Gatwick Airport Northern Runway Project

Transport Assessment Annex C – VISSIM Forecasting Report

Book 7

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1 Introduction

1.1 Background

1.1.1 This Forecasting Report is part of a suite of supporting documents annexed to the **Transport Assessment** (Doc Ref: 7.4) prepared on behalf of Gatwick Airport Limited (GAL) in support of the Northern Runway Project (the Project). While this report can be read without detailed knowledge of the associated supporting documentation, some elements are addressed in their own focussed documents and as such have not been discussed in detail here. This includes, inter alia, the Environmental Statement, Transport Assessment, Strategic Modelling Report and highway design reports.

1.1.2 Gatwick Airport is currently served by a single main runway. The airport also has a further runway, which is located north of the main runway and is only available for use when the main runway is closed. This runway is known as the 'northern runway' or the 'standby runway'.

1.1.3 The Project proposes to make alterations to the northern runway, including repositioning its centreline to the north by 12 metres which, along with the lifting of the planning condition restricting its use, would enable dual runway operations in accordance with international standards.

1.1.4 It is anticipated that by 2047 these improvements could increase airport capacity up to 80.2 million passengers per annum (mppa), compared to a maximum potential capacity based on existing facilities of 67.2 mppa within the same timescale. This represents an increase of approximately 13 mppa.

1.2 Purpose

1.2.1 Modelling was previously undertaken for the Preliminary Environmental Impact Report (PEIR) which fed into the public consultation in Autumn 2021. Following this and with feedback from stakeholders the model has been enhanced in order to support the DCO application.

1.2.2 This report sets out the forecast microsimulation modelling of core scenarios for the Project, undertaken in VISSIM. These models build on the base modelling presented in the VISSIM Local Model Validation Report (LMVR) and incorporate GAL's surface access proposals and predicted highway demand for both the future baseline and with Project scenarios.

1.3 Stakeholders consulted

1.3.1 Throughout the development of the transport models, technical aspects have been discussed with the relevant stakeholders, including National Highways (NH), Surrey County Council (SCC) and West Sussex County Council (WSCC). This has involved the sharing of technical notes, model outputs and data collection / validation reports for the base year models.

1.3.2 Outputs and findings from the forecast transport modelling have also been shared and discussed with these parties in detail. Given the nature of microsimulation modelling, this information has been shared through model videos and images as well as presentation and sharing of model output data.

1.4 Structure of report

1.4.1 The remainder of this report is set out as follows:

- Section 2 provides an overview of the VISSIM models and the scenarios assessed;
- Section 3 reviews the changes from the base model for the forecast model scenarios;
- Section 4 sets out the process of creating the forecast demand from the forecast strategic transport models;
- Section 5 addresses the operation of the future baseline network in VISSIM compared to the base model operation;
- Section 6 presents analysis of the VISSIM modelling of the with Project compared to the future baseline model operation; and
- Section 7 summarises the detailed analysis and presents the overall conclusions of the VISSIM modelling.

1.4.2 Detailed analysis is presented within the context of this report, with further information provided in the appendices where necessary.

2 DCO VISSIM modelling

2.1 Overview

2.1.1 Gatwick has three VISSIM traffic simulation models which can be used to test detailed highway junction performance. These comprise the following.

- A 24-hour Corridor model to test flows, congestion and mitigation on the highway network around Gatwick Airport; and
- Two 24-hour Terminal Forecourt models, one for the South Terminal and one for the North Terminal, including detailed pick-up and drop-off behaviour and dwell, car parking etc. to test how the forecourts perform.

2.1.2 For the purposes of assessing the DCO, an abbreviated version of the Corridor model has been used, covering the AM and PM peak periods to test highway junction performance and congestion effects of growth at the Airport both in the future baseline and with the Project. The performance of both the 24 hour and abbreviated base models is recorded in separate Local Model Validation Reports (LMVRs) which have been shared with key stakeholders. The base models have been accepted as suitable as a reference for assessing the effects of the project for the DCO application.

2.2 Base model recap

2.2.1 From east to west, the model includes the M23 Junction 9, Airport Way, the A23 up to Longbridge Roundabout, connecting minor roads and accesses in between, and all approaches to key junctions. To the south of the airport, the model extends along the A23 to Lowfield Heath Roundabout. Diagram 2.3.1 outlines the extent of the model, highlighting the junctions which have been included. Junction IDs in the table relate to the survey and modelled node labels.

2.2.2 The model focuses on the AM and PM peaks, aligned with those being assessed in the Highway Assignment Model of the GHOST (Gatwick's Holistic Overview of Strategic Transport) modelling suite (GHOST HAM). Evaluation hours in the VISSIM models are therefore:

- AM: 07:00 to 08:00 and 08:00 to 09:00; and
- PM: 16:00 to 17:00 and 17:00 to 18:00.

2.2.3 Either side of each peak period is a 1-hour warm up and 1-hour cooldown period. While the AM and PM peak periods are only those which are being evaluated, for ease of model development, analysis and evaluation this is run as a continuous model with the interpeak (between 10:00 and 15:00) not being assessed. Resultingly, the total simulation time of the model is 13 hours, starting from 06:00 until 19:00.

2.2.4 The model uses dynamic assignment, specifying origin-destination matrices for each vehicle user class for each fifteen minutes of the model. This allows route choice of vehicles within the micro-simulation model network where it exists, as well as better co-ordination in determining future demand from the GHOST HAM.

2.2.5 The vehicle user classes within the VISSIM model are shown in Table 2.2.1. These represent both the different vehicle types and their trip purposes, informing part of the uplift methodology for the forecast models.

Table 2.2.1: Vehicle classifications

Vehicle Class	Description
1	Air pax cars (includes mini-cabs and taxi)
2	Airport related LGV (including minibuses/midibuses)
3	Airport related OGV1
4	Airport related OGV2
5	Buses and coaches
6	Background cars
7	Background LGV
8	Background OGV1
9	Background OGV2
10	Staff cars

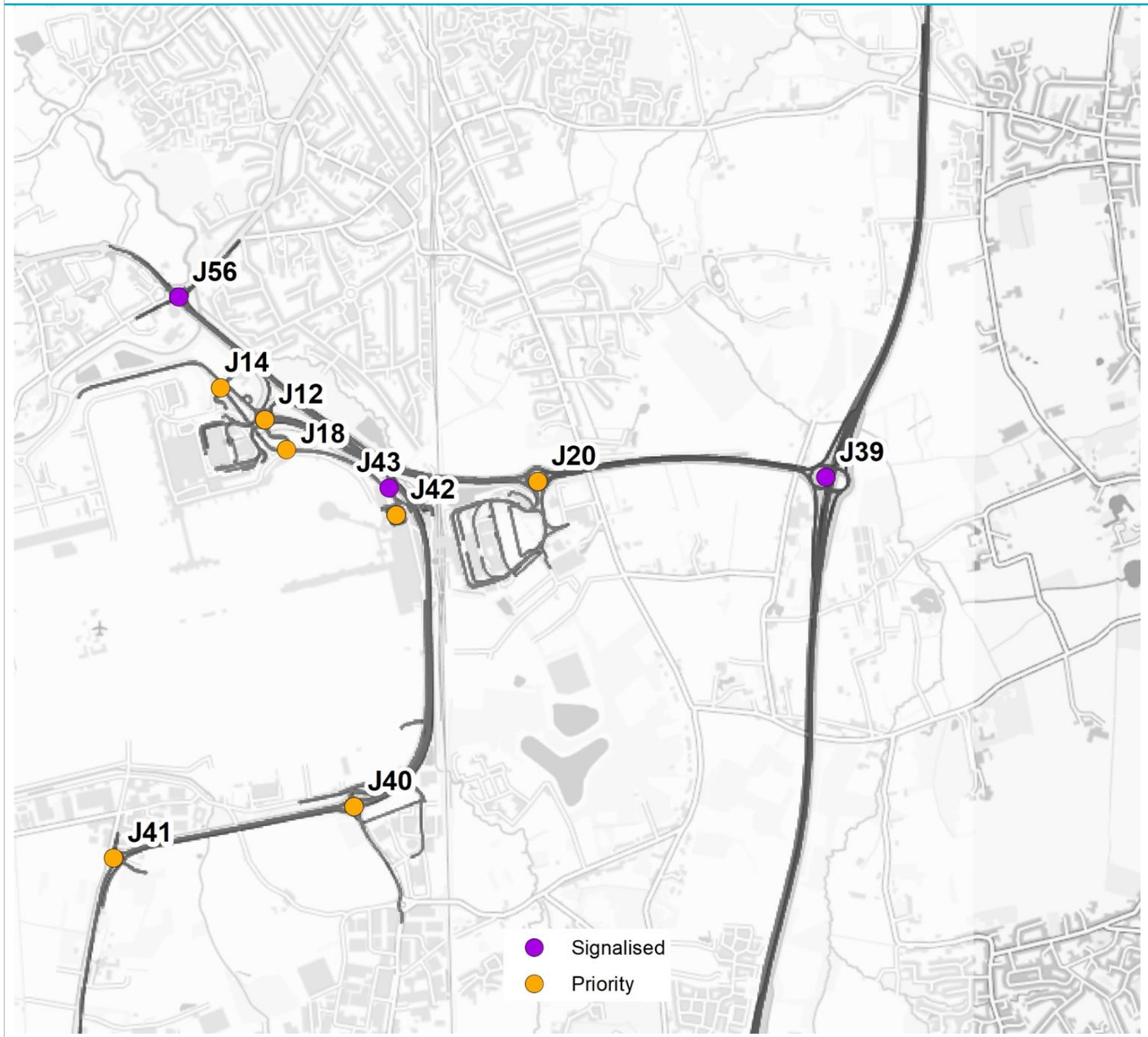
2.3 Forecast scenarios

2.3.1 As part of the wider strategic modelling for the Project, a large number of scenarios have been assessed within GHOST, including sensitivity and stress tests of the network. VISSIM modelling is being used to assess the network operation local to the Airport, which requires a level of certainty in highway layout configurations as well as reasonable confidence in some of the more detailed airport landside operations, such as locations of car parks. To that end, this report compares assessments of the four core highway scenarios:

- 2032 future baseline;
- 2032 with Project;
- 2047 future baseline; and
- 2047 with Project

2.3.2 The layouts and assumptions for each of these models are discussed in detail in the next section.

Diagram 2.3.1: Model extent and key junctions



ID	Key Junction
12	North Terminal roundabout
14	Longbridge Way/Perimeter Road N roundabout
18	Gatwick Way/Perimeter Road N
20	South Terminal roundabout
39	M23 Junction 9
40	Gatwick Road roundabout
41	Lowfield Heath roundabout
42	Queens Gate roundabout
43	Perimeter Road N/A23
56	Longbridge roundabout

3 Layouts and assumptions

3.1 Overview of key junction changes

3.1.1 Each of the core scenarios incorporates changes to the highway network and airport operations over and above the base network. Detailed descriptions of these network changes including technical drawings and analysis are provided in the Transport Assessment and supporting DCO documentation; at a high level these are described as follows:

- For all scenarios:
  - M23 Junction 9 Smart Motorways improvements including three lanes on the M23 Spur westbound; and
  - new multistorey car park, MSCP7, adjacent to North Terminal in operation accessed from Longbridge Way/Perimeter Road N roundabout (junction ID 14 in Diagram 2.3.1).
- In the future baseline:
  - signalisation and associated minor widening at North Terminal roundabout; and
  - signalisation and associated minor widening at South Terminal roundabout.
- With Project:
  - geometric improvements at Longbridge roundabout, including signalisation of A217 approach and improved active travel connections;
  - geometric improvements at North Terminal roundabout including signalisation of three arms, improved active travel connections, removal of the Airport Way exit arm and grade separation for traffic heading westbound from Airport Way to A23 London Road;
  - new junction on A23 London Road immediately adjacent to North Terminal roundabout, replacing the connection from North Terminal towards South Terminal and M23 with a new right turn onto A23 London Road eastbound at this location;
  - grade separation, reconfiguration and signalisation at South Terminal roundabout; and
  - enhancements to the forecourts and associated terminal operations. One approach, represented in the future VISSIM modelling at North Terminal by a change to vehicle destination zones, would be to provide for passenger drop off alongside the existing pick up arrangements within multi-storey car parks 5 and 6.

3.1.2 The models have been developed using scenario manager to ensure that coding remains consistent where relevant across the scenarios. Sections 3.3and 3.4 provide VISSIM network comparisons for junction coding in the base against the future baseline and with Project scenarios. An overview of the changes and model coding are described in the following section.

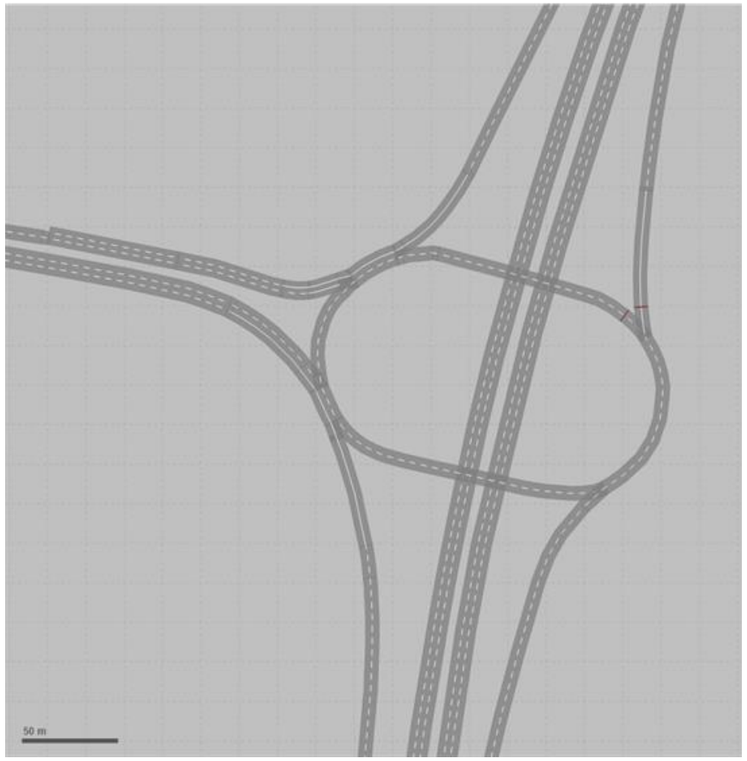
3.2 M23 Junction 9 Smart Motorways

3.2.1 Although the M23 Smart Motorways scheme covered the section from Junction 8 to Junction 10, the VISSIM model is predominantly interested in the grade separated junction at Junction 9. Changes to this junction in the models are therefore limited to:

- removal of the signals on the northbound approach to the junction;
- inclusion of the segregated left turn lane from M23 northbound to M23 Spur;
- widening of the westbound carriageway of the M23 Spur to three lanes for its full length;
- recoding of the entry and exit slip lanes at J9 to incorporate the change of configuration to lane gains with ghost island merge/diverge; and
- the additional running lane on this section of the M23.

3.2.2 Diagram 3.2.1Diagram 3.2.1 shows an image from the VISSIM model of the resultant configuration at J9.

Diagram 3.2.1: Smart Motorways – M23 Junction 9



3.3 Future baseline network changes

3.3.1 Developed prior to the Project proposals as part of GAL's Capital Investment Programme (CIP), the future baseline scheme is intended to optimise traffic flows on the network through improvements at North and South Terminal roundabouts and accommodate general traffic growth including planned growth at the Airport. This scenario incorporates M23 Smart Motorways and committed airport infrastructure including the completion of MSCP7 and implementation of forecourt charging.

North Terminal roundabout

3.3.2 The North Terminal roundabout future baseline configuration in the VISSIM model is shown in Diagram 3.3.1. This includes the following improvements:

- signalisation of the approach arms and circulatory of North Terminal roundabout;

- widened circulatory between North Terminal ingress and egress;
- widened entry and exit on Longbridge Way;
- extended two lane exit for A23 North; and
- widened A23 approach to North Terminal roundabout.

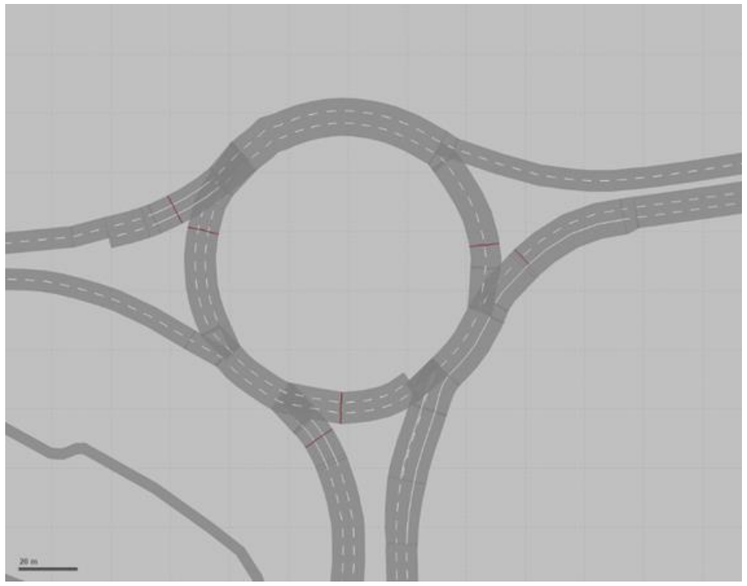
Diagram 3.3.1: North Terminal roundabout - future baseline model

South Terminal roundabout

3.3.3 The improvement works to South Terminal roundabout as coded in VISSIM are shown in Diagram 3.3.2. This includes the following improvements:

- signalisation of approach arms and circulatory;
- widening of the westbound exit on Airport Way;
- widening of the eastbound approach on Airport Way;
- widening of the eastbound exit on M23 Gatwick Spur;
- widening of the circulation lane between M23 Spur exit and approach; and
- widening of the exit to South Terminal.

Diagram 3.3.2: South Terminal roundabout – future baseline model



3.4 Network changes with the Project

3.4.1 The highway works which form part of the Project provide opportunities to rationalise some traffic movements and reduce conflicts in ways that were not possible in the future baseline scenario. For example, the introduction of grade separation at both North and South Terminal roundabouts reduces peak period conflicts between non-airport and airport traffic, allowing for a better road user experience.

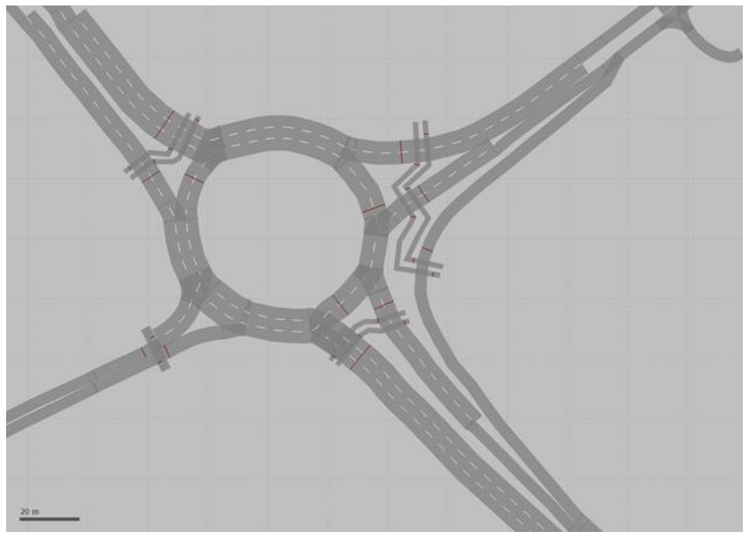
3.4.2 Within the limitations of the local network, this also provides opportunities to improve walking and cycling connections to the airport.

Longbridge roundabout

3.4.3 Improvements to Longbridge roundabout include an enhanced and enlarged roundabout, with signalisation of the A217 approach in addition to the existing Brighton Road, A23 northbound signalised approaches. As part of these works, the exit to Brighton Road north is also widened, extending the two-lane exit beyond the pedestrian crossing and improving the flow of traffic off the roundabout heading north towards Horley.

3.4.4 These improvements also provide opportunities to improve the walking and cycling provision, with improved footway/cycleway provision on both sides of Brighton Road approaching the roundabout and relocation of the signal-controlled crossings on the A217 approach closer to the junction. The VISSIM layout in the model is shown in Diagram 3.3.3.

Diagram 3.3.3: Longbridge Roundabout – with Project model



North Terminal roundabout

3.4.5 The North Terminal with Project scheme includes a new signalised junction where North Terminal meets the A23 beneath a flyover which allows westbound traffic to bypass the North Terminal roundabout towards Longbridge roundabout.

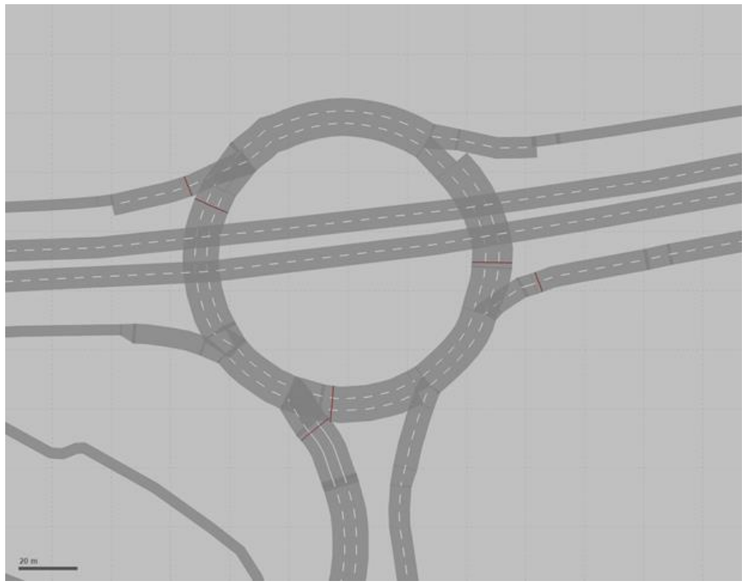
3.4.6 At North Terminal roundabout, there is signalisation of Airport Way, North Terminal egress, and A23 slip approaches, whilst Longbridge Way is priority controlled. The VISSIM layout of North Terminal roundabout and the North Terminal / A23 signalised junction is shown in Diagram 3.3.4.

Diagram 3.3.4: North Terminal Roundabout – with Project model

South Terminal roundabout

3.4.7 With the Project, South Terminal roundabout becomes a grade-separated junction, with the flyover allowing the free flow of mainline traffic between M23 Spur and the A23. The VISSIM layout is shown in Diagram 3.3.5.

Diagram 3.3.5: South Terminal roundabout – with Project model



4 Forecasting future transport demand

4.1 Methodology

4.1.1 Forecast traffic volumes are derived and assessed in the GHOST strategic transport models. The resultant increase in demand is then applied to the VISSIM base matrices in order to generate forecast demand matrices for each scenario. The following section outlines the process developed to generate these uplifts.

4.1.2 This process was initially developed using the 24-hour model, which has a finer grain zone structure at each of the terminals representing different passenger modes including kiss and fly, valet and car rental. This allowed elements of the demand model and changes to future operations to be better reflected in the VISSIM model, such as relocation of kiss and fly within North Terminal with the Project. Therefore, to uplift the VISSIM matrices by the respective vehicle classes, the demand model has been used to uplift airport related traffic (passengers and employees) whilst the highway model has been used to uplift the background traffic.

4.2 Zones

4.2.1 The SATURN model and the demand model have the same zoning system to represent the UK. In order to apply any uplifts to the VISSIM model the wider models must be cordoned to match the VISSIM model extents. This is a simple process in SATURN but far more complicated in the demand model (the methodology is explained below in section 4.6). Diagram 2.3.1 shows the VISSIM network extents, while Diagram 4.2.1 shows the SATURN network extents. The extent of the cordon applied to the SATURN model matches the extent of the VISSIM model and is shown in Diagram 4.2.2. Below shows the correspondence between the zones in the two models.

