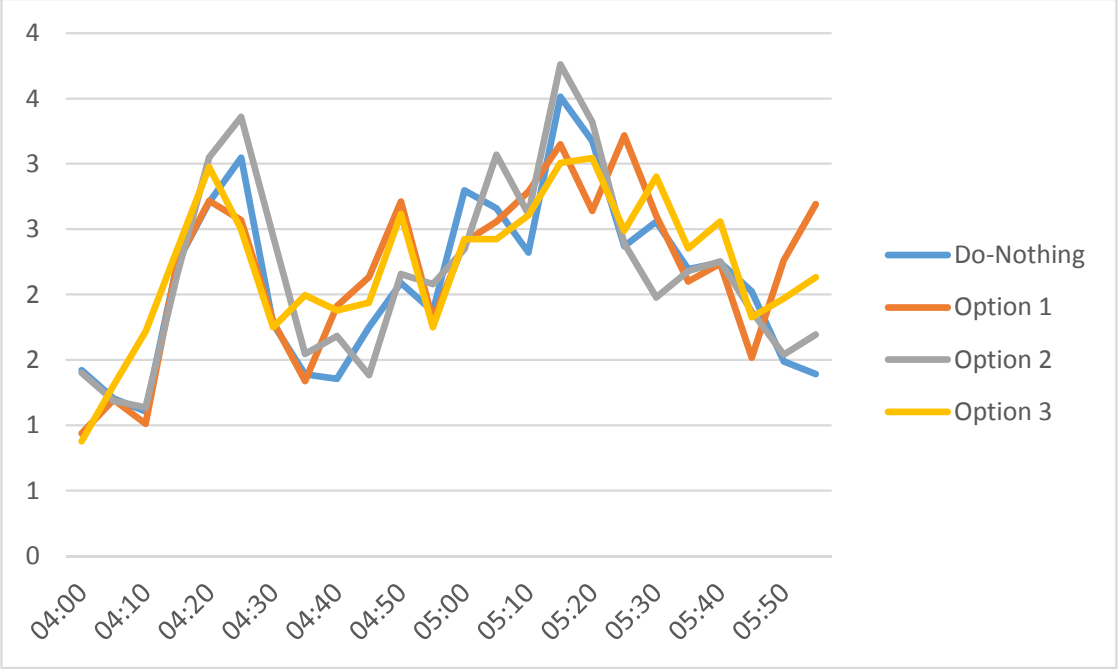


Figure E14: Max Queue Length (m) Comparison, A38/B4509, A38 s/b Left Turn, PM

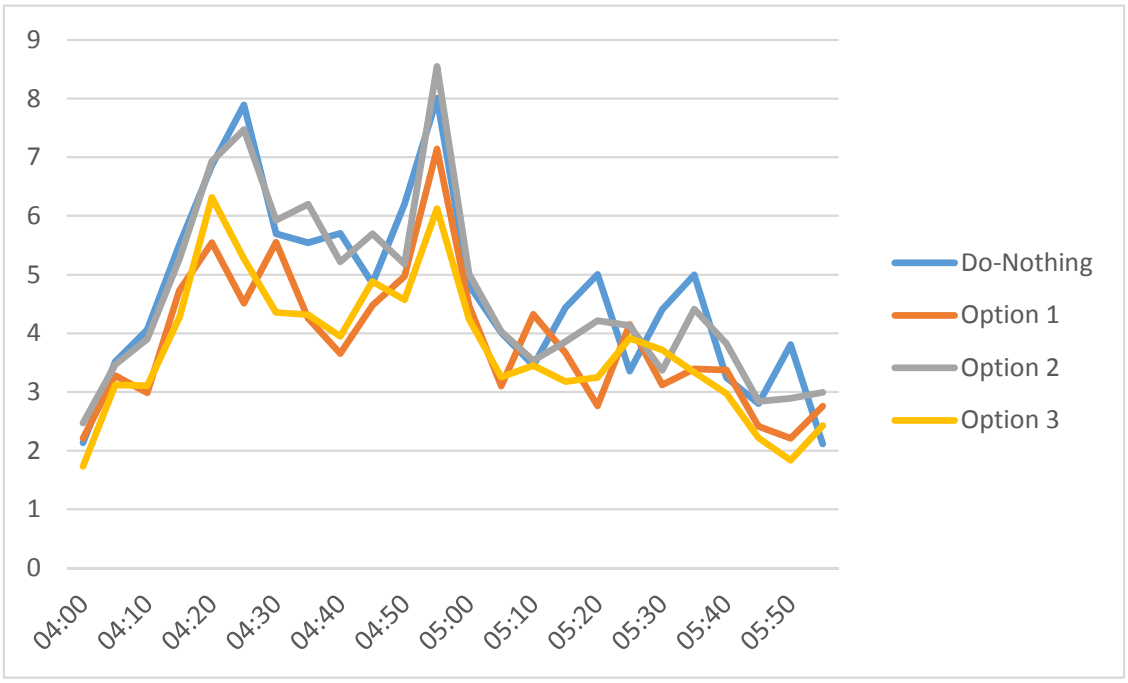


Figure E15: Max Queue Length (m) Comparison, A38/B4509, A38 s/b Ahead, PM

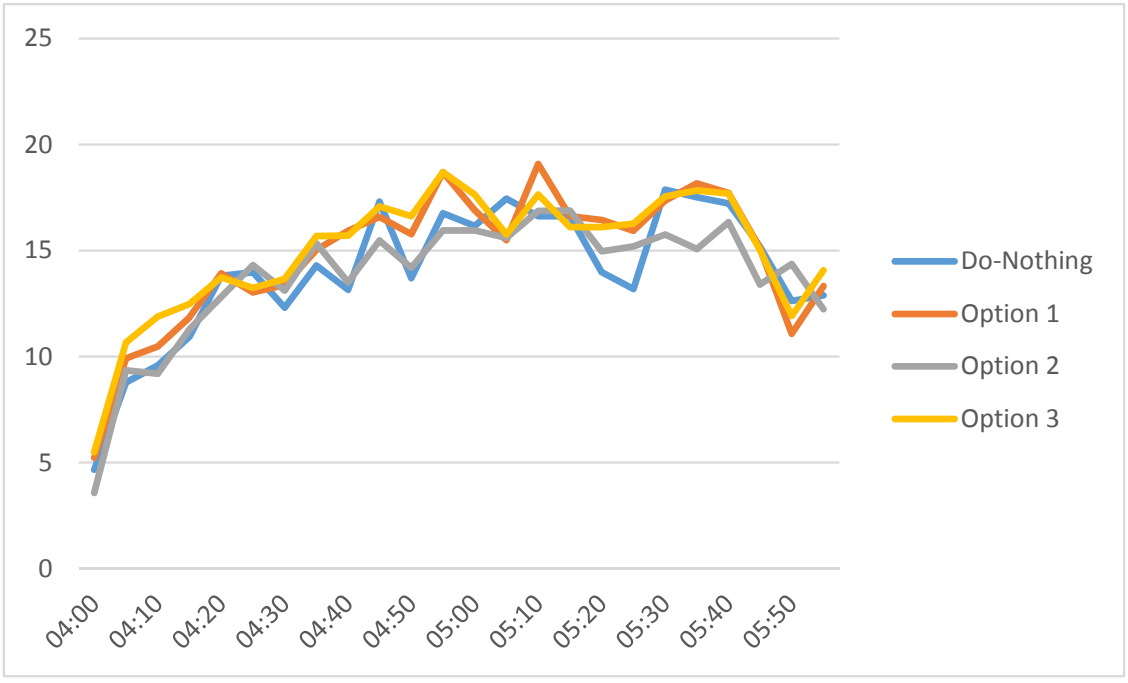


Figure E16: Max Queue Length (m) Comparison, A38/B4509, B4509 Approach, PM

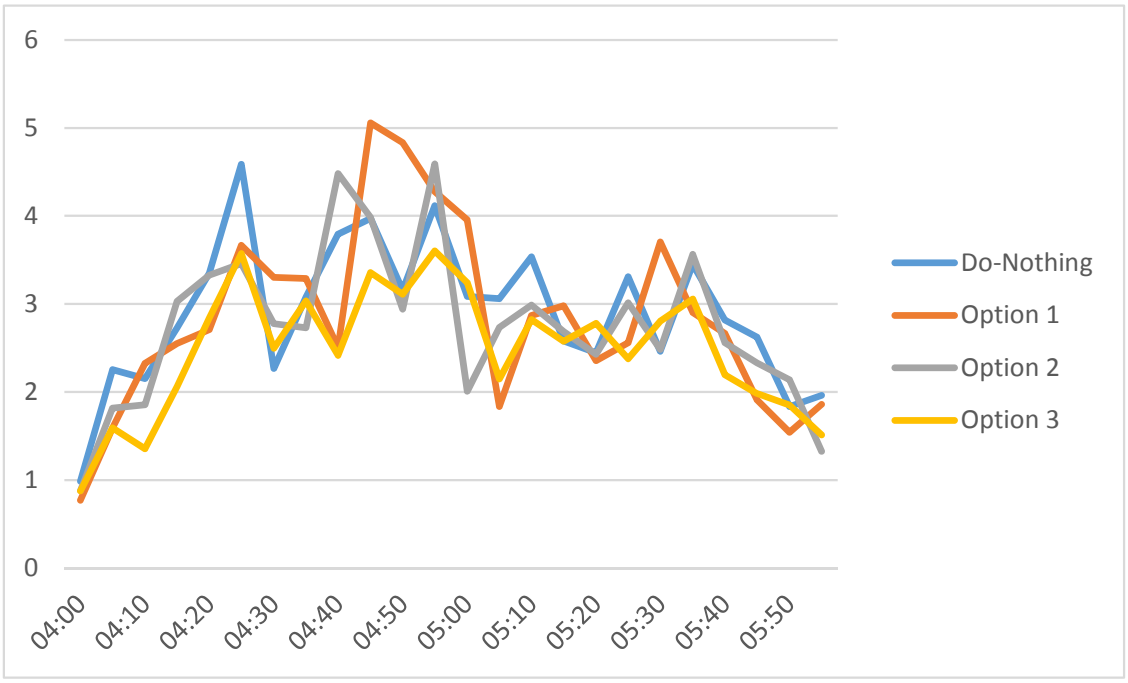


Figure E17: Max Queue Length (m) Comparison, A38/B4509, A38 n/b Ahead, PM

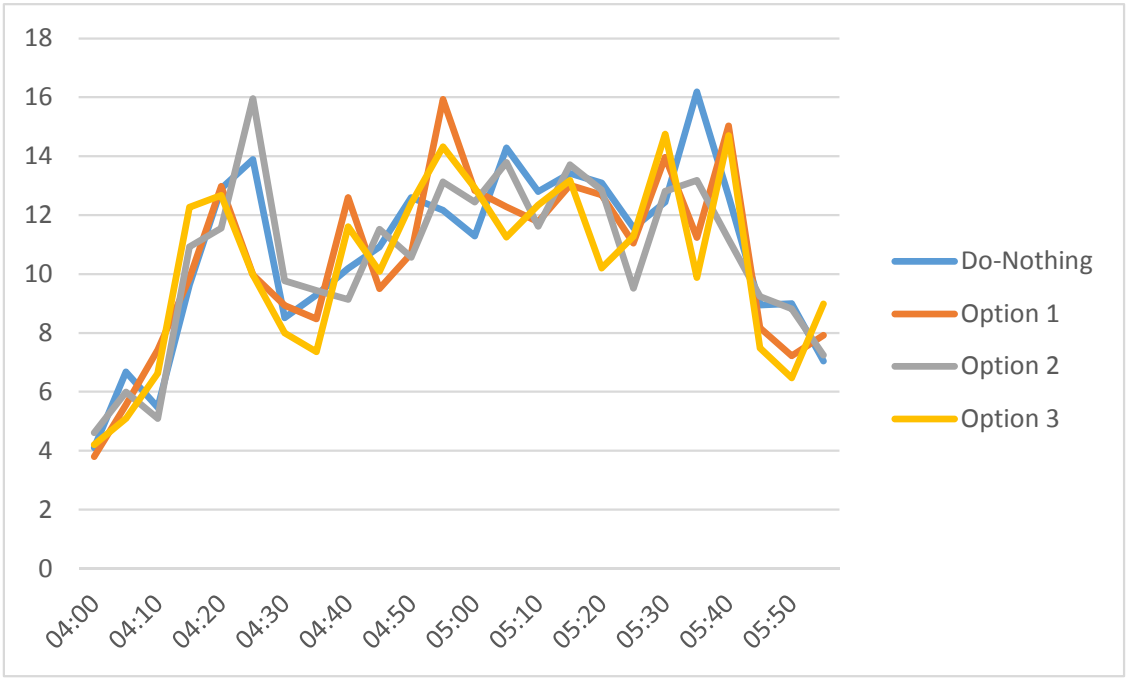
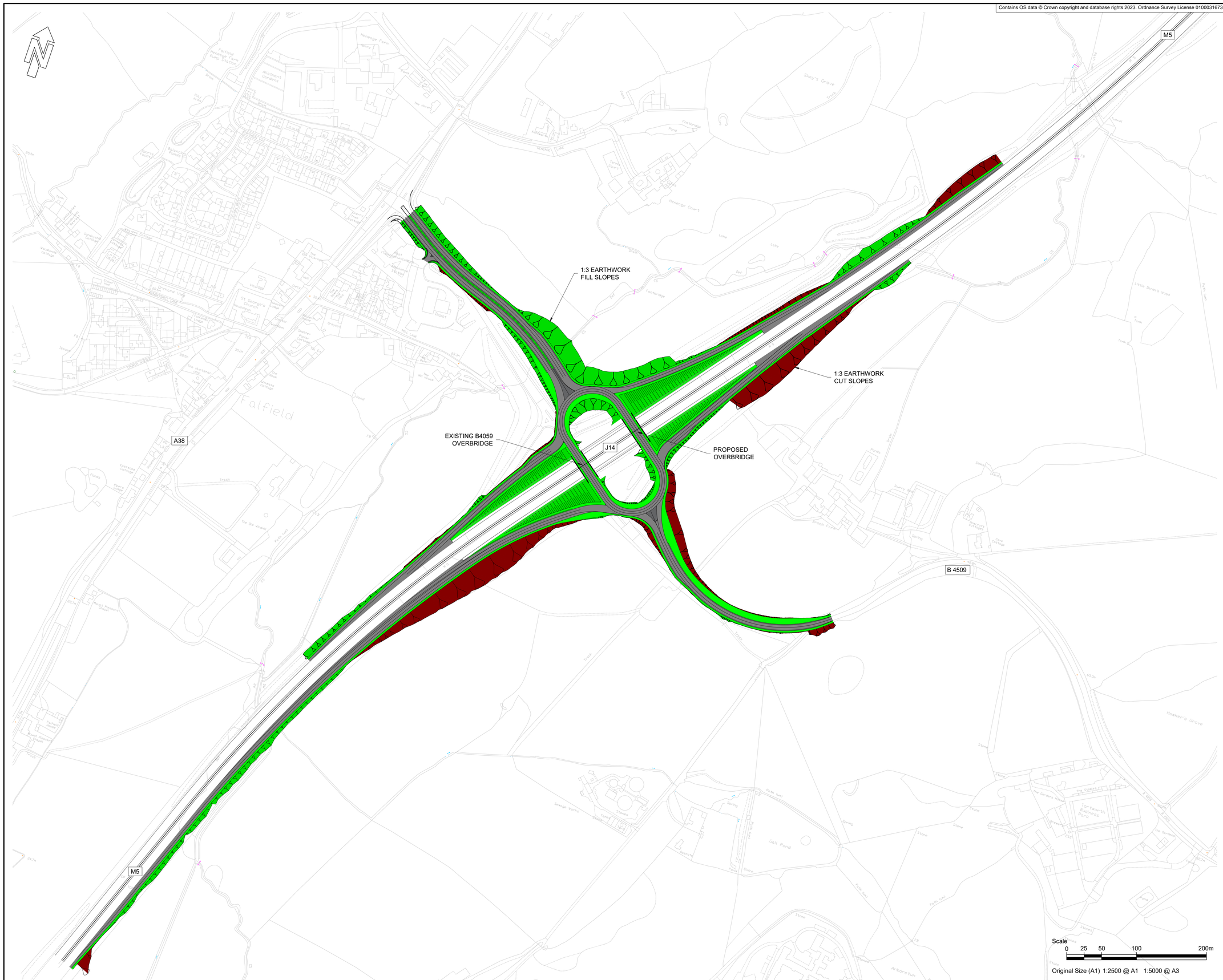


Figure E18: Max Queue Length (m) Comparison, A38/B4509, A38 n/b Right Turn, PM

Appendix C – General Arrangement of M5 Junction 14 Improvement Scheme



AECOM

PROJECT

M5 Junction 14
Improvement Scheme

CLIENT

Stroud District Council

CONSULTANT

AECOM
PORTWALL PLACE
PORTWALL LANE
BRISTOL, BS1 6NA, UK
Tel: +44 (0)117 315 0700
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NOTES

LEGEND

- PROPOSED CARRIAGEWAY
- PROPOSED TRAFFIC ISLAND
- PROPOSED VERGE
- PROPOSED EMBANKMENT
- PROPOSED EMBANKMENT BETWEEN VERGES
- PROPOSED CUTTING
- CHAINAGE

SUITABILITY

S0 WORK IN PROGRESS

ISSUE/REVISION

P03	06/09/2024	DESIGN UPDATE
P02	08/08/2024	DESIGN UPDATE
P01	30/05/2024	FIRST ISSUE
I/R	DATE	DESCRIPTION

FOR CONSULTATION

PROJECT NUMBER

60598598

SHEET TITLE

GRADE SEPARATED JUNCTION

GENERAL ARRANGEMENT

SHEET NUMBER

60598598-ACM-ZZ-DR-ZZ-00-00-0101

Filename: \\NA.AECOMNET.COM\LFS\EMEA\CARDIFF-UKCDF1\LEGACY\UKCDF1FP002\UKCDF1FP002-V1TP\PROJECTS\60598598 - STROUD LOCAL PLAN TA M5 JUNC 1415.0 CADD\5.3 DRAWINGS\SERIES 0100 - PRELIM\60598598-ACM-ZZ-DR-ZZ-00-00-0101.DWG
Last saved by: HATTONCM(2024-09-06) Last Plotted: 2024-09-06
Project Management Initials: Designer: CH Checked: DC Approved: CC ISO A1 594mm x 841mm

AECOM

PROJECT

M5 Junction 14 Improvement Scheme

CLIENT

Stroud District Council

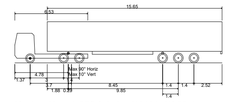
CONSULTANT

AECOM
PORTWALL PLACE
PORTWALL LANE
BRISTOL, BS1 6NA, UK
Tel: +44 (0)117 315 0700
www.aecom.com

NOTES

FOR CONSULTATION

LEGEND



Max Legal Length (UK) Articulated Vehicle (18.55m)

Overall Length	18.550m
Overall Width	2.550m
Overall Body Height	3.681m
Min Body Ground Clearance	0.411m
Max Track Width	2.500m
Lock to lock time	6.00s
Kerb to Kerb Turning Radius	6.530m