Table 4.2.1: SATURN and VISSIM DCO zone correspondence

Zone Name	VISSIM Zone	SATURN Entry	SATURN Exit
M23 North	1	95105	95104
M23 South	2	95102	95103
A23 South	3	95108	95108
Charlwood Rd	4000	95101	95101
A23 South	5	95108	95108
Gatwick Rd	6	95118	95118
Povey Cross Rd	7000	95113	95113
A217	8	95112	95111
Brighton Rd	9000	95107	95107
Brighton Rd	12	95107	95107
Brighton Rd	13	95107	95107
ST pick up/drop off	100000	95117	95117
ST lower forecourt	103000	95117	95117
ST upper forecourt	104	95117	95117
ST short stay car parking	106000	95117	95117
ST long stay car parking	108000	95117	95117
ST coach layover	110	95117	95117
Staff car park H	111	95117	95117
Eastway	112000	95117	95117
ST fuel station/ McDonald's	115	95117	95117
Buckingham Gate	116	95117	95117
NT pick up/drop off	200000	95116	95120
NT short term car parking	207000	95116	95120
NT coaches	210	95116	95120
NT Tunnel Road	211	95116	95120
Staff car park J	212	95116	95120
Staff car park M/MSCP7*	213	95115	95115
Longbridge Way garage	214	95106	95106
Staff car park Y/Premier Inn	215	95114	95114
Perimeter Road N**	216000	95114	95114
Queen's Gate control post	300	95119	95119
Perimeter Road E North	301	95119	95119
Station Approach Rd	302	95110	95110
Perimeter Rd E South	303	95109	95109
Beehive Ring Rd	304	95119	95119
Perimeter Rd S	400000	95109	95109

*MSCP7 replaces Car Park M in the future baseline and with Project scenarios

**Perimeter Road N includes NT long term parking, cargo and airport offices

Diagram 4.2.1: SATURN full network

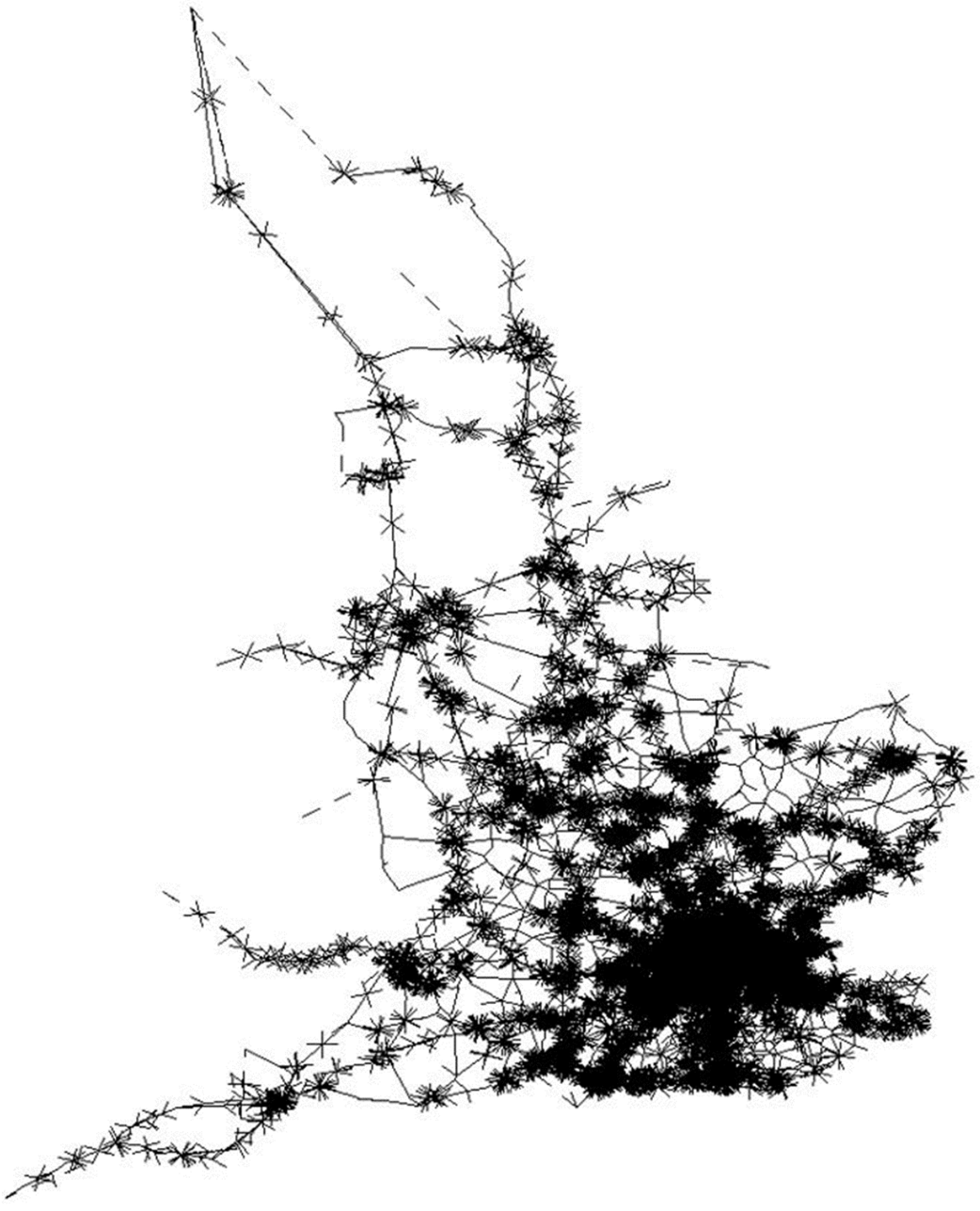
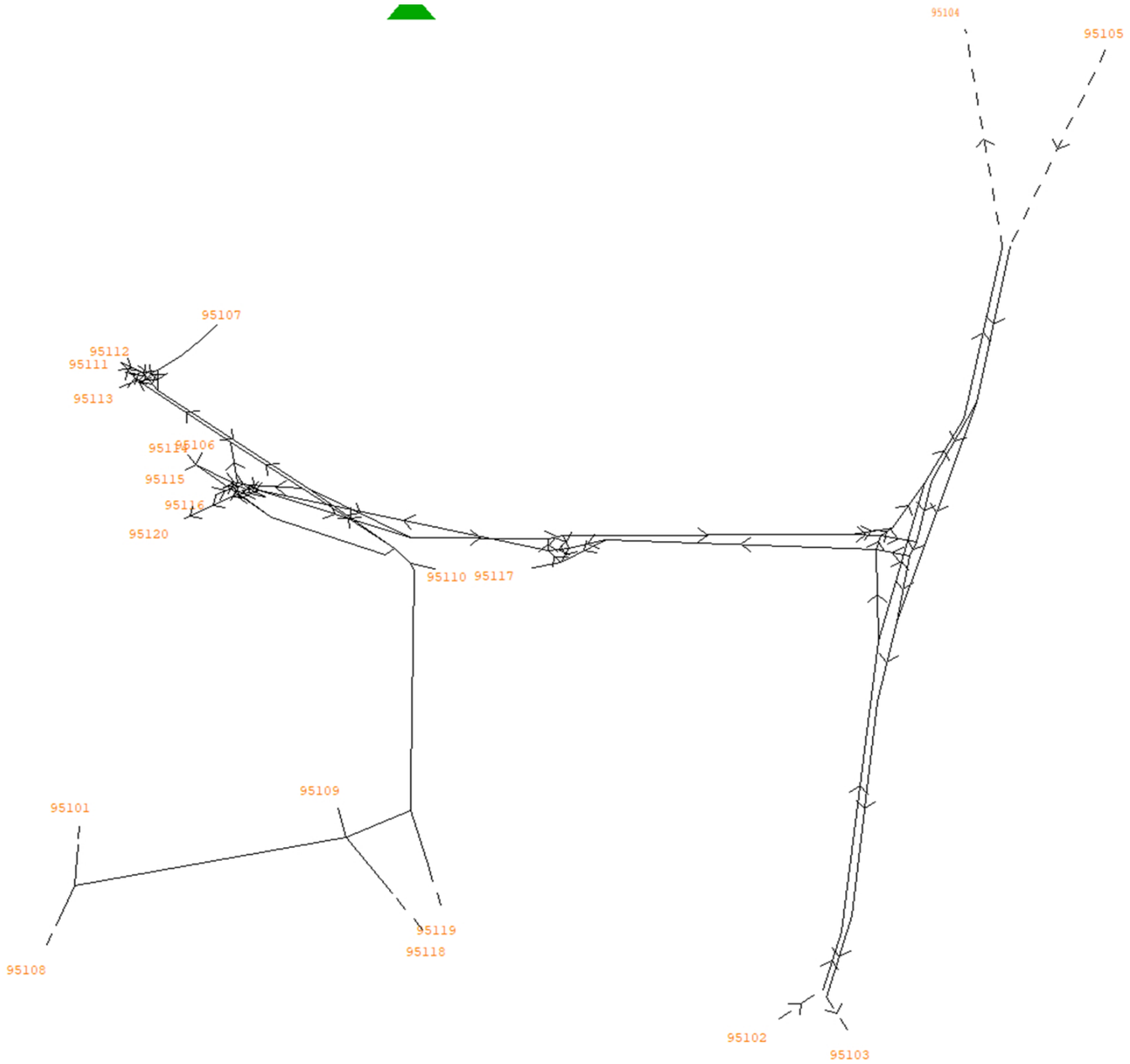


Diagram 4.2.2: SATURN DCO cordon network



4.3 User classes

4.3.1 The SATURN model contains seven user classes whilst the VISSIM model contains ten user classes, shown in Table 4.3.1Table 4.3.1 and Table 4.3.2Table 4.3.2 below. Table 4.3.2Table 4.3.2 also shows the SATURN related user class that is used to inform the VISSIM matrix uplifts. User classes are unchanged in the DCO model.

Table 4.3.1: SATURN User Classes

User Class No.	User Class Name
1	Car Business
2	Car Commute
3	Car Other
4	LGV
5	HGV
6	Airport Staff
7	Air Passengers

Table 4.3.2: VISSIM User Classes

User Class No.	User Class Name	SATURN UC
1	Air pax cars (includes mini-cabs and taxi)	Demand Model
2	Airport related LGV (including minibuses/midibuses)	4
3	Airport related OGV1	5
4	Airport related OGV2	5
5	Buses and coaches	Timetable
6	Background Car	1-3
7	Background LGV	4
8	Background OGV1	5
9	Background OGV2	5
10	Staff cars	Demand Model
55	Airport Related buses and coaches	Timetable

4.3.2 User classes one and ten are uplifted directly from the demand model rather than using SATURN user classes six (staff) and seven (passengers). Uplifts for SATURN user classes six and seven have been taken from the demand model so should be very similar, but the modelled time periods are different (see section 4.4), which is why the VISSIM user classes can be more accurately uplifted directly from the demand model.

4.3.3 The demand model is made up of several different user classes for staff and passengers allowing these user classes to be distributed to the correct zones in the VISSIM model. The demand model uses the following user classes:

- Air passenger demand:
  - car valet off airport;
  - car valet on airport;
  - car rental off airport;
  - car rental on airport;
  - car Park and Fly off airport;
  - car Park and Fly on airport;
  - taxi;
  - car Kiss and Fly;
  - rail*; and
  - bus and coach*.
- Staff demand:
  - car solo;
  - car share;
  - company car;
  - rail*;
  - bus and coach*; and
  - active*

4.3.4 Those classes marked with an asterisk are excluded from the uplift process in VISSIM.

4.4 Time periods

4.4.1 The modelled time periods differ in definition between the demand model, SATURN model and VISSIM model. The Demand Model time periods are shown in Table 4.4.1Table 4.4.1, alongside the associated SATURN model periods.

Table 4.4.1: Strategic model time periods

Demand Model Time Period	SATURN Model Time Period	Time
AM	AM1	07:00-08:00
	AM2	08:00-09:00
IP	IP	09:00-16:00
PM	PM	16:00-18:00
OP1	N/A	18:00-00:00
OP2	N/A	00:00-04:00
OP3	N/A	04:00-07:00

4.4.2 The Demand Model value differences between base and future year are used to uplift staff and air passengers in VISSIM and covers the whole 24 hour modelled period. The SATURN model is used to uplift background traffic; absolute values are used for AM1, AM2, IP and PM with percentage differences taken from the IP model used to uplift the interpeak and overnight periods. As the VISSIM model for DCO is focussed on the AM and PM peak periods, these models therefore use absolute value uplifts for the assessed periods for all classes.

4.4.3 For background traffic, the VISSIM matrices at crossover time periods were checked to see which they matched more closely with. Table 4.4.2 below shows where time periods lined up differently for background traffic and the actual time periods that SATURN model growth was applied to.

Table 4.4.2: Growth from SATURN applied to VISSIM background traffic by time period

SATURN Model Time Period	VISSIM matrices applied to
AM1	06:30-08:00
AM2	08:00-10:00
IP	10:00-15:15
PM	15:15-18:30

4.4.4 Table 4.4.1Table 4.4.1 and Table 4.4.2Table 4.4.2 show that the VISSIM matrices that the SATURN models apply to are not like for like. To account for this the exact SATURN uplift is applied to its respective hour whilst the 15-minute periods outside the SATURN hour are uplifted using a factor. This process is explained further in the worked example in VISSIM Forecasting Report Appendix B.

4.4.5 The process still creates all the matrices for the full 24-hour period however the DCO VISSIM model only loads in the matrices for 06:00-10:00 and 15:00-19:00, consistent with the warm-up, analysis and cool-down periods for each peak.

4.5 Highway model uplifts

4.5.1 Both the SATURN and VISSIM models are developed using 2016 data so uplifts to the VISSIM models can be applied directly after the zone, user class and time period splits have been applied to the SATURN matrices.

4.5.2 Diagram 4.7.1 shows the flowchart of how the models fit together to uplift the VISSIM base matrices.

4.5.3 The spatial and temporal distribution splits are created using the distributions from base models so the profiles will match the base model. This is true for zones, user classes and time periods.

4.5.4 In SATURN, LGVs and HGVs are combined whilst in VISSIM they are split into airport and background based on their origin or destination. Distribution matrices split the uplifts into which vehicles go to which VISSIM zone by user class which resolves this. The VISSIM matrices cover 15-minute time periods while the SATURN models are average hour: in order to apply the uplift, vehicles are distributed by zone for each 15-minute period. Finally, where more than one zone occurs in VISSIM compared to SATURN, distribution matrices are created to determine this split.

4.5.5 The base and future year SATURN models are cordoned to match the VISSIM extent for each time period. A difference matrix is then created between the base and the future year matrix. This difference matrix is disaggregated to match the VISSIM zone splits, then further split into the 15-minute periods that correlate with the specific SATURN model periods. Finally, the 15-minute uplift matrix is split into different VISSIM user classes if applicable (general background traffic is just applied as there is a 1:1 ratio between the two models). The result from these splits is a 15-minute uplift matrix for each user VISSIM user class split into VISSIM zones that can be directly added onto the respective VISSIM base matrix.

4.5.6 In some cases, adding the 15-minute uplift matrix results in negative numbers, which VISSIM cannot handle. These are zeroed out and the difference is taken off the positive movements within the matrix so that overall, the matrix uplift is the same. It should also be noted that as there is not a corresponding SATURN model for every 15-minute period, the matrices for the 12-hour period from 18:30 to 06:30 are uplifted by taking the IP percentage difference matrix and applying it to each 15-minute period.

4.6 Demand model uplifts

4.6.1 Similarly to the highway model uplifts there are differences between the VISSIM model and demand model in terms of times and zones. User classes are consistently either passengers or staff in both models. The base models again are both 2016 base years and the distribution matrices are created from these base models so passenger and staff arrival patterns will be consistent with the base models.

4.6.2 Diagram 4.7.2 shows how the models fit together to uplift the VISSIM base matrices.

4.6.3 The main difference in processing the demand model compared to the highway model is the cordoning process. The SATURN model and demand model have the same zone structure so the highway model can be used to help with the cordoning process. The demand model outputs exist as a list of origins and destinations with the flow between those.

4.6.4 In order to cordon the demand model, a list of all the passenger and staff full routes are produced from the highway model. The full routes are analysed to see which origin-destination pairs pass through the cordon. The routes that pass through the cordon are applied to the demand model outputs to create a cordoned matrix for both the base and future year, a difference matrix is then then created by taking the base from the future year matrix.

4.6.5 As before, the difference matrix is then disaggregated to match the VISSIM zone splits. Now the difference matrix is split into VISSIM zones it is further split into the 15-minute periods that correlate with the specific demand model time segment. The demand model has models for all time periods so absolute value uplifts can be used throughout.

4.7 Scenario specific adjustments

4.7.1 Two different adjustment processes were applied to the forecast matrices following completion of the uplift process. The first was to redistribute a small volume of traffic away from the A23 northbound in the future baseline PM peak. Following discussions and some high level analysis of the strategic highway model, approximately 170 PCUs in each of the PM peak assessment hours were redistributed. These trips were predominantly background traffic transferred from O-D pairs representing trips from Crawley to Horley split equally across three parallel routes of Charlwood Road, Balcombe Road and the M23.

4.7.2 The second process was to relocate passenger activity at North Terminal from the forecourt (zone 200000) to short term parking at MSCPs 5 and 6 (zone 207000), as mentioned in paragraph 3.1.1. This was a simple case of moving trips between zones within the VISSIM user class one matrices.

Diagram 4.7.1: Highway Model uplift flowchart

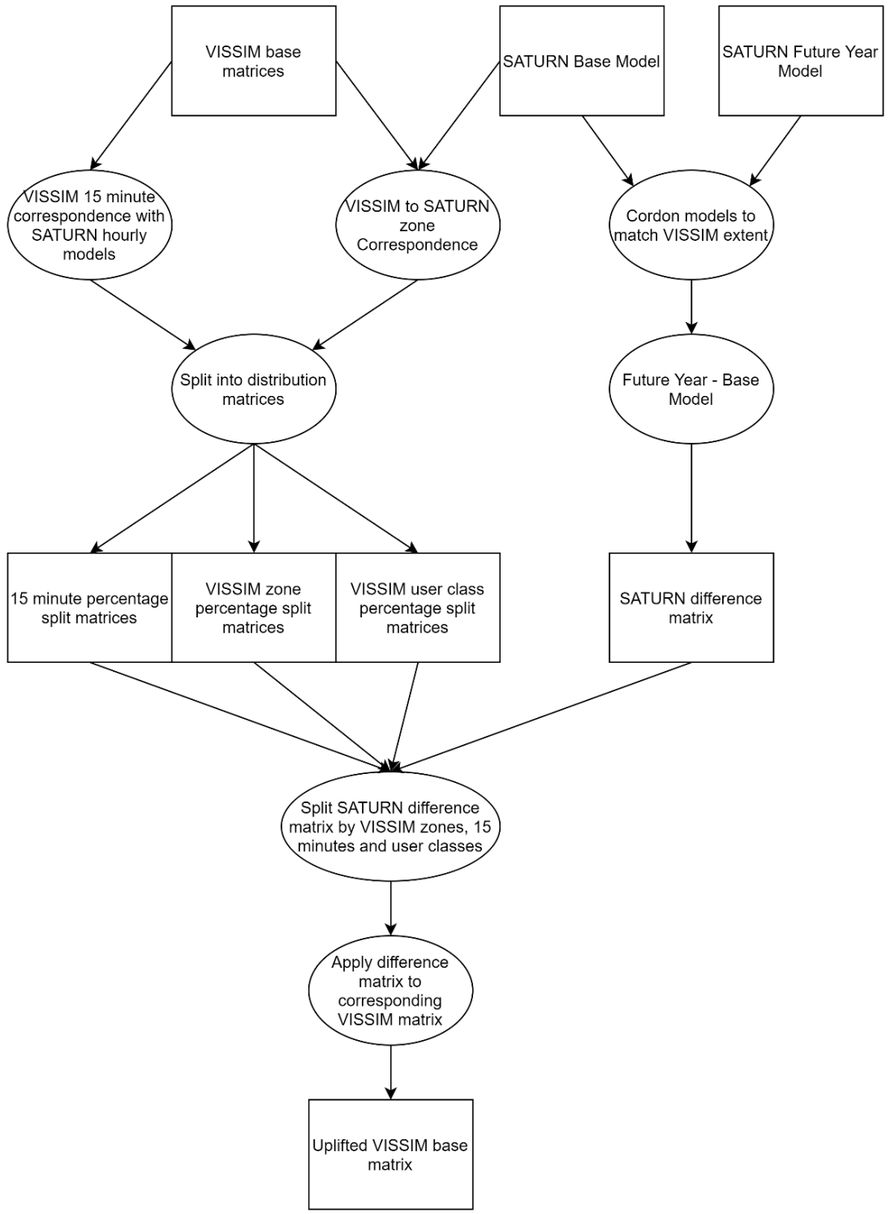


Diagram 4.7.2: Demand Model uplift flowchart

5 Model analysis – future baseline

5.1.1 The future baseline highway network in VISSIM reflects the existing (2016) highway arrangement with the following key alterations included

- M23 Junction 9 Smart Motorways improvements including three lanes on the M23 Spur westbound;
- new short stay multistorey car park, MSCP7; and
- minor widening and associated signalisation at the North and South terminal roundabouts.

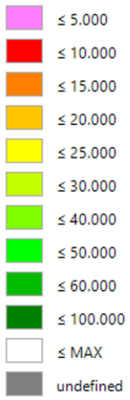
5.1.2 The future baseline scenario in VISSIM has been assessed in two future years, 2032 and 2047. Within this section the 2032 future baseline and 2047 future baseline model results are compared against the 2016 base model to understand future network operations. These future baseline models will then form the reference case for assessment of the with Project scenarios in Section 6.

5.2 Model operation overview

5.2.1 A description of operation of the 2032 future baseline and 2047 future baseline models is provided in this section. Select speed plots from the model throughout the model period have been used to present model operation. A full set of speed plots for each half hour of the model analysis period can be found in VISSIM Forecasting Report Appendix C.

5.2.2 The colouring shown in the speed plots within this section follows the key shown in Diagram 5.2.1. The plots have been focused to present locations on the network where traffic is slow moving.

Diagram 5.2.1: Speed Plot Key (mph)



2032 future baseline - AM peak

5.2.3 In the AM peak the 2032 future baseline generally operates well. The majority of approaches and links show a good level of operation, however there are some pockets of slow-moving and stationary vehicles throughout the AM analysis period.

5.2.4 Between 07:00 and 08:00 there is queueing on M23 Spur westbound between South Terminal and M23 Junction 9. At this time, queues are also shown to extend into the South Terminal network whilst waiting to access South Terminal roundabout. Queueing on the spur is contained on the spur and does not impact the M23 or M23 Junction 9 roundabout. Such queueing is illustrated in Diagram 5.2.2.

Diagram 5.2.2: 07:30 – 08:00 AM peak M23 Spur operation.

5.2.5 In the second AM peak analysis hour, this westbound queuing on the M23 spur decreases.

2032 future baseline - PM peak

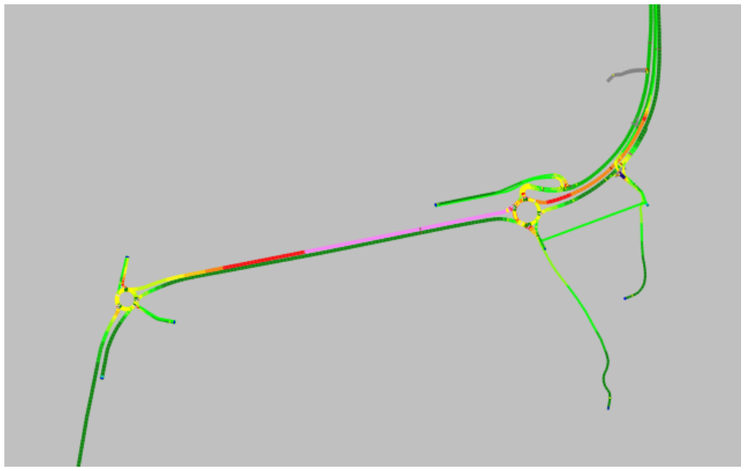
5.2.6 Much like the AM peak, there are pockets of slow moving and stationary vehicles throughout the PM analysis period. Longbridge Roundabout is notably busier in the PM peak compared to the AM peak, with queues apparent on the A217 approach, Povey Cross Road as well as A23 northbound approach. There is slow moving traffic from the North Terminal merge to the A23 northbound. These queues build up throughout the analysis peak period.

5.2.7 There are also queues on the westbound M23 spur at South Terminal Roundabout, which are contained on the spur and do not affect the M23 or M23 Junction 9 roundabout. Diagram 5.2.3 illustrates the queuing condition between 17:30 and 18:00.

Diagram 5.2.3: 17:30 – 18:00 PM peak model operation

5.2.8 In the PM peak, queueing originates from the merge on London Road to the east of the Beehive Ring Road / London Road signalised junction. Queues are at their most severe in the final half hour of the analysis period. During this time, queues form through the Gatwick Road roundabout towards the Lowfield Heath roundabout. The extent of queueing is shown in the speed plot presented in Diagram 5.2.4. A full set of half hour speed plots (AM and PM) for this location can also be found in VISSIM Forecasting Report Appendix C.

Diagram 5.2.4: 17:30 – 18:00 2032 future baseline PM peak London Road operation

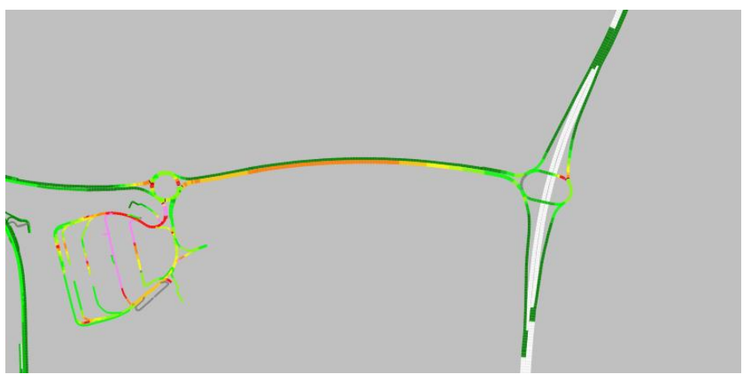


2047 future baseline – AM Peak

5.2.9 An increase in traffic volumes to 2047 without changes to the highway network results in a network with increased queueing and poorer performance.

5.2.10 Queuing on the westbound M23 spur is more pronounced in 2047 compared to 2032. The queue stretches back further towards the Junction 9 roundabout between 07:00 and 08:00. During this time traffic is also queued within the South Terminal network as it struggles to leave the terminal due to congestion. This queuing is shown in Diagram 5.2.5.

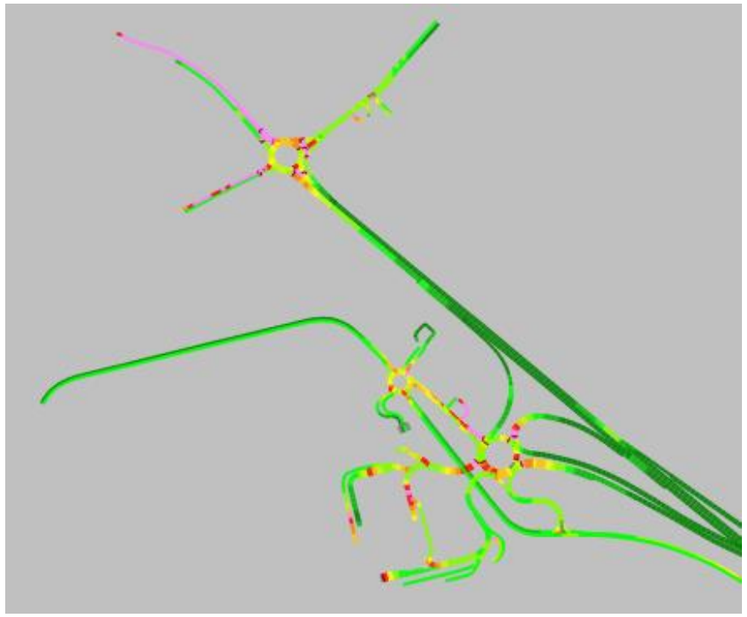
Diagram 5.2.5: 07:30 – 08:00 AM peak M23 spur operation



5.2.11 Between 07:00 and 07:30 queuing occurs on the ingress to North Terminal. This queuing stretches back to North Terminal Roundabout but has little impact on Airport Way. This queuing reduced from 07:30 to 08:00 onwards.

5.2.12 Throughout the AM peak period, queues at Longbridge roundabout build until they peak between 08:30 and 09:00. Queues are apparent on the A217 approach and Povey Cross Road. This queueing results in unreleased vehicles at these two locations in the AM peak period. The queuing on these approaches is illustrated in Diagram 5.2.6.

Diagram 5.2.6: 08:30 – 09:00 AM peak Longbridge Roundabout operation

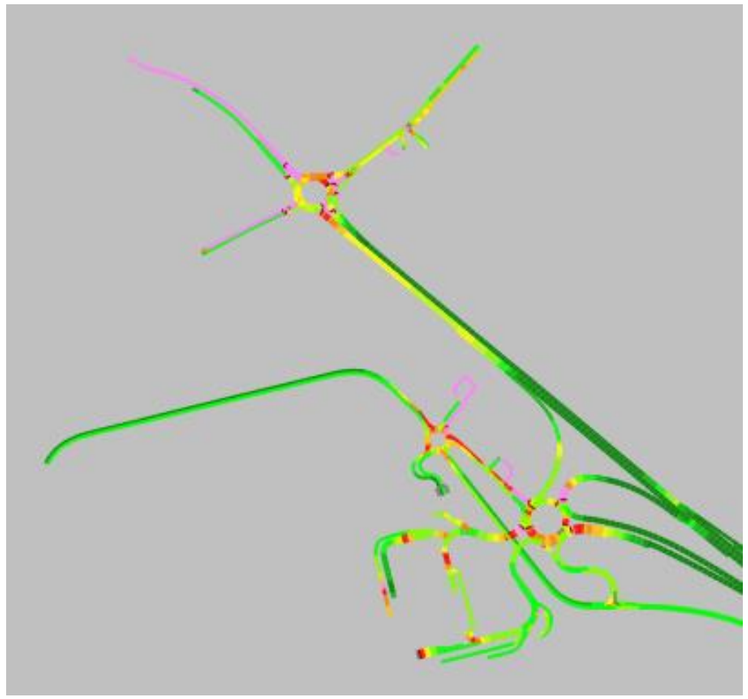


2047 future baseline - PM peak

5.2.13 Throughout the PM peak, queues are apparent at Longbridge Way roundabout. Queueing is also apparent on the A217 and Povey Cross Road approaches to Longbridge Roundabout. The queuing on these approaches results in unreleased vehicles unable to access the model network at the end of the PM peak period.

5.2.14 Between 17:30 and 18:00 the queue northbound to Longbridge roundabout on the A23 begins to interact with North Terminal roundabout. At this time, queueing is also apparent on Longbridge Way towards North Terminal roundabout. The model operation between 17:30 and 18:00 is shown in the speed plot presented in Diagram 5.2.7.

Diagram 5.2.7: 17:30 – 18:00 PM peak Longbridge Roundabout operation

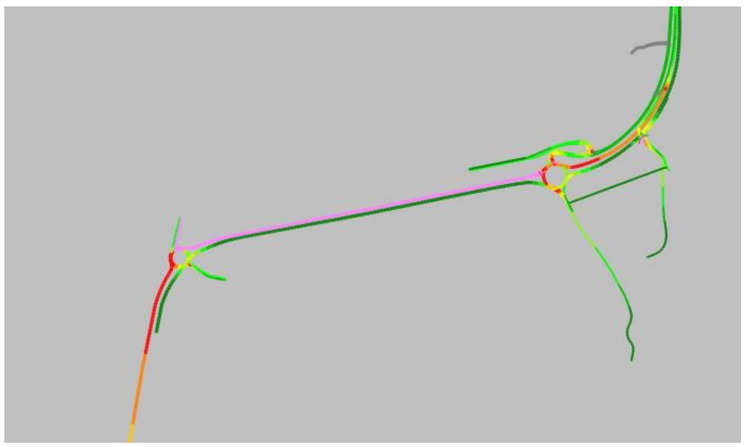


5.2.15 Between 17:00 and 18:00, queues are apparent on the M23 spur westbound. These queues build throughout this second PM peak analysis hour and are longest between 17:30 and 18:00. The speed plot in Diagram 5.2.8 illustrates the level of stationary and slow-moving vehicles at this location between 17:30 and 18:00.

Diagram 5.2.8: 17:30 – 18:00 PM peak M23 Spur operation

5.2.16 Diagram 5.2.9 provides a snapshot of queueing along London Road in the PM peak under the 2047 future baseline scenario. The queuing presented in Diagram 5.2.9 represents the queueing at its worst, within the final half hour of the PM peak analysis period. Queuing occurs from the merge from two lanes to one lane at the start of the bus lane on London Road to the east of the Beehive Ring Road / London Road signalised junction.

Diagram 5.2.9: 17:30 – 18:00 2047 future baseline PM peak London Road operation



5.3 Changes

5.3.1 Additional changes to the future baseline model have been made beyond those outlined in Section 3.3.

London Road merge

5.3.2 In both the 2032 and 2047 future baseline scenario certain parameter changes have been made to the merge location to the east of the Beehive Ring Road / London Road signalised junction. Whilst there are no planned highway alterations at these locations the changes reflect a change in model operation to adapt to the increased volume of traffic.

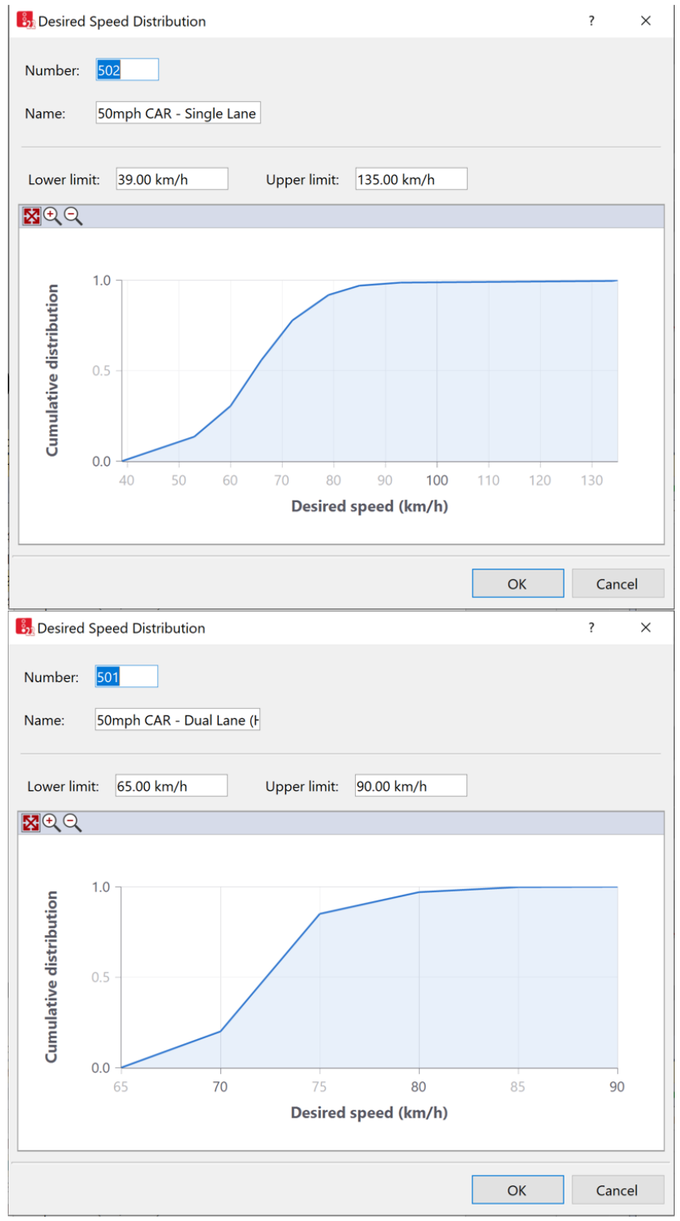
5.3.3 The alterations to model parameters in this location are summarised in Table 5.3.1Table 5.3.1.

Table 5.3.1: Future Year Model Parameter Alterations

Number	Object Description	Parameter Type	Old Value	New Value
1	Two to one lane connector (Connector: 10161)	Lane Change Distance (Fixed Value)	160m	350m
2	Motorway merge behaviour (Link: 60146)	Link Behaviour Type	Urban Motorised	Motorway merge behaviour
3	Desired Speed Decision (Point 200 & 201)	Desired Speed Distribution	502: 50mph CAR - Single Lane (based on single carriageway SPE0111, 2016)	501: 50mph CAR - Dual Lane (HA, 2007)

5.3.4 The difference between the previous and newly adopted desired speed distribution is shown in Diagram 5.3.1.

Diagram 5.3.1: Desired Speed Distribution Comparison



5.3.5 In each scenario approximately 100 vehicles using this merge section have been rerouted to use an alternative route to reach their destination based on information derived from the strategic highway models. These alternative routes mainly include using M23 and Charlwood Road to access their destination.

North Terminal ingress

5.3.6 Minor alterations were made to the model at the North Terminal ingress in the future baseline scenario. Firstly, entrance barriers to North Terminal short term car parking were set to operate once the initial modelled warm up hour was completed. This change has allowed for a more realistic operation of the North Terminal ingress to be modelled at the beginning of each analysis period. Secondly, barriers have been set to allow vehicles to enter every 8 seconds, which allows the equivalent of approximately 400 vehicles per hour per lane to enter the barriers at North Terminal. Both of these changes have consistently been applied to all future year model scenarios.

5.4 Model stability

Convergence stability

5.4.1 DfT's Traffic Analysis Guidance (TAG) does not state explicit convergence criteria. Transport for London (TfL) guidance suggests 95% of travel times on all paths should change by less than 20% for four iterations, with PTV suggesting that anywhere between 90-95% is suitable. After running 100 simulations, convergence has not been achieved in the 2032 and 2047 future baseline scenarios.

5.4.2 The maximum percentage share of converged paths reached is 78% and 70% respectively, which is lower than the 2016 base. Diagram 5.4.1 and Diagram 5.4.2 show the share of paths and the weighted share of paths converged for each of the runs. The highest of three consecutively stable runs was taken forward for each scenario. The 59th run and 98th run path and cost files were taken forward for 2032 and 2047 models respectively.

Diagram 5.4.1: 2032 future baseline travel time convergence

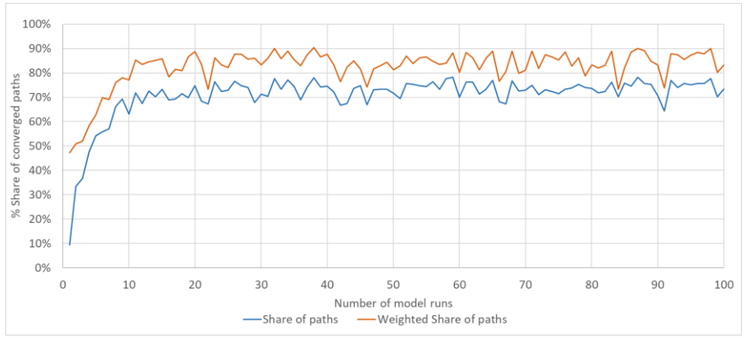
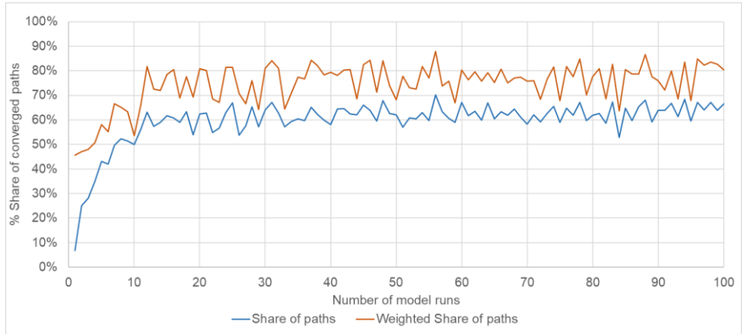


Diagram 5.4.2: 2047 future baseline travel time convergence



5.4.3 For both future baseline scenarios an additional 50 convergence runs were completed beyond the 100 simulations presented here. The levels of convergence remained similar to those presented in Diagram 5.4.1 and Diagram 5.4.2, hence no further analysis has been undertaken.

Evaluation stability

5.4.4 To ensure that future baseline model results are robust, the evaluation runs have been assessed for variability using vehicle network performance. This looks at network wide statistics and has been assessed at 5-minute intervals. Using low value time intervals for network performance provides much more confidence in model stability, as any minor incidental irregularities will show up more significantly than if it were aggregated at a larger time interval.

5.4.5 In this section the stability of the future baseline 2032 and 2047 models were assessed. For both future year scenarios vehicles in network and vehicle hours travelled have been assessed to determine model stability. Stability has been measured over 20 evaluation runs for the AM and PM peaks separately.

2032 future baseline

5.4.6 Diagram 5.4.3 to Diagram 5.4.6 show that across all 20 evaluation runs, both AM and PM peaks are stable – the vehicle hours travelled and vehicles in network follow the same profile with no notable anomalies in any of the seeds.

Diagram 5.4.3: 2032 future baseline vehicle hours travelled – AM

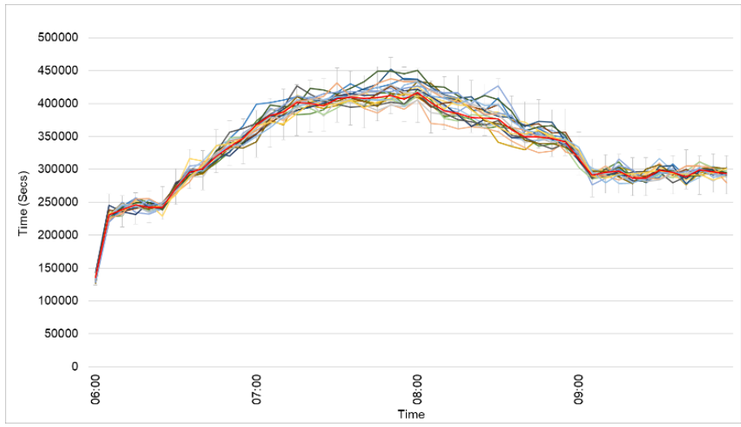


Diagram 5.4.4: 2032 future baseline vehicle hours travelled – PM

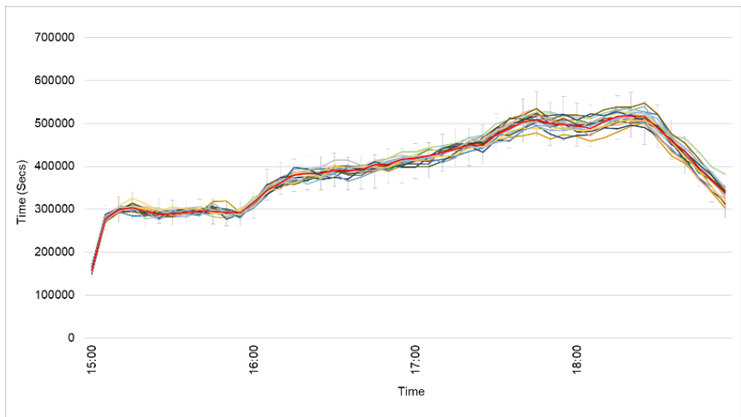


Diagram 5.4.5: 2032 future baseline vehicles in network – AM

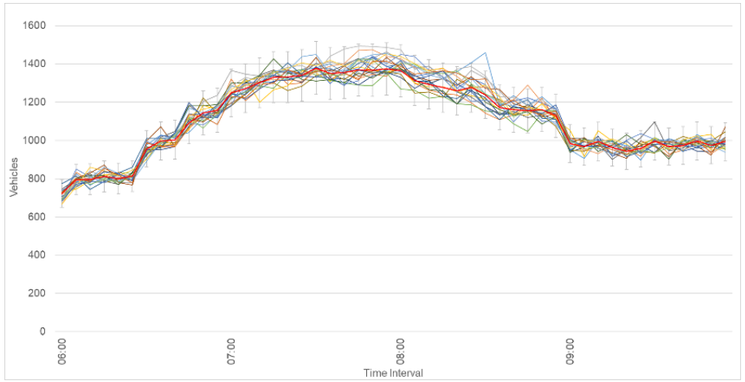
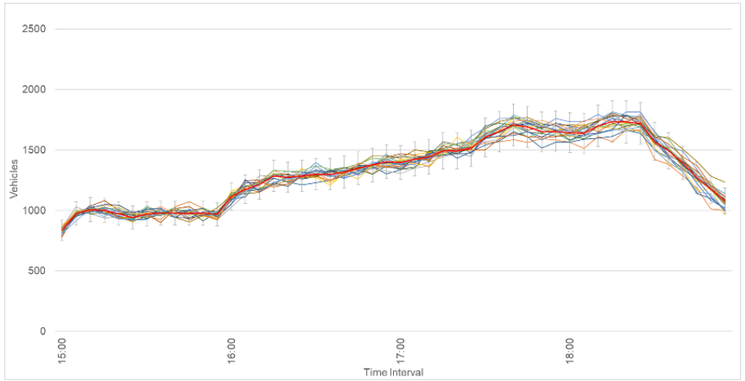


Diagram 5.4.6: 2032 future baseline vehicles in network – PM



2047 future baseline

5.4.7 Diagram 5.4.7 to Diagram 5.4.10 show that in the 2047 future baseline, both AM and PM peaks are stable – the vehicle hours travelled and vehicles in network follow the same profile with no notable anomalies in any of the seeds. There is more variation across the 20 runs compared to the 20 runs for 2032, as expected with the increase in background traffic growth and congestion.

Diagram 5.4.7: 2047 future baseline vehicle hours travelled – AM

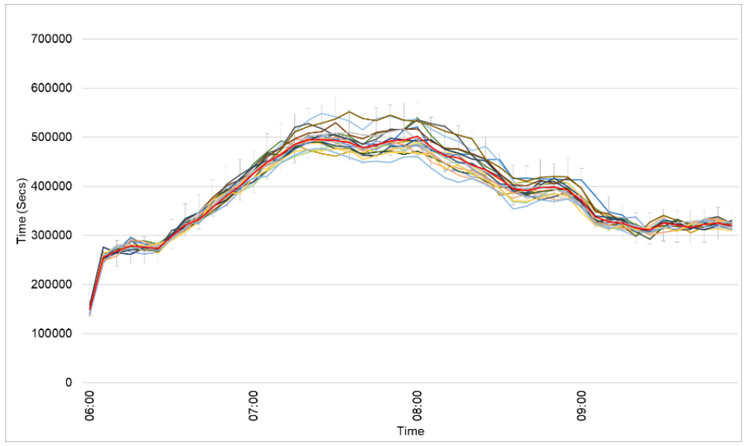


Diagram 5.4.8: 2047 future baseline vehicle hours travelled – PM

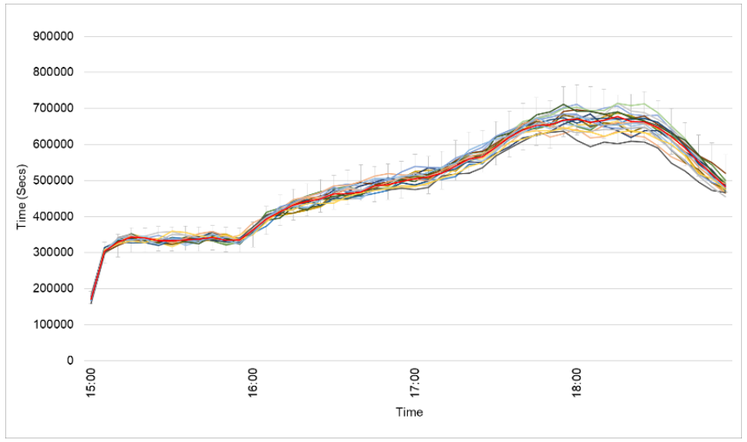


Diagram 5.4.9: 2047 future baseline vehicles in network – AM

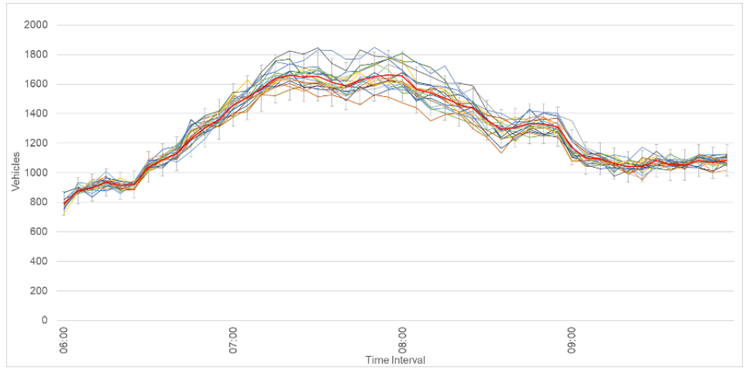
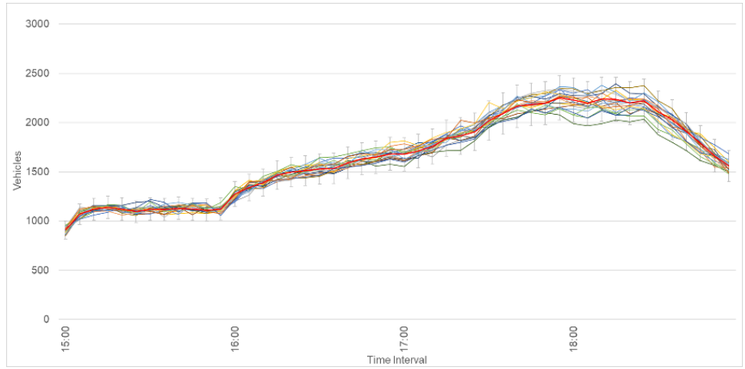


Diagram 5.4.10: 2047 future baseline vehicles in network – PM



5.5 Network performance

5.5.1 The following statistics were used to assess comparative network operation of the 2016 base, 2032 future baseline and 2047 future baseline models.