Wheels path
Body path

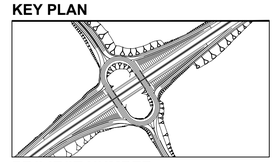
SUITABILITY

S0 WORK IN PROGRESS

ISSUE/REVISION

I/R	DATE	DESCRIPTION
P02	06/09/2024	DESIGN UPDATE
P01	26/07/2024	FIRST ISSUE

KEY PLAN



PROJECT NUMBER

60598598

SHEET TITLE

GRADE SEPARATED JUNCTION HGV TRACKING

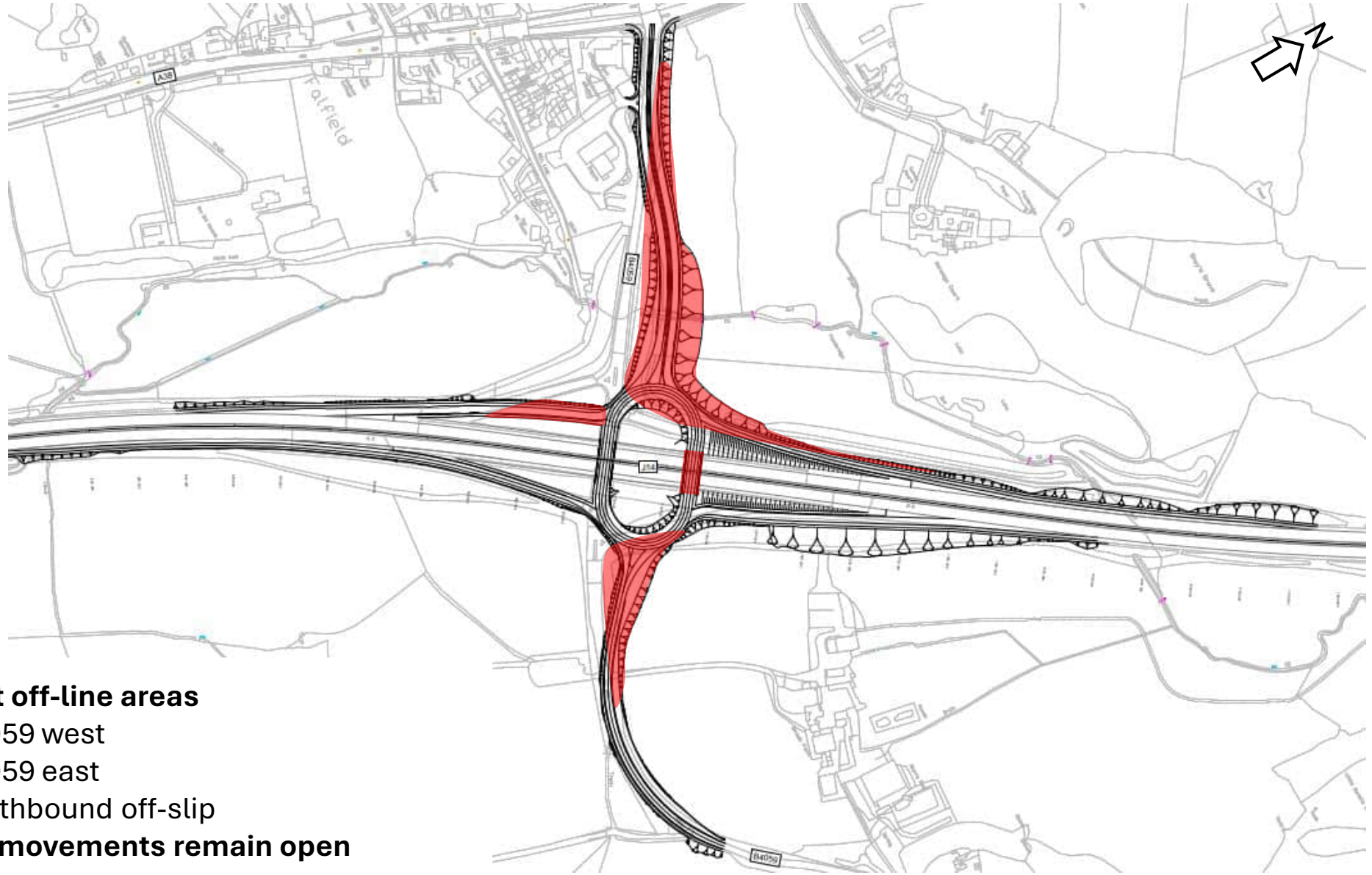
SHEET NUMBER

60598598-ACM-ZZ-DR-ZZ-00-00-0110

Appendix D – Potential Construction Phasing

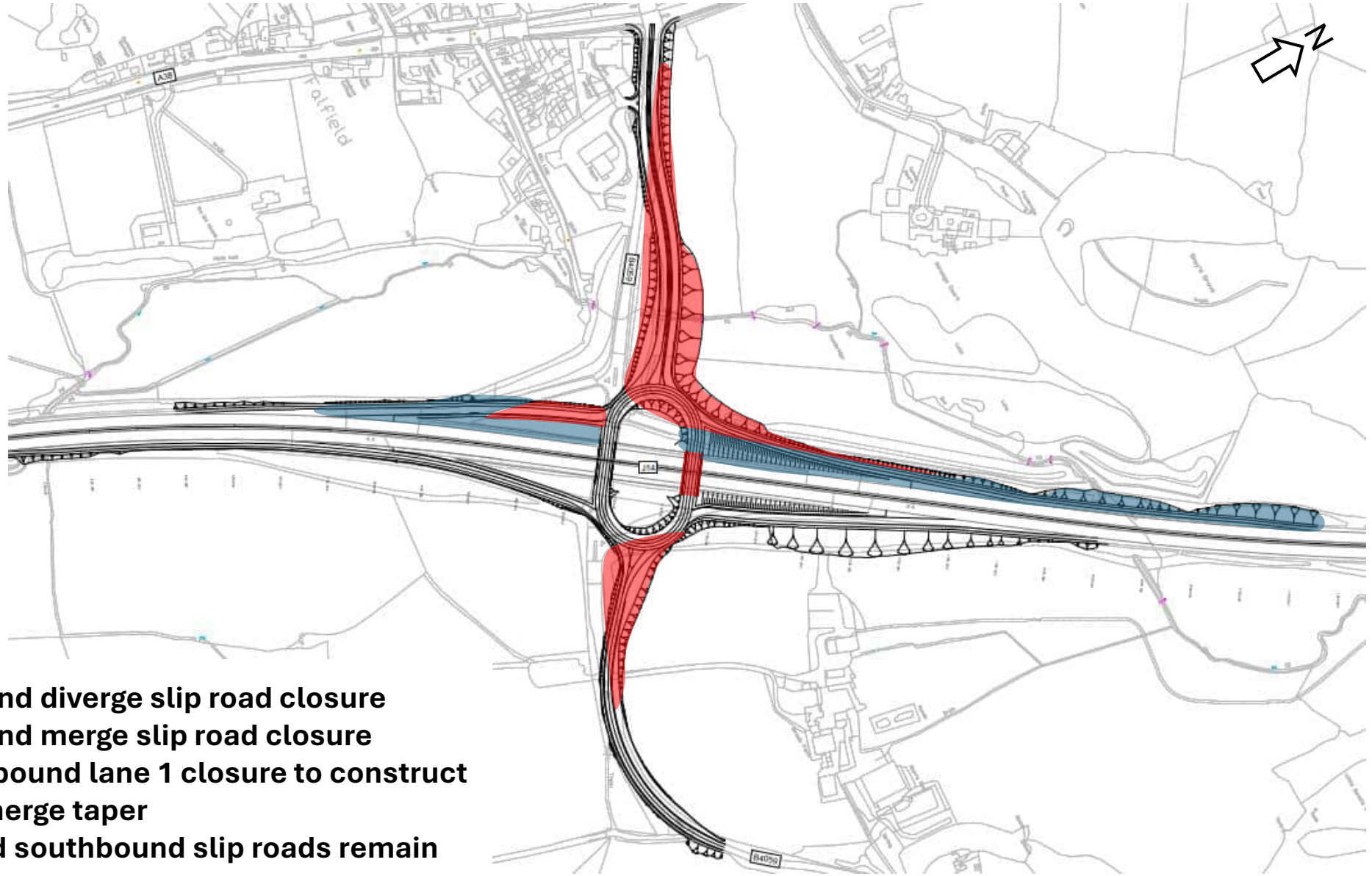
Possible Construction Phasing

Phase 1 – Off-line construction



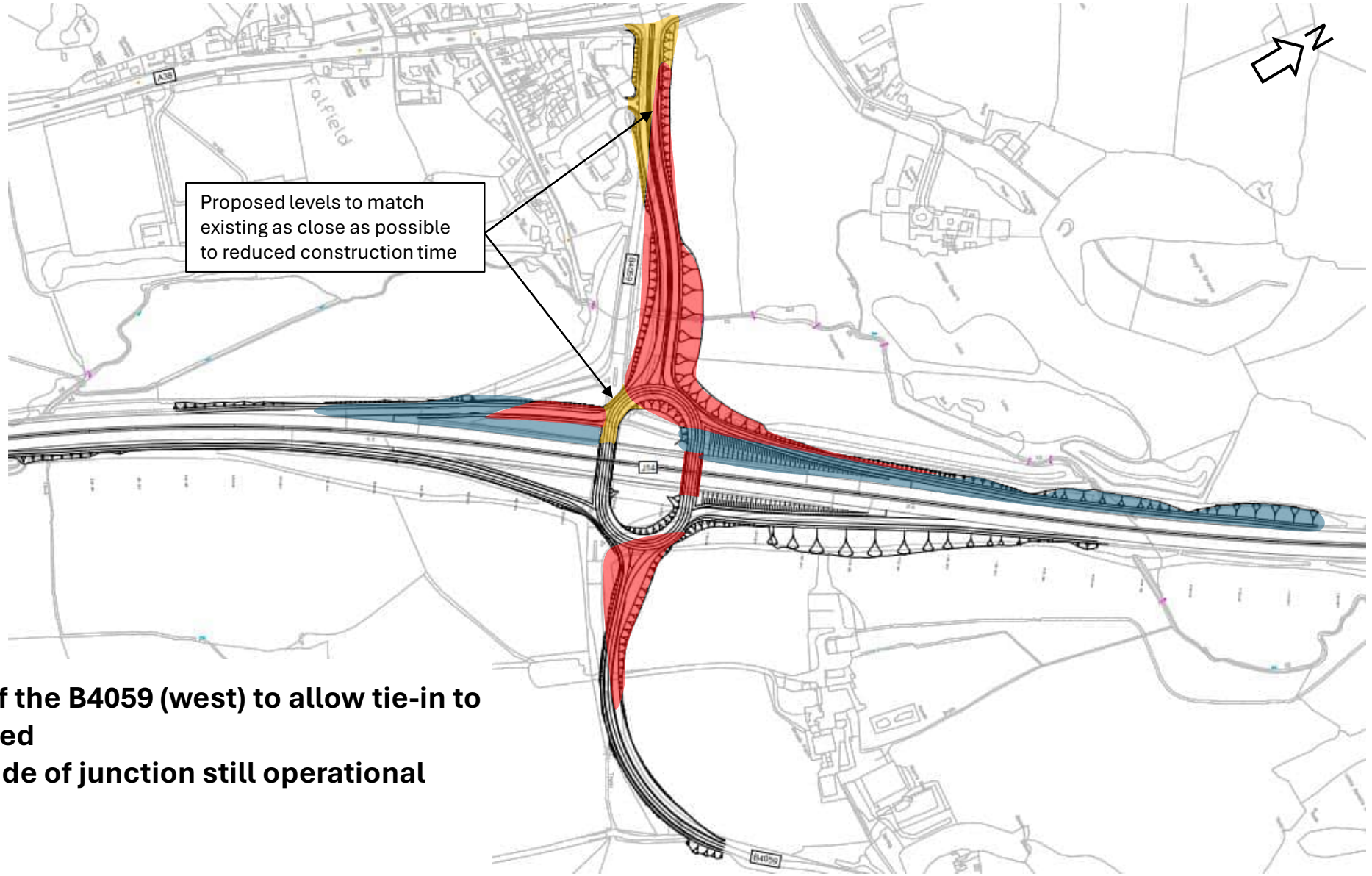
- **Construct off-line areas**
  - I. B4059 west
  - II. B4059 east
  - III. Northbound off-slip
- **All traffic movements remain open**

Phase 2 – Northbound slip road closures



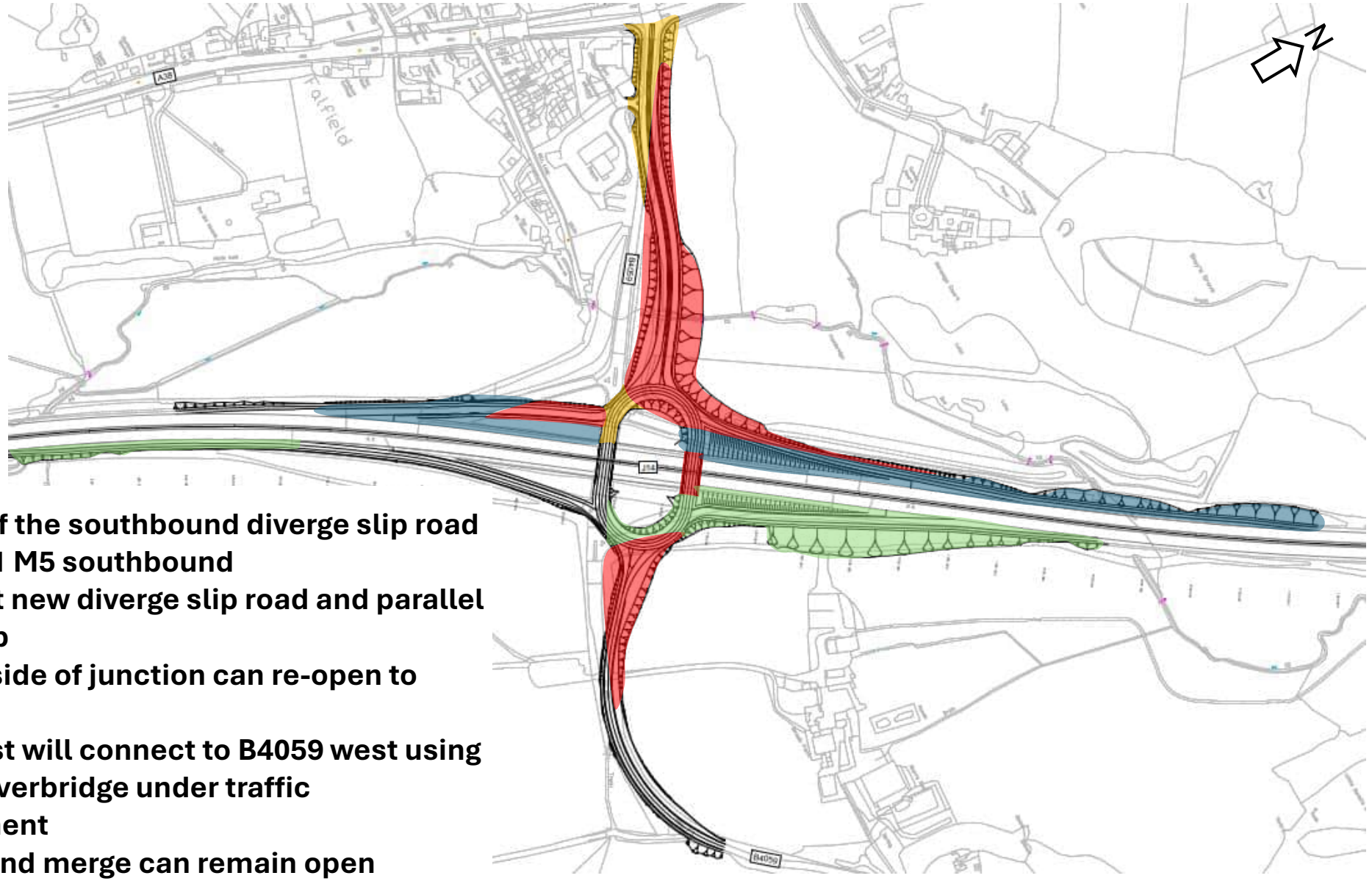
- Northbound diverge slip road closure
- Northbound merge slip road closure
- M5 Northbound lane 1 closure to construct parallel merge taper
- B4059 and southbound slip roads remain open

Phase 3 – Western tie-ins



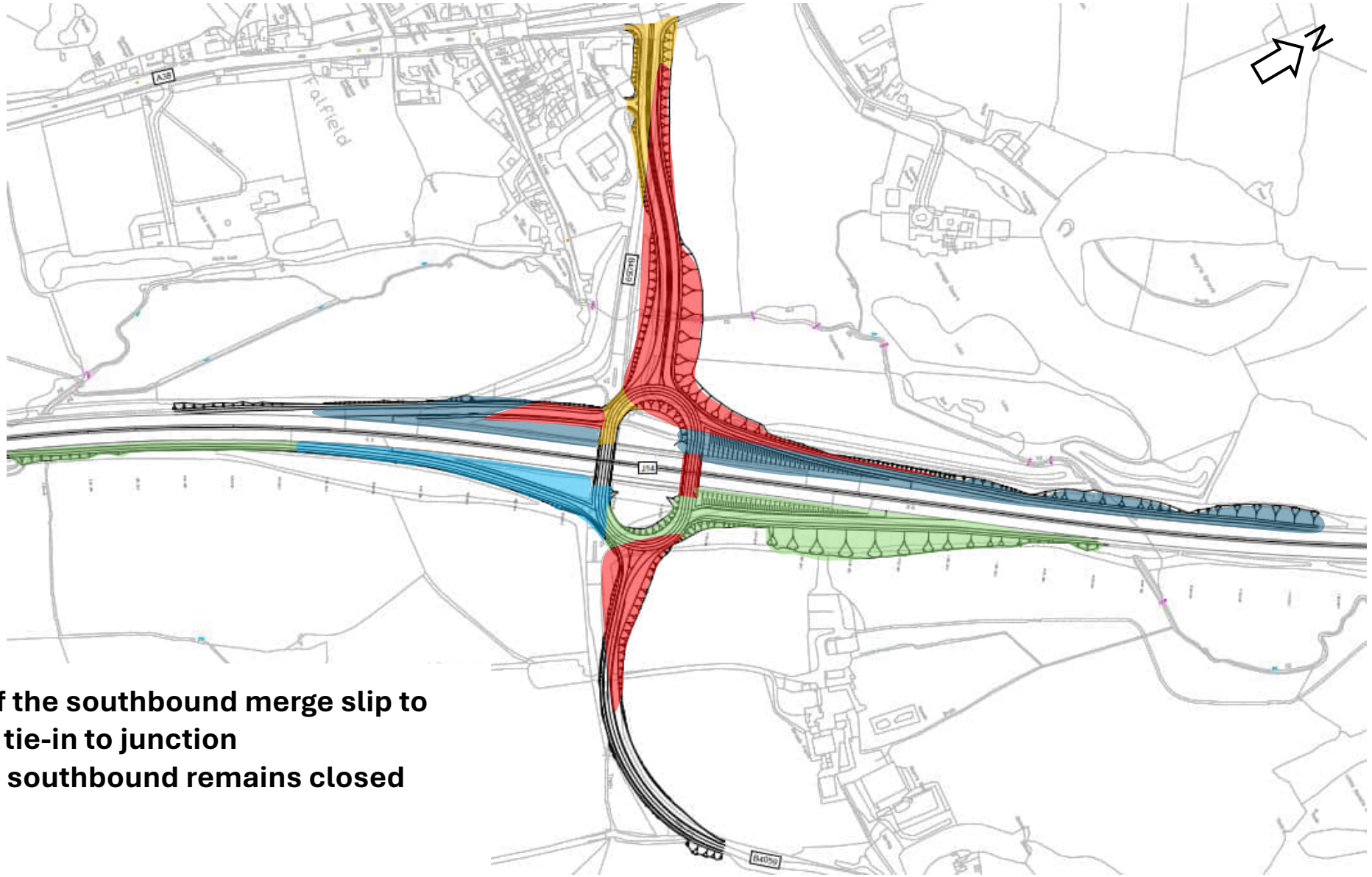
- **Closure of the B4059 (west) to allow tie-in to constructed**
- **Eastern side of junction still operational**

Phase 4 – Southbound diverge slip road closure



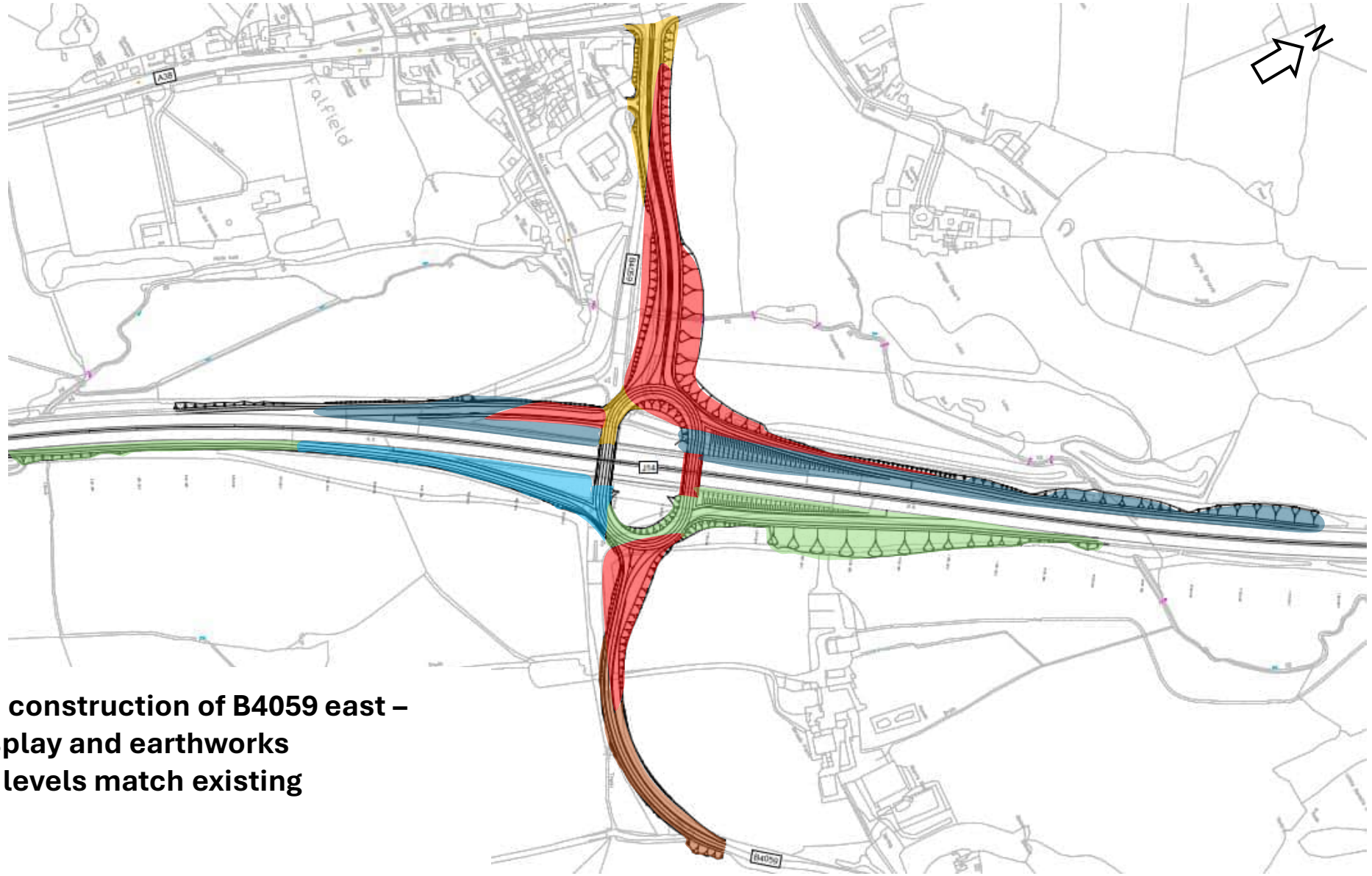
- Closure of the southbound diverge slip road and lane 1 M5 southbound
- Construct new diverge slip road and parallel merge slip
- Western side of junction can re-open to traffic
- B4059 east will connect to B4059 west using existing overbridge under traffic management
- Southbound merge can remain open

Phase 5 – Southbound merge slip road closure



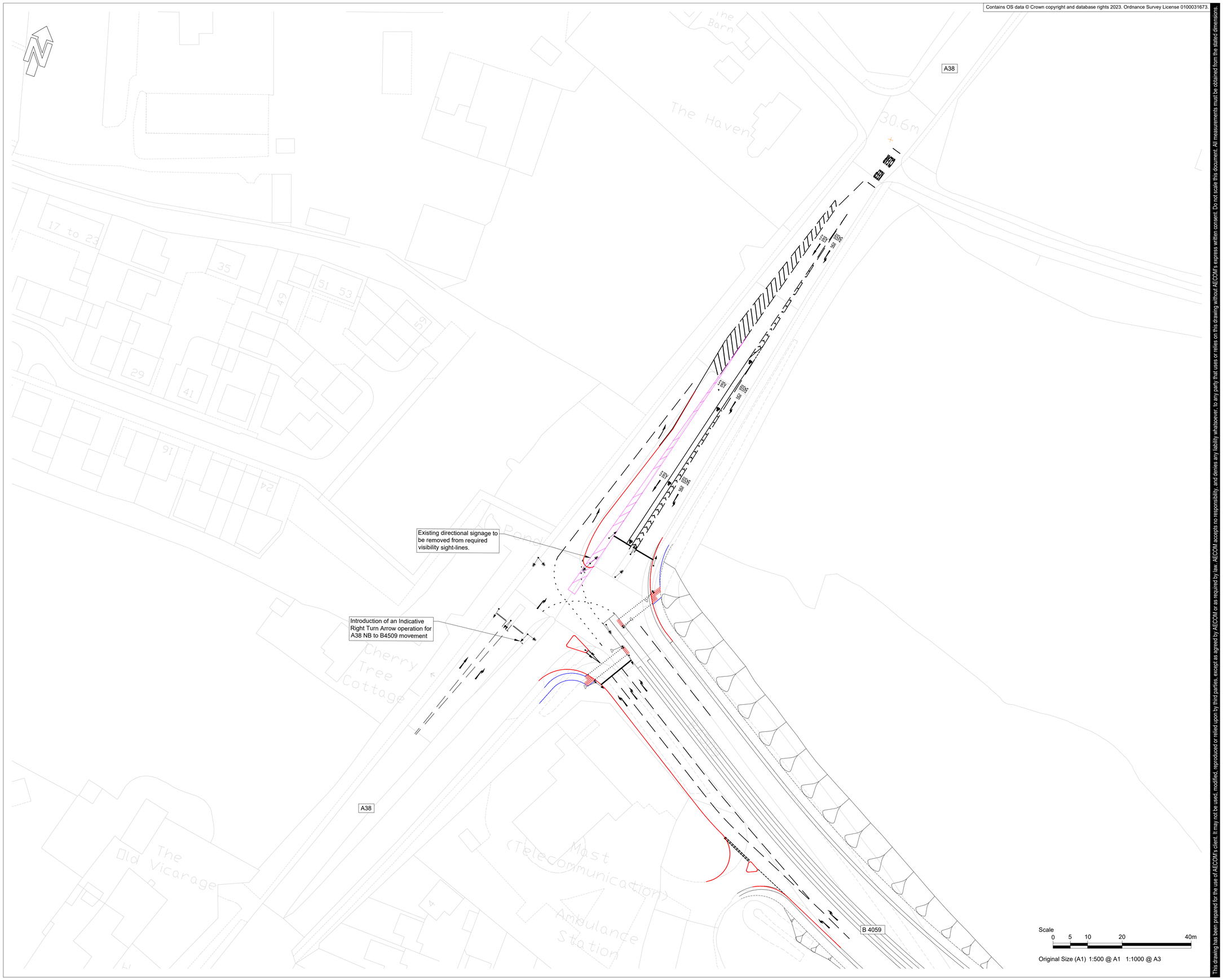
- Closure of the southbound merge slip to construct tie-in to junction
- Lane 1 M5 southbound remains closed

Phase 6 – B4059 east tie-in



- Complete construction of B4059 east – visibility splay and earthworks
- Proposed levels match existing

Appendix E – Concept Design of A38 / B4509 Junction Improvement Scheme



Scale
0 5 10 20 40m

Original Size (A1) 1:500 @ A1 1:1000 @ A3

AECOM

PROJECT

M5 Junction 14 Improvement Scheme

CLIENT

Stroud District Council

CONSULTANT

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PORTWALL PLACE
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NOTES

WORK IN PROGRESS

LEGEND

- PROPOSED ROAD MARKINGS
- NEW KERB LINES
- NEW FOOTWAY EDGING
- CONTROLLED TACTILE CROSSING
- CENTRAL RESERVE VISIBILITY SPLAY 2.4MX90M

SUITABILITY

S0 WORK IN PROGRESS

ISSUE/REVISION

I/R	DATE	DESCRIPTION
P01	30/08/2024	FIRST ISSUE

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60598598

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A38 JUNCTION DESIGN ALTERNATIVE OPTION

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60598598-ACM-ZZ-DR-ZZ-00-00-0112

ISO A1 594mm x 841mm
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Last saved by: HATTONCM(2024-08-30) Last Plotted: 2024-08-30

Appendix F – Micro-Simulation Modelling Report

M5 Junction 14 Improvement Scheme

Vissim Modelling - Stroud Local Plan Review

Stroud District Council

Project number: 60598598

September 2024

Delivering a better world

Quality information

Prepared by	Checked by	Verified by	Approved by
Daniel Brice Senior Consultant	Lee Marks Principal Consultant	James Gait Regional Director	Chris Carter Regional Director

Revision History

Revision	Revision date	Details	Authorized	Name	Position
V1	09/09/2024	First Issue	CC	Chris Carter	Regional Director

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Table of Contents

Figures

Tables

1. Introduction

AECOM has undertaken Vissim modelling associated with the potential upgrade of M5 Junction 14 (J14) to accommodate future traffic growth up to 2040. This modelling is part of a wider commission from Stroud District Council (SDC) in relation to the upcoming SDC Local Plan Review (LPR).

Previously, a 'proof of concept' traffic model was developed using ARCADY to assess proposed junction changes at M5 J14 in anticipation of 2040 traffic growth. Building on this foundation, this Technical Note presents more detailed operational microsimulation modelling conducted with Vissim 2021-01 (SP01) to illustrate the impacts of the scheme.

The M5 J14 is located near Falfield, South Gloucestershire and is used to access the B4509 towards Dursley and A38 towards Falfield and Thornbury. The existing layout of the M5 J14 consists of two priority junctions, with part-time traffic signal operation occurring in the PM peak period.

2. Modelling Purpose

National Highways, a government-owned company, is responsible for operating, maintaining, and improving the Strategic Road Network (SRN). As a statutory consultee for the SDC Local Plan process, National Highways requires the applicant/authority (i.e., SDC) to conduct operational modelling. This modelling assesses proposed developments likely to increase traffic on the SRN (e.g., the M5) to identify and evaluate necessary infrastructure improvements and/or mitigation measures.

3. 2021 Base Model

National Highways previously developed an operational Vissim microsimulation model of the M5 J14 and the A38/B4509 traffic signal junction, to understand the existing network performance and enable the assessment of potential infrastructure improvements and/or development proposals. Following a Licence Agreement for the models' use, the Vissim Base model was made available by National Highways for AECOM to undertake the proposed SDC Local Plan assessment and the proposed scheme at M5 J14. The scheme extents are shown in **Figure 3-1**.

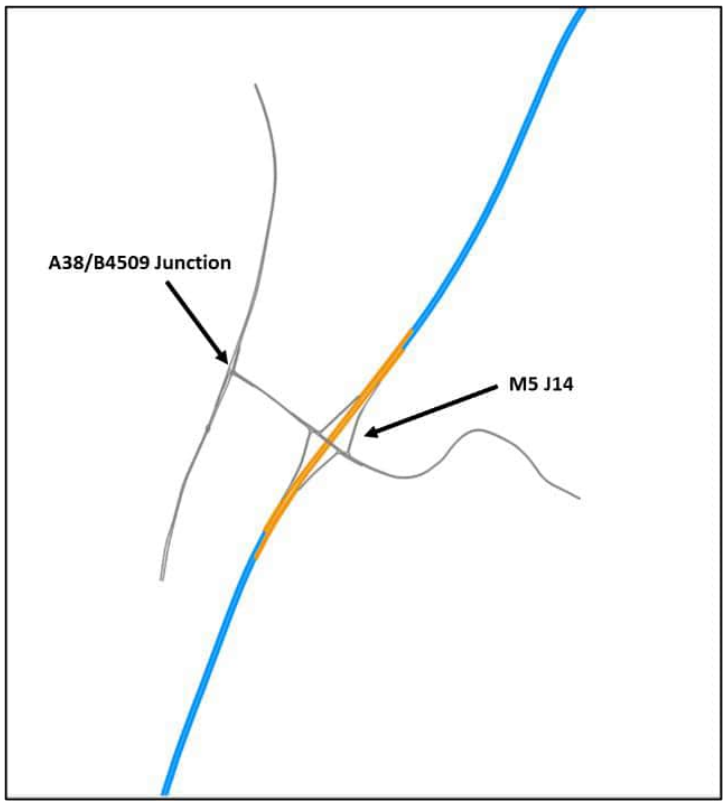


Figure 3-1 – Study extents.

The M5 J14 Vissim model represents a weekday Base year of 2021 and includes the use of PCMOVA to replicate the existing on-street traffic signal control at both M5 J14 (part-time operation in the PM peak) and the A38/B4509 junction. The model was developed by National Highways consultants WSP, with the Base model development, calibration and validation set out in the Local Model Validation Report (*M5_J14_VISSIM Model_LMVR_v5.pdf – May 2022*).

AECOM undertook a high-level review of the National Highways model to ascertain the key parameters, calibration and validation and the model's suitability for the assessment of proposed highway schemes. A summary of the key Base model information and parameters is set out below:

- **Built in Vissim Version 2021 SP01**: Standalone AM and PM peak .inpx files.
- **Uses PCMOVA Version 3.2.0.381**: Applied to both M5 J14 and A38/B4509 three-arm signals.
- **Base Network**: Coded against Bing Maps and Google Maps.
- **Base Year**: 2021, representing weekday AM and PM peaks.
- Modelled Periods:
    - **AM Peak Period:** 06:45 to 08:30
    - **AM Peak Hour**: 07:15 to 08:15
    - **PM Peak Period**: 15:45 to 17:30
    - **PM Peak Hour**: 16:15 to 17:15
- **Dynamic Assignment**: Used to assign traffic demand movements (15-minute matrices for vehicle classes: Cars, LGV, OGV1, OGV2), alongside eight public transport routes.
- **No Convergence**: No route choice within the network.
- **Part-Time Signals at J14**: The only model coding difference between AM and PM Vissim models. The AM model includes additional priority rules and reduced speed areas at J14, while the PM model runs traffic signals at J14.
- **Calibration and Validation**: Models run for 20 seed results runs for base model calibration (turn flows) and validation (journey times).