- vehicle kilometres travelled (VKT) per vehicle;
- vehicle hours travelled (VHT) expressed as time travelled in network per vehicle (minutes);
- average network speed (mph);
- average network delay per vehicle (seconds); and
- unreleased trips at the end of the modelled evaluation period (ie trips which could not be released into the modelled network due to congestion).

5.5.2 These general statistics can be used to provide an overview of the operation of the modelled road network in relation to its efficiency and to cross-check conclusions.

5.5.3 Differences are presented between the 2016 base, 2032 future baseline and 2047 future baseline scenarios. These differences allow for an understanding of impact to the network under future baseline scenarios.

AM peak

5.5.4 Table 5.5.1 presents AM peak model network statistics for the AM 2016 base, 2032 and 2047 future baseline scenarios. As the future year scenarios progress there is increased congestion in the network as time travelled in network per vehicle as well as average delay per vehicle increases. This is due to background growth in traffic, and this leads to 517 vehicles unable to enter the network in the AM peak 2047 future baseline scenario. Average speed, as expected, has decreased from the 2016 base to the 2032 and 2047 future baseline scenarios.

Table 5.5.1: base and future baseline AM peak network performance statistics

Network Statistic	AM 2016 base	AM 2032 future baseline	2016 base – 2032 future baseline difference	AM 2047 future baseline	2032 future baseline – 2047 future baseline difference
Vehicle kilometres travelled per vehicle	4.5	3.7	-0.8	3.7	0.0
Time travelled in network per vehicle (minutes)	3.9	4.2	0.3	4.7	0.6
Average network speed (mph)	69.3	53.4	-15.9	47.1	-6.3
Average network delay per vehicle (s)	38.8	79.3	40.5	113.5	34.2
Unreleased Trips	1	282	280	517	235

PM peak

5.5.5 Table 5.5.2 presents PM peak model network statistics for the PM 2016 base, 2032 and 2047 future baseline scenarios. The trend in the AM peak is also observed in the PM with increased time travelled in network and average delay per vehicle from the base to the future years. More than 2150 vehicles are unable to enter the network at the end of the PM evaluation period in 2047, which is significantly higher than the AM. Average speed, as expected, has decreased from the 2016 base to 2032 and 2047 future baseline scenarios.

Table 5.5.2: base and future baseline PM peak network performance statistics

Network Statistic	PM 2016 base	PM 2032 future baseline	2016 base – 2032 future baseline difference	PM 2047 future baseline	2032 future baseline – 2047 future baseline difference
Vehicle kilometres travelled per vehicle	4.5	3.7	-0.8	3.7	0.0
Time travelled in network per vehicle (minutes)	4.0	4.5	0.5	5.2	0.8
Average network speed (mph)	68.1	50.1	-18.0	43.4	-6.7
Average network delay per vehicle (s)	43.9	101.2	57.3	147.8	46.6
Unreleased Trips	2	912	909	2161	1249

5.6 Journey times

Journey time routes

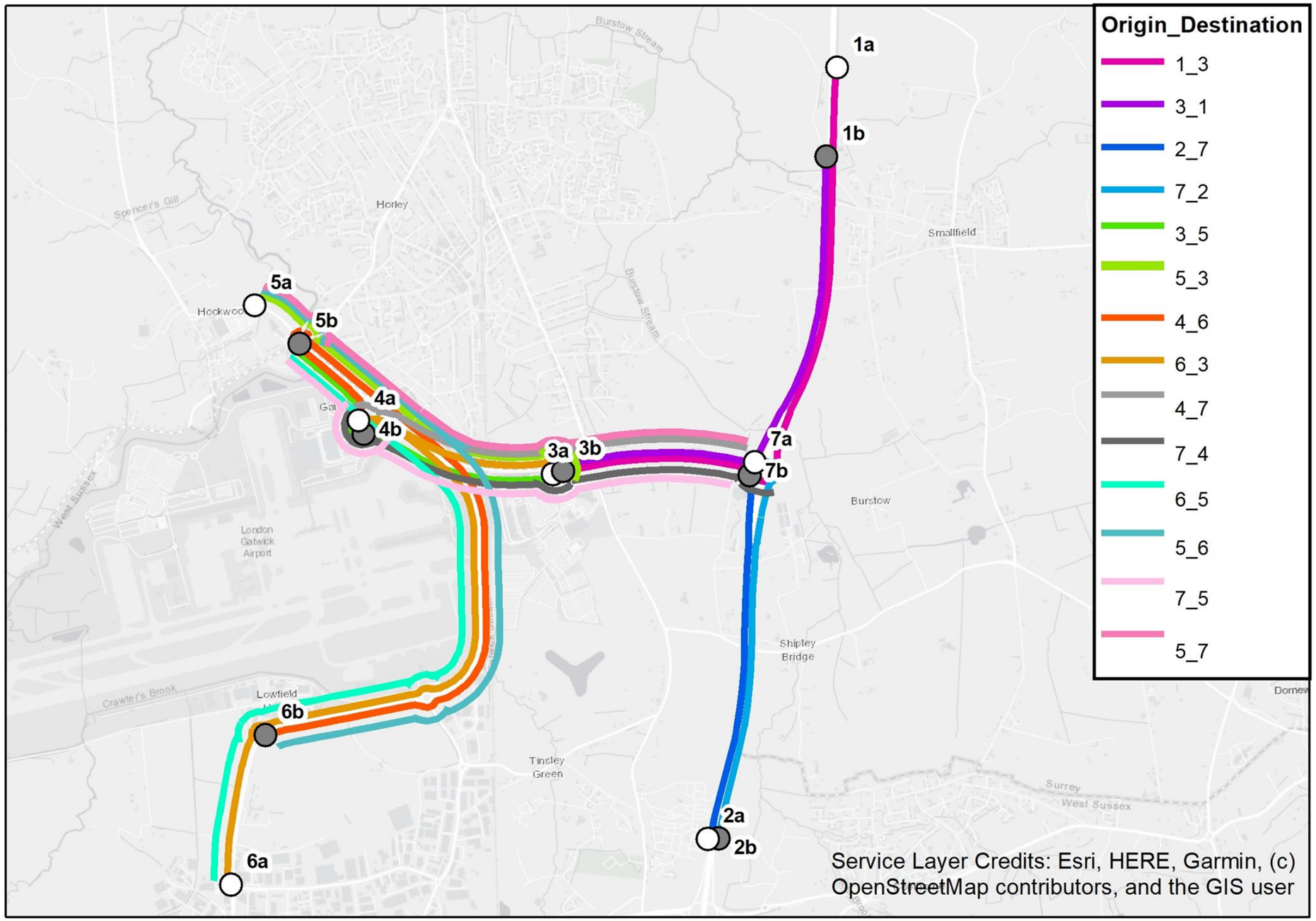
5.6.1 Fourteen journey time routes were assessed, to provide a good level of coverage across the model network. Eight of these are journey time routes assessed in the base model for travel time validation, whilst the additional 6 routes are longer end-to-end journey time routes. Analysis of each route individually has allowed for an understanding of the impact of the future baseline scenarios compared to the 2016 base modelling. Confidence levels of 95% have been added to the charts to indicate where there is larger variation between evaluation runs.

5.6.2 The modelled journey times are presented in Diagram 5.6.1 and described in Table 5.6.1.

Table 5.6.1: Journey time routes description

O-D identification	Description
1-3	M23 North to South Terminal Roundabout
3-1	South Terminal Roundabout to M23 North
7-2	Junction 9 to M23 South
2-7	M23 South to Junction 9
3-5	South Terminal Roundabout to Longbridge Roundabout
5-3	Longbridge Roundabout to South Terminal Roundabout
4-6	North Terminal Roundabout to Lowfield Heath Roundabout
6-3	Lowfield Heath Roundabout to South Terminal Roundabout
4-7	North Terminal Roundabout to Junction 9
7-4	Junction 9 to North Terminal Roundabout
6-5	Lowfield Heath Roundabout to Longbridge Roundabout
5-6	Longbridge Roundabout to Lowfield Heath Roundabout
7-5	Junction 9 to Longbridge Roundabout
5-7	Longbridge Roundabout to Junction 9

Diagram 5.6.1: Journey time routes



Journey time results

5.6.3 This section provides an overview comparison of journey times routes modelled in the Base, 2032 and 2047 future baseline scenarios. In this section specific journey time routes are analysed and key patterns within the results are presented. A full set of journey time graphs across all fourteen journey time routes can be found in VISSIM Forecasting Report Appendix D.

5.6.4 Across the majority of journey time routes there is an increase in journey time from the 2016 base to 2032 and 2047 future baseline scenarios in both the AM and PM peaks. This is due to growth in background traffic between the base and forecast years. There are more vehicles in the network resulting in increased congestion and longer journey times. This is demonstrated in Diagram 5.6.2 to Diagram 5.6.6Diagram 5.6.4.

5.6.5 A 95% confidence interval threshold is included within each bar in the graphs. Generally, the confidence level suggests there is little difference in recorded journey time between analysis runs. However, in the later future year of 2047, confidence levels are greater due to increased instability in the model.

Diagram 5.6.2: base vs future baseline for M23 Junction 9 to North Terminal roundabout

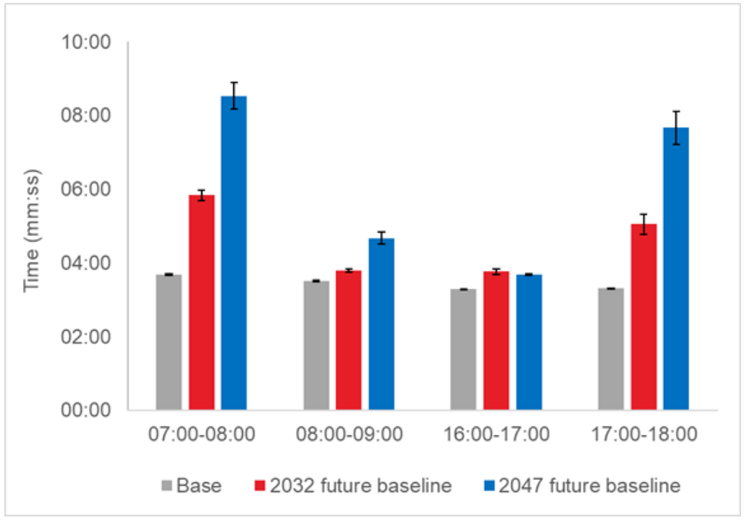


Diagram 5.6.3: base vs future baseline for Lowfield Heath roundabout to Longbridge roundabout

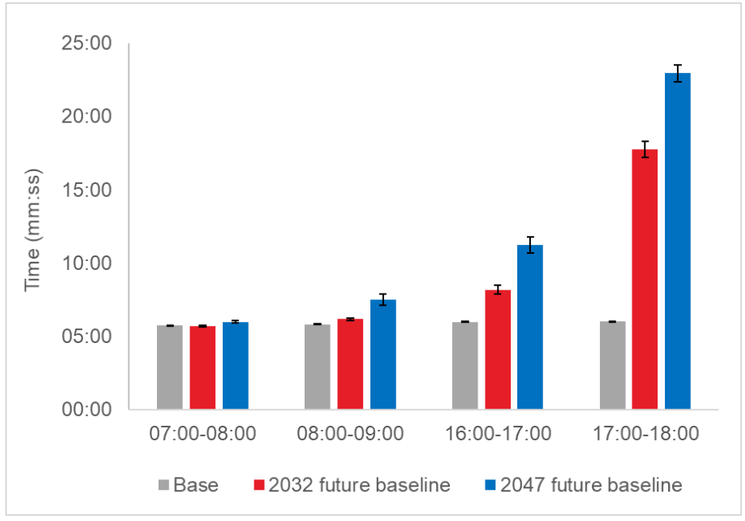
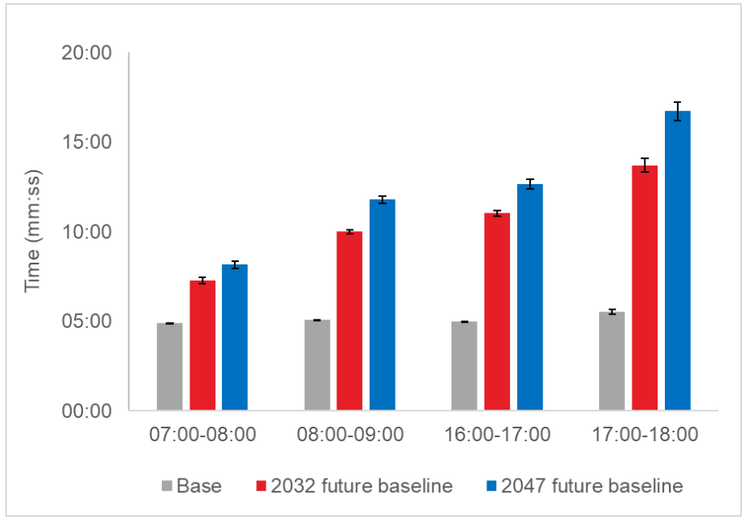
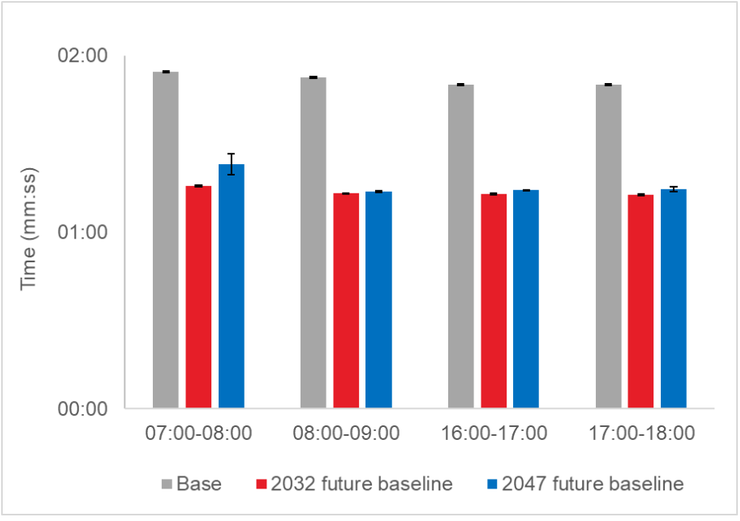


Diagram 5.6.4: base vs future baseline for Longbridge roundabout to Lowfield Heath roundabout



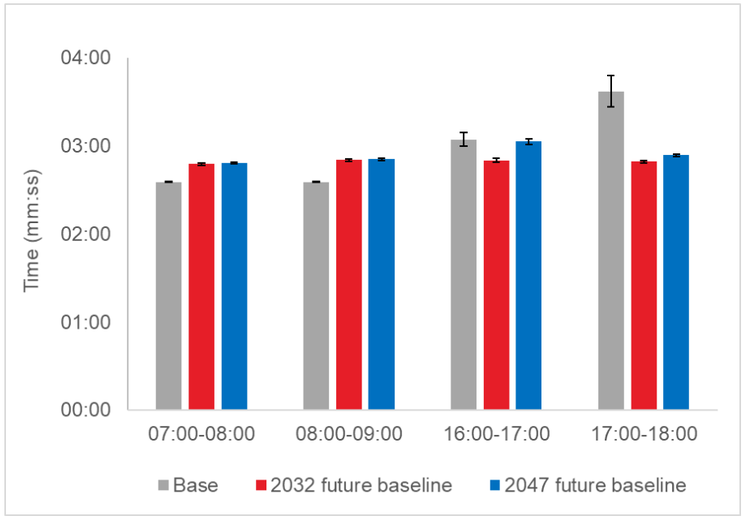
5.6.6 The trend of worsening performance is not apparent across all journey times. On certain journey time routes the total journey time is noticeably quicker in both future baseline scenarios compared to the base year. This is particularly apparent for the journey time from M23 South to Junction 9, as illustrated in Diagram 5.6.5. In this instance the reduction in journey time is due to the removal of the signals on the M23 northbound off slip at Junction 9 as part of the Smart Motorways scheme.

Diagram 5.6.5: base vs future baseline for M23 South to M23 Junction 9



5.6.7 A similar pattern is present in the North Terminal to Junction 9 journey time. As shown in Diagram 5.6.6 there are journey time improvements in the PM peak between the base and future baseline scenarios. This is likely due to Smart Motorways improvements being implemented in the future baseline.

Diagram 5.6.6: base vs future baseline for North Terminal roundabout to M23 Junction 9



6 Model analysis – with Project

6.1.1 The with Project scenario reflects a scenario which includes key proposals included within the future baseline model plus all highway proposals related to the Project.

6.1.2 The highway proposals included with the with Project scenario are described detail in in Section 3.4. Key changes as part of the scheme are as follows:

- geometric improvements at Longbridge roundabout
- geometric improvements at North Terminal and South Terminal roundabout including signalisation
- grade separation for traffic heading westbound from Airport Way to A23 London Road;
- new junction on A23 London Road immediately adjacent to North Terminal roundabout; and
- reconfiguration of forecourt operations at North Terminal.

6.1.3 The with Project scenario has been forecast to the same future years as the future baseline, 2032 and 2047.

6.1.4 Within this section 2032 and 2047 with Project model results are compared back to the equivalent future baseline model scenarios to determine the impact of the proposed scheme.

6.2 Model operation overview

6.2.1 This section provides an overview of model operation for the 2032 with Project and 2047 with Project scenarios. Select speed plots from the model throughout the model period have been used to present operation of the model in each scenario. A full set of speed plots for each half hour of the model analysis period can be found in VISSIM Forecasting Report Appendix B.

6.2.2 The speed plot key for with Project scenarios is the same as the future baseline model operation plots and is shown on Diagram 5.2.1.

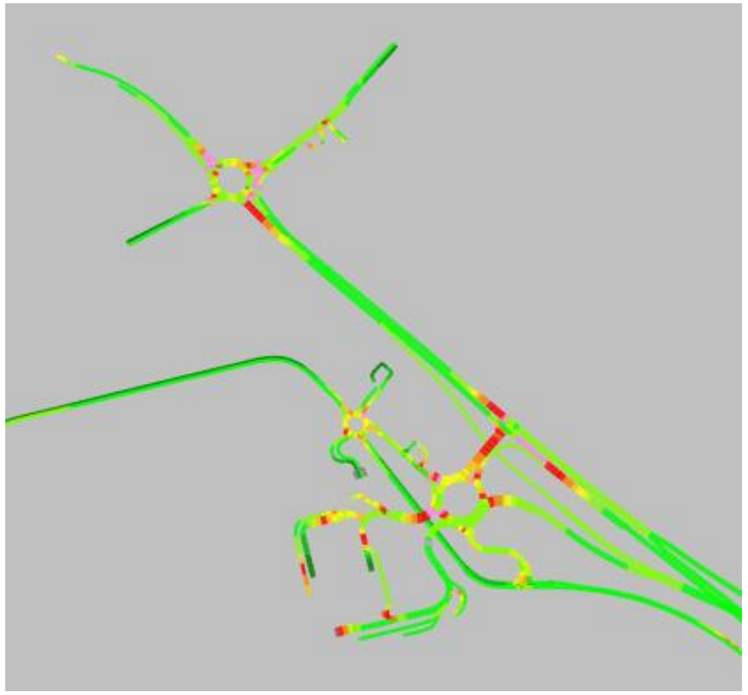
2032 with Project – AM peak

6.2.3 In the AM peak the 2032 with Project scenario performs well with minimal queuing. Generally queueing only occurs where signal heads are apparent in the network. All queues are contained within approach lanes and do not impact the flow of vehicles on major routes in the modelled network.

6.2.4 The latter part of the AM peak period is busier than the first. At the new signalised junction on the A23 at North Terminal, the split of green times has been used to balance queues on approach lanes on the A23 and from North Terminal.

6.2.5 Between 08:00 and 09:00, Longbridge Way queues back from North Terminal roundabout. The stationary and slow-moving vehicles on Longbridge Way and at the new signalised junction at North Terminal and the A23 are shown in Diagram 6.2.1.

Diagram 6.2.1: 08:30 – 09:00 2032 with Project AM peak vehicle speeds

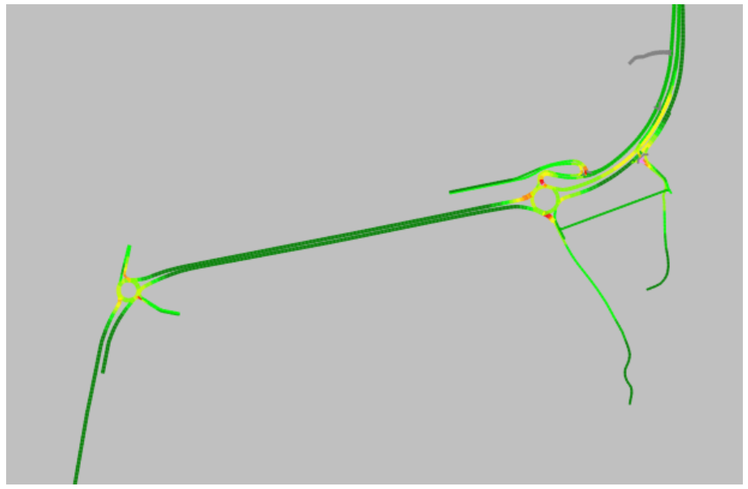


2032 with Project - PM peak

6.2.6 In the PM peak the 2032 with Project scenario operates well with minimal queuing. Queues do not impact the flow of vehicles on major routes in the modelled network. The majority of queues only occur where signal heads are apparent in the network.

6.2.7 Diagram 6.2.2 illustrates the level of queueing caused by the merge from two to one lane to the east of the Beehive Ring Road / London Road junction during the PM peak. The queueing here is improved compared to the corresponding future baseline scenario. The queueing is unsurprising considering the level of delay experienced in the base model and that no upgrades are planned at this location in 2032. A full set of half hour speed plots (AM and PM) for this location can be found in Appendix C.

Diagram 6.2.2: 17:30 – 18:00 2032 with Project PM peak London Road operation



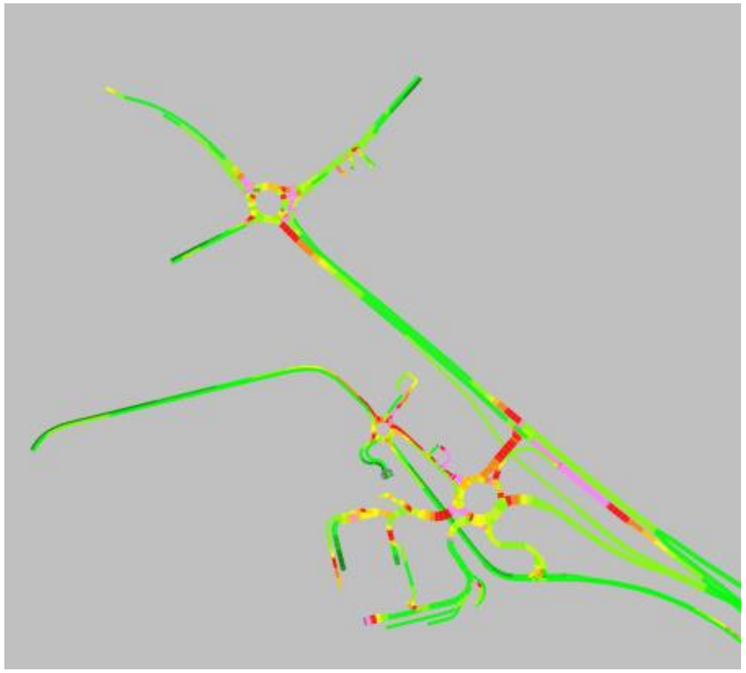
2047 with Project – AM peak

6.2.8 The AM peak 2047 with Project scenario operates generally well with pockets of queueing forming as the peak period progresses. The second AM hour is the busier of the two hours within the peak period.

6.2.9 Queues at the new A223 / North Terminal junction have been balanced between traffic exiting North Terminal and traffic travelling and A23 NB queues, particularly between 08:30 and 09:00.

6.2.10 Towards the end of the peak period queues form along Longbridge Way on approach to North Terminal roundabout. Model operation on the A23, at North Terminal roundabout and at Longbridge roundabout at the end of the AM peak period is shown in Diagram 6.2.3.