4. Scheme Modelling

4.1 Future Year Traffic Flows

2040 future year traffic flows for the M5 J14 are shown in **Appendix A** and were derived from the strategic transport modelling (SATURN), which was undertaken to inform the traffic impact assessment of the SDC Local Plan Review (LPR). Flows have been assessed for a forecast year of 2040, which reflects the end of the LPR period. The assessment has compared a 2040 'Do Minimum' (DM) scenario and a 2040 'Do Something' (DS) scenario for the AM and PM peak hours.

SATURN traffic flows were provided for an AM and PM average peak hour, based on an average of 3 peak period hours. The traffic flows represent two forecasted 2040 development growth as part of proposed Local Plans (alongside the implementation of the Local Plan's Sustainable Transport Strategy and highway mitigation packages). The traffic flows have been converted from Passenger Car Units (PCUs) into vehicles for use in the Vissim model.

Two 2040-year demand scenarios were cordoned and extracted from the SATURN model:

- **2040 Do Minimum** (DM) scenario includes growth up to 2040 but excludes the adoption of the SDC LPR. This scenario assumes no changes to the existing M5 J14 arrangement.
- **2040 Do Something** (DS) scenario includes growth in traffic up to 2040 and includes adoption of the SDC LPR. This scenario assumes the implementation of the proposed grade-separated roundabout scheme at J14. The traffic flows for this scenario also account for the effects of induced demand at the junction (i.e., where the capacity improvements make traffic routes through the junction quicker and more reliable, which means more traffic is drawn towards the junction).

In both 2040 DS peaks, there is a considerable increase to traffic volumes at the A38/B4509 junction (compared to 2040 DM):

- A38 Southbound flows increase by approximately 50% in the AM peak, and over 31% in the PM peak on movements to the M5.
- B4509 Westbound (towards A38) flows increase around 34% in both peaks.
- A38 Northbound flows increase by approximately 4% and 2% in each respective peak.

Cordons of the respective SATURN demand scenarios were made, reflective of the Vissim study area extent. The cordoned flows used for the assessment adopted a 'delta' flow approach (outlined below) to represent 2040 demands and provide robustness to the modelled results:

- **Delta Flows** This flow scenario uses the 2021 Base Vissim traffic flows and adds the difference between the 2040 (DM and DS) SATURN traffic flows and the 2015 Base SATURN traffic flows adjusted to 2021 based on factors derived from TEMPro (Trip End Model Presentation Program).
  - **2015 to 2021 TEMPro growth factors**: 4.2% in the AM peak period and 4.0% in the PM peak period based on the boundaries, South Glos 001 (Thornbury North) and South Glos 003 (Charfield, Wickwar and Iron Acton).

To ensure the key conclusions in this Technical Note would not change if the demand methodology was different a sensitivity run in Vissim was also undertaken using the 2040 SATURN flows direct from the SATURN model. This was to support any future discussions with National Highways but is not reported in this document.

4.2 Scheme Design

Within the Do Something Vissim model, and following a period of design-modelling optioneering, there were three key design changes incorporated:

1. **Grade-Separated Junction at M5 J14:**
   - The provisional design proposes a grade-separated layout, utilising the existing M5 overbridge and adding an additional bridge structure to the northeast.
   - The overbridges will operate with two lanes each.
   - The eastern and western circulatory will each have three lanes.
   - Each approach will also have three lanes.
   - Lane allocations were optimized through Vissim modelling to ensure maximum capacity. (see 4.2.1)
   - Drawings of the design are attached in **Appendix B**.
2. **A38 Design:**
   - A concept design was produced for the A38 junction in response to previous modelling tests that showed increased journey times, particularly on the northbound approach. The concept layout is shown in **Figure 4-1**.

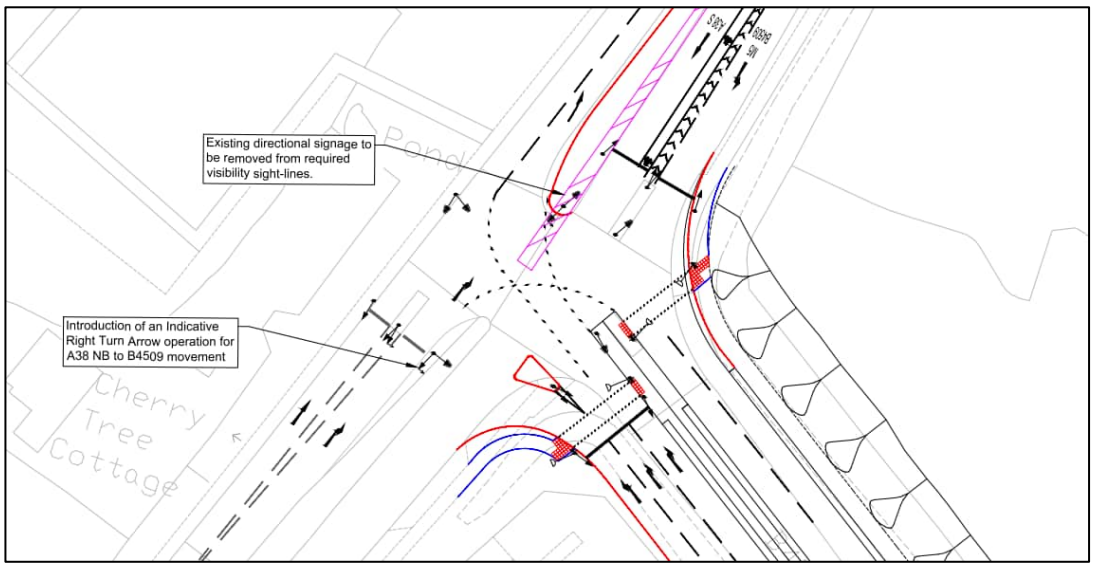


Figure 4-1 - A48/B4509 Signals Concept Design

- Proposed changes include a northbound right-turn indicative arrow to reduce congestion, an additional right-turn flare lane for westbound traffic, and a two-to-one lane merge on the northbound exit.
- The existing uncontrolled pedestrian crossing is formalised and upgraded to a controlled crossing across the westbound approach, owing to the increased traffic flow.
- These changes have been applied to the previous MOVA signal dataset and tested operationally, though safety and detailed works are not included at this stage.
- The option has been developed to show that there is an improvement available for the junction, although this would be subject to additional design optioneering and consultation prior to being finalised and delivered.

3. **M5 Southbound On slip (part of point 1):**
   - Due to projected development growth in the area by 2040, the M5 SB On slip was shown to exceed the vehicular threshold of the existing layout according to CD 122 – Geometric Design of Grade Separated Junctions.
   - The guidance indicated the need for a lane gain with a 'ghost island offside merge,' which has been included in the modelling process.
   - The same distances quoted in the guidance have been applied in the Vissim model.
   - Drawings of the designs are attached in **Appendix B**.

In addition to the above Do Something scheme proposals there is one committed scheme included within the Do Minimum scenario, as this is expected to be constructed in the next couple of years:

1. **M5 Northbound Off slip (applicable in Do Minimum):**
   - An additional 50m two-lane off slip (totalling 350m length) has been committed as part of surrounding developments to accommodate increased vehicle flow and is included in the DM modelling.
   - This has been coded in Vissim based on a drawing provided by National Highways, reference 39209-5501-SK31 350 M5 J14 NB Off slip (003).pdf.

4.2.1 Grade-Separated Junction at M5 J14: Lane Allocation

Lane allocations at the proposed grade-separated junction at M5 J14 were based on a review of initial model performance and traffic demands to provide the most efficient operation and capacity at the junction. Three lane entries are provided on each of the approaches to the M5 J14, with a three-lane circulatory on the western and eastern extents, reducing to two lanes across the overbridges.

Maintaining three lanes on the western and eastern circulatory allows the left-turn lane on each approach to function as an exit/entry for the M5 off slips/on slips. The lanes outlined in the study have been assessed operationally, but design standards and safety considerations for these lane allocations have not been included in this stage of the study.

Lane allocations assumed within the Vissim modelling are indicated in **Figure 4-2.**

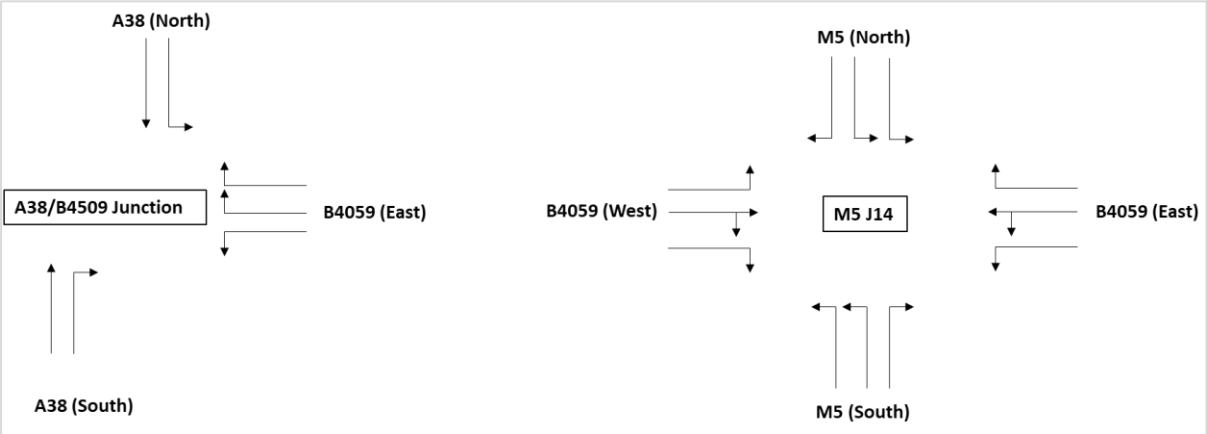


Figure 4-2 - Modelled Lane Usage at A38/B4509 junction and M5 J14.

4.3 Vissim Modelling

The proposed junction layout was modelled using Vissim 2021 (SP01), the same Vissim version used to develop the original Base Model developed by WSP for National Highways.

The National Highways Base model was used as the basis to assess the proposed highway schemes combined with 2040 Local Plan traffic flows.

Where the highway network is unchanged between the base and option models, the base model coding, such as reduced speed area distributions and driving behaviours were retained to maintain a consistent approach.

The following scenarios were modelled:

- **2040 Do Minimum:**
  - M5 NB off slip change,
  - 2040 Do Minimum Traffic demand derived from SATURN.
  - No other changes.
- **2040 Do Something:**
  - M5 J14 Grade Separated junction coded, as shown in **Appendix B**.
  - A38/B4509 signals concept design layout
  - 2040 Do Something Traffic demand derived from SATURN.

The schemes were coded within two modification files after the Vissim network was placed into scenario management. The previous peak differences of the part-time signal no longer applied in the Do Something models, allowing for its utilization, while the Do Minimum scenarios remained outside of scenario management.

- **Modification 1:** Coded the grade-separated junction at M5 J14, as well as changes to both the M5 northbound off slip and southbound on slip.
- **Modification 2:** coded the A38 design. As part of the scheme coding for the A38 design, an assumed 15 pedestrians per hour were modelled using the controlled pedestrian crossing.

As part of the coding for the M5 southbound on slip, which included a ghost island offside merge, two locations were created for southbound vehicles to merge onto the M5. This introduced route choice in the model, necessitating a convergence process for each of the Do Something scenarios. The model was converged over 20 runs to balance the flows between the two entry points. The relevant cost (bew) and path (weg) files were then used for the final modelling results.

5. Model Results

This section assesses the model performance of the M5 Junction 14 grade separated proposals (and A38/B4509 signals mitigation) in a 2040 Local Plan year ‘Do Something (DS)’, with a comparative assessment against a 2040 Local Plan year ‘Do Minimum (DM)’ scenario (i.e., no significant intervention at M5 J14 and/or A38/B4509 signals) for AM and PM peak hours. The scenarios assessed are:

- 2040 Do Minimum (2040 DM); and
- 2040 Do Something (2040 DS).

The ‘2040 DM’ scenario has been provided for comparative purposes only. This scenario involved running 2040 DM demand matrices (derived from the SATURN Model) through the predominantly ‘existing’ M5 J14 Vissim network. The only network change made to the DM model was to include the committed M5 J14 northbound off slip two-lane extension to approximately 350m. To confirm, this scenario does not include any other changes made to any network coding.

The DM model operation was reviewed to understand the network operation, performance and issues seen in a 2040 DM year without any major interventions, but driver behaviours and/or optimising of signal timings were not undertaken.

The AM and PM peak hour results presented represent the following time periods, for the scenario years (peaks as per the validated base year peak hours):

- AM peak hour: 07:15 – 08:15; and
- PM peak hour: 16:15 – 17:15.

Model results are provided for an average of 20 seed model runs (based on the same random seeds as ran in the Base modelling by WSP). Results from multiple seed values are used to check that model results are stable, with marginally varying parameter values, such as vehicle input, speed, and dwell time distributions, contained within each seed run.

The remainder of this section analyses the following model results outputs for key routes and junctions within the scheme study area extent:

- Maximum queue lengths;
- Vehicular journey times; and
- Key network performance statistics.

5.1 2040 Queue Comparison

The M5 J14 grade separated operation and capacity has been assessed through the modelled maximum queue length, in metres, from the averaged model seed runs.

5.1.1 2040 AM Peak Queues

Figure 5-1 to **Figure 5-4** show the maximum queue length results for each of the four approaches at M5 J14 in the AM peak period for the 2040 Local Plan year. Each Figure (except the B4509 WB approach) also contains a horizontal line to show the approximate storage capacity of the approach road; either back to the start of the off slip, or the A38/B4509 signals junction.

The M5 J14 southbound off slip queues shown in **Figure 5-1** are marginally greater in 2040 DS, compared to 2040 DM, with both scenarios remaining well within the extents of the off slip.

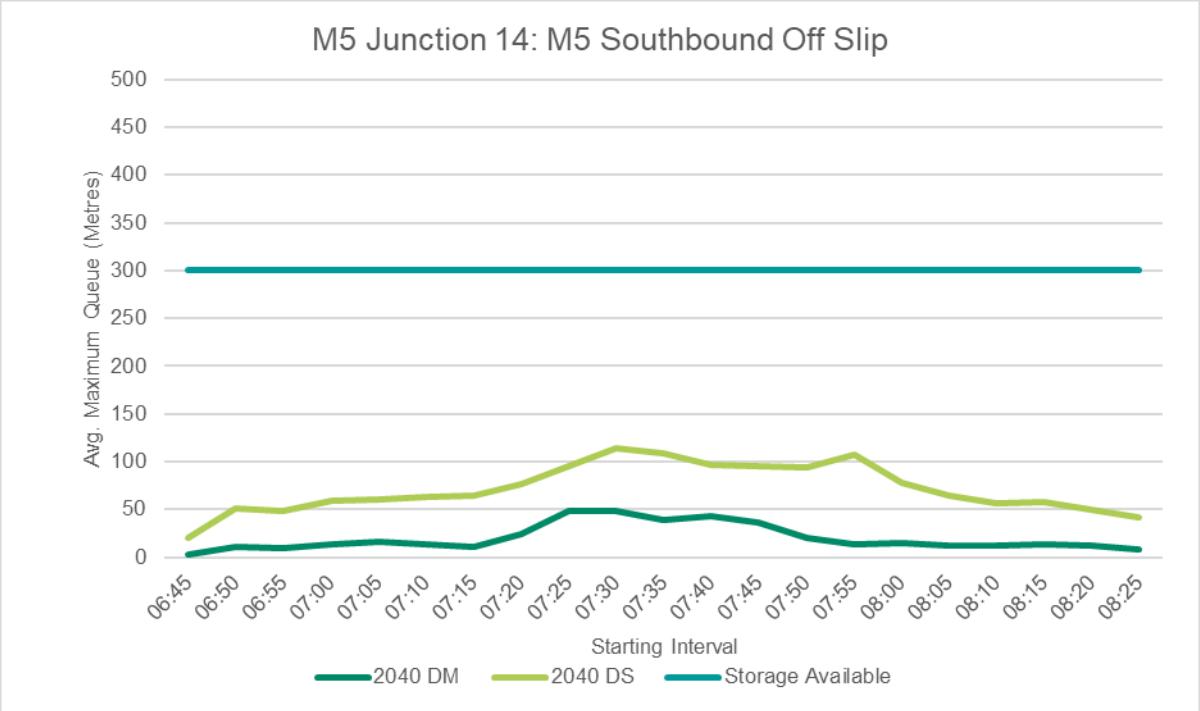


Figure 5-1 – 2040 AM Maximum Queue Length (metres) Comparison at M5 J14: SB Off Slip.

The B4509 westbound approach queues to M5 J14, shown in **Figure 5-2**, are considerably greater in 2040 DS, compared to 2040 DM. In 2040 DM the part-time signals at J14 are not in operation, therefore the B4509 westbound has a priority movement through the motorway junction and hence

there are minimal queues. The spike shown in the DM queue is where the right turn lane (onto M5 NB) starts to block back beyond its storage and blocks the westbound ahead flow.

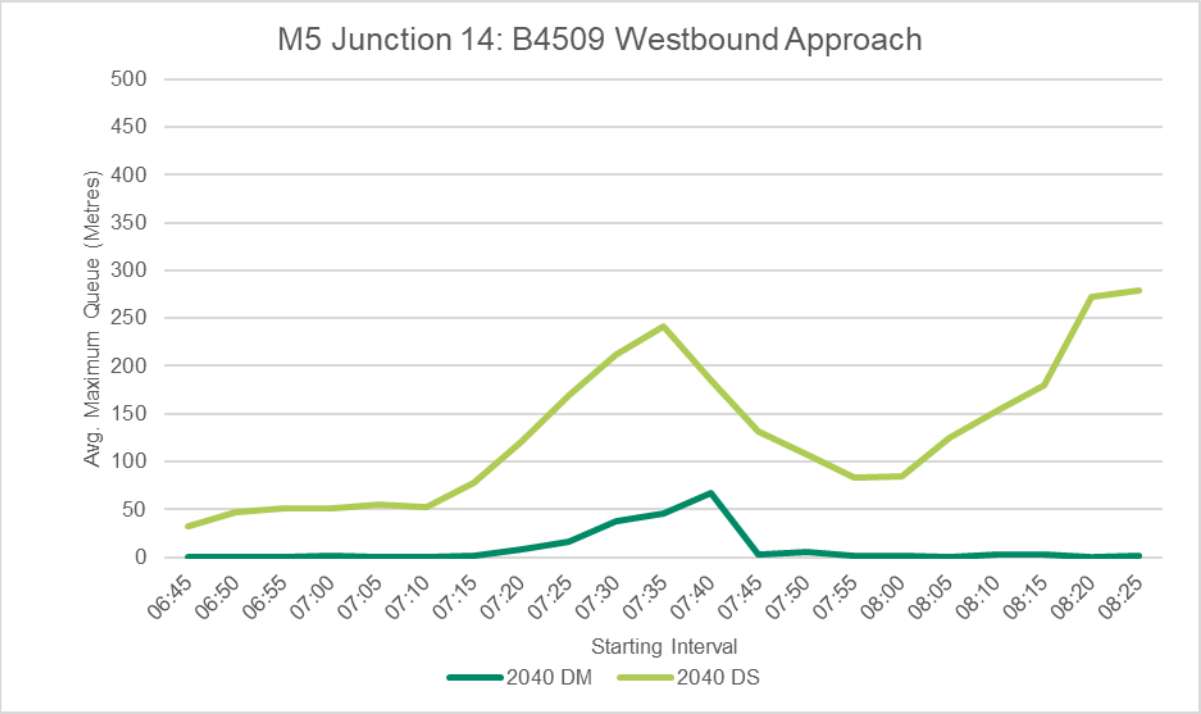


Figure 5-2 – 2040 AM Maximum Queue Length (metres) Comparison at M5 J14: B4509 WB.

The M5 J14 northbound off slip queues shown in **Figure 5-3** are marginally greater in 2040 DS, compared to 2040 DM, with both scenarios remaining well within the extents of the off slip. The 2040 DM scenario does also include the committed off slip extension to 350 metres length.

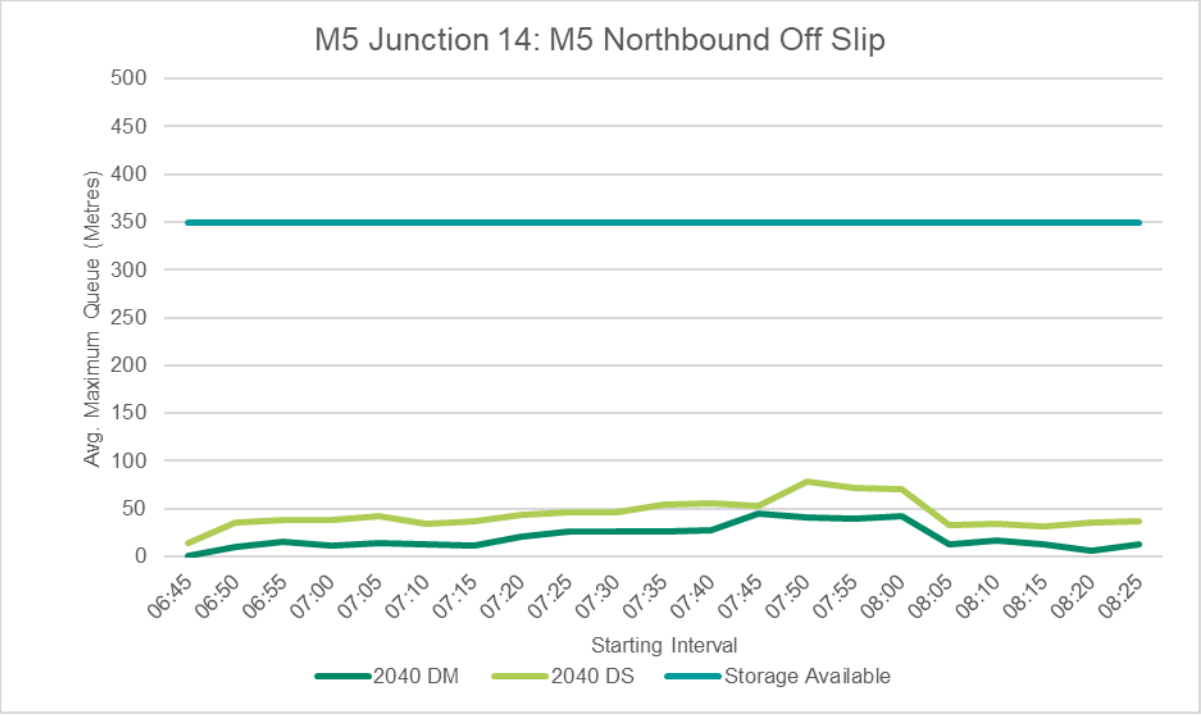


Figure 5-3 – 2040 AM Maximum Queue Length (metres) Comparison at M5 J14: NB Off Slip.

The B4509 eastbound approach queues to M5 J14, shown in **Figure 5-4**, are greater in 2040 DS, compared to 2040 DM, but demonstrates it can accommodate the considerable demand increase expect in the DS AM peak from the A38 north.

In 2040 DM the part-time signals at J14 are not in operation, therefore the B4509 eastbound approach has a priority movement through the motorway junction leading to the minimal queues

reported. However, some spikes are shown in the 2040 DM scenario caused when the right turn lane (onto M5 SB) starts to block back beyond its storage, blocking the ahead flow on occasions.

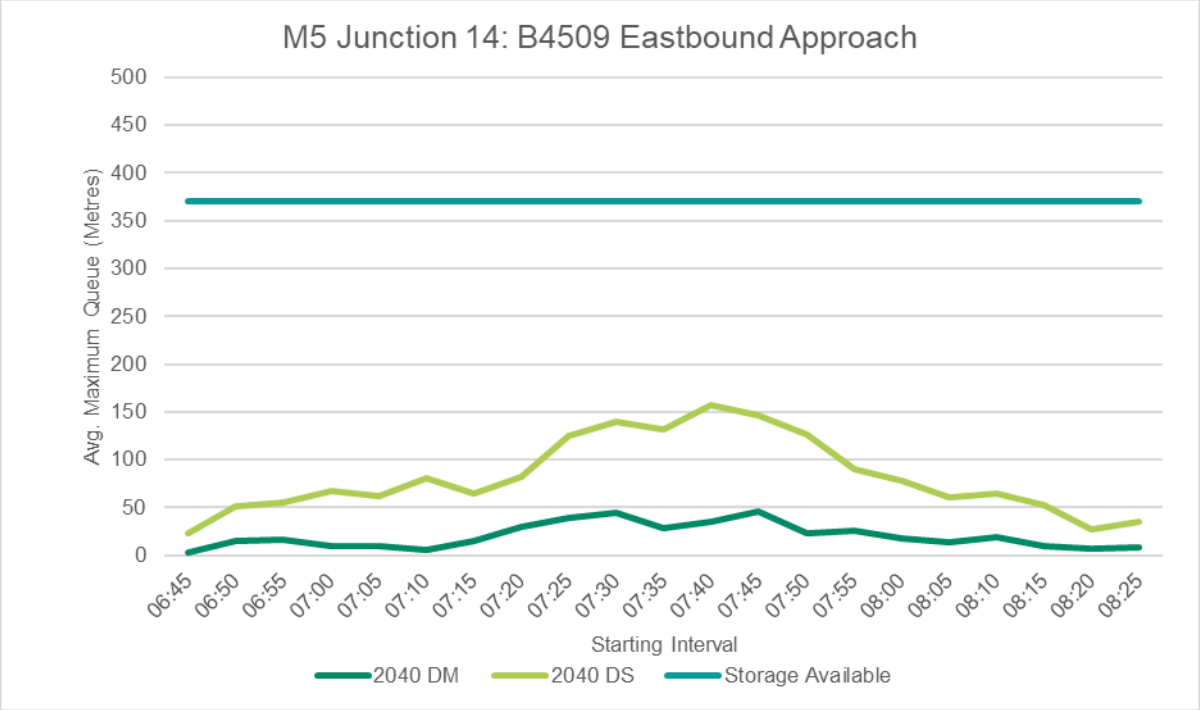


Figure 5-4 – 2040 AM Maximum Queue Length (metres) Comparison at M5 J14: B4509 EB.

5.1.2 2040 PM Peak Queues

Figure 5-5 to **Figure 5-8** show the maximum queue length results for each of the four approaches at M5 J14 in the PM peak period for the 2040 Local Plan year. Each Figure (except the B4509 WB approach) also contains a horizontal line to show the approximate storage capacity of the approach road; either back to the start of the off slip, or the A38/B4509 signals junction.

It should be noted that the part time signals are operational at M5 J14 during the 2040 DM PM period.

The M5 J14 southbound off slip queues shown in Figure 5-5 improve marginally in 2040 DS, compared to 2040 DM, with both scenarios remaining well within the extents of the off slip.