Diagram 6.2.3: 08:30 – 09:00 2047 with Project AM peak North Terminal and Longbridge roundabouts operation

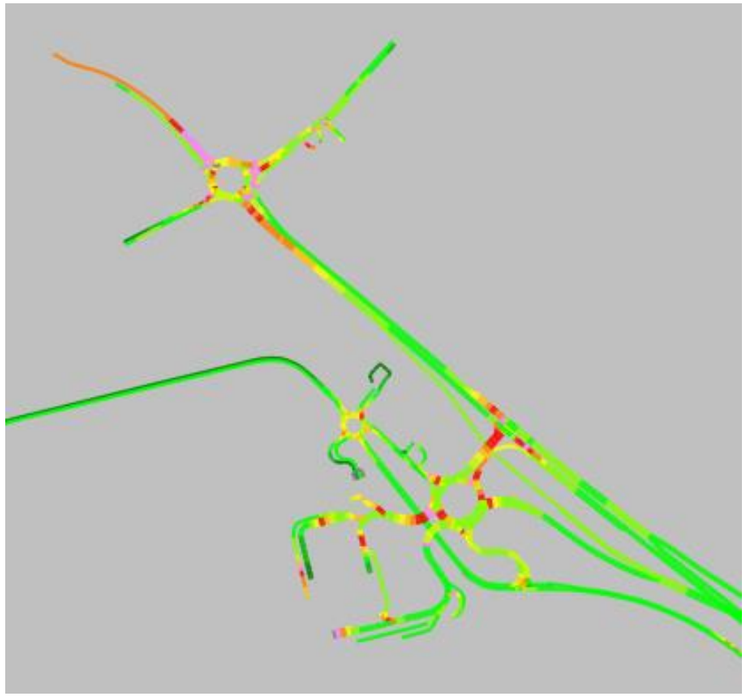


2047 with Project - PM peak

6.2.11 Queuing under the 2047 with Project PM peak scenario is generally minimal. Where queues do occur, they do so during the later stages of the peak period. Queues do not impact the flow of vehicles on major travel routes within the network.

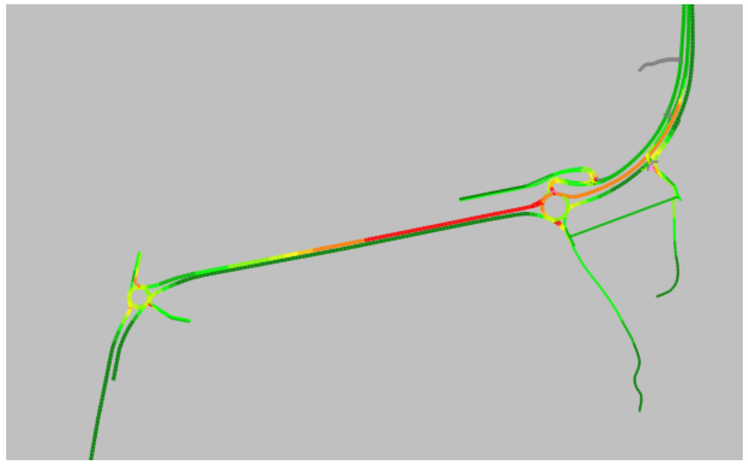
6.2.12 From 16:30 onwards queues begin to build on the A217 approach of Longbridge roundabout. These queues build throughout the remaining peak period. Whilst there are stationary and slow-moving vehicles on this approach the level of queuing within this scenario is significantly lower than the corresponding future baseline scenario modelled. Operation of the 2047 with Project PM scenario is illustrated in Diagram 6.2.4.

Diagram 6.2.4: 17:30 – 18:00 2047 with Project PM peak North Terminal and Longbridge roundabouts operation



6.2.13 The level of queueing along London Road in the 2047 with Project PM peak scenario is shown in Diagram 6.2.5. Queues are their most severe in the final half hour of the analysis period. Like the future baseline scenarios, queues form through Gatwick Road roundabout westwards. The queues in the with Project scenarios compared to the same year future baseline scenario are shorter and do not reach Lowfield Heath roundabout.

Diagram 6.2.5: 17:30 – 18:00 2047 with Project PM peak London Road operation



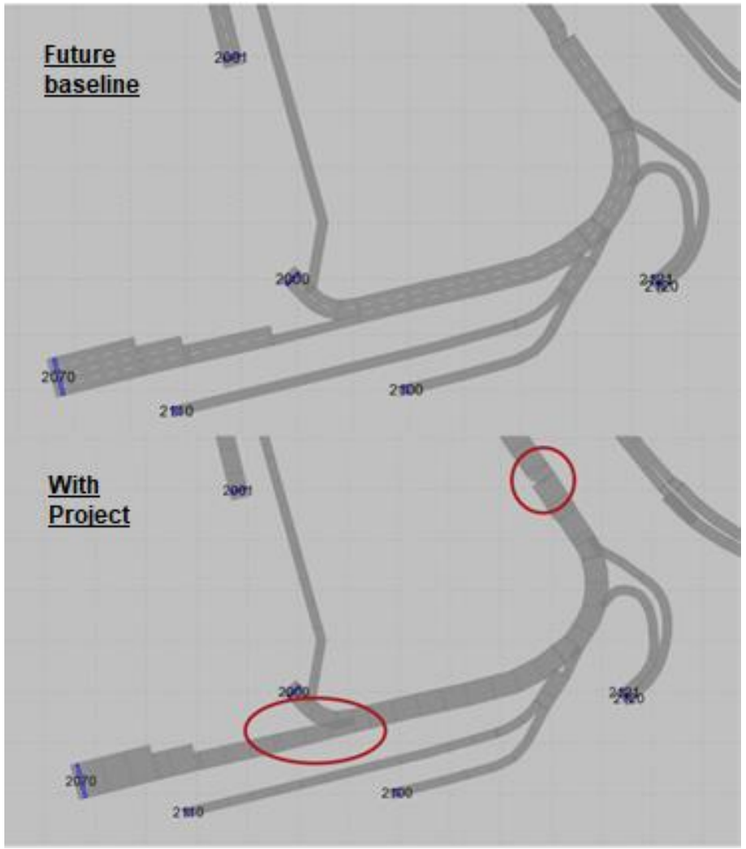
6.3 Changes

6.3.1 The with Project model scenarios were developed from the future baseline network and therefore include the changes as described in Section 5.3. The difference between with Project and future baseline are the new junction layouts at North Terminal roundabout, South Terminal roundabout and Longbridge Roundabout.

6.3.2 Additional changes have been made to the with Project model scenarios isolated from those listed in Section 3 and Section 5.3. At the North Terminal ingress the lane arrangement has been altered as well as traffic destination in the with Project scenario compared to the future baseline. Lane arrangement changes ensure there is realistic lane changing in this section of the forecourt. Passenger activity has been relocated at North Terminal from the forecourt to short term parking, as described in Section 4.7.

6.3.3 A comparison of the North Terminal ingress lane arrangement layout for the future baseline and with Project is highlighted in Diagram 6.3.1.

Diagram 6.3.1: future baseline and with Project North Terminal ingress arrangement



6.4 Model stability

Convergence stability

6.4.1 TAG does not state explicit convergence criteria. TfL guidance suggests 95% of travel times on all paths should change by less than 20% for four iterations, with PTV suggesting that anywhere between 90-95% is suitable. After running 100 simulations, the maximum percentage share of converged paths reached is 84% and 94% for 2032 and 2047 with Project scenarios respectively. This performance is much better than that seen in the future baseline models.

6.4.2 This stability is clear in Diagram 6.4.1 and Diagram 6.4.2, which show the profiles of share of paths and weighted share of paths across the full set of convergence runs. The profile for 2032 has less variation than 2047. For 2032 with Project, the majority of runs after 12 exceed 90% share of converged paths. The highest of three consecutively stable runs was taken forward for each scenario. The 43rd and 93rd run path and cost files were taken forward for 2032 and 2047 with Project scenarios respectively.

Diagram 6.4.1: 2032 with Project travel time convergence

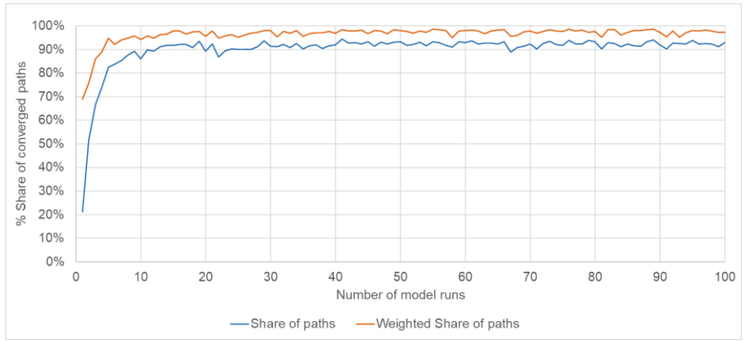
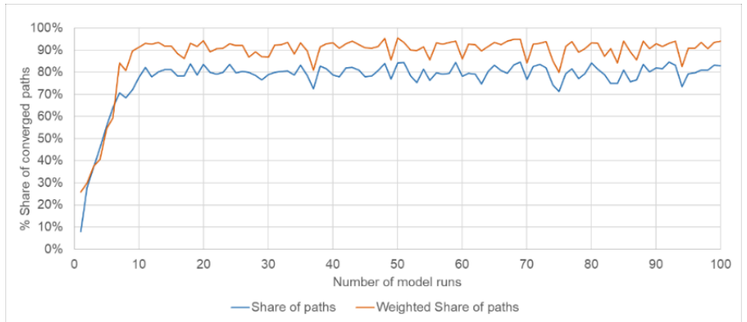


Diagram 6.4.2: 2047 with Project travel time convergence



Evaluation stability

6.4.3 The variability of network performance statistics can be analysed to determine that stability and therefore robustness of a model.

6.4.4 In this section the stability of the 2032 and 2047 with Project models were assessed. For both future year scenarios, vehicles in network and vehicle hours travelled have been assessed to determine model stability. Stability has been measured over 20 evaluation runs for the AM and PM peaks separately.

2032 with Project

6.4.5 Diagram 6.4.3 to Diagram 6.4.6 show that across all 20 evaluation runs in 2032, both AM and PM peaks are stable – the vehicle hours travelled and vehicles in network follow the same profile with no notable anomalies in any of the seeds.

Diagram 6.4.3: 2032 with Project vehicle hours travelled – AM

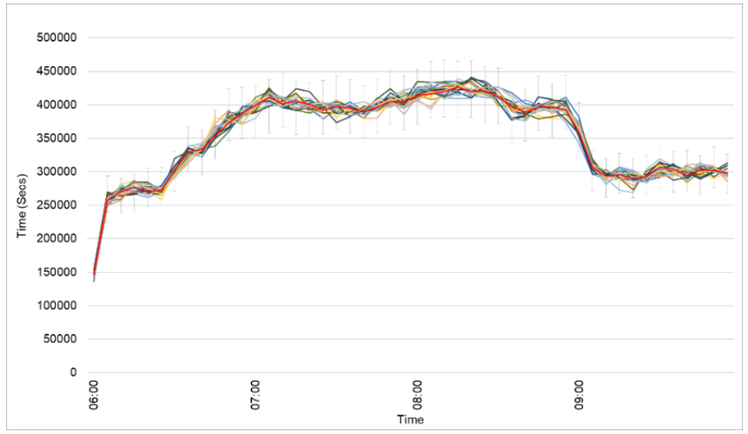


Diagram 6.4.4: 2032 with Project vehicle hours travelled – PM

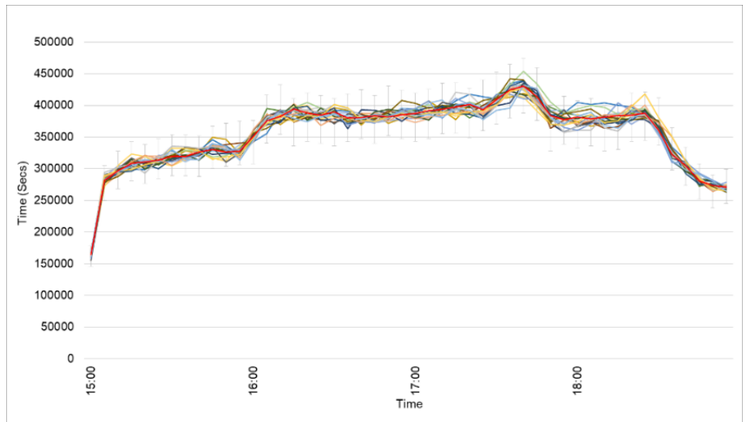


Diagram 6.4.5: 2032 with Project vehicles in network – AM

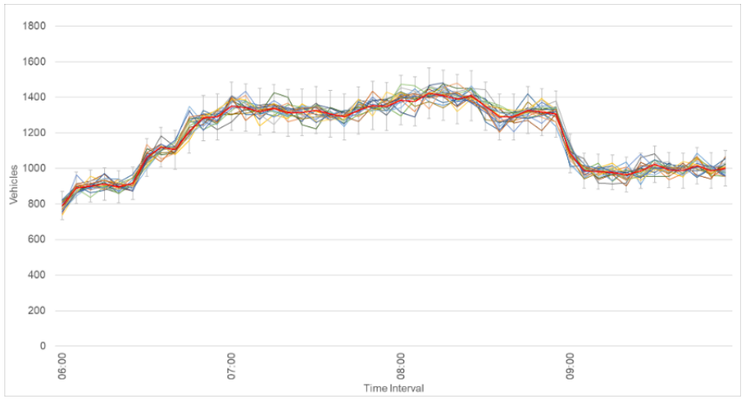


Diagram 6.4.6: 2032 with Project vehicles in network – PM

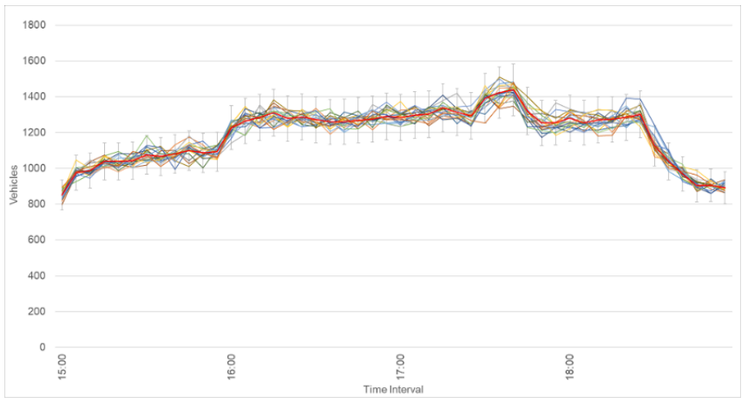


Diagram 6.4.7: 2047 with Project vehicle hours travelled – AM

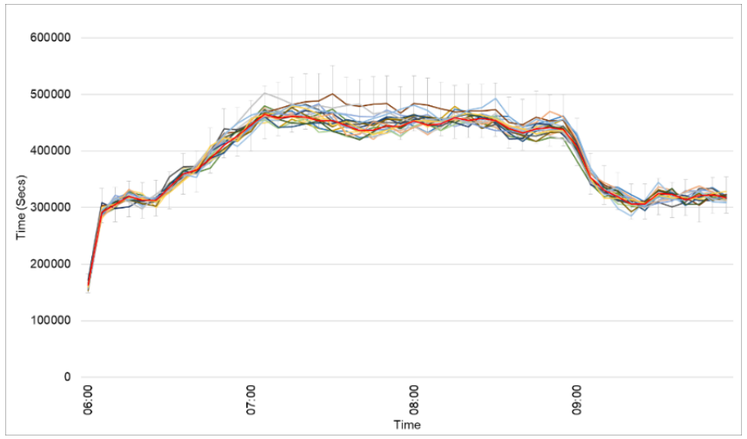


Diagram 6.4.8: 2047 with Project vehicle hours travelled – PM

Diagram 6.4.9: 2047 with Project vehicles in network – AM

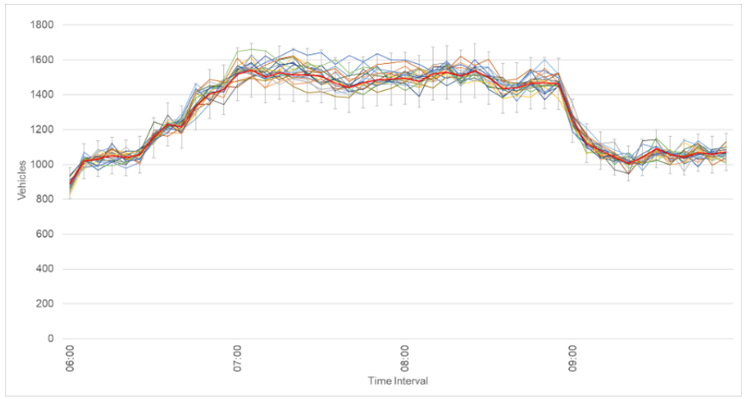
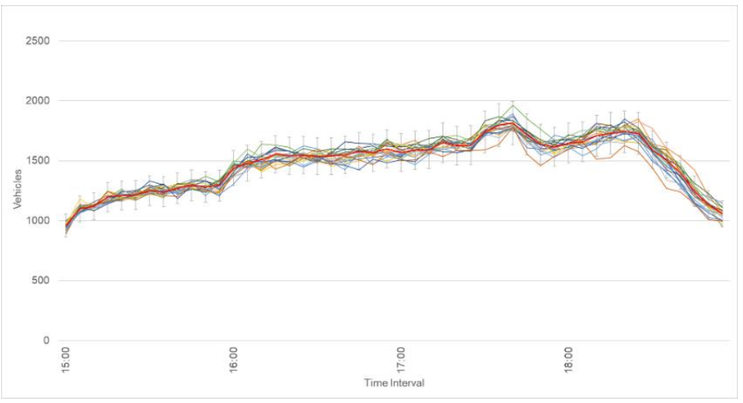


Diagram 6.4.10: 2047 with Project vehicles in network – PM



2047 with Project

6.4.6 Diagram 6.4.7 to Diagram 6.4.10 show that in 2047 with Project, the 20 evaluation runs are stable and follow the same profile.

6.5 Network Performance

6.5.1 The following statistics were used to assess the comparative network operation of the future baseline and with Project models.

- vehicle kilometres travelled (VKT) per vehicle;
- vehicle hours travelled (VHT) expressed as time travelled in network per vehicle (minutes);
- average network speed (mph);
- average network delay per vehicle (seconds); and
- unreleased trips at the end of the modelled evaluation period (ie trips which could not be released into the modelled network due to congestion).

6.5.2 Results have been split by each future year hour (2032 and 2047) to understand the impact of the proposed scheme.

2032 with Project – AM peak

6.5.3 Table 6.5.1 presents AM peak network statistics for the 2032 future baseline and with Project scenarios. Between these scenarios, there is a reduction in average network delay, along with an increase in average network speed. There is a significant improvement in unreleased trips as only 1 vehicle was unable to enter the network in the AM peak with Project compared with 345 vehicles in the future baseline scenario.

Table 6.5.1: 2032 future baseline and 2032 with Project AM peak network performance statistics

Network Statistic	AM 2032 future baseline	AM 2032 with Project	Difference
Vehicle kilometres travelled per vehicle	3.7	3.7	0.0
Time travelled in network per vehicle (minutes)	4.2	4.0	-0.1
Average network speed (mph)	53.4	55.5	2.1
Average network delay per vehicle (s)	79.3	57.5	-21.8
Unreleased Trips	282	1	-280

2032 with Project - PM peak

6.5.4 Table 6.5.2 presents PM peak network statistics for the 2032 future baseline and with Project scenarios. The same trend is observed in the PM comparisons with decrease in average network delay and increase in average network speed. The implementation of the with Project has reduced the unreleased trips from 912 vehicles at the end of the evaluation period in the future baseline to only 4 vehicles.

Table 6.5.2: 2032 future baseline and 2032 with Project PM peak network performance statistics

Network Statistic	PM 2032 future baseline	PM 2032 with Project	Difference
Vehicle kilometres travelled per vehicle	3.7	3.6	-0.1
Time travelled in network per vehicle (minutes)	4.5	3.8	-0.7
Average network speed (mph)	50.1	57.2	7.1
Average network delay per vehicle (s)	101.2	51.5	-49.7
Unreleased Trips	912	4	-908

2047 with Project – AM peak

6.5.5 Table 6.5.3 presents AM peak network statistics for the 2047 future baseline and with Project scenarios. As with the 2032 comparisons, in 2047, the scheme significantly reduces network delay. There are only 18 vehicles that were unable to enter the network in the AM peak compared to 517 vehicles in 2047 future baseline.

Table 6.5.3: 2047 future baseline and 2047 with Project AM peak network performance statistics

Network Statistic	AM 2047 future baseline	AM 2047 with Project	Difference
Vehicle kilometres travelled per vehicle	3.7	3.7	0.0
Time travelled in network per vehicle (minutes)	4.7	4.3	-0.4
Average network speed (mph)	47.1	51.6	4.5
Average network delay per vehicle (s)	113.5	75.5	-38.0
Unreleased Trips	517	18	-499

2047 with Project - PM peak

6.5.6 Table 6.5.4 presents PM peak network statistics for the 2047 future baseline and with Project scenarios. Results show a similar trend to the AM with average network delay and time travelled in network decreasing with the scheme. The magnitude of unreleased trips is largest in the 2047 future baseline with over 2,100 vehicles unable to enter the network. With the Project, this is significantly reduced to 52 vehicles.

Table 6.5.4: 2047 future baseline and 2047 with Project PM peak network performance statistics

Network Statistic	PM 2047 future baseline	PM 2047 with Project	Difference
Vehicle kilometres travelled per vehicle	3.7	3.6	-0.1
Time travelled in network per vehicle (minutes)	5.2	4.3	-0.9
Average network speed (mph)	43.4	50.1	6.7
Average network delay per vehicle (s)	147.8	84.1	-63.7
Unreleased Trips	2161	52	-2109

6.5.7 Across the board in all peak periods and future years there is a similar pattern when comparing network statistics between the future baseline and with Project scenarios. There are noticeable improvements in model operation following the introduction of the Project compared to the future baseline scenario.

6.6 Journey times

Journey time routes

6.6.1 Fourteen journey time routes were assessed, to provide a good level of coverage across the model network. Each route is outlined and described in Section 0.

Journey time analysis

6.6.2 In order to understand the impact of the Project, future baseline travel times have been compared against equivalent with Project travel times. In this section, select travel time routes have been assessed which present key trends between the equivalent scenarios. The comparison of future baseline and with Project journey time routes has been completed for 2032 and 2047 future years. A full set of journey time graphs for all routes can be found in VISSIM Forecasting Report Appendix D.

6.6.3 The overarching theme when comparing the journey times in the future baseline with the with Project scenarios is that there is an overall improvement in journey times with Project. This improvement occurs in the majority of travel times. Select examples are illustrated in Diagram 6.6.1 to Diagram 6.6.2.

6.6.4 Improvements in journey times in the with Project scenario are in part due to the introduction of the flyover at South Terminal roundabout allowing free flow mainline traffic. In particular, routes from Junction 9 or South Terminal to Longbridge roundabout will benefit from this new infrastructure as it bypasses the North Terminal roundabout.

Diagram 6.6.1: future baseline vs with Project for M23 Junction 9 to Longbridge roundabout

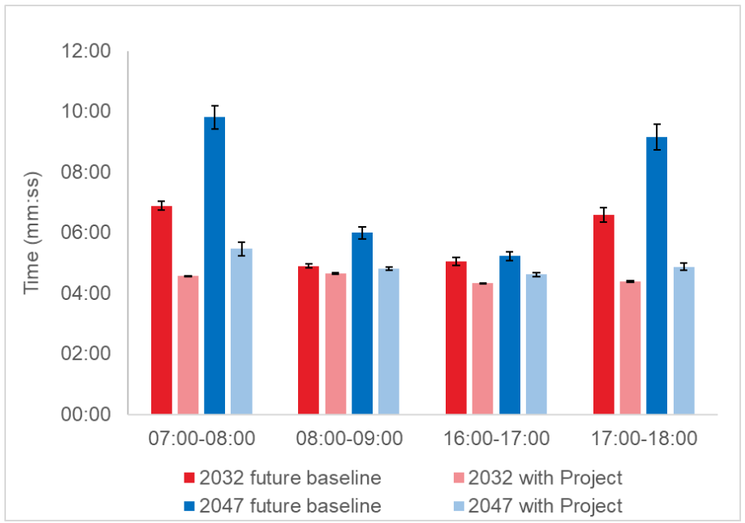
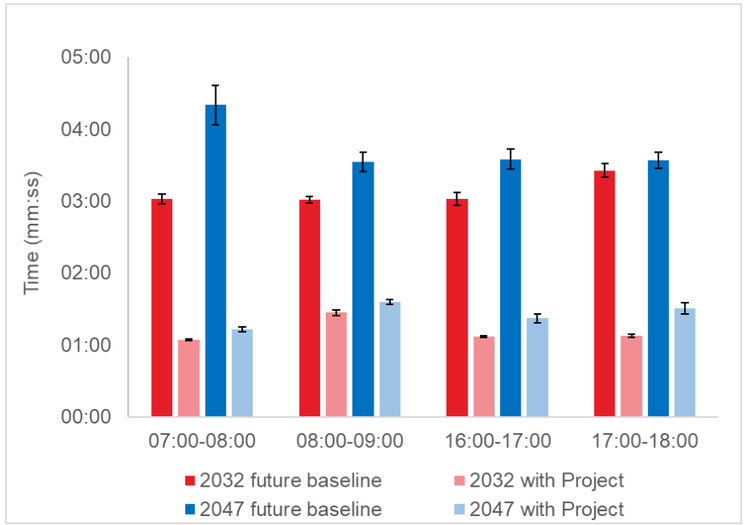
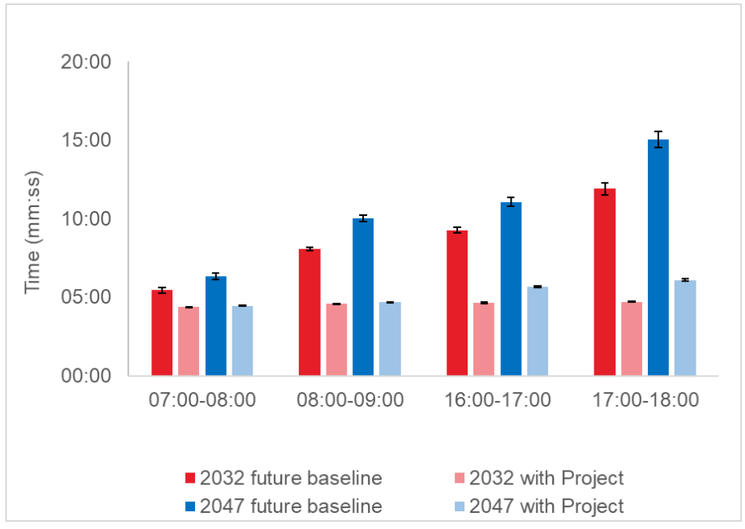


Diagram 6.6.2: future baseline vs with Project for South Terminal roundabout to Longbridge roundabout



6.6.5 In the opposite direction, from Longbridge roundabout to South Terminal roundabout, improvements in journey times in the with Project scenario are also apparent. These are shown illustrated in Diagram 6.6.3 and are likely due to improvement works at Longbridge roundabout and South Terminal roundabout.

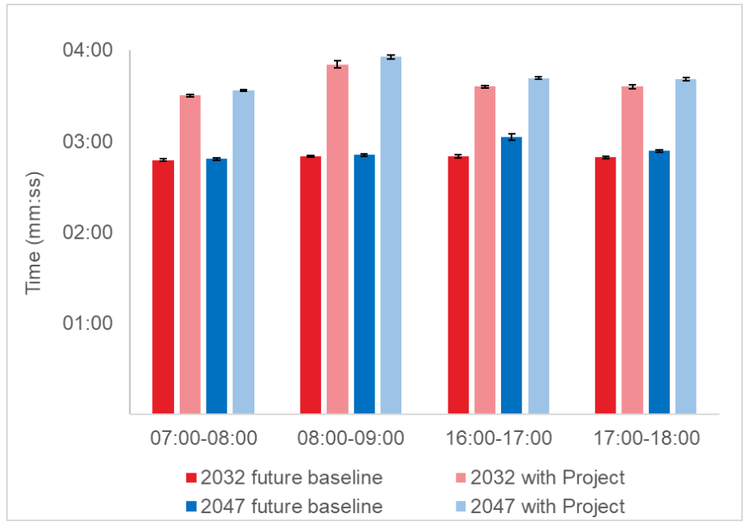
Diagram 6.6.3: 2032 future baseline vs with Project for Longbridge roundabout to South Terminal roundabout



6.6.6 Whilst the majority of journey time routes show improvements as a result of the Project, certain routes worsen. For example, as shown in Diagram 6.6.4 the journey time between North Terminal roundabout and Junction 9 worsens in all time periods.

6.6.7 This is due to vehicles having to travel through the new North Terminal / A23 signalised junction, compared to exiting the North Terminal roundabout via Airport Way in the future baseline configuration. Vehicles stopping at the stop line of the junction slow down vehicles completing this route.

Diagram 6.6.4: 2032 future baseline vs with Project for North Terminal roundabout to Junction 9

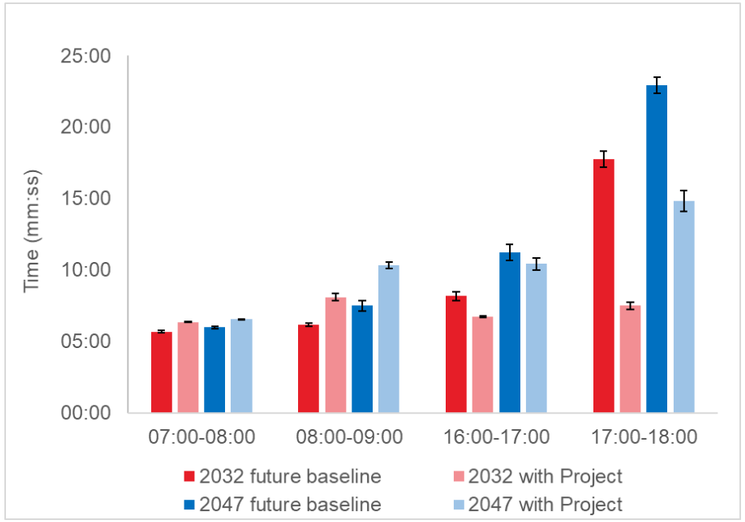


6.6.8 Diagram 6.6.5 provides a comparison of travel times between Lowfield Heath and Longbridge roundabouts. This route is also impacted by the new North Terminal / A23 signalised junction. In the AM peak, journey times increase, especially during the second AM hour (08:00-09:00). During this hour, North Terminal is busier, particularly in 2047. There is a need to balance queues at North Terminal exit and on the A23 northbound. This leads to up to 2 minutes 51 seconds increase in journey times through the signalised junction from the A23 south, a 35% increase over the 2047 future baseline journey time of 8 minutes and 6 seconds in this hour.

6.6.9 In the PM peak hours, for routes starting at Lowfield Heath roundabout, queuing is also apparent from the London Road merge east of the Beehive Ring Road. This leads to slower journey times along this section in the PM peak. The extent of the

queuing is greater in the future baseline compared to with Project, which leads to a decrease in journey times from the future baseline with implementation of the Project, particularly in 2047.

Diagram 6.6.5: 2047 future baseline vs with Project for Lowfield Heath roundabout to Longbridge roundabout



7 Summary and conclusion

7.1 Model development process

7.1.1 Using the 2016 Gatwick VISSIM base models presented in the VISSIM Local Model Validation Report (LMVR), future year model scenarios have been created. These future year scenarios cover the future baseline scenario and with Project scenarios.

7.1.2 The future baseline scenario reflects the existing 2016 highway arrangement with the following key alterations included:

- M23 Junction 9 Smart Motorways improvements including three lanes on the M23 Spur westbound; and
- new short stay multistorey car park, MSCP7

7.1.3 The with Project scenario incorporates GAL's surface access proposals and predicted highway demand. The GAL surface access proposals included the following key infrastructure changes. The key changes made in the future baseline scenarios are retained in the with Project scenarios:

- geometric improvements at Longbridge roundabout;
- geometric improvements at North Terminal and South Terminal roundabout including signalisation;
- grade separation for traffic heading westbound from Airport Way to A23 London Road;
- new junction on A23 London Road immediately adjacent to North Terminal roundabout; and
- reconfiguration of forecourt operations at North Terminal.

7.1.4 A full description of all changes in each future year scenario are provided within section 3 of this report.

7.1.5 For each scenario, traffic flows have been incorporated from the associated scenario from the strategic highway model of the GHOST modelling suite.

7.2 Modelling results summary

Model analysis - future baseline

7.2.1 To analyse the performance of the future baseline scenario, modelling results for each future year were compared back to the 2016 base modelling. This comparison allowed for the understanding of impact to the existing highway in the modelled future years of 2032 and 2047.

7.2.2 These comparisons between the future baseline and base scenarios outlined an overarching trend. There was a predicted general worsening of model performance moving to a 2032 future baseline and then to a 2047 future baseline scenario.

7.2.3 In the 2047 future baseline scenario, there is a significant worsening of model performance in relation to network performance statistics and modelled journey times. Average network speeds reduce by 21.4mph and 24.7mph in the AM and PM peaks respectively compared to the 2016 base model. Such decreases are a result of an increase in vehicles – an additional 7423 and 5833 vehicles arrive in the network in the AM and PM peak periods respectively in 2047, compared to the base 2016 scenario. This also results in a general worsening of journey times compared to the 2016 base scenario.

7.2.4 Some improvements to journey times between the 2016 base and future baseline scenarios are also apparent. These are largely due to the implementation of the Smart Motorways improvements at M23 junction 9. However, these improvements are minor and do not reflect the main theme of the comparison between 2016 base and future baseline scenario model results.

Model analysis - with Project

7.2.5 To understand the impact of the proposed scheme, with Project scenario model results were compared against the model results from the future baseline model scenarios.

7.2.6 In general, when comparing the two scenarios in both 2032 and 2047, the with Project scenario provides a better level of model operation than the future baseline scenario.

7.2.7 There are certain modelled journey time routes which have slower journey times in the with Project scenario. This is due to the inclusion of the new A23 / North Terminal signalised junction which slows traffic down through this particular part of the network. Beyond these journey time routes, general improvements are seen across the majority of journey time routes in each of the with Project year scenarios compared to the future baseline.

7.2.8 For each future year and peak period, the with Project scenarios recorded a lower level of unreleased trips and an increased average network speed than the corresponding future baseline scenario. This indicates the network is operating more efficiently in the 2047 with Project scenario than in the 2047 future baseline condition.

7.3 Conclusions

7.3.1 This report describes the method and assumptions used to create the following four future year Gatwick VISSIM models.

- 2032 future baseline;
- 2032 with Project;
- 2047 future baseline; and
- 2047 with Project.

7.3.2 The report presents model results for each of these core scenarios. Model results have been compared to each other and back to the 2016 validated and calibrated base model to gather a set of conclusions.

7.3.3 Model results suggest that across the future baseline scenarios, model performance decreases over time. In the 2047 future baseline scenario, there are significant numbers of unreleased trips, and large amounts of delay recorded across the model network.

7.3.4 The provision of the with Project scheme improves model performance and modelled journey times compared to the future baseline. Such improvements are most noticeable in 2047 where the with Project scheme is required to ensure the model network operates satisfactorily.

Our northern runway: making best use of Gatwick

Gatwick Airport Northern Runway Project

Transport Assessment Annex C - VISSIM Forecasting Report - Appendices

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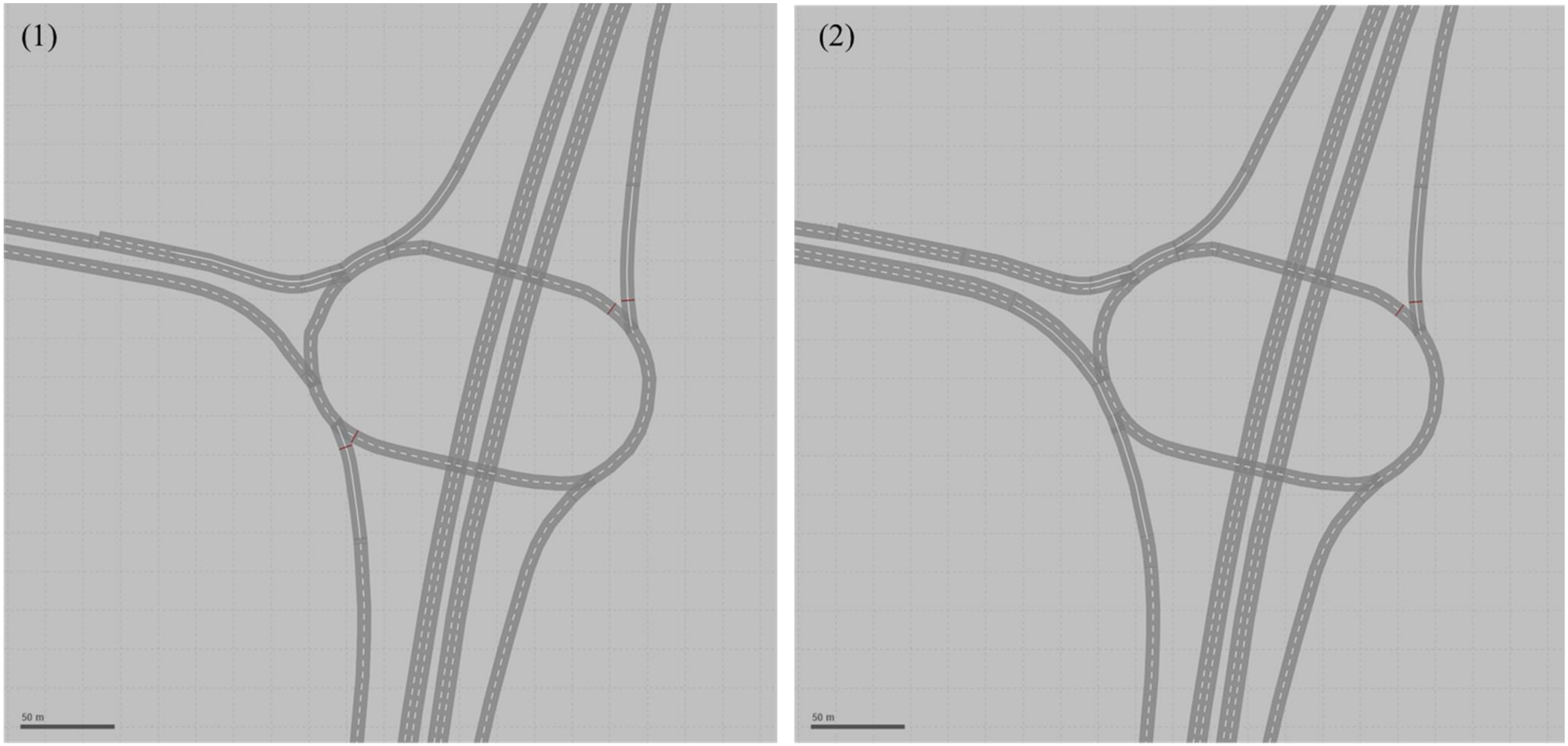
A. Base, future baseline & with Project layout comparisons

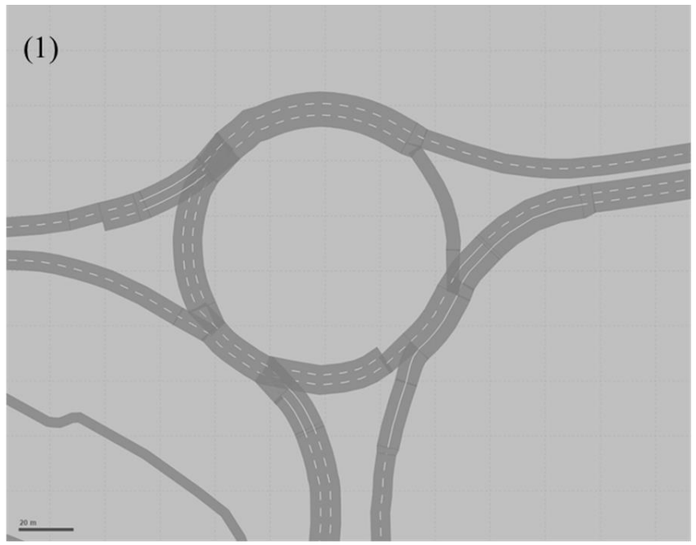
M23 J9 VISSIM layout

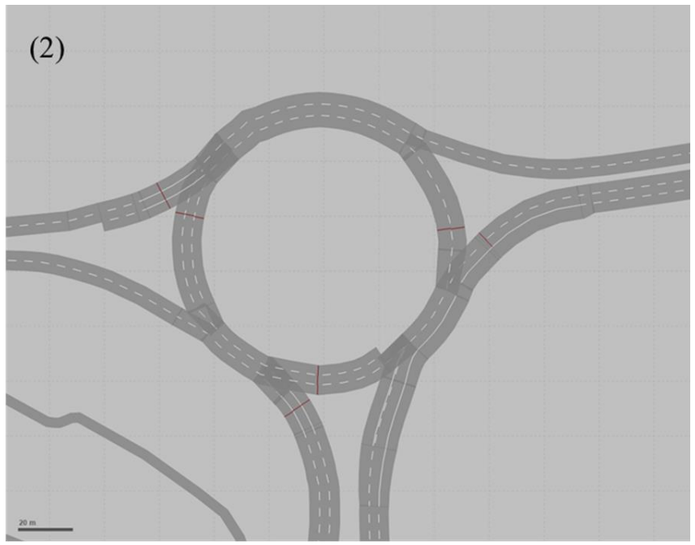


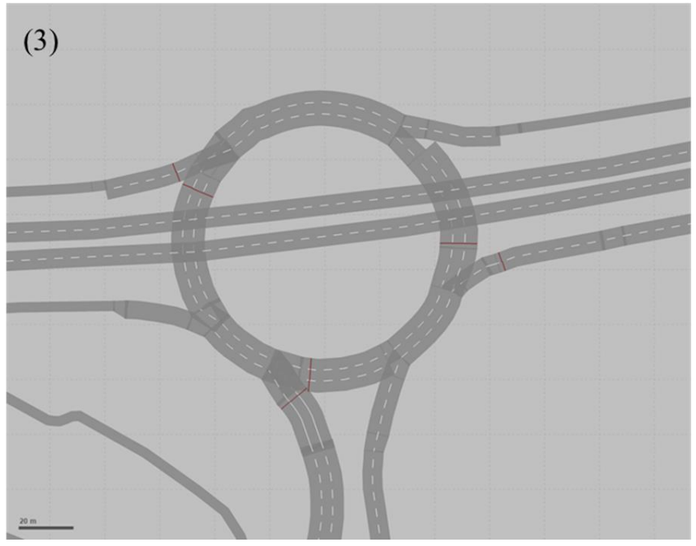
M23 Junction 9

(1) Base
(2) Future baseline & with Project

South Terminal roundabout VISSIM layout



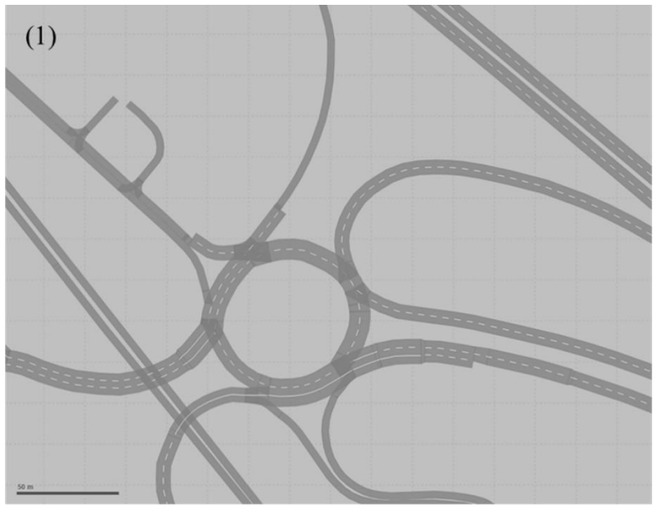


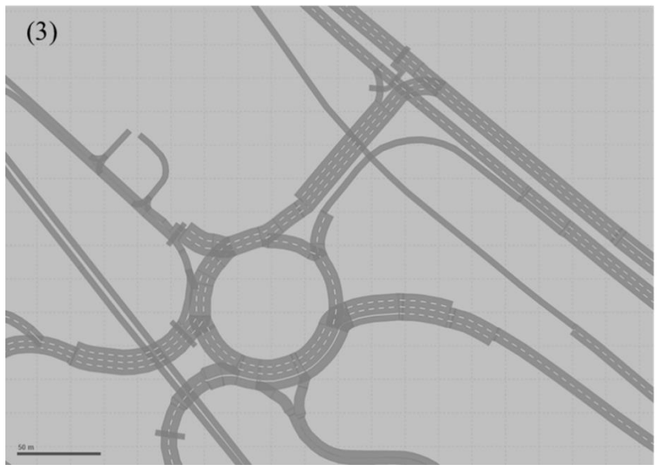


South Terminal Roundabout

(1) Base
(2) Future baseline
(3) With Project

North Terminal roundabout VISSIM layout

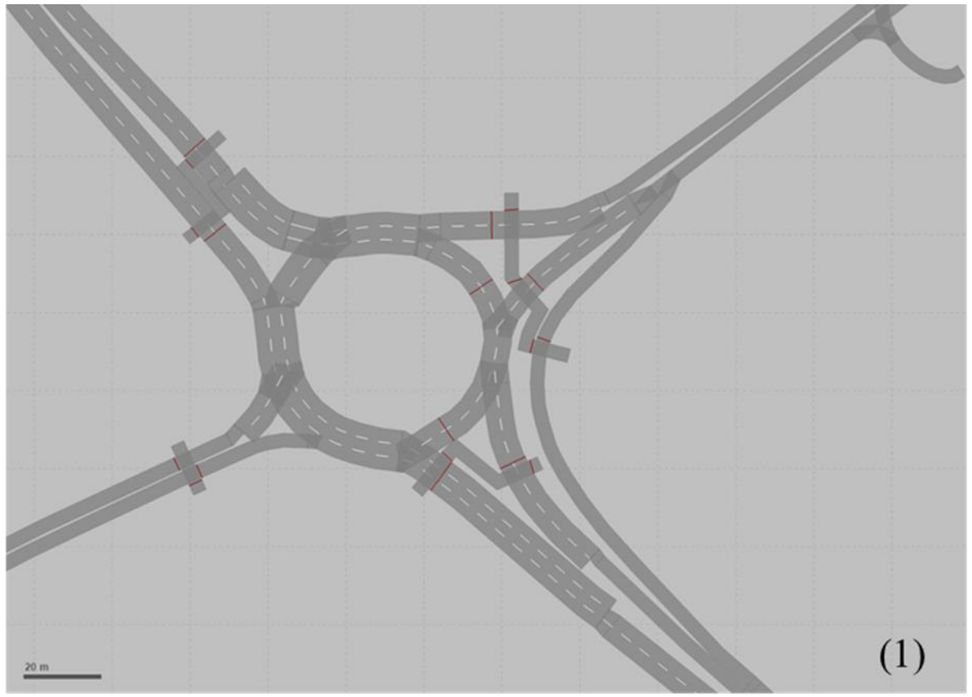


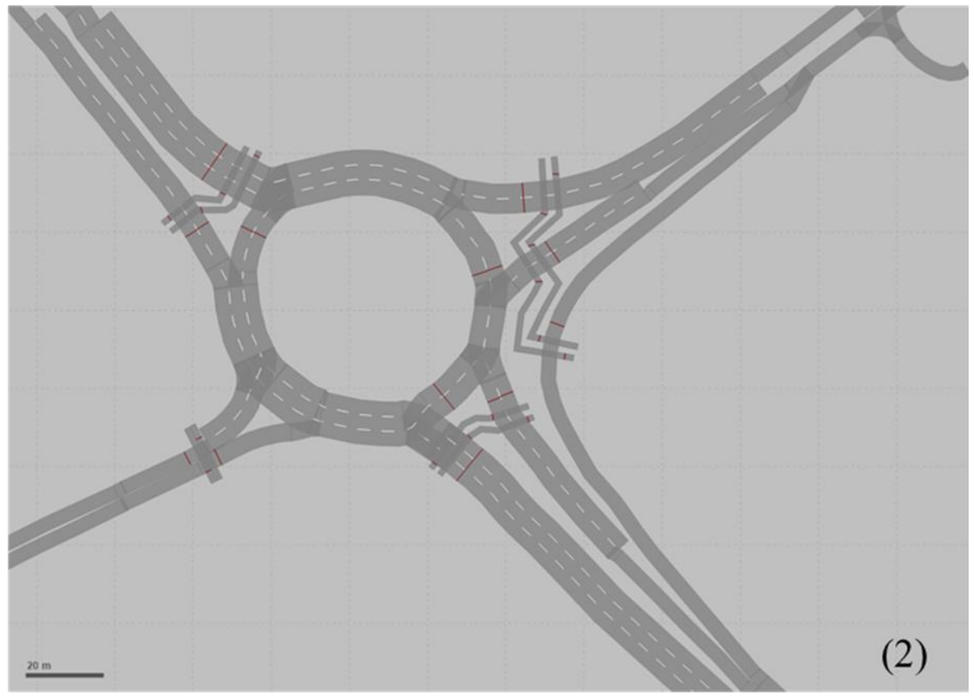


North Terminal Roundabout

(4) Base
(5) Future baseline
(6) With Project

Longbridge roundabout VISSIM layout





Longbridge Roundabout

(1) Base and future baseline
(2) With Project

B. Forecast demand worked example

B.1 VISSIM matrix uplifts worked example

B.1.1 The example given here is for uplifting SATURN User Class 4 (LGVs) in the AM1 period (07:00-08:00) for a single movement from 95114 to 95103. The numbers used are not numbers taken from the actual SATURN models but are just used to provide an example.