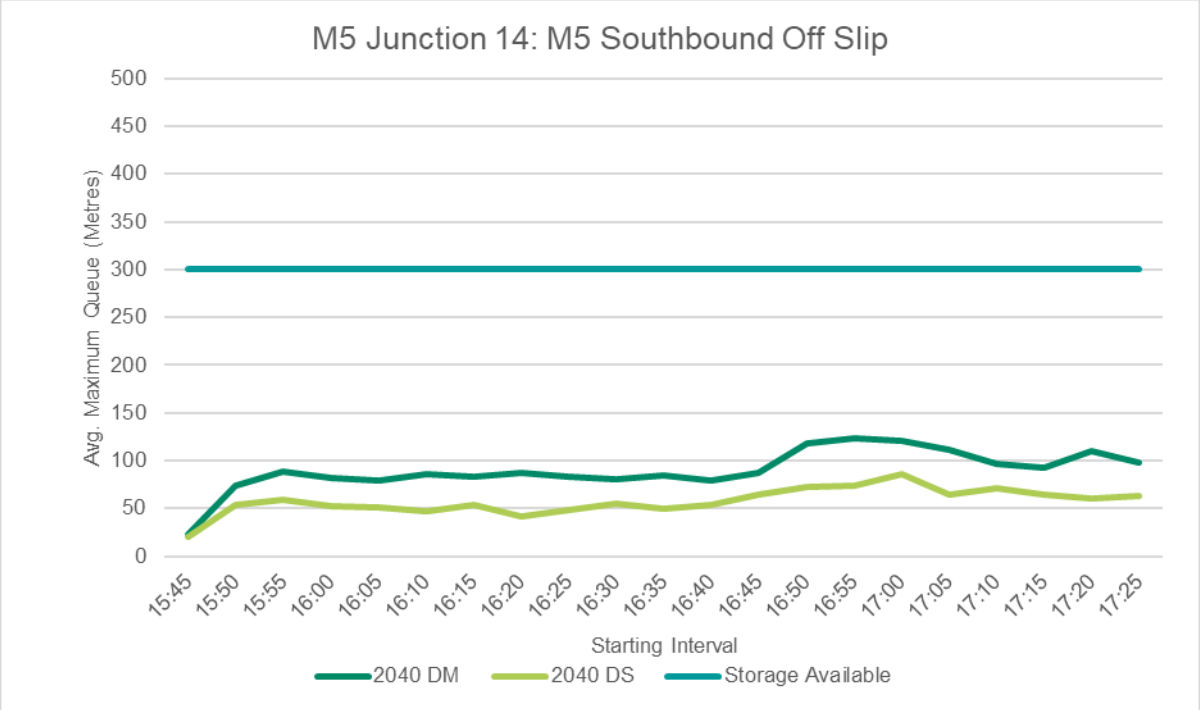


Figure 5-5 – 2040 PM Maximum Queue Length (metres) Comparison at M5 J14: SB Off Slip.

The B4509 westbound approach queues to M5 J14, shown in **Figure 5-6,** show significant queuing expected in 2040 DM, with the part time signals in place and without any interventions at J14. The DM queues from the model reach the model entry points (over 1km) and do not reduce before the end of the modelled period. The 2040 DS shows the grade separated proposal will provide sufficient capacity and that even when queues build, that they can recover.

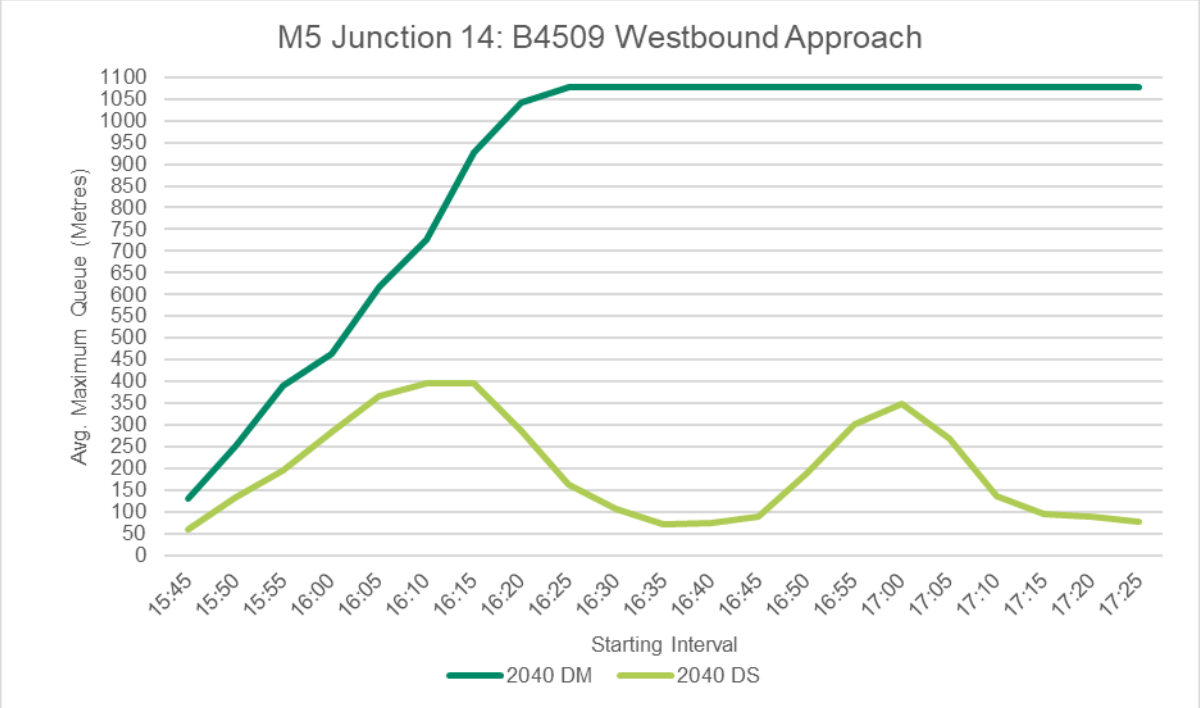


Figure 5-6 – 2040 PM Maximum Queue Length (metres) Comparison at M5 J14: B4509 WB.

The M5 J14 northbound off slip queues shown in **Figure 5-7** improve marginally in 2040 DS, compared to 2040 DM, with both scenarios remaining well within the extents of the off slip. The grade separated proposal also demonstrates that it can accommodate the considerable increase to return

(left turn) trips towards the A38 in the DS scenario. The 2040 DM scenario does also include the committed off slip extension to 350 metres length.

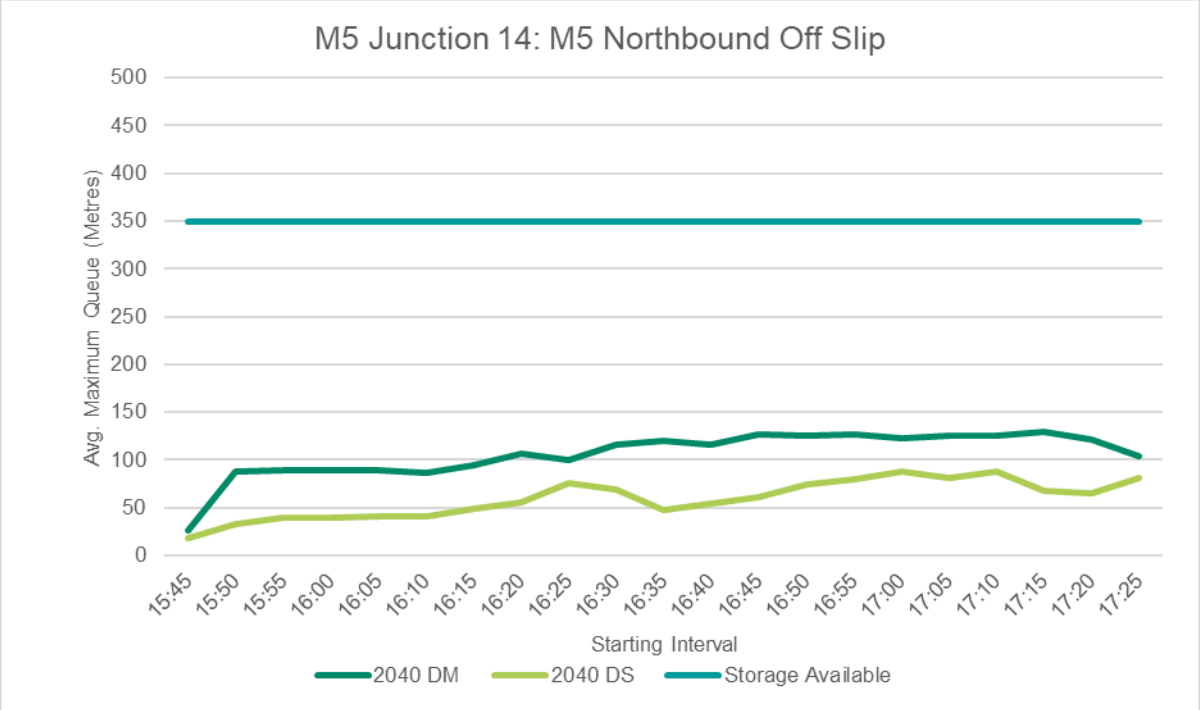


Figure 5-7 – 2040 PM Maximum Queue Length (metres) Comparison at M5 J14: NB Off Slip.

The B4509 eastbound approach queues to M5 J14, shown in **Figure 5-8**, show significant queueing is expected in 2040 DM, with the part time signals in place and without any interventions at J14. The DM queues in the model extend back to and through the A38/B4509 signals, in turn increasing queues on both A38 stop line approaches, and do not recover before the end of the modelled period.

The 2040 DS shows the grade separated proposal will provide sufficient capacity throughout the PM period.

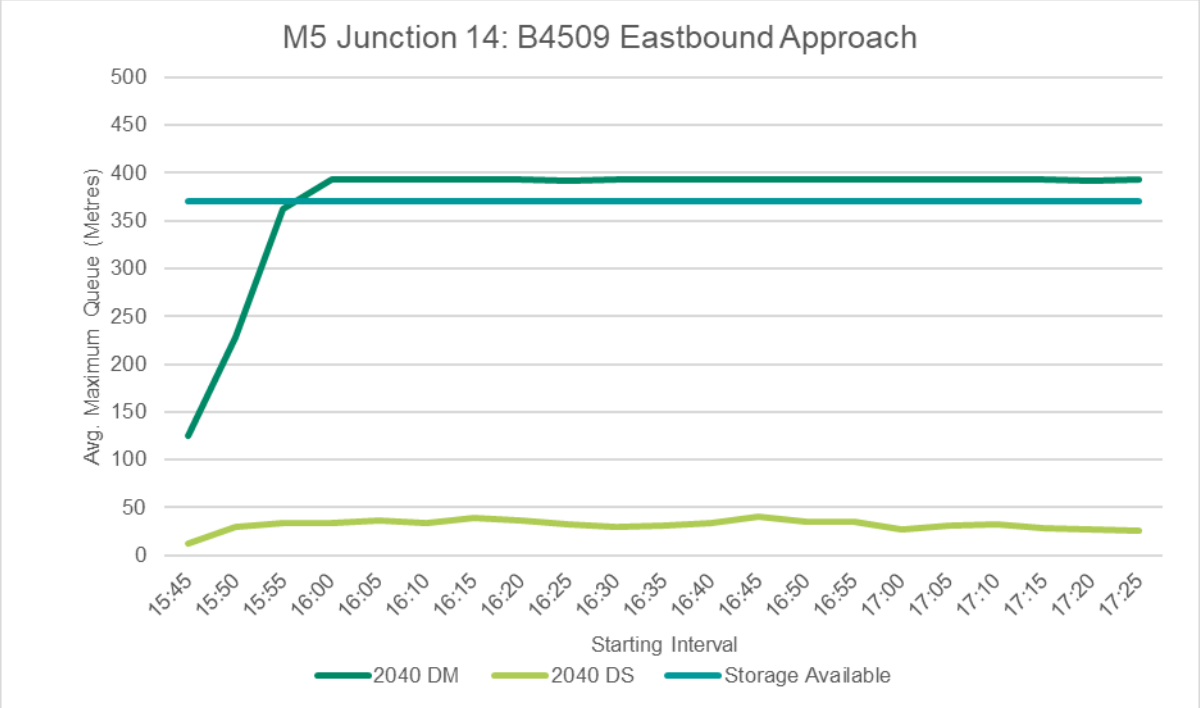


Figure 5-8 – 2040 PM Maximum Queue Length (metres) Comparison at M5 J14: B4509 EB.

5.1.3 A38/B4509 Signalised Junction - Queues

Queue length analysis for the A38/B4509 signals junction is shown in **Appendix C**. When reviewing the queue comparisons there are two key items which should be acknowledged for the respective 2040 DM and 2040 DS scenarios:

- In both 2040 DS peaks, there is a considerable increase to traffic volumes at the A38/B4509 junction (compared to 2040 DM):
  - A38 Southbound flows increase by approximately 50% in the AM peak, and over 31% in the PM peak.
  - B4509 Westbound flows increase around 34% in both peaks.
  - A38 Northbound flows increase by approximately 4% and 2% in each respective peak.
- The 2040 DS scenario includes a concept mitigation layout at the signals junction which includes a controlled pedestrian crossing within the operation. (DM assumes no change).

In summary, the queue length comparison at the A38/B4509 signals junction show:

- In the 2040 AM peak, the A38 southbound queues are considerably greater in the DS scenario, compared to the DM scenario; associated to the expected 50% increase in traffic flows and the addition of the pedestrian crossing. predominantly associated to the two points above. The B4509 westbound and A38 northbound queues are marginally greater in the DS scenario compared to the DM scenario.
- In the 2040 PM peak hour, the A38 southbound and A38 northbound queues are considerably greater in the DM scenario compared to the DS scenario. These DM queues are associated to the queues seen at M5 J14 on the B4509 eastbound approach (with signals operating in the PM), which block back from J14 to and through the A38 signals junction, meaning the exit is blocked. The B4509 westbound queues are marginally greater in the DM scenario compared to the DS scenario.

5.2 Journey Time Comparison

Averaged 2040 AM and PM peak hour journey time results have been reported for the same routes as defined and validated in the 2021 Base Vissim model. The six routes are shown in **Figure 5-9**.

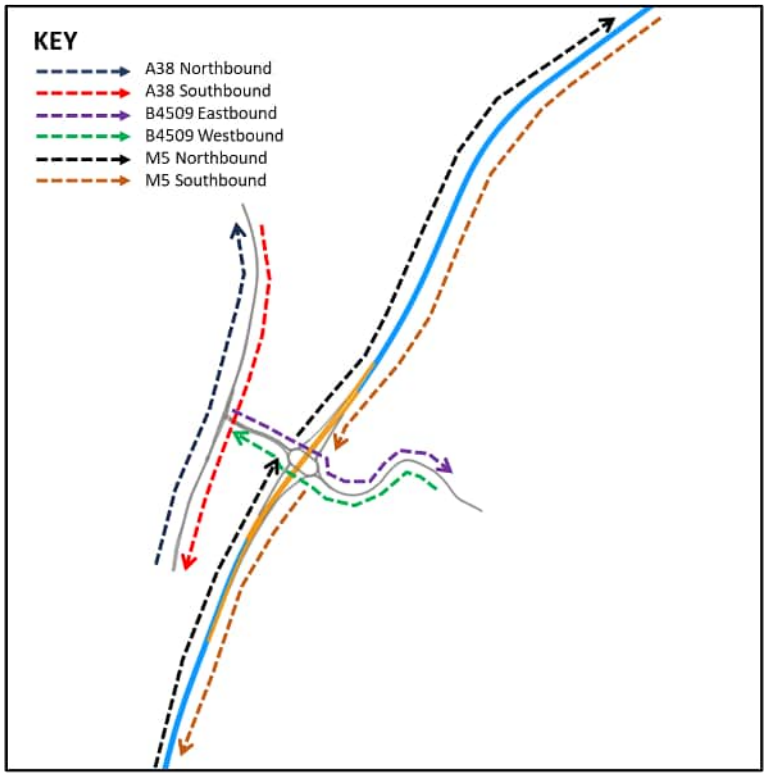


Figure 5-9 – Map of Modelled Journey Times.

The six routes were constructed with multiple journey time segments which were split at key sections (junctions / points of interest) along each route. The combined segments make the combined/cumulative route as reported tabularly in this section, and graphically within **Appendix D**.

5.2.1 2040 AM Peak Journey Times

The 2040 AM peak hour (07:15 – 08:15) journey time results are presented in **Table 5-1**.

Table 5-1 – 2040 AM Peak Journey Times.

Journey Time Route	2040 DM	2040 DS	DS-DM Difference (seconds)
1a. A38 Northbound	121	141	+14
1b. A38 Southbound	113	204	+91
2a. B4509 Eastbound	110	124	+14
2b. B4509 Westbound	124	163	+39
3a. M5 Northbound	105	107	+2
3b. M5 Southbound	79	132	+53

The AM peak results in **Table 5-1** indicate some notable increases in journey times in the 2040 DS scenario compared to the 2040 DM scenario. However, these differences are logical and align with the PM peak performance, which is much better compared to the DM scenario. The reasons for these differences are as follows:

- **Increased Flow at M5 J14**: The 2040 DS scenario includes a grade-separated junction at M5 J14, with a considerable increase to traffic flows. This scenario accounts for induced demand, where capacity improvements make the route through the junction quicker and more reliable, attracting more traffic.
- **Signal Operations**: The 2040 DM scenario does not operate the part-time signals at J14, giving priority to routes 2a and 2b.
- **Southbound Merge on Route 3b**: Route 3b features a significantly increased southbound merge onto the motorway. While this provision incurs some increased travel time, it is a longer route at a slightly slower speed.

5.2.2 2040 PM Peak Journey Times

The 2040 PM peak hour (16:15 – 17:15) journey time results are presented in **Table 5-2**.

Table 5-2 – 2040 PM Peak Journey Times.

Journey Time Route	2040 DM	2040 DS	DS-DM Difference (seconds)
A38 Northbound	448	128	-320
A38 Southbound	813	134	-679
B4509 Eastbound	389	104	-285
B4509 Westbound	397	170	-227
M5 Northbound	149	118	-31
M5 Southbound	110	86	-24

The PM peak hour journey time results in **Table 5-2** show the 2040 DS has considerably quicker journey times, compared to 2040 DM scenario. As highlighted in the queue analysis, the delays in 2040 DM scenario are associated with the part-time signals at J14, which significantly impacts on the capacity of the A38/B4509 signalised junction. These results demonstrate that the M5 J14 grade-separated proposal effectively mitigates these issues, even with the considerable increases in traffic flow within the 2040 DS scenario.

5.3 Network Performance Comparison

Network Performance statistics have been collected for each 2040 AM and PM scenario peak hours. The networks average delay are reported, along with the latent demand, as shown in **Table 5-3**. The Latent demand is the number of vehicles unable to enter the modelled network during the peak hour.

Table 5-3 – 2040 Network Performance Statistics for Each Scenario.

Network Statistic	2040 DM AM Peak	2040 DS AM Peak	2040 DM PM Peak	2040 DS PM Peak
Average Delay (secs/veh)	24	35	60	29
Latent Demand (no.)	0	17	118	1

In the AM peak there is a marginal increase, of 11 seconds per vehicle to the average delay in 2040 DS, compared to 2040 DM. This is associated with the considerable traffic flow increase in the DS, particularly around the A38 signals (where the latent demand is) and that in the DM the B4509 eastbound/westbound movement is unconstrained through J14 (no part time signals).

In the 2040 PM peak the network performance statistics show and reflect the significant increases shown in the queue and journey time results of the DM scenario. The DM delay is over double compared to 2040 DS, and reports a considerable latent demand, which shows vehicles are unable to enter the network on the A38.

6. Summary

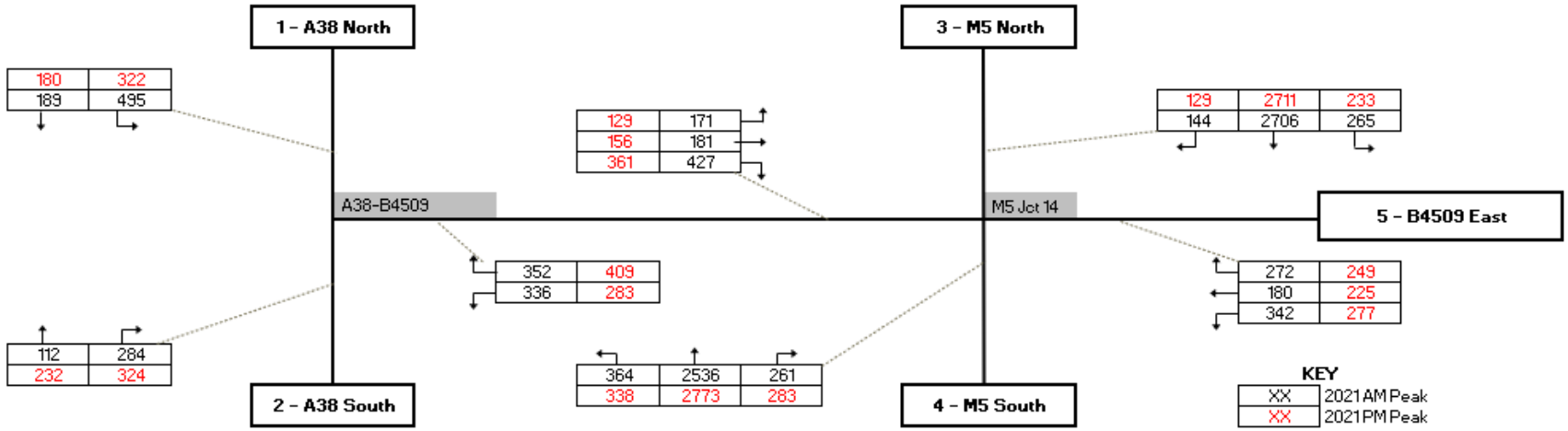
AECOM has conducted Vissim modelling for the potential upgrade of M5 Junction 14 (J14) to accommodate future traffic growth up to 2040. This modelling is part of a broader commission from Stroud District Council (SDC) related to the upcoming SDC Local Plan Review (LPR).

Summary of Findings:

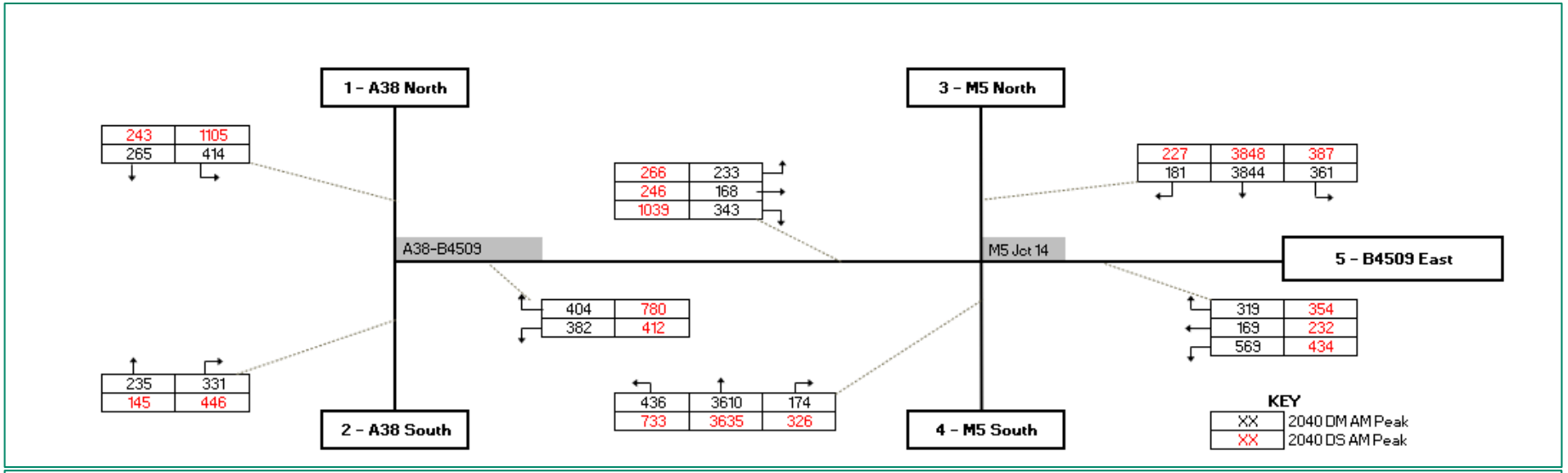
- **2040 Modelling Results:** The grade-separated proposal at M5 Junction 14 performs well, providing sufficient capacity and operation to support Local Plan growth.
  - **2040 DS AM Peak**: While there are some increases in journey times and marginal queue increases at M5 J14, these are within available storage capacity. Importantly, there is a considerable increase in traffic flows, particularly from the A38 (over 50%), compared to the 2040 DM AM peak. The 2040 DM AM peak does not operate the part-time signals, leaving B4509 eastbound/westbound movements through J14 unconstrained.
  - **2040 DS PM Peak:** The modelling results show that the M5 J14 grade-separated proposal works very well, in contrast to the 2040 DM scenario, which operates part-time signals and shows significant congestion throughout the network.
- **Capacity Improvements:** The scheme provides significantly more capacity at the M5 J14 and A38 junction during the PM period for all flow scenarios. Although the AM results show a marginal increase in queuing and journey time, the PM benefits are substantial, with the PM DM scenario causing considerable congestion.
- **Future-Proofing:** The grade-separated layout is considered future-proof, as traffic signals could be added later if required by National Highways to better manage the network.
- **A38/B4509 Signals Concept Design:** This design can accommodate the substantial traffic flow increase in the 2040 DS scenario and offers potential improvements for the junction. However, this was not the focus of the study and would require additional design optioneering and consultation before finalization and implementation.
- **Further Assessments**: The modelled schemes have only been assessed from an operational standpoint. Safety and engineering assessments are still pending.

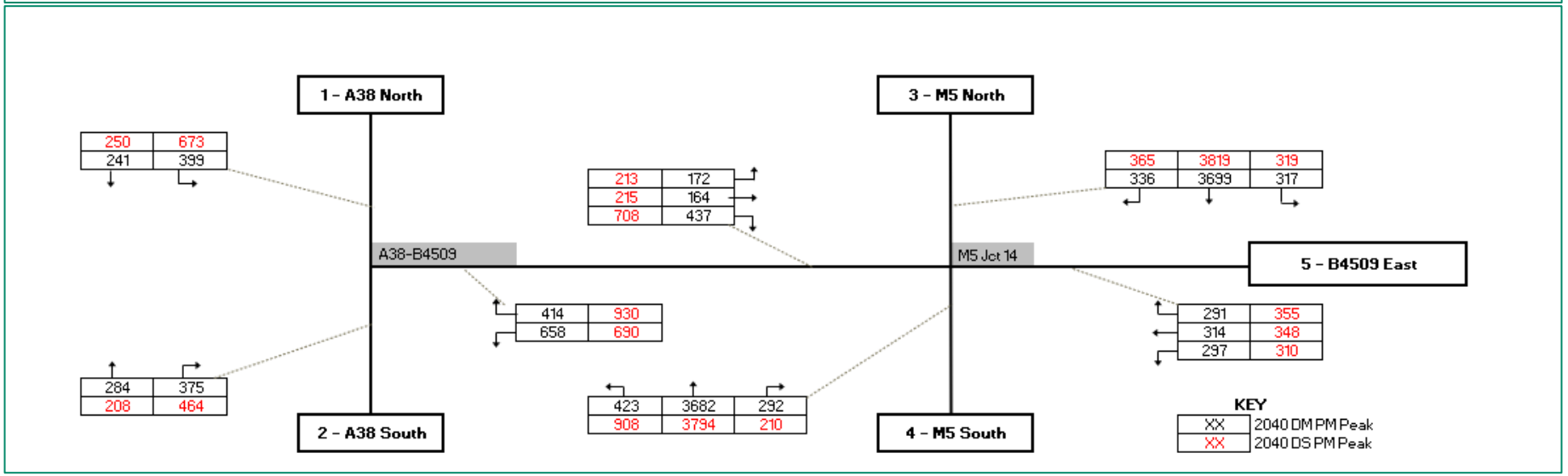
Appendix A – Model Scenarios Peak Hour Flows

A.1 2021 Vissim Base Flows

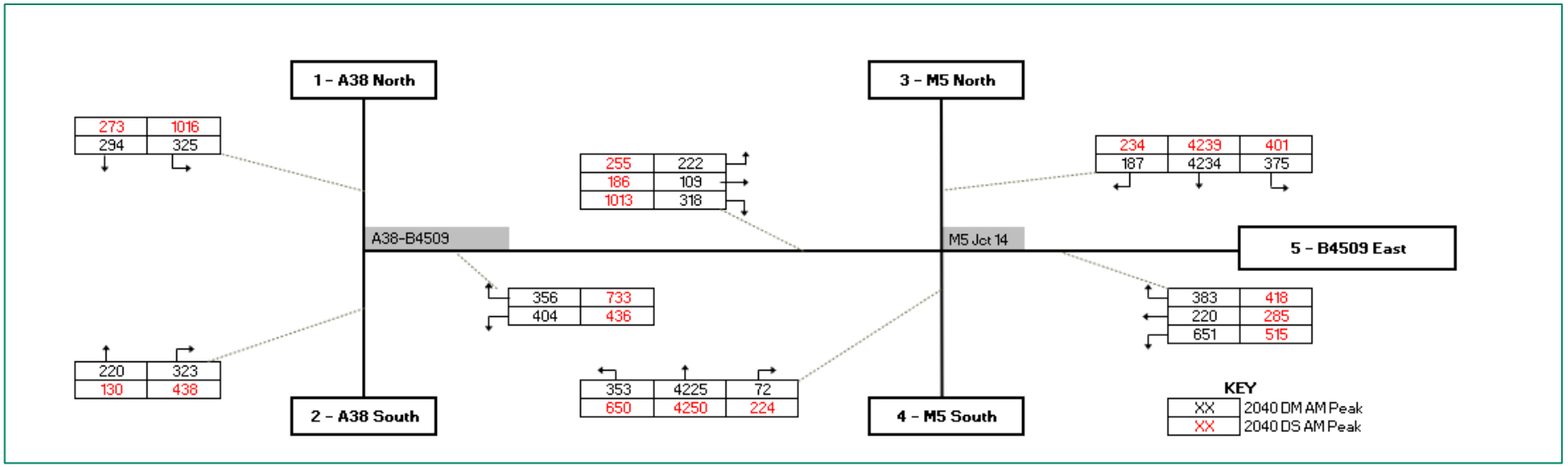


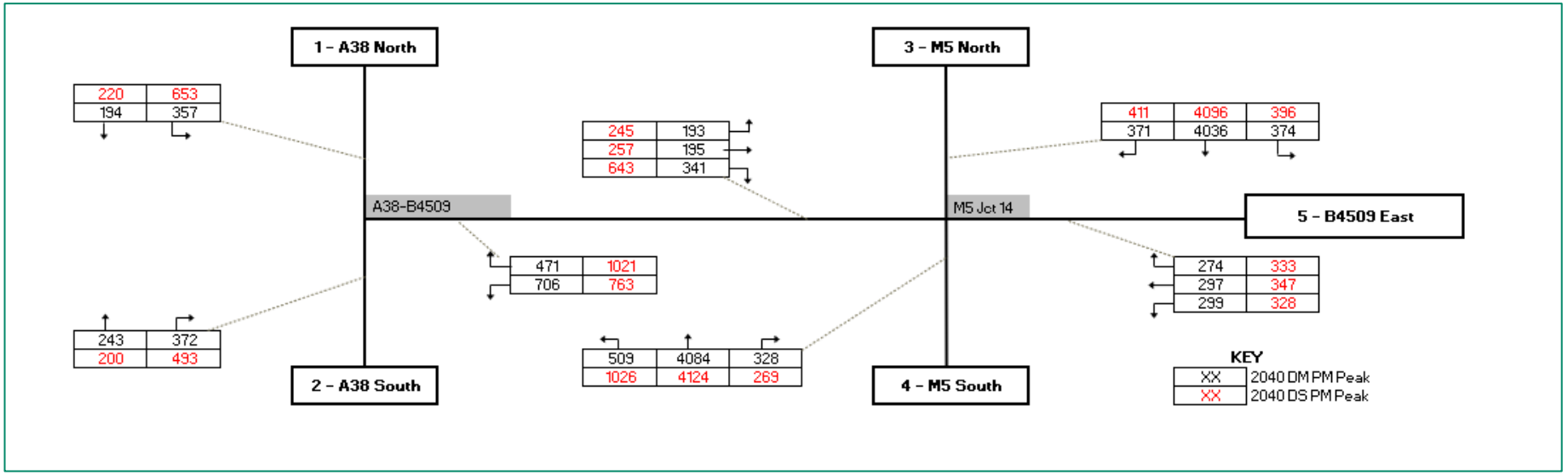
A.2 2040 DM & 2040 DS Flows (Vissim Base + SATURN DELTA)



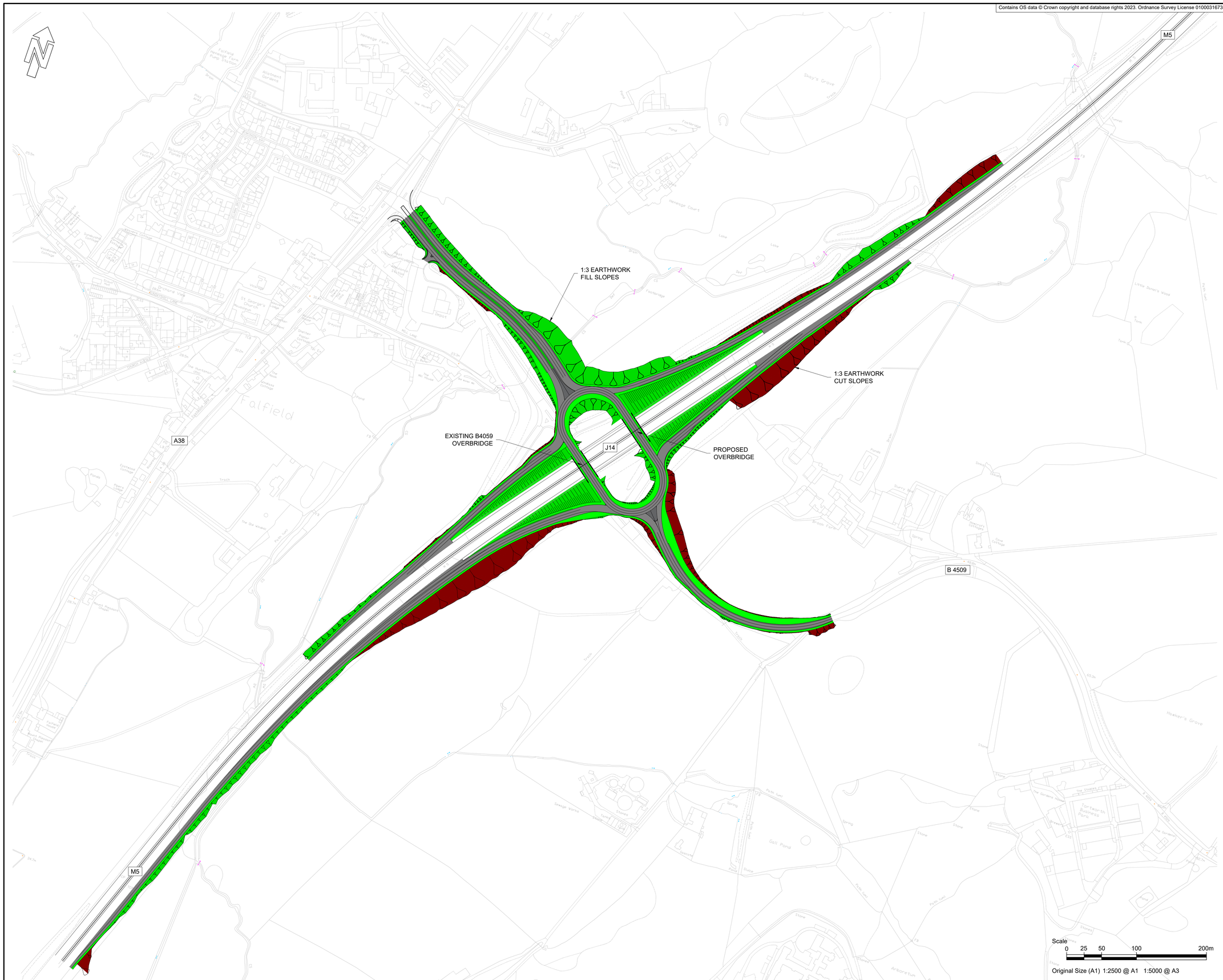


A.3 2040 DM & 2040 DS Flows (SATURN Outputs)





Appendix B Scheme Designs



AECOM

PROJECT

M5 Junction 14
Improvement Scheme

CLIENT

Stroud District Council

CONSULTANT

AECOM
PORTWALL PLACE
PORTWALL LANE
BRISTOL, BS1 6NA, UK
Tel: +44 (0)117 315 0700
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NOTES

LEGEND

- PROPOSED CARRIAGEWAY
- PROPOSED TRAFFIC ISLAND
- PROPOSED VERGE
- PROPOSED EMBANKMENT
- PROPOSED EMBANKMENT BETWEEN VERGES
- PROPOSED CUTTING
- CHAINAGE

SUITABILITY

S0 WORK IN PROGRESS

ISSUE/REVISION

P03	06/09/2024	DESIGN UPDATE
P02	08/08/2024	DESIGN UPDATE
P01	30/05/2024	FIRST ISSUE
I/R	DATE	DESCRIPTION

FOR CONSULTATION

PROJECT NUMBER

60598598

SHEET TITLE

GRADE SEPARATED JUNCTION

GENERAL ARRANGEMENT

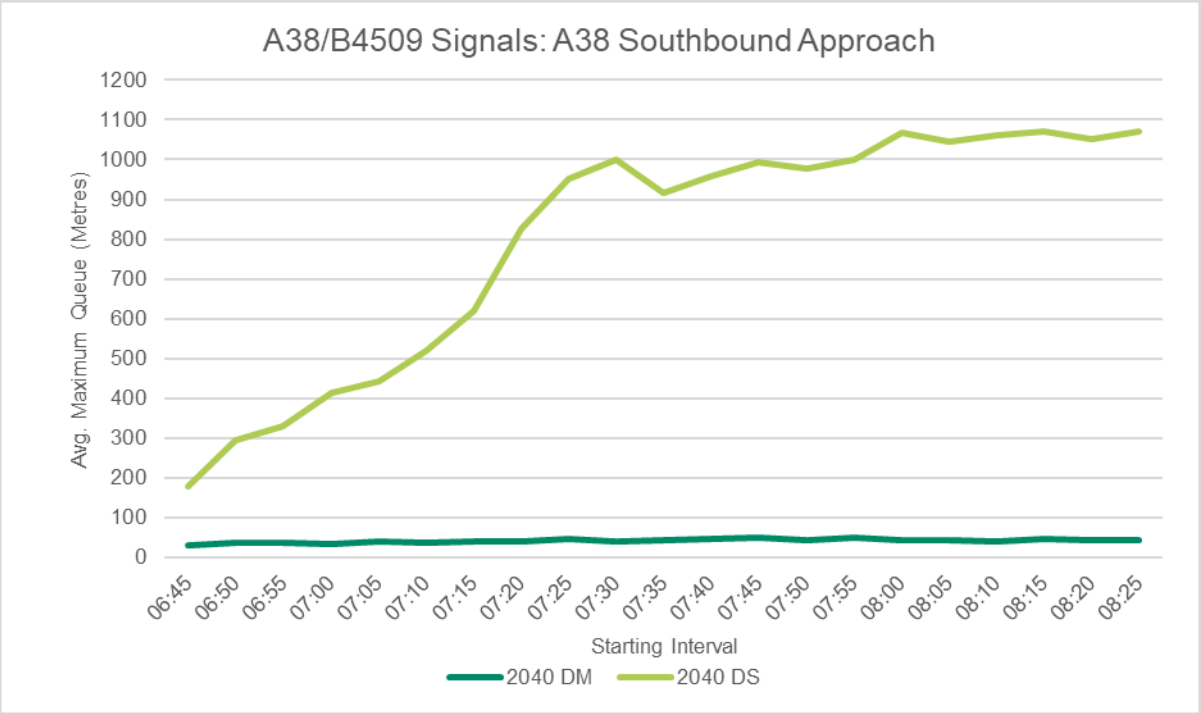
SHEET NUMBER

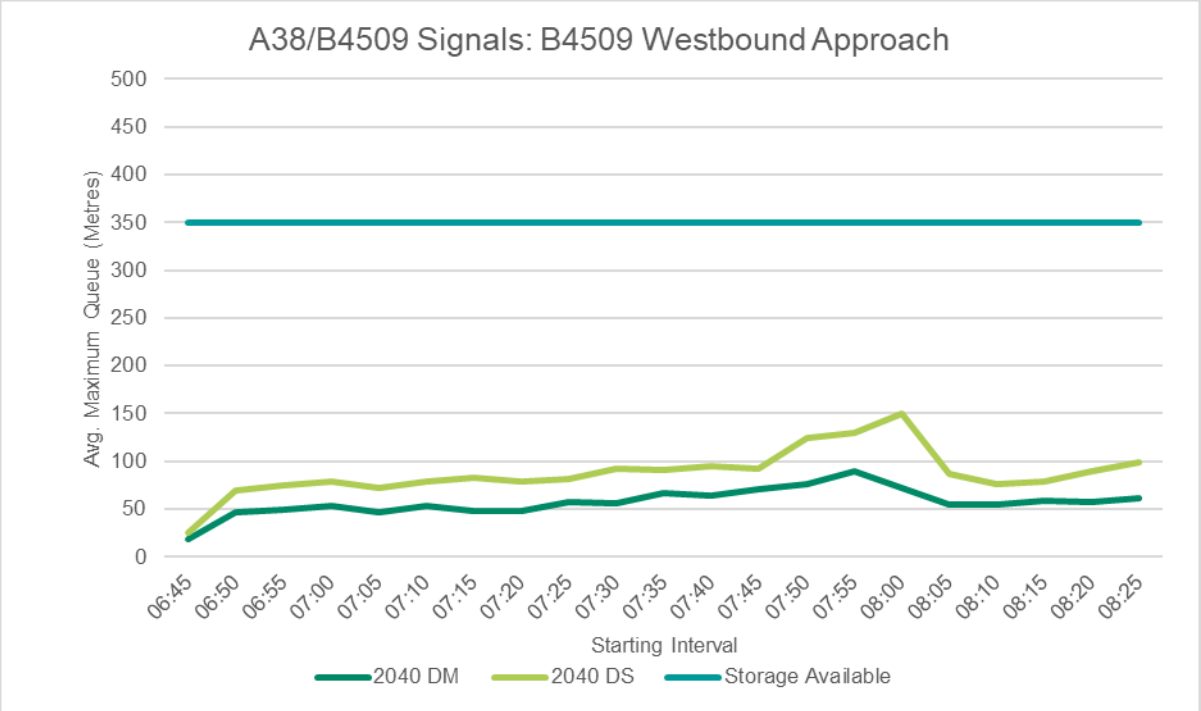
60598598-ACM-ZZ-DR-ZZ-00-00-0101

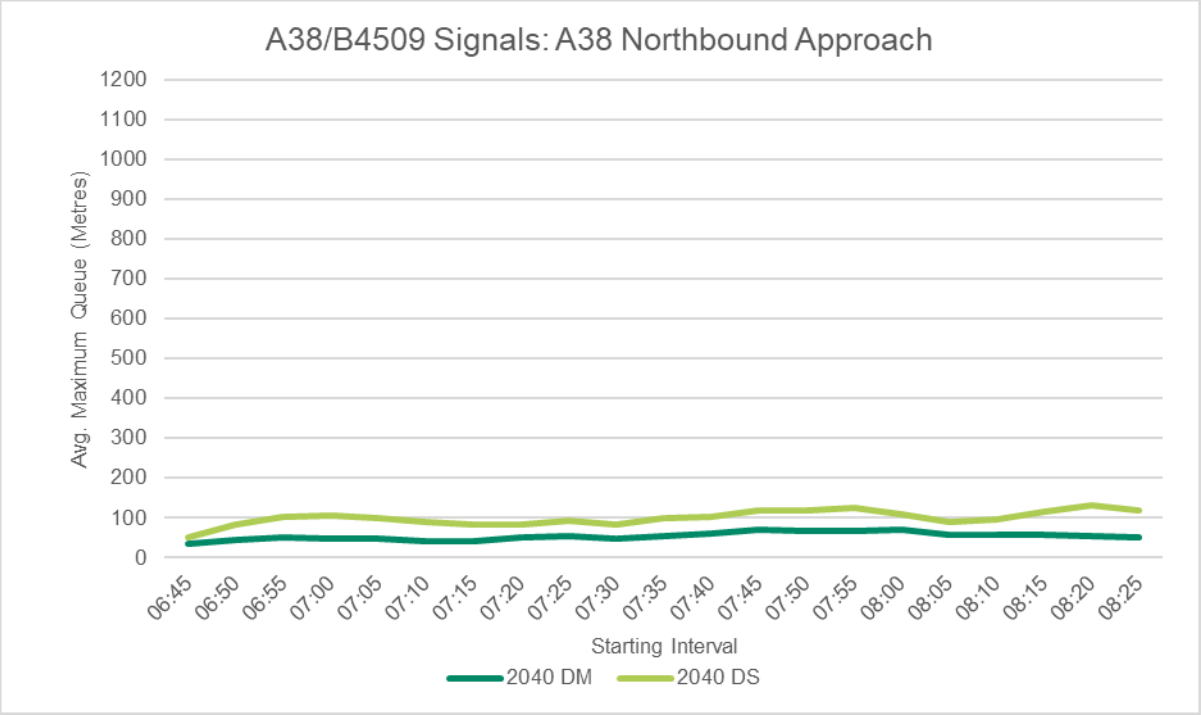
Filename: \\NA.AECOMNET.COM\LFS\EMEA\CARDIFF-UKCDF1\LEGACY\UKCDF1FP002\UKCDF1FP002-V1TP\PROJECTS\60598598 - STROUD LOCAL PLAN TA M5 JUNC 1415.0 CADD\5.3 DRAWINGS\SERIES 0100 - PRELIM\60598598-ACM-ZZ-DR-ZZ-00-00-0101.DWG
Last saved by: HATTONCM(2024-09-06) Last Plotted: 2024-09-06
Project Management Initials: Designer: CH Checked: DC Approved: CC ISO A1 594mm x 841mm

Appendix C – A38/B4509 Maximum Queue Lengths

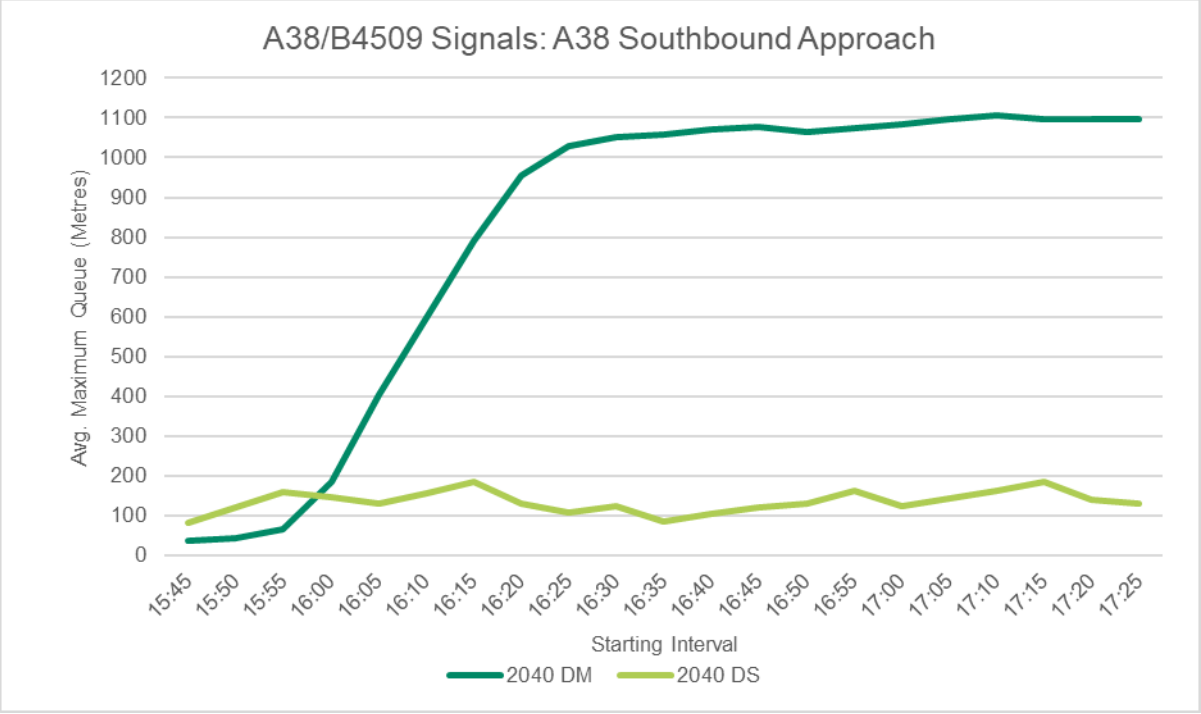
C.1 2040 AM

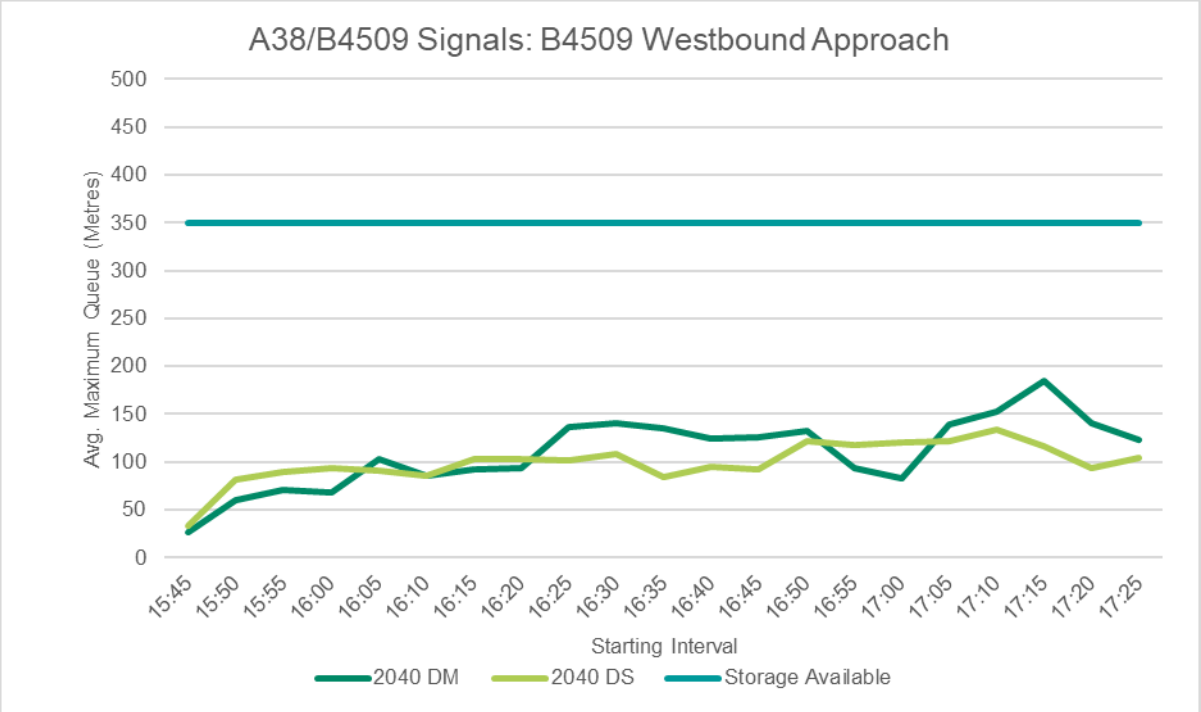


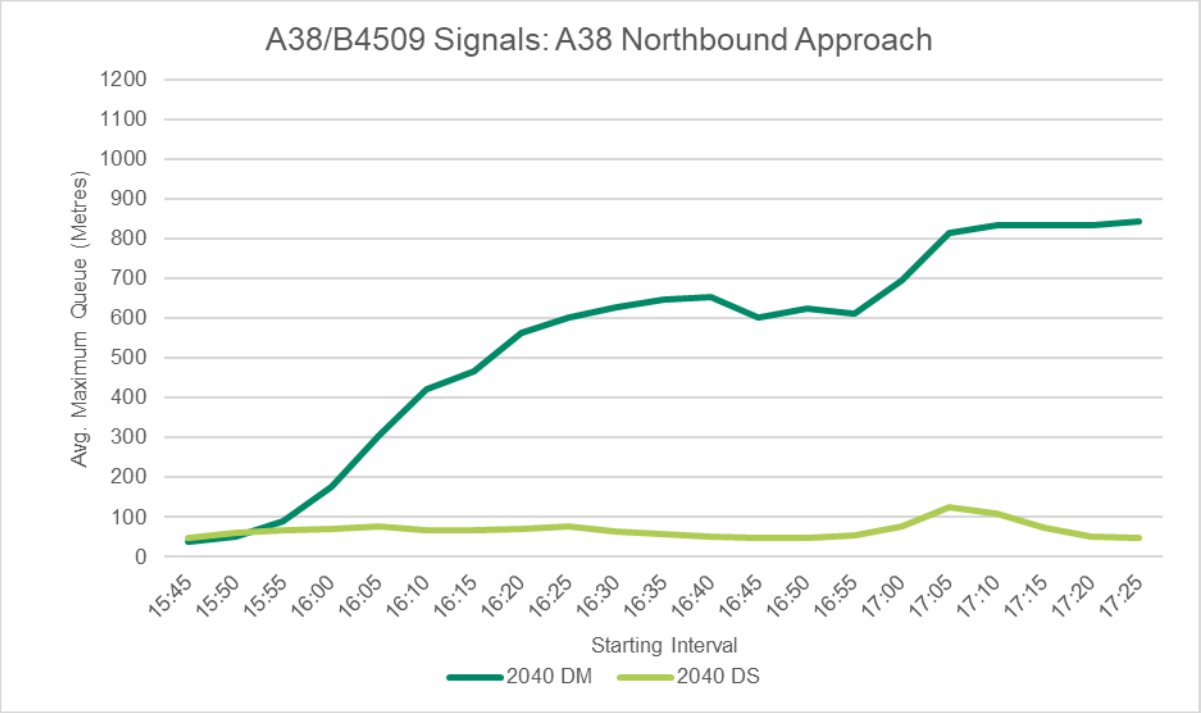



A38/B4509 Signals: A38 Northbound Approach
Avg. Maximum Queue (Metres)
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
06:45
06:50
06:55
07:00
07:05
07:10
07:15
07:20
07:25
07:30
07:35
07:40
07:45
07:50
07:55
08:00
08:05
08:10
08:15
08:20
08:25
Starting Interval
2040 DM
2040 DS