B.1.2 Table B.1.1 to Table B.1.9 show the uplift and split information.

Table B.1.1: North Terminal Zone Section

Zone Name	VISSIM Zone	SATURN Entry	SATURN Exit
Staff CP Y / Hotel	215	95114	95114
NT Long stay	216	95114	95114
NT Block Park	217	95114	95114
Cargo Rd	218	95114	95114
Logistics	219	95114	95114

Table B.1.2: User Classes

SATURN UC	VISSIM Class	VISSIM Class Name
UC4	CL2	Airport LGVs
UC4	CL7	Background LGVs

Table B.1.3: AM1 time period

SATURN Model Time Period	VISSIM matrices applied to
AM1 (07:00-08:00)	06:30-08:00

Table B.1.4: Zone to zone uplift

Zone	Base	Future	Difference
95114 to 95103	100	300	200

Table B.1.5: Uplift splits by time (%)

Time period	Proportion of peak hour (base)*	Vehicle volume uplift
06:30-07:00	55%	0.55x200=110
07:00-08:00	100%	200

*Indicative: total base LGV in period 06:30-07:00 as a percentage of total base LGV in period 07:00-08:00

B.1.3 The raw splits for each 15-minute period based on the numbers in Table B.1.4 are split using the base distributions as shown in Table B.1.6.

Table B.1.6: 15-minute raw splits

Start time	End time	VISSIM Base distribution percentage	Total Vehicles (UC4) uplift for time period
06:30	06:45	0.44	48
06:45	07:00	0.56	62
Total (06:30-07:00)		1	110
07:00	07:15	0.2	40
07:15	07:30	0.24	47
07:30	07:45	0.27	54
07:45	08:00	0.29	59
Total (07:00-08:00)		1	200

B.1.4 From Table B.1.6 we specifically look at 07:15-07:30 and split the 47 vehicles by zone, again this is done using the distributions from the base model and is shown in Table B.1.7.

Table B.1.7: 07:15-07:30 zone split

VISSIM zone	VISSIM Base distribution percentage	Total Vehicles (UC4) uplift by zone
215	0	0
216	0	0
217	0	0
218	0.333333	16
219	0.666667	31
Total	1	47

B.1.5 Many of the SATURN to VISSIM zones are one-to-one unlike this example and because we are looking at LGVs we only see vehicles using Cargo Rd and the Logistics zone. In this case the destination zone 95103 maps one-to-one with VISSIM zone 2 so only the origin is split.

B.1.6 The final split shown in Table B.1.8 shows how the vehicles are split from SATURN user class to VISSIM user classes, specifically looking at the 31 vehicles from zone 219 from Table B.1.7.

Table B.1.8: 07:15-07:30, zone 219 vehicle class split

VISSIM vehicle class	VISSIM Base distribution percentage	Total Vehicles (UC4) uplift for time period and zone
2	1	31
7	0	0
Total	1	31

B.1.7 Finally, Table B.1.9 shows a section of the 07:15-07:30, VISSIM Class 2 O-D matrix.

Table B.1.9: Cross section of 15-minute VISSIM uplift matrix after splits

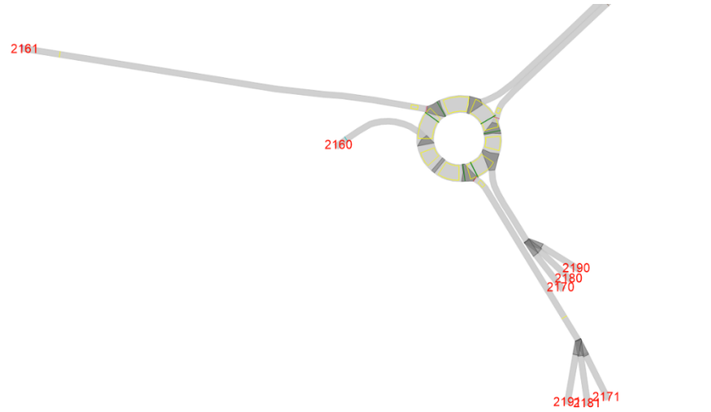
VISSIM zone entry	Class 2 uplift
215	0
216	0
217	0
218	16
219	31

B.1.8 The uplift matrix is then added to the base matrix to create a future year scenario matrix. Where negatives are present, these are attempted to be removed from other VISSIM classes containing the same vehicles, however this is not always possible due to airport and non-airport specific zones. In the cases where negatives remain, they are zeroed out and the matrix is then factored back down to match the overall matrix total with the negatives in.

B.1.9 Initially the uplifts are done for the full 62 zone VISSIM matrix, these therefore need to be aggregated down to match the 36 DCO matrices.

B.1.10 In the example above zones 216, 217, 218 and 219 are removed with the cordon process and become zone 216000.

Diagram B.1.1: Zones to be cordoned



B.1.11 In VISSIM Class 2 the matrix is uplifted by 47 for the specific movement between origin zone 216000 and destination zone 2 after we have aggregated the matrices.

C. Full model speed plots

2032 future baseline – AM peak

07:00 – 07:30

07:30 – 08:00


Color Scheme
Links (Segments)
Attribute: Speed (Avg,5400-7200,All) [km/h]
≤ 5.000
≤ 10.000
≤ 15.000
≤ 20.000
≤ 25.000
≤ 30.000
≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
undefined
500 m

08:00 – 08:30


Color Scheme
Links (Segments)
Attribute: Speed (Avg,7200-9000,All) [km/h]
≤ 5.000
≤ 10.000
≤ 15.000
≤ 20.000
≤ 25.000
≤ 30.000
≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
undefined
500 m

08:30 – 09:00


Color Scheme
Links (Segments)
Attribute: Speed (Avg,9000-10800,All) [km/h]
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≤ 10.000
≤ 15.000
≤ 20.000
≤ 25.000
≤ 30.000
≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
undefined
500 m

2032 future baseline - PM peak

16:00 – 16:30

16:30 – 17:00


Color Scheme
Links (Segments)
Attribute: Speed (Avg,37800-39600,All) [km/h]
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≤ 10.000
≤ 15.000
≤ 20.000
≤ 25.000
≤ 30.000
≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
undefined
500 m

17:00 – 17:30


Color Scheme
Links (Segments)
Attribute: Speed (Avg,39600-41400,All) [km/h]
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≤ 10.000
≤ 15.000
≤ 20.000
≤ 25.000
≤ 30.000
≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
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500 m

17:30 – 18:00


Color Scheme
Links (Segments)
Attribute: Speed (Avg,41400-43200,All) [km/h]
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≤ 10.000
≤ 15.000
≤ 20.000
≤ 25.000
≤ 30.000
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≤ 60.000
≤ 100.000
≤ MAX
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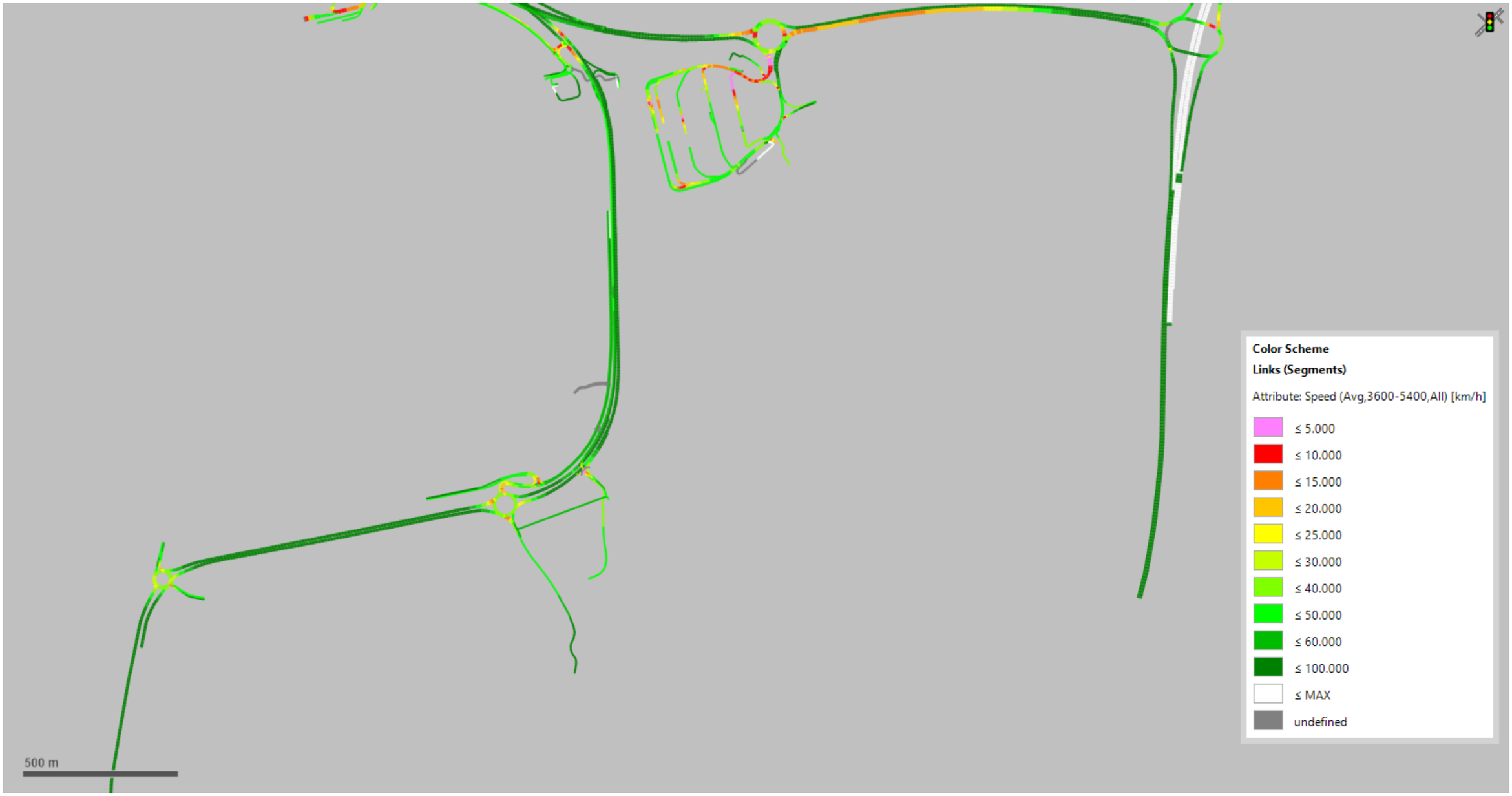
500 m

2032 future baseline – southern extent of model (London Road)

07:00-07:30



07:30-08:00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≤ 40.000
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≤ 60.000
≤ 100.000
≤ MAX
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500 m

08:00-08:30


Color Scheme
Links (Segments)
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≤ 25.000
≤ 30.000
≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
undefined
500 m

08:30-09:00


Color Scheme
Links (Segments)
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≤ 60.000
≤ 100.000
≤ MAX
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500 m

16:00-16:30


Color Scheme
Links (Segments)
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≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
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500 m

16:30-17:00


Color Scheme
Links (Segments)
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≤ 15.000
≤ 20.000
≤ 25.000
≤ 30.000
≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
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500 m

17:00-17:30


Color Scheme
Links (Segments)
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≤ 15.000
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≤ 30.000
≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
undefined
500 m

17:30-18:00


Color Scheme
Links (Segments)
Attribute: Speed (Avg,41400-43200,All) [km/h]
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≤ 15.000
≤ 20.000
≤ 25.000
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≤ MAX
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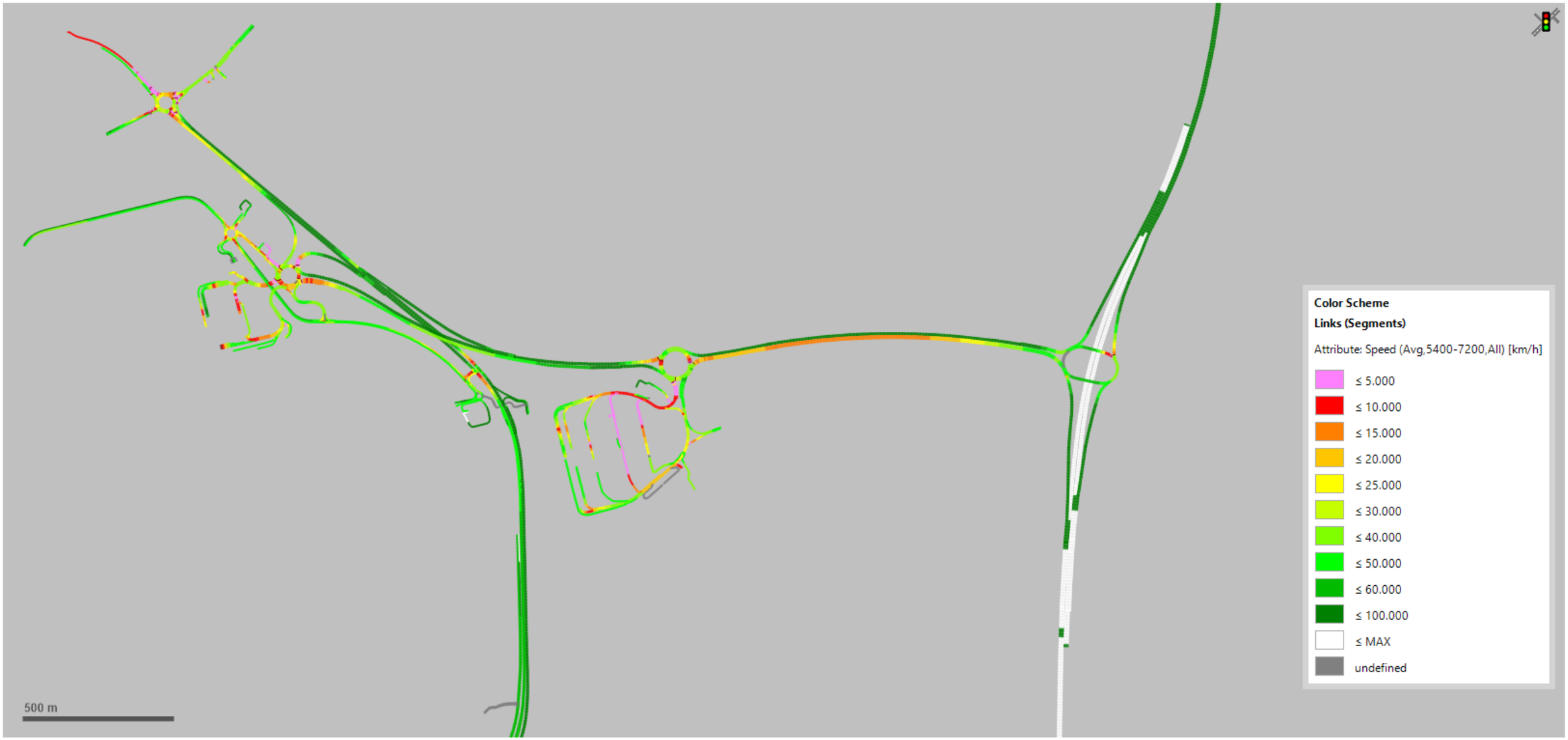
2047 future baseline AM peak

07:00 – 07:30

07:30 – 08:00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≤ 40.000
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≤ 60.000
≤ 100.000
≤ MAX
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500 m

08:00 – 08:30


Color Scheme
Links (Segments)
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≤ 40.000
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≤ 100.000
≤ MAX
undefined
500 m

08:30 – 0900


Color Scheme
Links (Segments)
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≤ 30.000
≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
undefined
500 m

2047 future baseline - PM peak

16:00 – 16:30

16:30 – 17:00


Color Scheme
Links (Segments)
Attribute: Speed (Avg,37800-39600,All) [km/h]
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≤ 60.000
≤ 100.000
≤ MAX
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500 m

17:00 – 17:30


Color Scheme
Links (Segments)
Attribute: Speed (Avg,39600-41400,All) [km/h]
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≤ MAX
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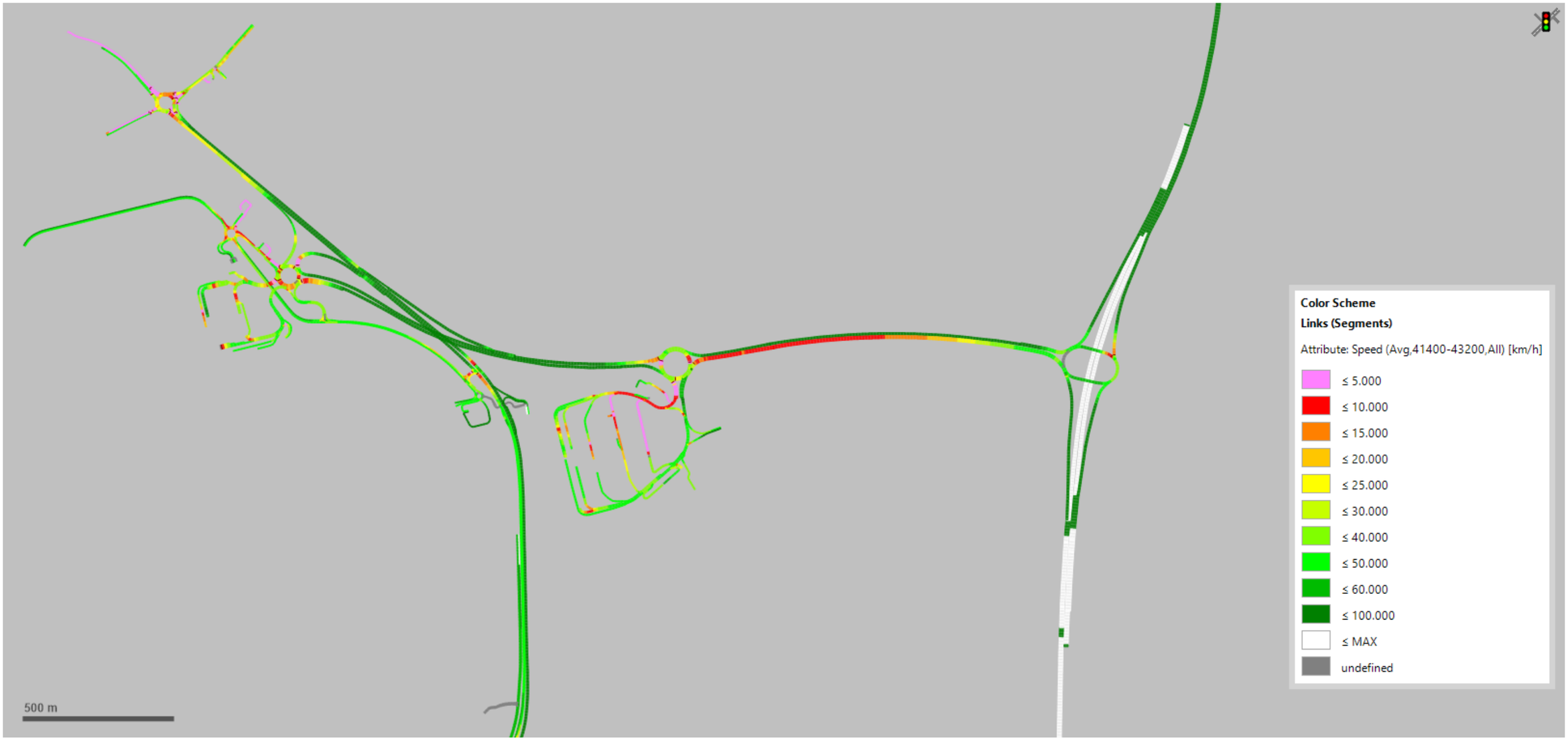
500 m

17:30 – 18:00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≤ 100.000
≤ MAX
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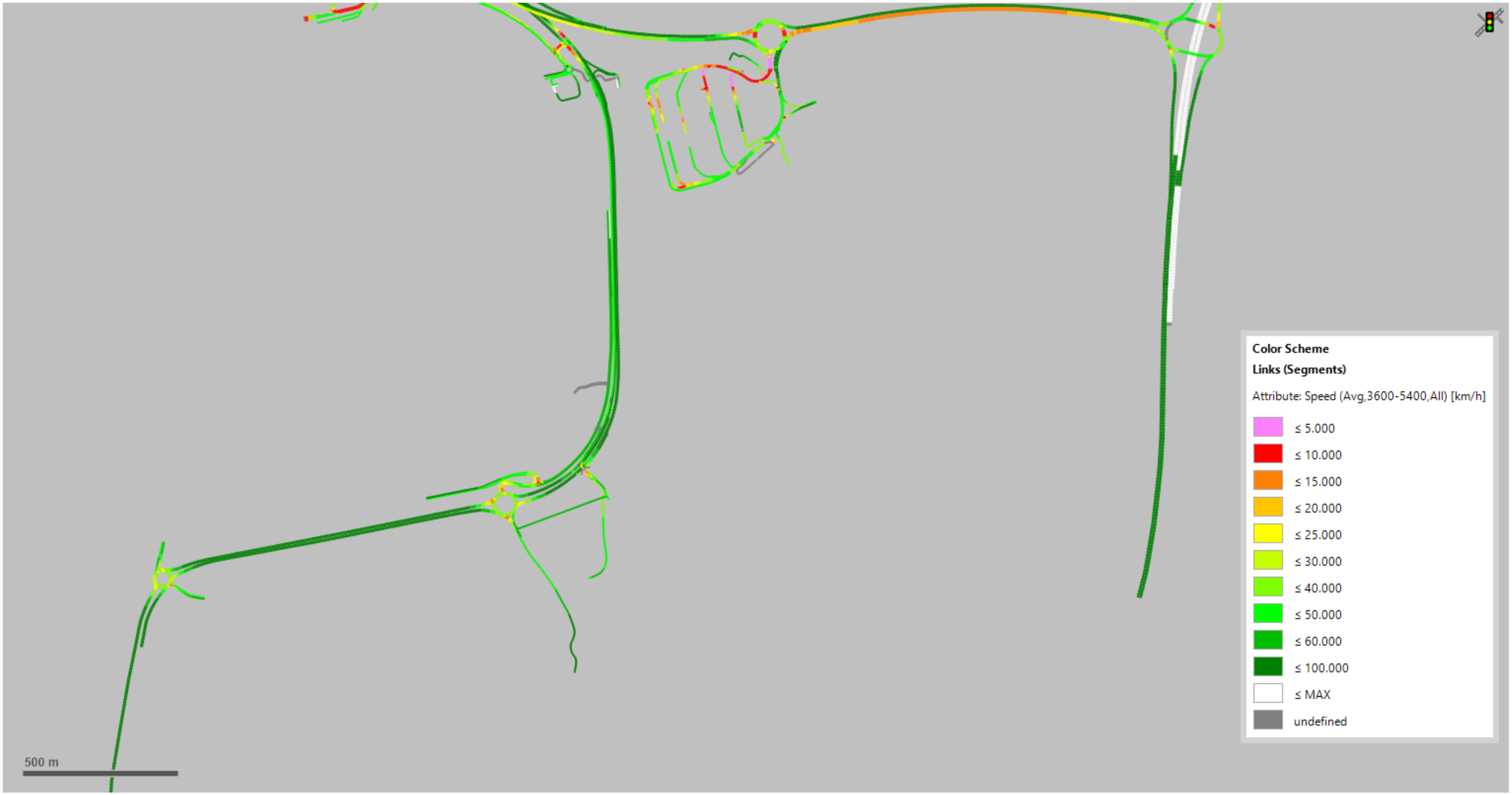
2047 future baseline – southern extent of model (London Road)

07:00-07:30



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≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
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500 m

08:00-08:30


Color Scheme
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≤ 60.000
≤ 100.000
≤ MAX
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500 m

08:30-09:00


Color Scheme
Links (Segments)
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≤ MAX
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500 m