C.2 2040 PM

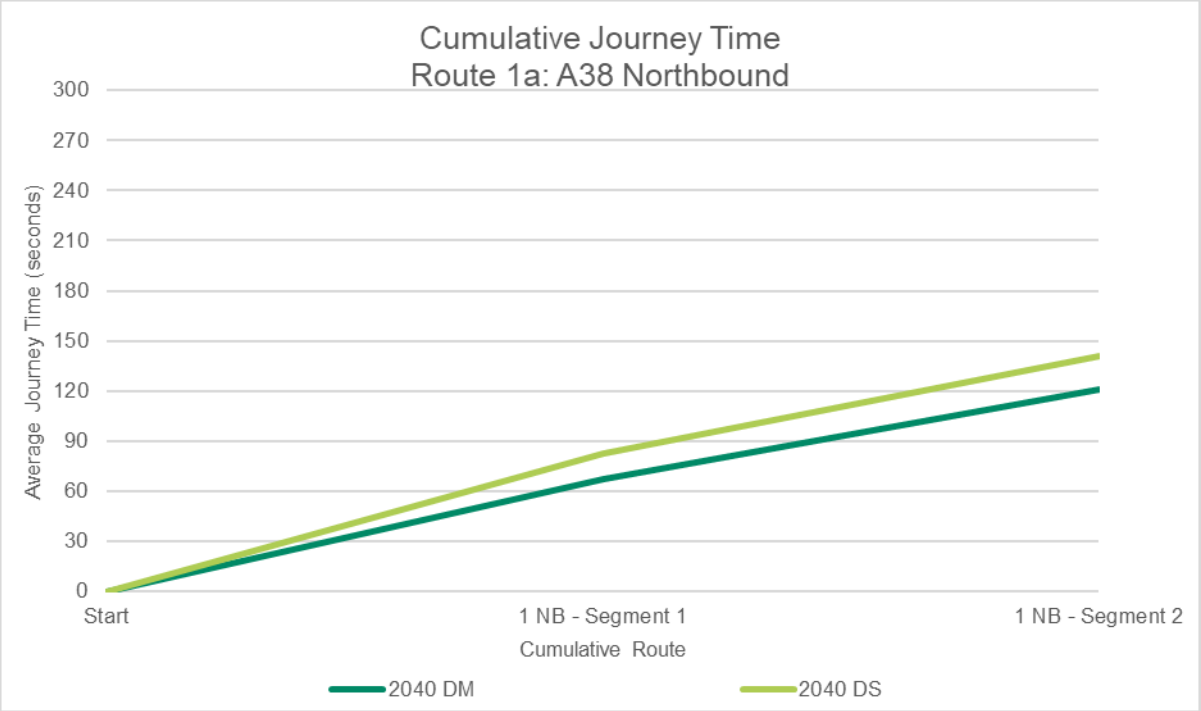

A38/B4509 Signals: A38 Southbound Approach
Avg. Maximum Queue (Metres)
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
15:45
15:50
15:55
16:00
16:05
16:10
16:15
16:20
16:25
16:30
16:35
16:40
16:45
16:50
16:55
17:00
17:05
17:10
17:15
17:20
17:25
Starting Interval
2040 DM
2040 DS

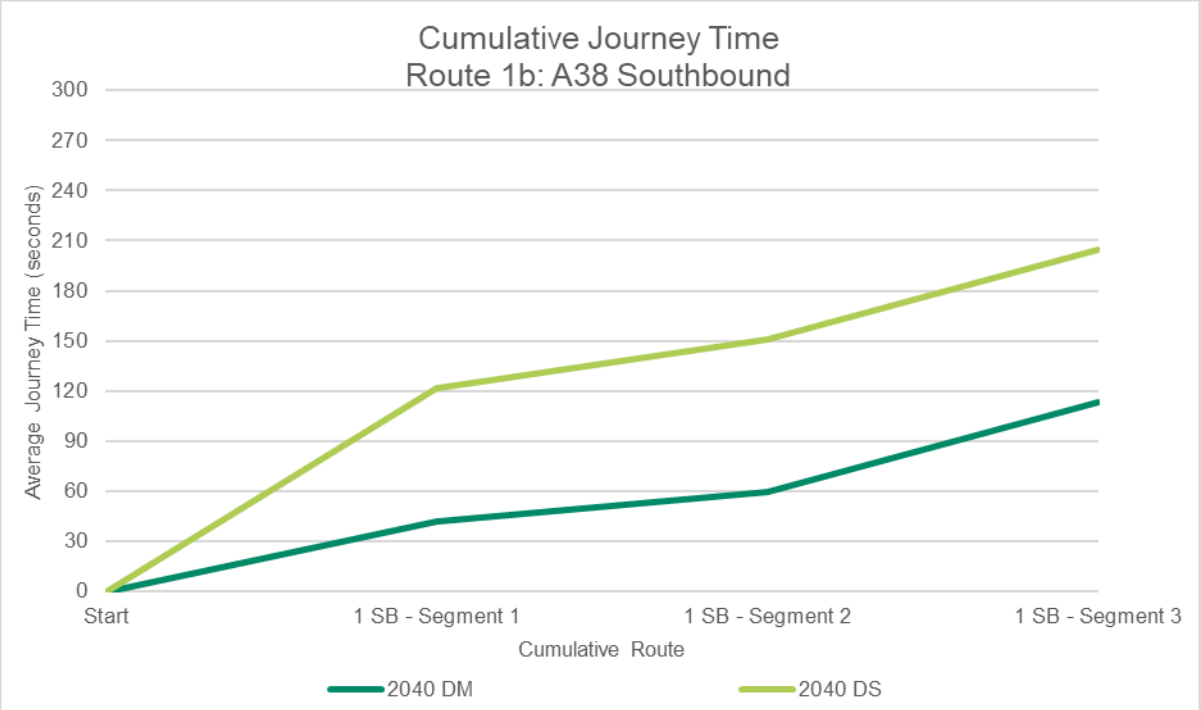

A38/B4509 Signals: B4509 Westbound Approach
Avg. Maximum Queue (Metres)
500
450
400
350
300
250
200
150
100
50
0
15:45
15:50
15:55
16:00
16:05
16:10
16:15
16:20
16:25
16:30
16:35
16:40
16:45
16:50
16:55
17:00
17:05
17:10
17:15
17:20
17:25
Starting Interval
2040 DM
2040 DS
Storage Available

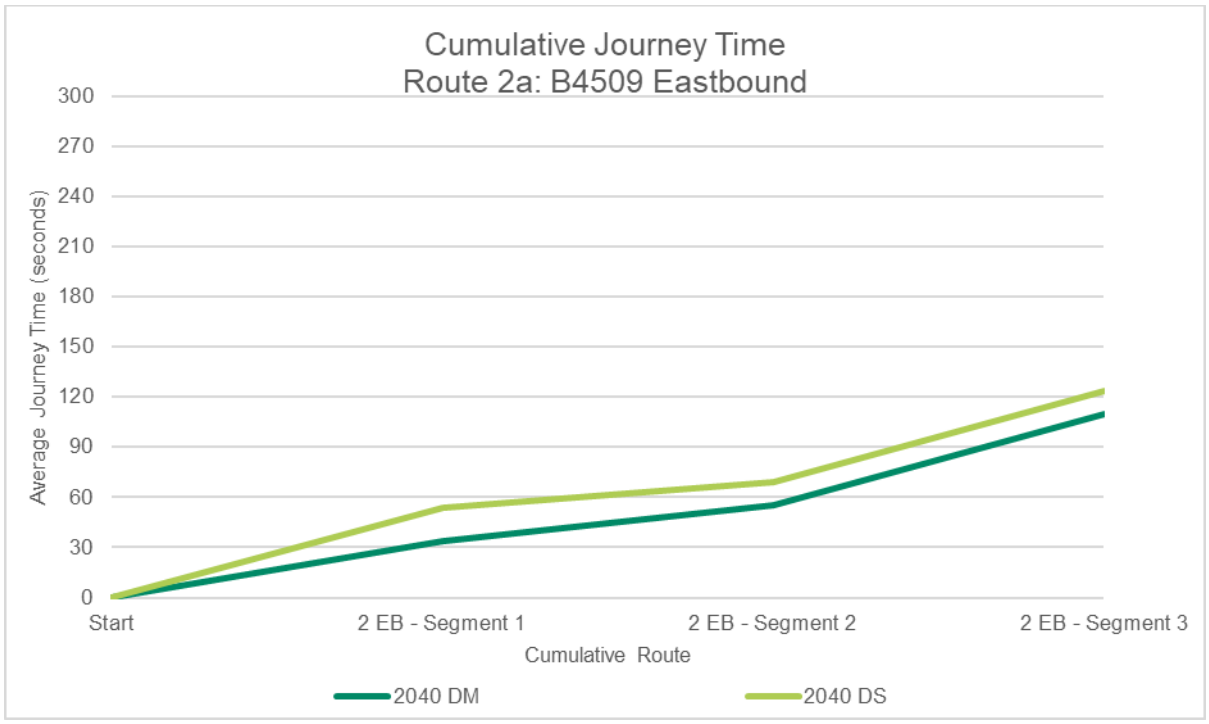

A38/B4509 Signals: A38 Northbound Approach
Avg. Maximum Queue (Metres)
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
15:45
15:50
15:55
16:00
16:05
16:10
16:15
16:20
16:25
16:30
16:35
16:40
16:45
16:50
16:55
17:00
17:05
17:10
17:15
17:20
17:25
Starting Interval
2040 DM
2040 DS

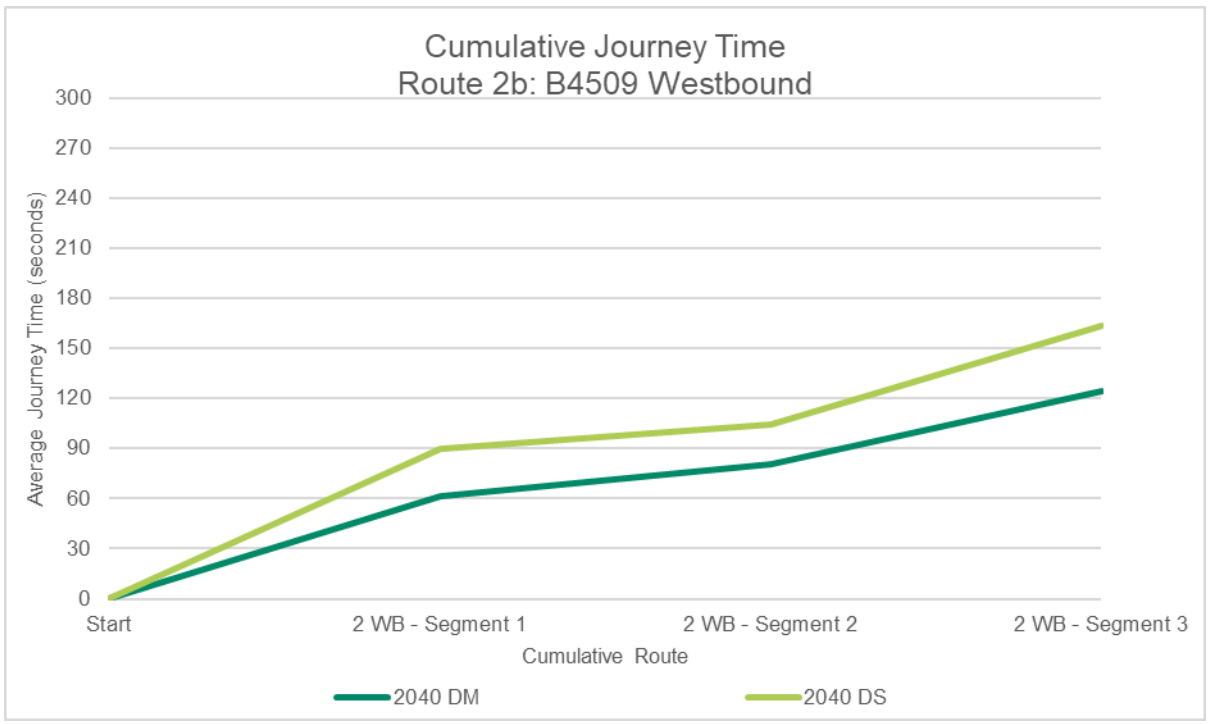
Appendix D – 2040 Journey Time Results

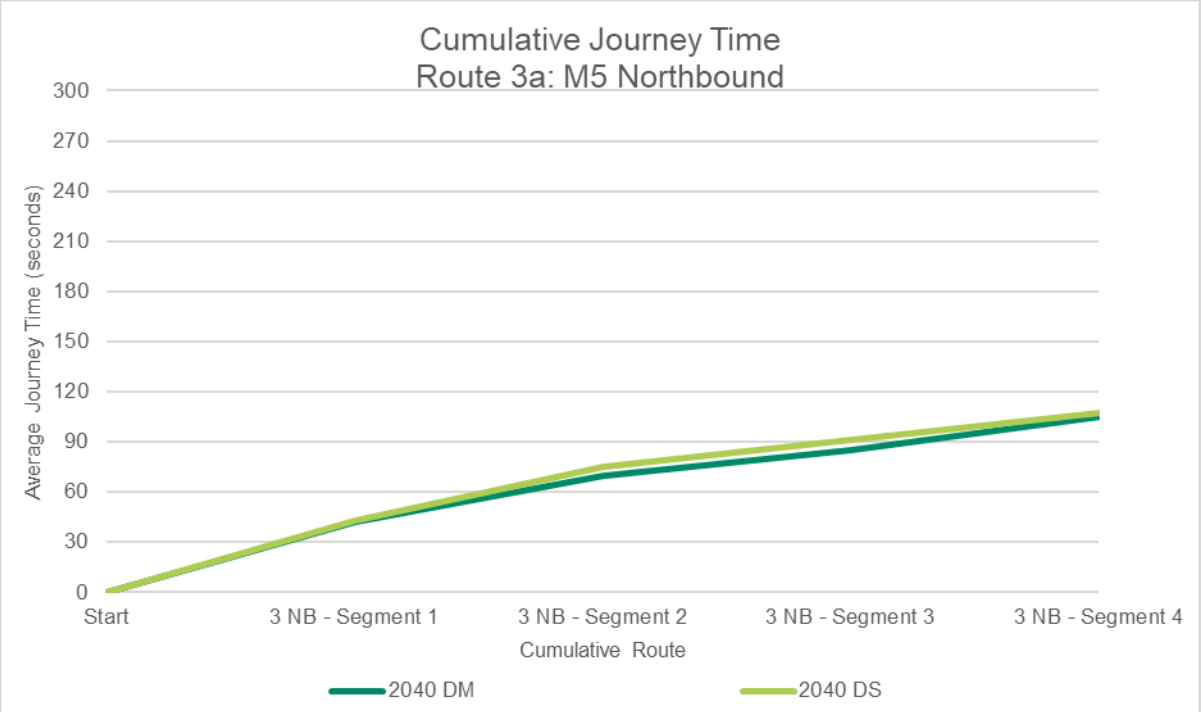
D.1 2040 AM Peak Hour (07:15 – 08:15)

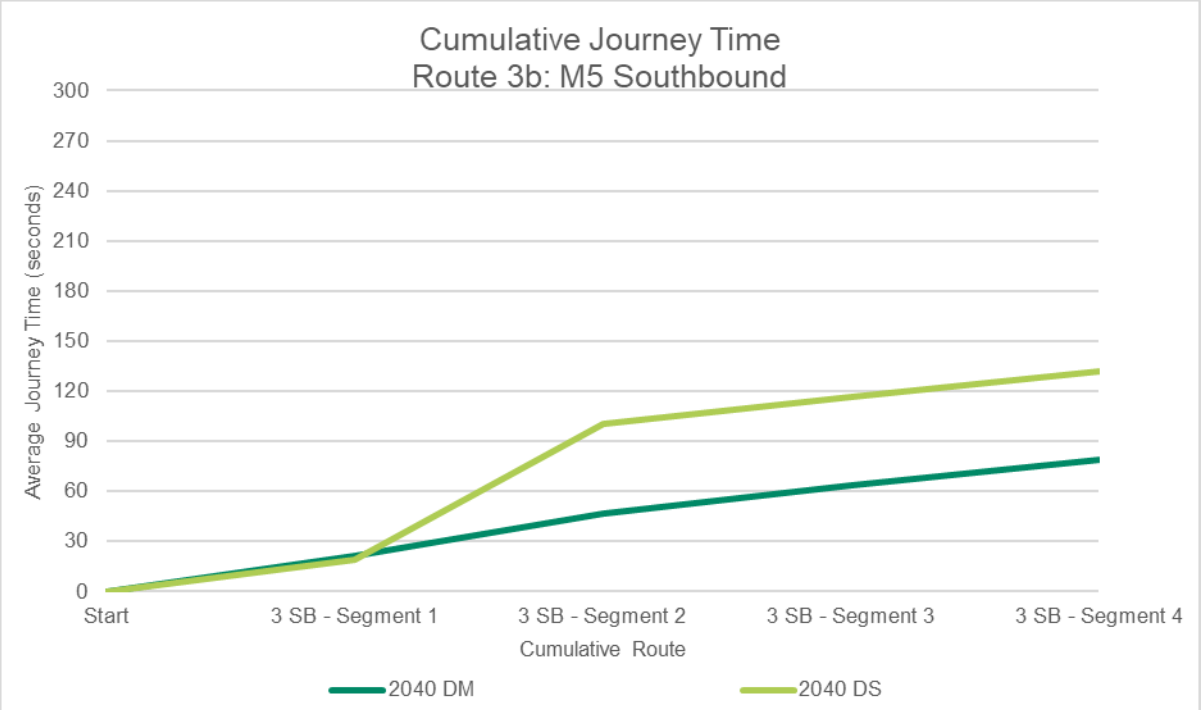




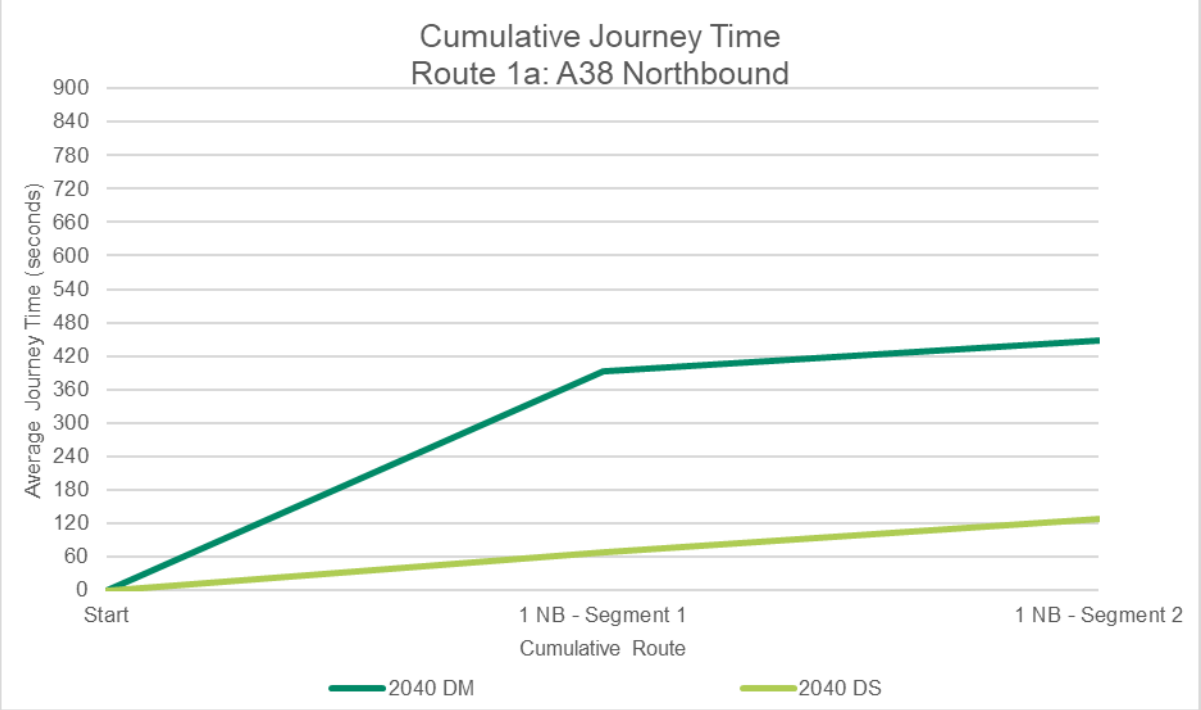

Cumulative Journey Time
Route 2a: B4509 Eastbound
Average Journey Time (seconds)
300
270
240
210
180
150
120
90
60
30
0
Start
2 EB - Segment 1
2 EB - Segment 2
2 EB - Segment 3
Cumulative Route
2040 DM
2040 DS

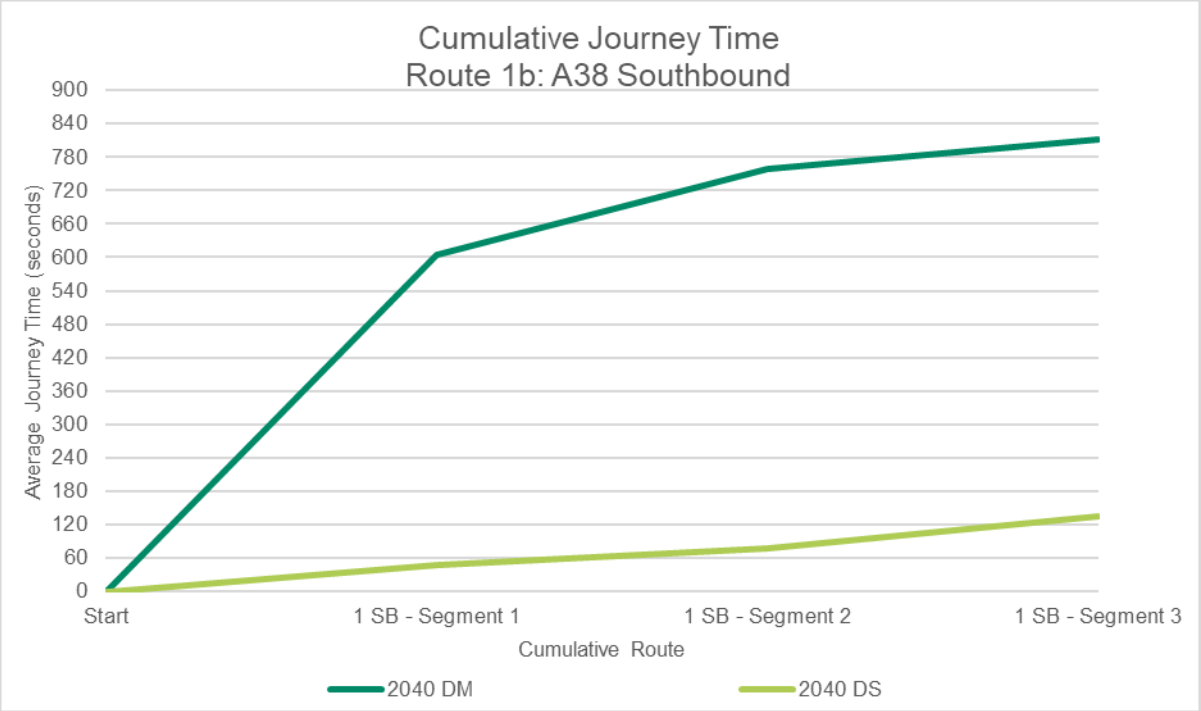

Cumulative Journey Time
Route 2b: B4509 Westbound
Average Journey Time (seconds)
300
270
240
210
180
150
120
90
60
30
0
Start
2 WB - Segment 1
2 WB - Segment 2
2 WB - Segment 3
Cumulative Route
2040 DM
2040 DS

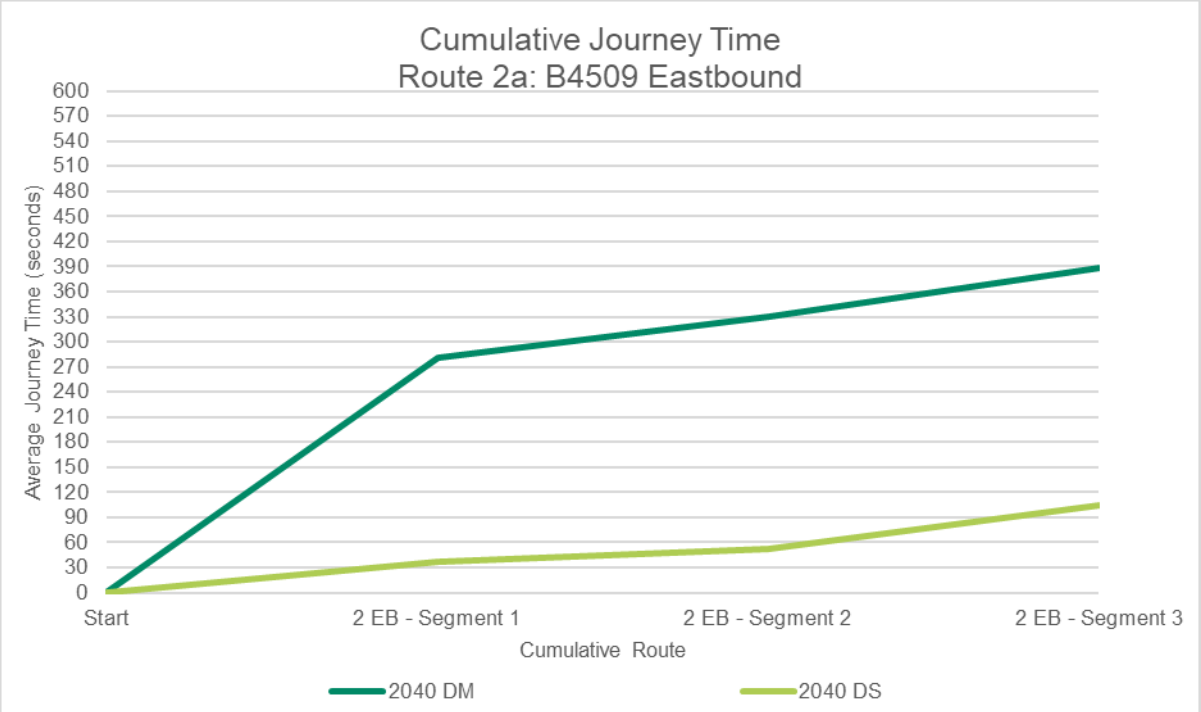

Cumulative Journey Time
Route 3a: M5 Northbound
Average Journey Time (seconds)
300
270
240
210
180
150
120
90
60
30
0
Start
3 NB - Segment 1
3 NB - Segment 2
3 NB - Segment 3
3 NB - Segment 4
Cumulative Route
2040 DM
2040 DS

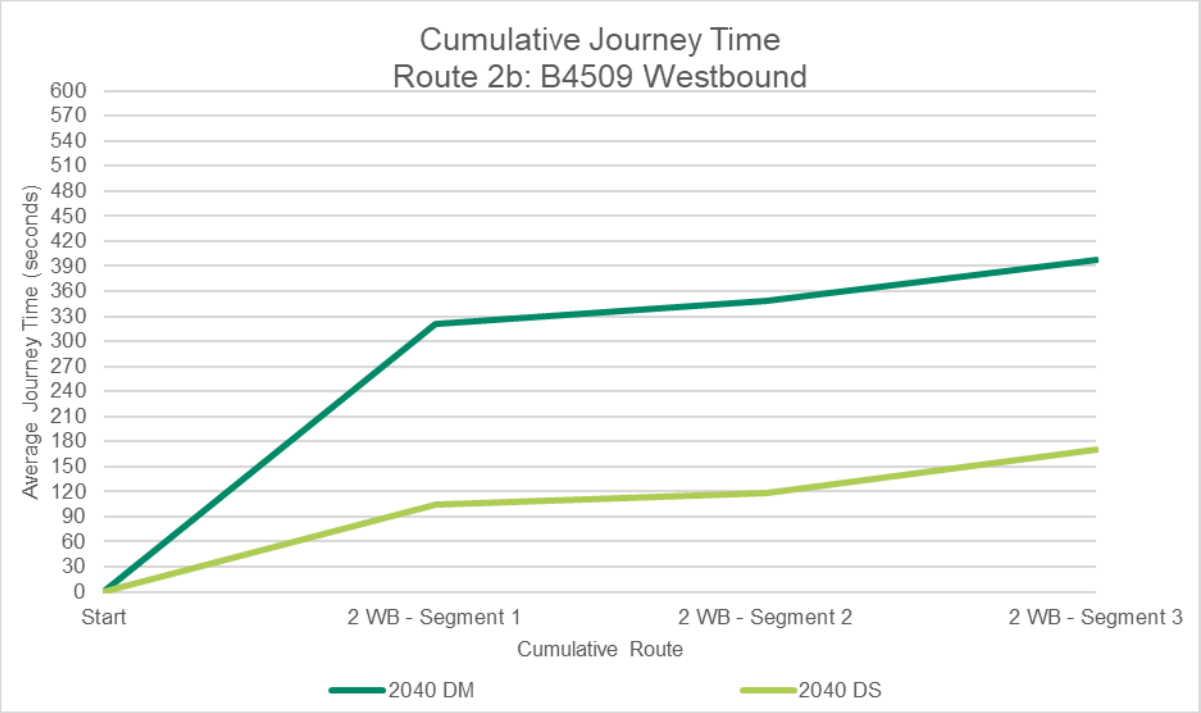

Cumulative Journey Time
Route 3b: M5 Southbound
Average Journey Time (seconds)
300
270
240
210
180
150
120
90
60
30
0
Start
3 SB - Segment 1
3 SB - Segment 2
3 SB - Segment 3
3 SB - Segment 4
Cumulative Route
2040 DM
2040 DS

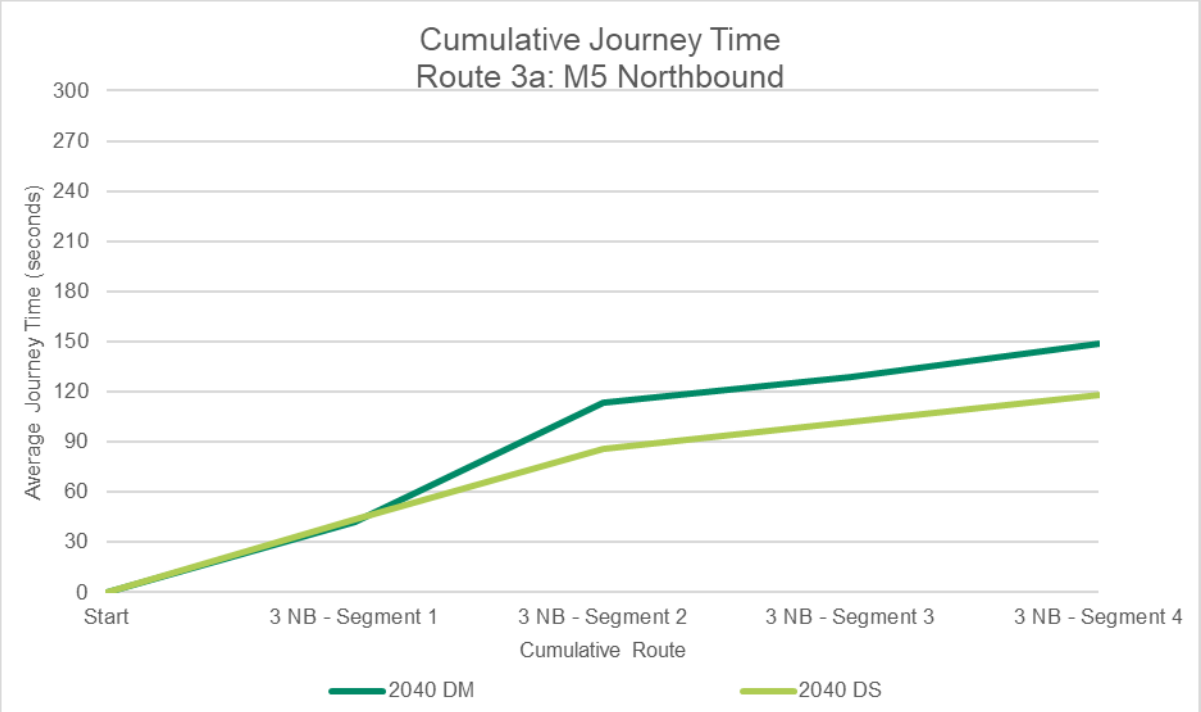
D.2 2040 PM Peak Hour (16:15 – 17:15)

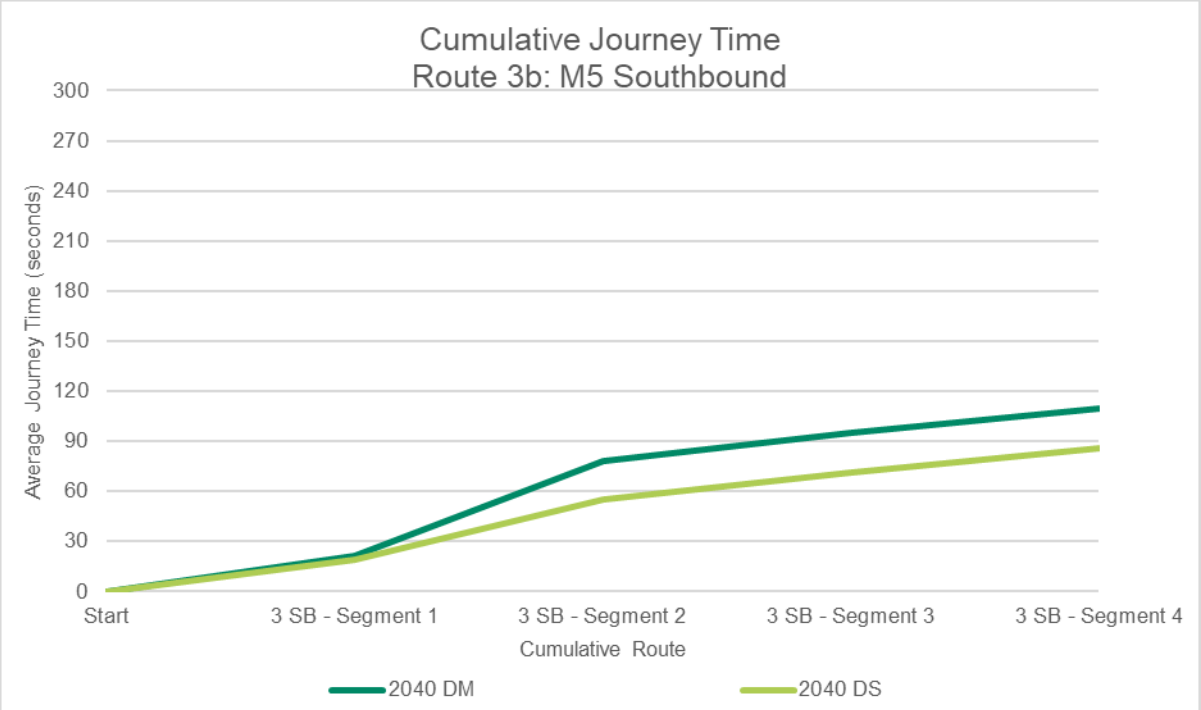





Cumulative Journey Time
Route 2a: B4509 Eastbound
Average Journey Time (seconds)
600
570
540
510
480
450
420
390
360
330
300
270
240
210
180
150
120
90
60
30
0
Start
2 EB - Segment 1
2 EB - Segment 2
2 EB - Segment 3
Cumulative Route
2040 DM
2040 DS


Cumulative Journey Time
Route 2b: B4509 Westbound
Average Journey Time (seconds)
600
570
540
510
480
450
420
390
360
330
300
270
240
210
180
150
120
90
60
30
0
Start
2 WB - Segment 1
2 WB - Segment 2
2 WB - Segment 3
Cumulative Route
2040 DM
2040 DS


Cumulative Journey Time
Route 3a: M5 Northbound
Average Journey Time (seconds)
300
270
240
210
180
150
120
90
60
30
0
Start
3 NB - Segment 1
3 NB - Segment 2
3 NB - Segment 3
3 NB - Segment 4
Cumulative Route
2040 DM
2040 DS


Cumulative Journey Time
Route 3b: M5 Southbound
Average Journey Time (seconds)
300
270
240
210
180
150
120
90
60
30
0
Start
3 SB - Segment 1
3 SB - Segment 2
3 SB - Segment 3
3 SB - Segment 4
Cumulative Route
2040 DM
2040 DS

Appendix G – Order of Cost Estimate

M5 J14
Order of Cost Estimate

06 September 2024

Version 2.00

60598598

Delivering a better world

Table of Contents

Main Report

Appendices

QUALITY INFORMATION

Prepared by	Checked by	Verified by
T. Garland		
Tom Garland MRICS	Sam Cassidy	Mark Lowman MRICS

Revision History

Version	Date	Details	Approved by	Signature	Position
2.00	06-Sep-24	M5 J14 Order of Cost Estimate	James Morrison MRICS		Project Director

Distribution List

# Hard Copies	PDF Required	Client Name	Company Name	Association
N/A	√	Stroud District Council	Stroud District Council	Client

Prepared for:

Stroud District Council, Stroud District Council

Prepared by:

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Executive Summary

1. Executive Summary

This estimate has been prepared by AECOM for Stroud District Council and provides the Order of Cost Estimate for the proposed construction of the M5 J14 works. This Order of Cost Estimate reflects the final release of the RIBA Stage 1 design information on 6th September 2024 produced by AECOM.

M5 J14 is a circa 110,195m² GEA road construction with associated new bridge. The proposed project includes re-surfacing works, construction of new roads, and construction of a new overbridge.

Refer to section 2.0 for a full breakdown of the basis, assumptions and exclusions.

The rates within this Order of Cost Estimate are dated 3Q24 and the Cost Estimate excludes inflation.

Project Cost

	Total
Order of Cost Estimate	£110,462,905

Total Area & Key Metrics

Gross External Area	110,195m2
Traffic Management	13.9%
Preliminaries	35.0%
OH&P	10.0%
Risk Allowances	10.0%
Optimism Bias	59.0%

Programme

The Cost Estimate and Programme currently assumes a two-stage design & build procurement route.

Programme and Timeframe are yet to be agreed.

1.1 Cost Summary

The following summarises the current Rough Order of Cost Estimate

Summary of Costs		Order of Cost Estimate	£/GEA
Civil Engineering Works		£25,923,329	£ 235/m²
Traffic Management	13.9%	£3,605,117	£ 33/m²
Main Contractor's Preliminaries	35.0%	£10,334,956	£ 94/m²
Main Contractor's OH&P	10.0%	£3,986,340	£ 36/m²
Total Works Cost Estimate		**£43,849,743**	**£ 398/m²**
Design Team Fees	30.0%	£13,154,923	£ 119/m²
Sub-total		**£57,004,666**	**£ 517/m²**
Other Project Costs - commuted sum, land fees, and bond		£6,172,000	£ 56/m²
Base Cost Estimate		**£63,176,666**	**£ 573/m²**
Risk Allowances	10.0%	£6,317,667	£ 57/m²
Cost Limit (excl. Inflation and Optimism Bias)		**£69,494,332**	**£ 631/m²**
Tender Inflation - Excluded	0.0%	£0	£ -/m²
Construction Inflation - Excluded	0.0%	£0	£ -/m²
Cost Limit (incl. Inflation and excl. Optimism Bias)		**£69,494,332**	**£ 631/m²**
Optimism Bias	59.0%	£40,968,573	£ 372/m²
Cost Limit (incl. Inflation and Optimism Bias)		**£110,462,905**	**£ 1,002/m²**
VAT Assessment - Excluded	0.0%	£ -	£ -/m²
Cost Limit (incl. Inflation, Optimism Bias and VAT)		**£110,462,905**	**£ 1,002/m²**

1.2 Inflation

As no time frame or programme has been agreed inflation has been excluded.

Basis, Assumptions and Exclusions

2 Basis, Assumptions and Exclusions

2.1 Basis

This Order of Cost Estimate has been prepared by AECOM for Stroud District Council based on the RIBA Stage 1 design information using the drawings as outlined within Appendix B of this report.

The rates within this Order of Cost Estimate are based at 3Q24 price levels and the Cost Estimate excludes inflation. The basis of the pricing generally reflects a two-stage design and build approach.

The measurements and rates contained within this estimate were compiled for use within this estimate only and should not be used by any third parties.

2.1.1 Changes from Last Report

Following discussions with the National Highways on this project and the M5 J12 project, for consistency between the Order of Cost Estimates the following was add or Omitted on the advise of the National Highway

Allowance of £500k for Land acquisition added.
Allowance of £5 million for National Highways Commuted sums for maintenance added .
Allowance of £675k for National Highways bond for third party delivery Added.
VAT now Excluded

Changes to Quantities following changes to slip roads

2.1.1 Primary Design Metrics

Gross External Area (GEA): **110,195m2**

2.2 Key Assumptions and Exclusions

Included within Order of Cost Estimate

1	Procurement of the Main Contractor will be two-stage design and build.
2	Excavated materials removed offsite have been assumed to be non-hazardous.
3	Traffic management at 13.9%. General Traffic management and over night closers based on the allowance included with the benchmark projects.
4	Total risk contingency at 10%.
5	Preliminaries at 35%.
6	OH&P at 8%.
7	Design fees at 30%.
8	Other project costs other than land allowance, commuted sum, and bond costs included in with design fees
9	Land allowance of £500k. Value included based on discussions with NH and consistency with J12 work. Level of land take likely to be lower than J12.
10	Commuted sums of £5m. Value included based on discussion with NH and consistency with J12 work.
11	Bond of £672k. Value included based on discussion with NH and consistency with J12 work.
12	Optimism Bias set at 66% for any works next to Motorway and new overbridge construction all other section set out 44% given a average 59%.
13	General site clearance required to existing road and verges/embankments areas.
14	Existing kerbs and road restraint systems to be taken up and disposed of.
15	New road restraint system to be double-sided corrugated beam.
16	Allowances made for drainage to roads and verges/embankments based on a m2 basis.
17	Assumed no work is required to the existing overbridge.
18	Existing carriageway to be excavated to sub-base level and re-constructed.
19	Embankments to be built up and cuttings to be completed as per cut and fill quantities provided on drawings.
20	All cuttings to be disposed off site.
21	Topsoiling required to embankments, cuttings, and verges.
22	Geotextile required to both carriageway and landscaping works.
23	Carriageway costing to include base course, binder course, and surface course only.
24	Existing signs on slip roads to remain as per existing.
25	Allowance made for road lighting to all carriageways.
26	New bridge to be single span bridge reinforced concrete with pre-fabricated steel beams subject to further design.
27	Only grass seeding works required to verges and embankments.
28	Allowance for Service Diversions is based on a low risk of major work to services given location and that we are retaining exising brigde

Excluded from Order of Cost Estimate

1	Professional Legal fees, planning/building control fees, statutory fees, site surveys, environmental audits, wind studies, monitoring costs, third party fees/costs, wind studies, novated design fees, other fees.
2	Air rights, rights to light, oversailing licences, sale or letting fees/costs, compensation payment costs (incl. third party compensation settlements) and other development costs.
3	Client finance costs (e.g. interest charges) and insurances.
4	Local Authority charges e.g. road closures etc.
5	Costs relating to CIL, Section 106 or 278 agreements.
6	Taxation related costs; i.e. Carbon Abatement Tax.
7	Inflation
8	Statutory Authorities works.
9	Decanting of existing facilities or provision of temporary facilities.
10	Client direct IT equipment (e.g. PC's/telephones/projectors etc.).
11	Costs associated with offsite infrastructure upgrades.
12	Costs associated with hazardous materials (e.g. asbestos) or removal of contaminated materials offsite.
13	Costs associated with bio-diversity off-setting.
14	Costs associated change in regulations or COVID-19 guidance.
15	Out of hours working.
16	Changes in legislation/regulatory requirements/statutory levies.
17	Capital allowances or other incentives/grants.
18	Costs related to abnormal ground conditions (e.g. arch discoveries, UXO).
19	Hyperinflation.
20	Sub-base to carriageway.
21	Excavation of existing embankments to base level for re-construction.
22	Works to the motorway not including the slip roads.
23	Exchange rate fluctuations or tariffs resulting from Brexit.
24	New Traffic signals
25	Biodiversity net gain.
26	Regulatory process costs.
27	Land Compensation Claim costs
28	VAT.

Elemental Summary

3 Elemental Summary

3.1 Breakdown of Order of Cost Estimate

The following table outlines the Order of Cost Estimate and allows for the review of the estimate on a £/m² GEA basis:

Elemental Summary		Totals		£/GEA	Comments
Series 100 - Preliminaries	Included		£	-/m²	
Series 200 - Site Clearance	£	293,972	£	3/m²	
Series 300 - Fencing	£	-	£	-/m²	
Series 400 - Road Restraint	£	200,077	£	2/m²	
Series 500 - Drainage and Service Ducts	£	3,601,024	£	33/m²	
Series 600 - Earthworks	£	11,018,137	£	100/m²	
Series 700 - Pavements	£	3,842,432	£	35/m²	
Series 1100 - Kerbs	£	116,201	£	1/m²	
Series 1200 - Traffic Signs	£	40,000	£	0/m²	
Series 1300 - Road Lighting	£	260,166	£	2/m²	
Series 1400 - Electrical Works	£	-	£	-/m²	
Series 1600 - Piling	£	-	£	-/m²	
Series 1700 - Structural Concrete	£	6,203,787	£	56/m²	
Series 1800 - Steel	£	-	£	-/m²	
Series 1900 - Steel Protection	£	-	£	-/m²	
Series 2000 - Waterproofing	£	-	£	-/m²	
Series 2100 - Bridge Bearings	£	-	£	-/m²	Included in Series 1700 with bridge costs
Series 2300 - Bridge Expansion Joints	£	-	£	-/m²	Included in Series 1700 with bridge costs
Series 2500 - Special Structures	£	-	£	-/m²	
Series 3000 - Landscaping	£	347,532	£	3/m²	
Traffic Management 13.9%	£	3,605,117	£	33/m²	
Main Contractor Preliminaries 35.0%	£	10,334,956	£	94/m²	
Main Contractor OH&P 10.0%	£	3,986,340	£	36/m²	
Total Works Cost Estimate	**£**	**43,849,743**	**£**	**398/m²**	

Design Team Fees		£	13,154,923	£	119/m²	
Sub-total		**£**	**57,004,666**	**£**	**517/m²**	
Other Project Costs		£	6,172,000	£	56/m²	Includes for land allowance, commuted sum, and bond
Base Cost Estimate		**£**	**63,176,666**	**£**	**573/m²**	
Risk Allowances						
Design Development	2.5%	£	1,579,417	£	14/m²	
Construction	2.5%	£	1,579,417	£	14/m²	
Employer Change	2.5%	£	1,579,417	£	14/m²	
Employer Other	2.5%	£	1,579,417	£	14/m²	
Cost Limit (excl. Inflation and Optimism Bias)		**£**	**69,494,332**	**£**	**631/m²**	
Tender Price Inflation		Excluded		£	-/m²	
Construction Price Inflation		Excluded		£	-/m²	
Cost Limit (incl. Inflation and excl. Optimism Bias)		**£**	**69,494,332**	**£**	**631/m²**	
Optimism Bias	59.0%	£	40,968,573	£	372/m²	
Cost Limit (incl. Inflation and Optimism Bias)		**£**	**110,462,905**	**£**	**1,002/m²**	
VAT Assessment	0.0%	£	-	£	-/m²	
Cost Limit (incl. Inflation and Optimism Bias)		**£**	**110,462,905**	**£**	**1,002/m²**	

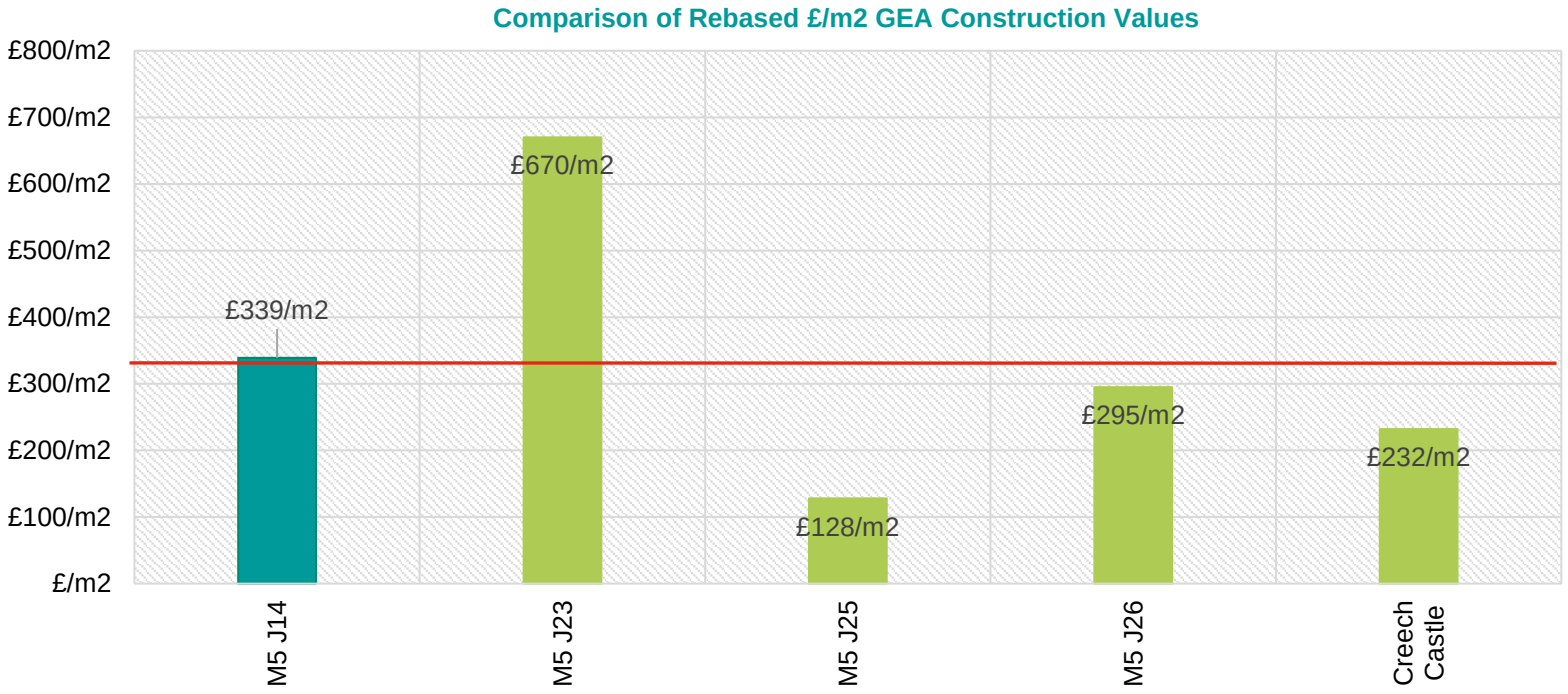
Benchmarking

4 Benchmarking

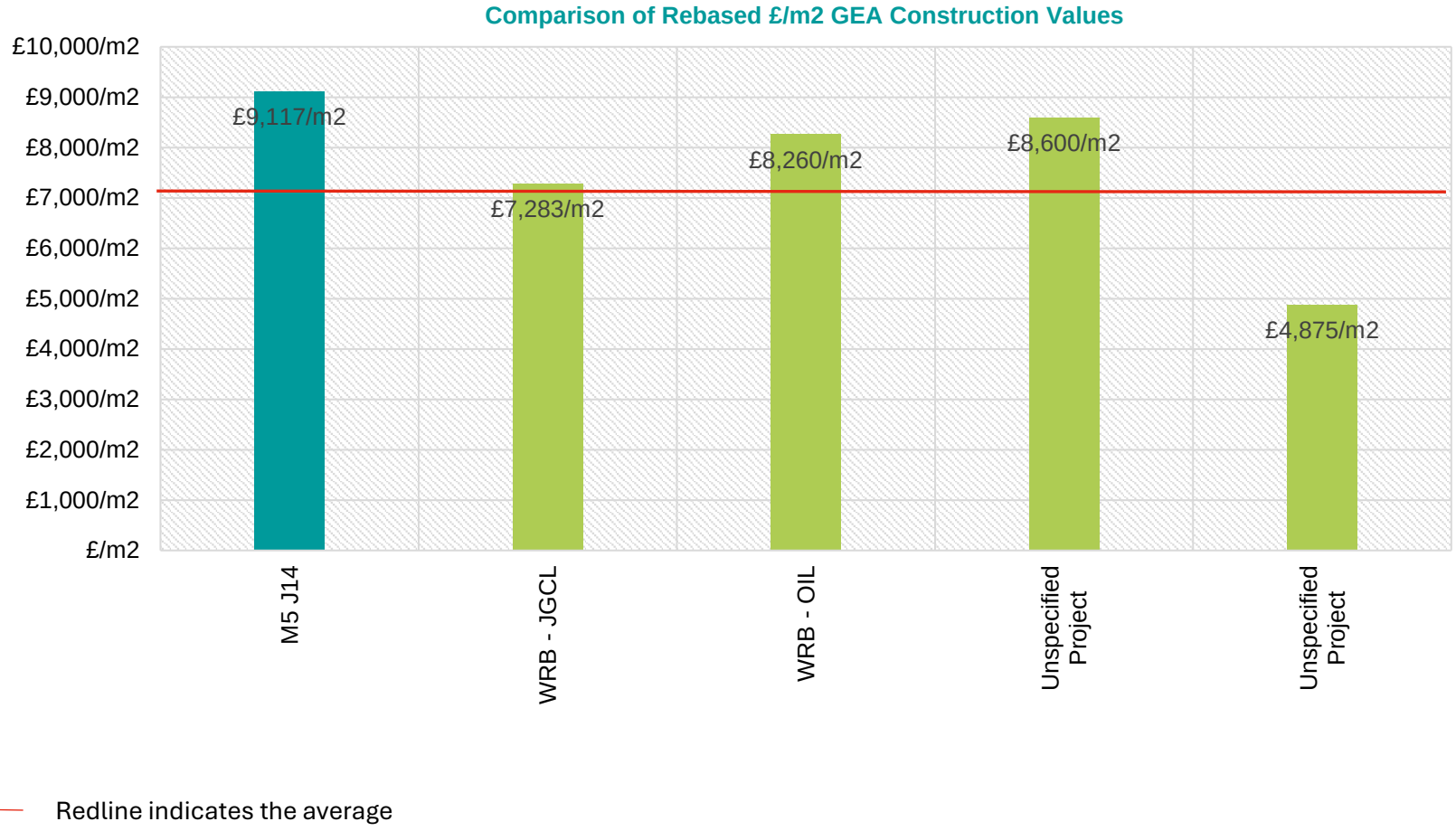
4.1 Benchmarking with Relevant Projects

Benchmarking information is a useful tool in determining the comparative costs of the works in relation to other projects of a similar nature.

The following chart displays the cost of this scheme compared against other relevant highways projects. All costs have been adjusted to a base date of 3Q24.



The following chart displays the cost of this scheme compared against other relevant bridge projects. All costs have been adjusted to a base date of 3Q24.



4.2 Relevant Projects

Project			
M5 J23	M5 junction works including the conversion of the existing roundabout to allow traffic to cut through from south to east. Includes for significant work to the underground utilities in the area and for additional traffic signals to assist in traffic reduction, as well as re-surfacing works to the existing carriageways leading to the roundabout. Project costs are from 2023.	£	9,782,408.3
M5 J25	M5 Junction expansion works including a new road bridge to complement the existing road bridge on the junction. Includes for the excavation and re-building of existing roads and all ancillaries including lighting and signage. Project costs are from 2018.	£	15,580,073.3
M5 J26	M5 junction widening works of the existing carriageway leading off of the junction, including removal of the existing pavement and the use of the rubblization construction method. It also includes for significant drainage and utilities works to the road area where it has been widened for the project. Project costs are from 2023.	£	6,071,224.6
Creech Castle	Includes for the excavation and re-building of the existing road, as well as new roads leading off the junction. Also includes for all ancillaries including lighting, signs and external services. Project costs are from 2020.	£	7,331,565.2
WRB - JGCL	Reinforced concrete road-over-rail bridge with pre-fabricated steel beams. Reduced temporary works requirement to the project below. Includes for temporary pedestrian bridge and associated services. Project costs are from 2021.	£	19,203,037.7
WRB - OIL	Reinforced concrete road-over-rail bridge with pre-fabricated steel beams. Includes for temporary pedestrian bridge and associated services. Works require increased temporary works due to worse than originally thought ground conditions in the work area. Project costs are from 2024.	£	20,014,248.0
Unspecified Bridge Project 1	Reinforced concrete bridge with pre-fabricated steel beams. Includes for concrete, formwork, bridge bearings, etc. Project costs are from 2024.	£	10,320,000.0
Unspecified Bridge Project 2	Reinforced concrete bridge with pre-fabricated steel beams. Includes for concrete, formwork, bridge bearings, etc. Excludes external lighting and ancillary works. Project costs are from 2024.	£	5,850,000.0

Detailed Breakdown of Estimate

Appendix A

Appendix A - Detailed Breakdown of Estimate

Description	Area 1 Quantity	Unit	Rate	Item Cost	Totals	Area 2 Quantity	Unit	Rate	Item Cost	Totals	Area 3 Quantity	Unit	Rate	Item Cost	Totals	Area 4 Quantity	Unit	Rate	Item Cost	Totals	Area 7 (East) Quantity	Unit	Rate	Item Cost	Totals	Area 7 (West) Quantity	Unit	Rate	Item Cost	Totals	Area 8 Quantity	Unit	Rate	Item Cost	Totals	Area 9 Quantity	Unit	Rate	Item Cost	Totals
Series 100 - Preliminaries	Included			Included	Included	Included			Included	Included	Included			Included	Included	Included			Included	Included	Included			Included	Included	Included			Included	Included	Included			Included	Included	Included			Included	Included
Series 200 - Site Clearance					£ 91,753					£ 20,914					£ 27,853					£ 32,294					£ 23,461					£ 22,605					£ 39,234					£ 35,858
Site clearance of existing road	0.77	ha	£ 8,500.00	£ 6,549.67		0.51	ha	£ 8,500.00	£ 4,313.75		0.44	ha	£ 8,500.00	£ 3,744.25		0.40	ha	£ 8,500.00	£ 3,387.35		0.24	ha	£ 8,500.00	£ 2,014.50		0.21	ha	£ 8,500.00	£ 1,755.25		0.98	ha	£ 8,500.00	£ 8,347.00		0.46	ha	£ 8,500.00	£ 3,910.00	
Site clearance for verges and embankments	0.84	ha	£ 2,800.00	£ 2,340.80		1.32	ha	£ 2,800.00	£ 3,705.21		1.44	ha	£ 2,800.00	£ 4,030.72		0.82	ha	£ 2,800.00	£ 2,290.21		0.16	ha	£ 2,800.00	£ 449.40		0.22	ha	£ 2,800.00	£ 611.80		1.55	ha	£ 2,800.00	£ 4,343.49		0.60	ha	£ 2,800.00	£ 1,690.14	
Taking up and disposal of existing kerbs	1,542	m	£ 35.00	£ 53,954.53		197	m	£ 35.00	£ 6,886.18		456	m	£ 35.00	£ 15,954.59		760	m	£ 35.00	£ 26,615.96		300	m	£ 35.00	£ 10,498.77		289	m	£ 35.00	£ 10,118.98		653	m	£ 35.00	£ 22,868.06		451	m	£ 35.00	£ 15,783.79	
Taking up and disposal of existing fencing	826	m	£ 35.00	£ 28,907.98		172	m	£ 35.00	£ 6,008.41		118	m	£ 35.00	£ 4,123.86		0	m	£ 35.00	£ -		300	m	£ 35.00	£ 10,498.77		289	m	£ 35.00	£ 10,118.98		105	m	£ 35.00	£ 3,675.60		414	m	£ 35.00	£ 14,474.27	
Series 300 - Fencing					£ -					£ -					£ -					£ -					£ -					£ -					£ -					£ -
Series 400 - Road Restraint					£ 74,335					£ 15,450					£ 10,604					£ -					£ 26,997					£ 26,020					£ 9,452					£ 37,220
Road restraint barrier	826	m	£ 90.00	£ 74,334.80		172	m	£ 90.00	£ 15,450.20		118	m	£ 90.00	£ 10,604.20		0	m	£ 90.00	£ -		300	m	£ 90.00	£ 26,996.83		289	m	£ 90.00	£ 26,020.24		105	m	£ 90.00	£ 9,451.55		414	m	£ 90.00	£ 37,219.54	
Series 500 - Drainage and Service Ducts					£ 558,220					£ 453,000					£ 426,200					£ 409,404					£ 344,800					£ 332,600					£ 642,800					£ 434,000
Allowance for drainage to new road	7,705	m2	£ 40.00	£ 308,219.55		5,075	m2	£ 40.00	£ 203,000.00		4,405	m2	£ 40.00	£ 176,200.00		3,985	m2	£ 40.00	£ 159,404.49		2,370	m2	£ 40.00	£ 94,800.00		2,065	m2	£ 40.00	£ 82,600.00		9,820	m2	£ 40.00	£ 392,800.00		4,600	m2	£ 40.00	£ 184,000.00	
Service Diversions	1	Item	£ 250,000.00	£ 250,000.00		1	Item	£ 250,000.00	£ 250,000.00		1	Item	£ 250,000.00	£ 250,000.00		1	Item	£ 250,000.00	£ 250,000.00		1	Item	£ 250,000.00	£ 250,000.00		1	Item	£ 250,000.00	£ 250,000.00		1	Item	£ 250,000.00	£ 250,000.00		1	Item	£ 250,000.00	£ 250,000.00	
Series 600 - Earthworks					£ 3,268,842					£ 1,955,386					£ 1,478,071					£ 1,015,663					£ 487,335					£ 1,006,695					£ 1,256,564					£ 549,582
Excavation of carriageway to base level (including breaking through hard surfaces)	7,705	m2	£ 20.00	£ 154,109.77		5,075	m2	£ 20.00	£ 101,500.00		4,405	m2	£ 20.00	£ 88,100.00		3,985	m2	£ 20.00	£ 79,702.24		2,370	m2	£ 20.00	£ 47,400.00		2,065	m2	£ 20.00	£ 41,300.00		9,820	m2	£ 20.00	£ 196,400.00		4,600	m2	£ 20.00	£ 92,000.00	
Disposal of above	7,705	m2	£ 35.00	£ 269,692.10		5,075	m2	£ 35.00	£ 177,625.00		4,405	m2	£ 35.00	£ 154,175.00		3,985	m2	£ 35.00	£ 139,478.93		2,370	m2	£ 35.00	£ 82,950.00		2,065	m2	£ 35.00	£ 72,275.00		9,820	m2	£ 35.00	£ 343,700.00		4,600	m2	£ 35.00	£ 161,000.00	
Cut to area	390	m3	£ 15.00	£ 5,850.00		5,300	m3	£ 15.00	£ 79,500.00		6,335	m3	£ 15.00	£ 95,025.00		12,900	m3	£ 15.00	£ 193,500.00		2,525	m3	£ 15.00	£ 37,875.00		60	m3	£ 15.00	£ 900.00		6,070	m3	£ 15.00	£ 91,050.00		1,810	m3	£ 15.00	£ 27,150.00	
Fill and compaction to area	48,345	m3	£ 55.00	£ 2,658,975.00		21,645	m3	£ 55.00	£ 1,190,475.00		12,485	m3	£ 55.00	£ 686,675.00		165	m3	£ 55.00	£ 9,075.00		3,485	m3	£ 55.00	£ 191,675.00		15,365	m3	£ 55.00	£ 845,075.00		2,310	m3	£ 55.00	£ 127,050.00		1,625	m3	£ 55.00	£ 89,375.00	
Disposal of cuttings	390	m2	£ 35.00	£ 13,650.00		5,300	m2	£ 35.00	£ 185,500.00		6,335	m2	£ 35.00	£ 221,725.00		12,900	m2	£ 35.00	£ 451,500.00		2,525	m2	£ 35.00	£ 88,375.00		60	m2	£ 35.00	£ 2,100.00		6,070	m2	£ 35.00	£ 212,450.00		1,810	m2	£ 35.00	£ 63,350.00	
Topsoil to areas	8,360	m2	£ 7.00	£ 58,519.98		13,233	m2	£ 7.00	£ 92,630.33		14,395	m2	£ 7.00	£ 100,767.95		8,179	m2	£ 7.00	£ 57,255.36		1,605	m2	£ 7.00	£ 11,235.00		2,185	m2	£ 7.00	£ 15,295.00		15,512	m2	£ 7.00	£ 108,587.17		6,036	m2	£ 7.00	£ 42,253.40	
Geotextile to carriageway and verges	10,385	m2	£ 7.00	£ 72,695.00		8,120	m2	£ 7.00	£ 56,840.00		6,680	m2	£ 7.00	£ 46,760.00		7,715	m2	£ 7.00	£ 54,005.79		3,430	m2	£ 7.00	£ 24,010.00		3,040	m2	£ 7.00	£ 21,280.00		13,920	m2	£ 7.00	£ 97,440.00		7,100	m2	£ 7.00	£ 49,700.00	
Geotextile embankments	5,050	m2	£ 7.00	£ 35,349.98		10,188	m2	£ 7.00	£ 71,315.33		12,120	m2	£ 7.00	£ 84,842.95		4,449	m2	£ 7.00	£ 31,145.36		545	m2	£ 7.00	£ 3,815.00		1,210	m2	£ 7.00	£ 8,470.00		11,412	m2	£ 7.00	£ 79,887.17		3,536	m2	£ 7.00	£ 24,753.40	
Series 700 - Pavements					£ 742,021					£ 487,125					£ 423,475					£ 383,586					£ 227,650					£ 198,675					£ 937,900					£ 442,000
Carriageway (including base, binder, and surface course)	7,705	m2	£ 95.00	£ 732,021.42		5,075	m2	£ 95.00	£ 482,125.00		4,405	m2	£ 95.00	£ 418,475.00		3,985	m2	£ 95.00	£ 378,585.66		2,370	m2	£ 95.00	£ 225,150.00		2,065	m2	£ 95.00	£ 196,175.00		9,820	m2	£ 95.00	£ 932,900.00		4,600	m2	£ 95.00	£ 437,000.00	
Allowance for white lining	1.00	Item	£ 10,000.00	£ 10,000.00		1.00	Item	£ 5,000.00	£ 5,000.00		1.00	Item	£ 5,000.00	£ 5,000.00		1.00	Item	£ 5,000.00	£ 5,000.00		1.00	Item	£ 2,500.00	£ 2,500.00		1.00	Item	£ 2,500.00	£ 2,500.00		1.00	Item	£ 5,000.00	£ 5,000.00		1.00	Item	£ 5,000.00	£ 5,000.00	
Series 1100 - Kerbs					£ 38,539					£ 4,919					£ 11,396					£ 19,011					£ 7,499					£ 7,228					£ 16,334					£ 11,274
Kerbing to carriageway	1,542	m	£ 25.00	£ 38,538.95		197	m	£ 25.00	£ 4,918.70		456	m	£ 25.00	£ 11,396.13		760	m	£ 25.00	£ 19,011.40		300	m	£ 25.00	£ 7,499.12		289	m	£ 25.00	£ 7,227.84		653	m	£ 25.00	£ 16,334.33		451	m	£ 25.00	£ 11,274.14	
Series 1200 - Traffic Signs					£ 10,000					£ -					£ -					£ 10,000					£ 10,000					£ 10,000					£ -					£ -
Allowance for traffic signs	1	item	£ 10,000.00	£ 10,000.00												1	item	£ 10,000.00	£ 10,000.00		1	item	£ 10,000.00	£ 10,000.00		1	item	£ 10,000.00	£ 10,000.00											
Series 1300 - Road Lighting					£ 50,086					£ 32,988					£ 28,633					£ 25,903					£ 15,405					£ 13,423					£ 63,830					£ 29,900
Allowance for road lighting to carriageways	7,705	m2	£ 6.50	£ 50,085.68		5,075	m2	£ 6.50	£ 32,987.50		4,405	m2	£ 6.50	£ 28,632.50		3,985	m2	£ 6.50	£ 25,903.23		2,370	m2	£ 6.50	£ 15,405.00		2,065	m2	£ 6.50	£ 13,422.50		9,820	m2	£ 6.50	£ 63,830.00		4,600	m2	£ 6.50	£ 29,900.00	
Series 1400 - Electrical Works					£ -					£ -					£ -					£ -					£ -					£ -					£ -					£ -
Allowance for traffic signals at roundabout																																								
Series 1600 - Piling					£ -					£ -					£ -					£ -					£ -					£ -					£ -					£ -
Series 1700 - Structural Concrete					£ -					£ -					£ -					£ -					£ 6,203,787					£ -					£ -					£ -
Reinforced concrete road overbridge																					663	m2	£ 8,600.00	£ 5,703,787.47															
Allowance for works to existing bridge																					1	item	£ 500,000.00	£ 500,000.00															
Series 1800 - Steel					£ -					£ -					£ -					£ -					£ -					£ -					£ -					£ -
Series 1900 - Steel Protection					£ -					£ -					£ -					£ -					£ -					£ -					£ -					£ -
Series 2000 - Waterproofing					£ -					£ -					£ -					£ -					£ -					£ -					£ -					£ -
Series 2100 - Bridge Bearings					£ -					£ -					£ -					£ -					£ -					£ -					£ -					£ -
Series 2300 - Bridge Expansion Joints					£ -					£ -					£ -					£ -					£ -					£ -					£ -					£ -
Series 2500 - Special Structures					£ -					£ -					£ -					£ -					£ -					£ -					£ -					£ -
Series 3000 - Landscaping					£ 41,800					£ 66,165					£ 71,977					£ 40,897					£ 8,025					£ 10,925					£ 77,562					£ 30,181
Grass seeding to verges and embankments	8,360	m2	£ 5.00	£ 41,799.98		13,233	m2	£ 5.00	£ 66,164.52		14,395	m2	£ 5.00	£ 71,977.11		8,179	m2	£ 5.00	£ 40,896.69		1,605	m2	£ 5.00	£ 8,025.00		2,185	m2	£ 5.00	£ 10,925.00		15,512	m2	£ 5.00	£ 77,562.26		6,036	m2	£ 5.00	£ 30,181.00	
Construction Works Sub-Total					£ 4,875,595					£ 3,035,945					£ 2,478,209					£ 1,936,758					£ 7,354,960					£ 1,628,171					£ 3,043,677					£ 1,570,015
Traffic Management	10.00	%	£ 4,875,595	£ 487,560	£ 487,560	20	%	£ 3,035,945	£ 607,189	£ 607,189	20	%	£ 2,478,209	£ 495,642	£ 495,642	10	%	£ 1,936,758	£ 193,676	£ 193,676	10	%	£ 7,354,960	£ 735,496	£ 735,496	10	%	£ 1,628,171	£ 162,817	£ 162,817	20	%	£ 3,043,677	£ 608,735	£ 608,735	20	%	£ 1,570,015	£ 314,003	£ 314,003
Preliminaries	35.00	%	£ 5,363,155	£ 1,877,104	£ 1,877,104	35	%	£ 3,643,134	£ 1,275,097	£ 1,275,097	35	%	£ 2,973,851	£ 1,040,848	£ 1,040,848	35	%	£ 2,130,433	£ 745,652	£ 745,652	35	%	£ 8,090,456	£ 2,831,660	£ 2,831,660	35	%	£ 1,790,988	£ 626,846	£ 626,846	35	%	£ 3,652,412	£ 1,278,344	£ 1,278,344	35	%	£ 1,884,018	£ 659,406	£ 659,406
OH&P	10.00	%	£ 7,240,259	£ 724,026	£ 724,026	10	%	£ 4,918,231	£ 491,823	£ 491,823	10	%	£ 4,014,699	£ 401,470	£ 401,470	10	%	£ 2,876,085	£ 287,609	£ 287,609	10	%	£ 10,922,115	£ 1,092,212	£ 1,092,212	10	%	£ 2,417,833	£ 241,783	£ 241,783	10	%	£ 4,930,756	£ 493,076	£ 493,076	10	%	£ 2,543,424	£ 254,342	£ 254,342
Total Works Cost Sub-Total					£ 7,964,285					£ 5,410,054					£ 4,416,169					£ 3,163,694					£ 12,014,327					£ 2,659,617					£ 5,423,832					£ 2,797,766
Design Team Fees	30.00	%	£ 7,964,285	£ 2,389,285	£ 2,389,285	30	%	£ 5,410,054	£ 1,623,016	£ 1,623,016	30	%	£ 4,416,169	£ 1,324,851	£ 1,324,851	30	%	£ 3,163,694	£ 949,108	£ 949,108	30	%	£ 12,014,327	£ 3,604,298	£ 3,604,298	30	%	£ 2,659,617	£ 797,885	£ 797,885	30	%	£ 5,423,832	£ 1,627,150	£ 1,627,150	30	%	£ 2,797,766	£ 839,330	£ 839,330
Sub-Total					£ 10,353,570					£ 7,033,071					£ 5,741,020					£ 4,112,802					£ 15,618,625					£ 3,457,502					£ 7,050,981					£ 3,637,096
Other Project Costs					£ 771,500					£ 771,500					£ 771,500					£ 771,500					£ 771,500					£ 771,500					£ 771,500					£ 771,500
Land allowance	1.00	item	£ 62,500	£ 62,500		1.00	item	£ 62,500	£ 62,500		1.00	item	£ 62,500	£ 62,500		1.00	item	£ 62,500	£ 62,500		1.00	item	£ 62,500	£ 62,500		1.00	item	£ 62,500	£ 62,500		1.00	item	£ 62,500	£ 62,500		1.00	item	£ 62,500	£ 62,500	
Commuted Sum	1.00	item	£ 625,000	£ 625,000		1.00	item	£ 625,000	£ 625,000		1.00	item	£ 625,000	£ 625,000		1.00	item	£ 625,000	£ 625,000		1.00	item	£ 625,000	£ 625,000		1.00	item	£ 625,000	£ 625,000		1.00	item	£ 625,000	£ 625,000		1.00	item	£ 625,000	£ 625,000	
Bond	1.00	item	£ 84,000	£ 84,000		1.00	item	£ 84,000	£ 84,000		1.00	item	£ 84,000	£ 84,000		1.00	item	£ 84,000	£ 84,000		1.00	item	£ 84,000	£ 84,000		1.00	item	£ 84,000	£ 84,000		1.00	item	£ 84,000	£ 84,000		1.00	item	£ 84,000	£ 84,000	
Base Cost Estimate					£ 11,125,070					£ 7,804,571					£ 6,512,520					£ 4,884,302					£ 16,390,125					£ 4,229,002					£ 7,822,481					£ 4,408,596
Risk Allowances					£ 1,112,507					£ 780,457					£ 651,252					£ 488,430					£ 1,639,013					£ 422,900					£ 782,248					£ 440,860
Design Development	2.50	%	£ 11,125,070	£ 278,127		2.5	%	£ 7,804,571	£ 195,114		2.5	%	£ 6,512,520	£ 162,813		2.5	%	£ 4,884,302	£ 122,108		2.5	%	£ 16,390,125	£ 409,753		2.5	%	£ 4,229,002	£ 105,725		2.5	%	£ 7,822,481	£ 195,562		2.5	%	£ 4,408,596	£ 110,215	
Construction	2.50	%	£ 11,125,070	£ 278,127		2.5	%	£ 7,804,571	£ 195,114		2.5	%	£ 6,512,520	£ 162,813		2.5	%	£ 4,884,302	£ 122,108		2.5	%	£ 16,390,125	£ 409,753		2.5	%	£ 4,229,002	£ 105,725		2.5	%	£ 7,822,481	£ 195,562		2.5	%	£ 4,408,596	£ 110,215	
Employer Change	2.50	%	£ 11,125,070	£ 278,127		2.5	%	£ 7,804,571	£ 195,114		2.5	%	£ 6,512,520	£ 162,813		2.5	%	£ 4,884,302	£ 122,108		2.5	%	£ 16,390,125	£ 409,753		2.5	%	£ 4,229,002	£ 105,725		2.5	%	£ 7,822,481	£ 195,562		2.5	%	£ 4,408,596	£ 110,215	
Employer Other	2.50	%	£ 11,125,070	£ 278,127		2.5	%	£ 7,804,571	£ 195,114		2.5	%	£ 6,512,520	£ 162,813		2.5	%	£ 4,884,302	£ 122,108		2.5	%	£ 16,390,125	£ 409,753		2.5	%	£ 4,229,002	£ 105,725		2.5	%	£ 7,822,481	£ 195,562		2.5	%	£ 4,408,596	£ 110,215	
Cost Limit (excluding inflation and optimism bias)					£ 12,237,577					£ 8,585,028					£ 7,163,771					£ 5,372,732					£ 18,029,138					£ 4,651,902					£ 8,604,729					£ 4,849,456
Tender Price Inflation - Excluding					£ -					£ -					£ -					£ -					£ -					£ -					£ -					£ -
Construction Cost Inflation - Excluding					£ -					£ -					£ -					£ -					£ -					£ -					£ -					£ -
Cost Limit (excluding optimism bias)					£ 12,237,577					£ 8,585,028					£ 7,163,771					£ 5,372,732					£ 18,029,138					£ 4,651,902					£ 8,604,729					£ 4,849,456
Optimism Bias	44	%	£ 12,237,577	£ 5,384,534	£ 5,384,534	66	%	£ 8,585,028	£ 5,666,118	£ 5,666,118	66	%	£ 7,163,771	£ 4,728,089	£ 4,728,089	44	%	£ 5,372,732	£ 2,364,002	£ 2,364,002	66	%	£ 18,029,138	£ 11,899,231	£ 11,899,231	44	%	£ 4,651,902	£ 2,046,837	£ 2,046,837	66	%	£ 8,604,729	£ 5,679,121	£ 5,679,121	66	%	£ 4,849,456	£ 3,200,641	£ 3,200,641
Cost Limit (including inflation and optimism bias)					£ 17,622,111					£ 14,251,146					£ 11,891,861					£ 7,736,734					£ 29,928,368					£ 6,698,739					£ 14,283,851					£ 8,050,096

Information Used

Appendix B

Appendix B - Information Used

Information Used

The following information was used to compile this estimate:

Design Information

- 0598598-ACM-ZZ-DR-00-00-002 – Grade Separated Junction Principle Quantities
- 60598598-ACM-ZZ-DR-ZZ-00-00-0101 - Grade Separated Junction Option 1 General Arrangement
- 60598598-ACM-ZZ-DR-ZZ-00-00-0102 - Grade Separated Junction Option 1 M5 Existing Long Section
- 60598598-ACM-ZZ-DR-ZZ-00-00-0103 - Grade Separated Junction Option 1 Proposed Long Sections South
- 60598598-ACM-ZZ-DR-ZZ-00-00-0104 - Grade Separated Junction Option 1 Proposed Long Sections North
- 60598598-ACM-ZZ-DR-ZZ-00-00-0105 - Grade Separated Junction Option 1 Proposed Circulatory Carriageway Long Section
- 60598598-ACM-ZZ-DR-ZZ-00-00-0106 - Grade Separated Junction Option 1 Proposed Long Section B4059 East
- 60598598-ACM-ZZ-DR-ZZ-00-00-0107 - Grade Separated Junction Option 1 Proposed Long Section B4059 West
- 60598598-ACM-ZZ-DR-ZZ-00-00-0108 - Grade Separated Junction Option 1 M5 Mainline and Junction Cross Sections

Programme

- M5 Junction 14 Construction Phase Plan

Pricing

- SPONS 2024
- Previous Projects

Area Schedule

Appendix C

Appendix C - Area Schedule

Schedule of Areas

	External Works m²
Area 1	16,065
Area 2	18,308
Area 3	18,800
Area 4	12,164
Area 7 (East)	4,638
Area 7 (West)	4,250
Area 8	25,332
Area 9	10,636
Total	**110,195**

Basis of Measurement

1. All areas have been broadly measured with the drawings that can be found in appendix B

2. The measurements contained within this document should not be relied upon for any other purpose other than the creation of this Cost Estimate.

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