16:00-16:30


Color Scheme
Links (Segments)
Attribute: Speed (Avg,36000-37800,All) [km/h]
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≤ MAX
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500 m

16:30-17:00


Color Scheme
Links (Segments)
Attribute: Speed (Avg,37800-39600,All) [km/h]
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undefined
500 m

17:00-17:30


Color Scheme
Links (Segments)
Attribute: Speed (Avg,39600-41400,All) [km/h]
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≤ MAX
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500 m

17:30-18:00


Color Scheme
Links (Segments)
Attribute: Speed (Avg,41400-43200,All) [km/h]
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≤ 60.000
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≤ MAX
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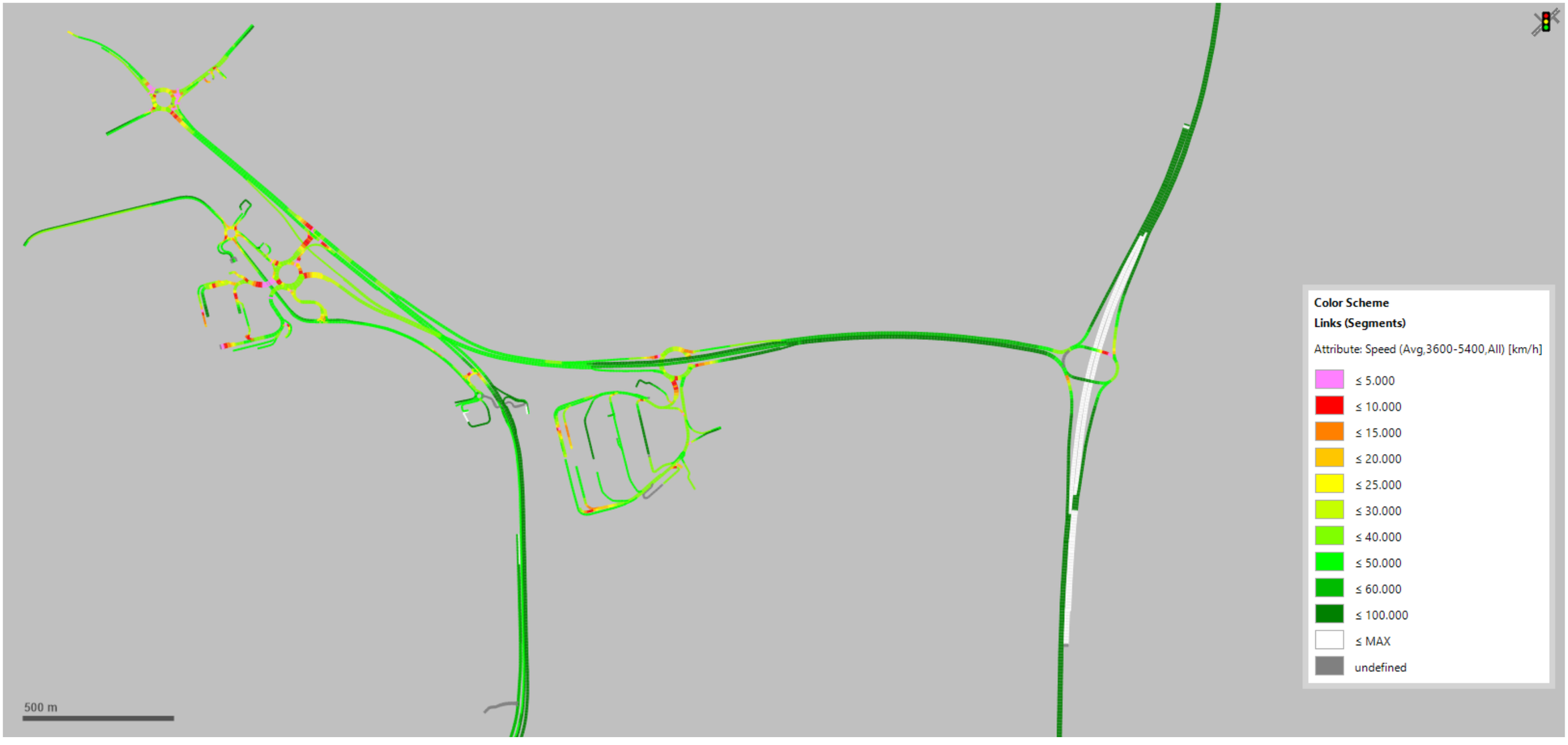
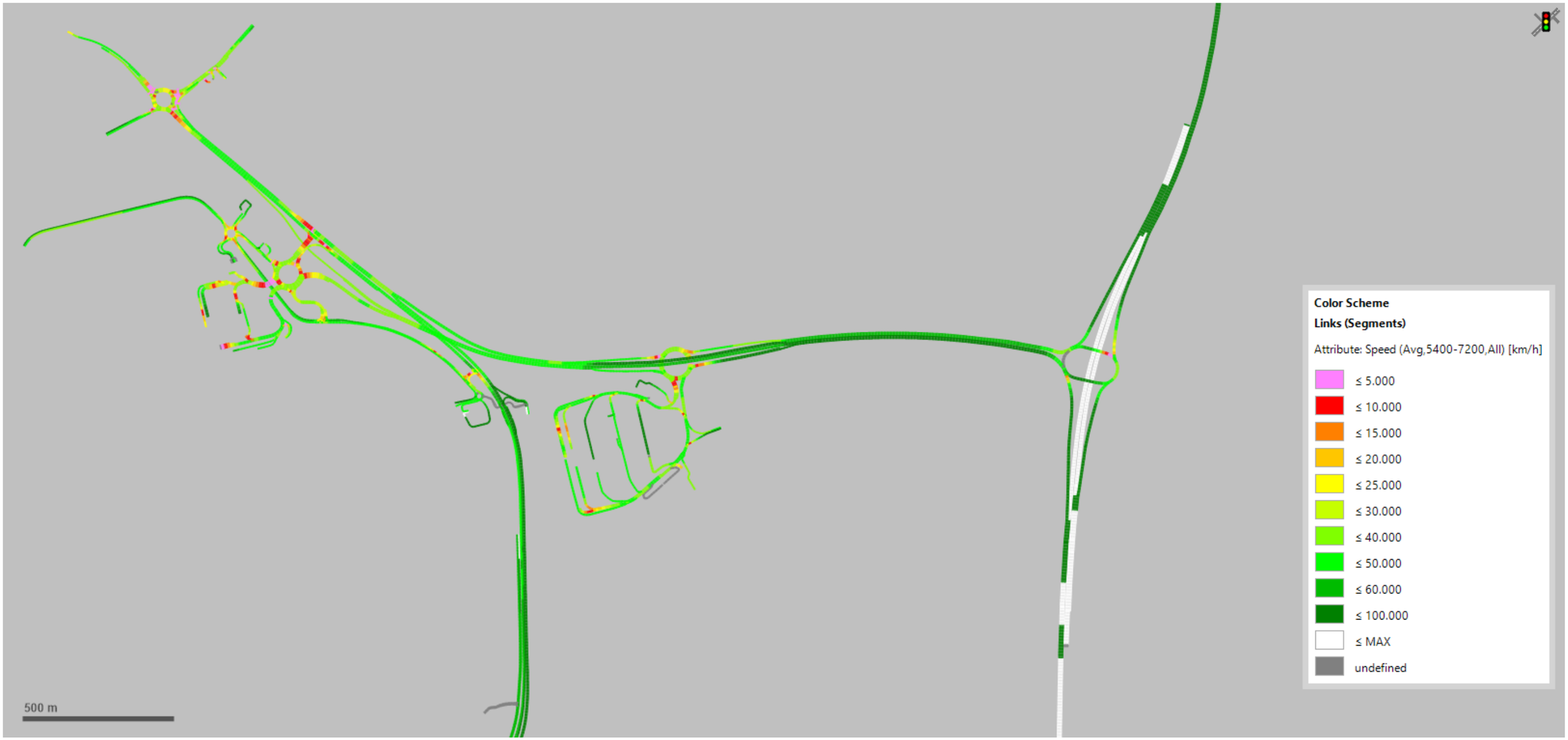
500 m

2032 with Project – AM peak

07:00 – 07:30



07:30 – 08:00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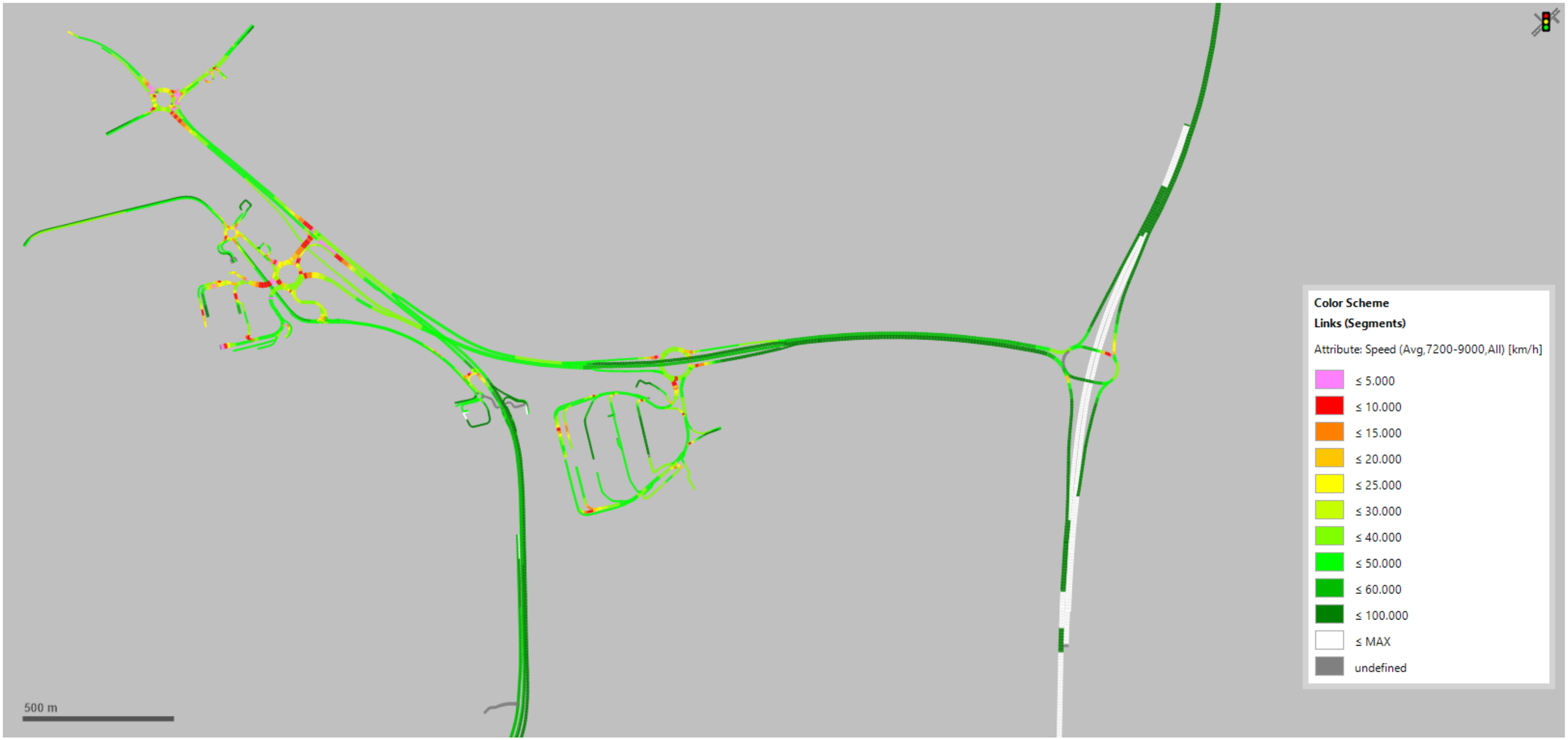
500 m

08:00 – 08:30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≤ 60.000
≤ 100.000
≤ MAX
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500 m

08:30 – 09:00


Color Scheme
Links (Segments)
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≤ 25.000
≤ 30.000
≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
undefined
500 m

2032 with Project - PM peak

16:00 – 16:30

16:30 – 17:00


Color Scheme
Links (Segments)
Attribute: Speed (Avg,37800-39600,All) [km/h]
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≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
undefined
500 m

17:00 – 17:30


Color Scheme
Links (Segments)
Attribute: Speed (Avg,39600-41400,All) [km/h]
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≤ 10.000
≤ 15.000
≤ 20.000
≤ 25.000
≤ 30.000
≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
undefined
500 m

17:30 – 18:00


Color Scheme
Links (Segments)
Attribute: Speed (Avg,41400-43200,All) [km/h]
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≤ 10.000
≤ 15.000
≤ 20.000
≤ 25.000
≤ 30.000
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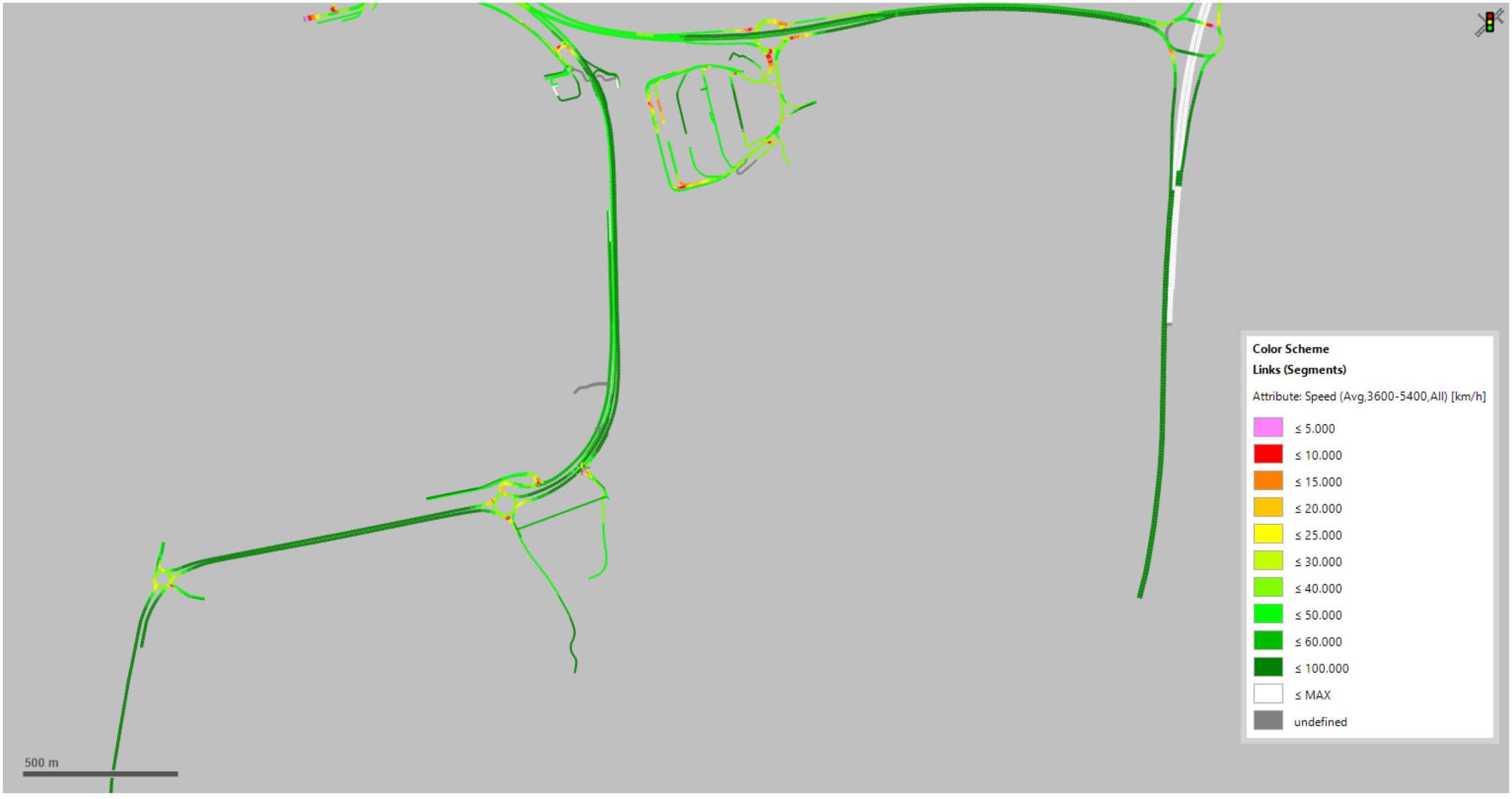
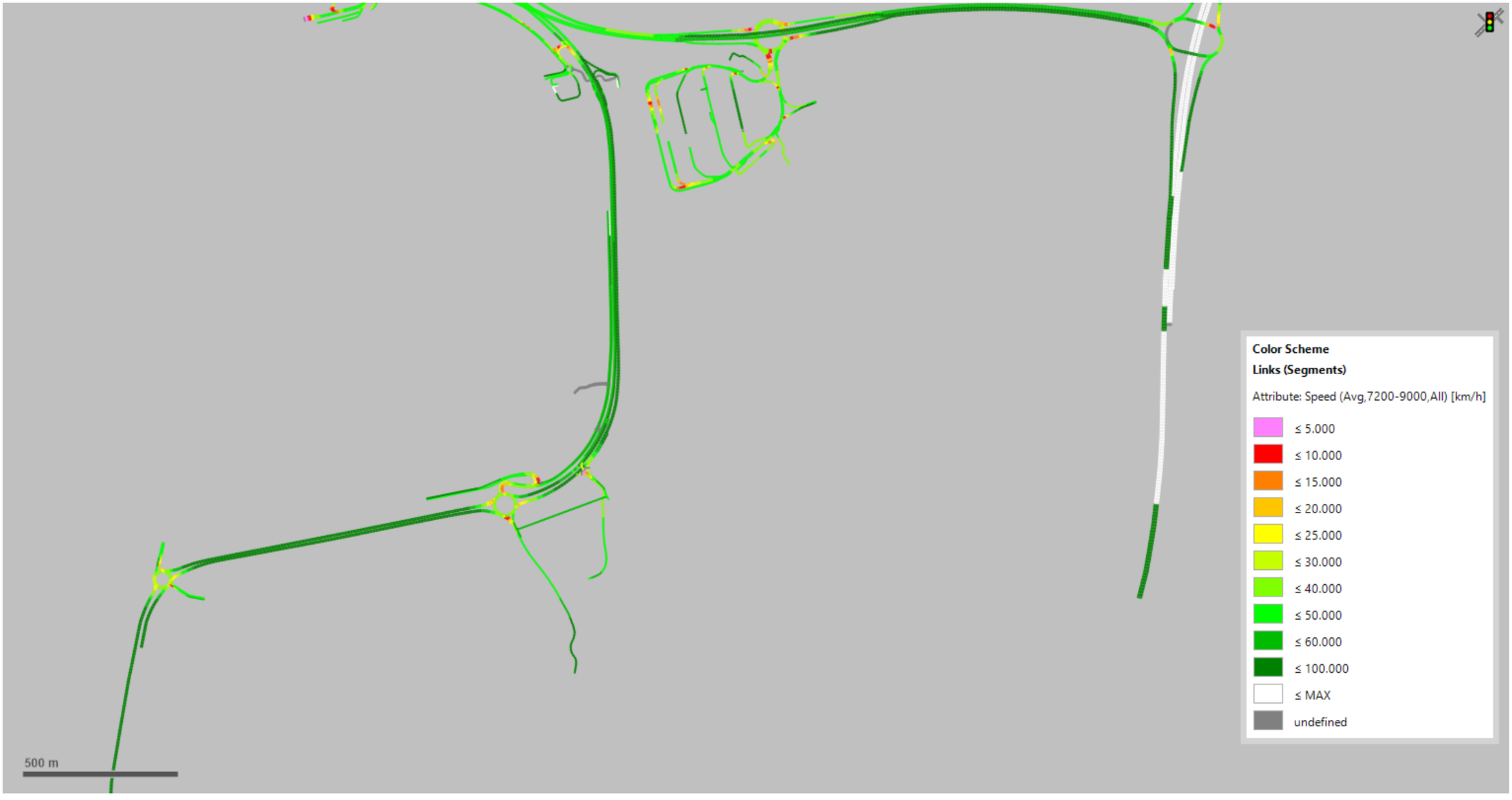
≤ 100.000
≤ MAX
undefined
500 m

2032 with Project –southern extent of model (London Road)

07:00-07:30



07:30-08:00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≤ 40.000
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≤ 100.000
≤ MAX
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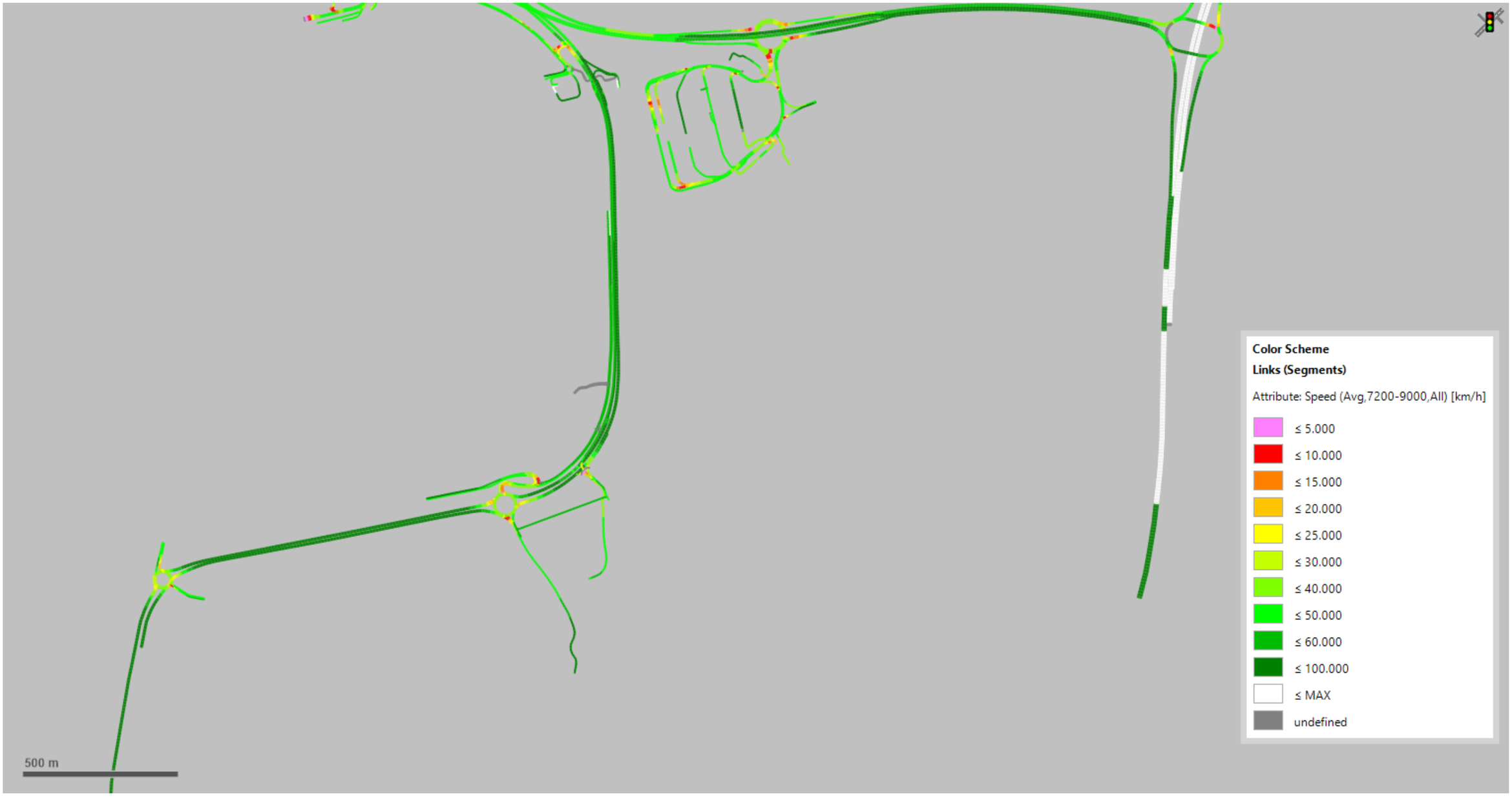
500 m

08:00-08:30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≤ 25.000
≤ 30.000
≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
undefined
500 m

08:30-09:00


Color Scheme
Links (Segments)
Attribute: Speed (Avg,9000-10800,All) [km/h]
≤ 5.000
≤ 10.000
≤ 15.000
≤ 20.000
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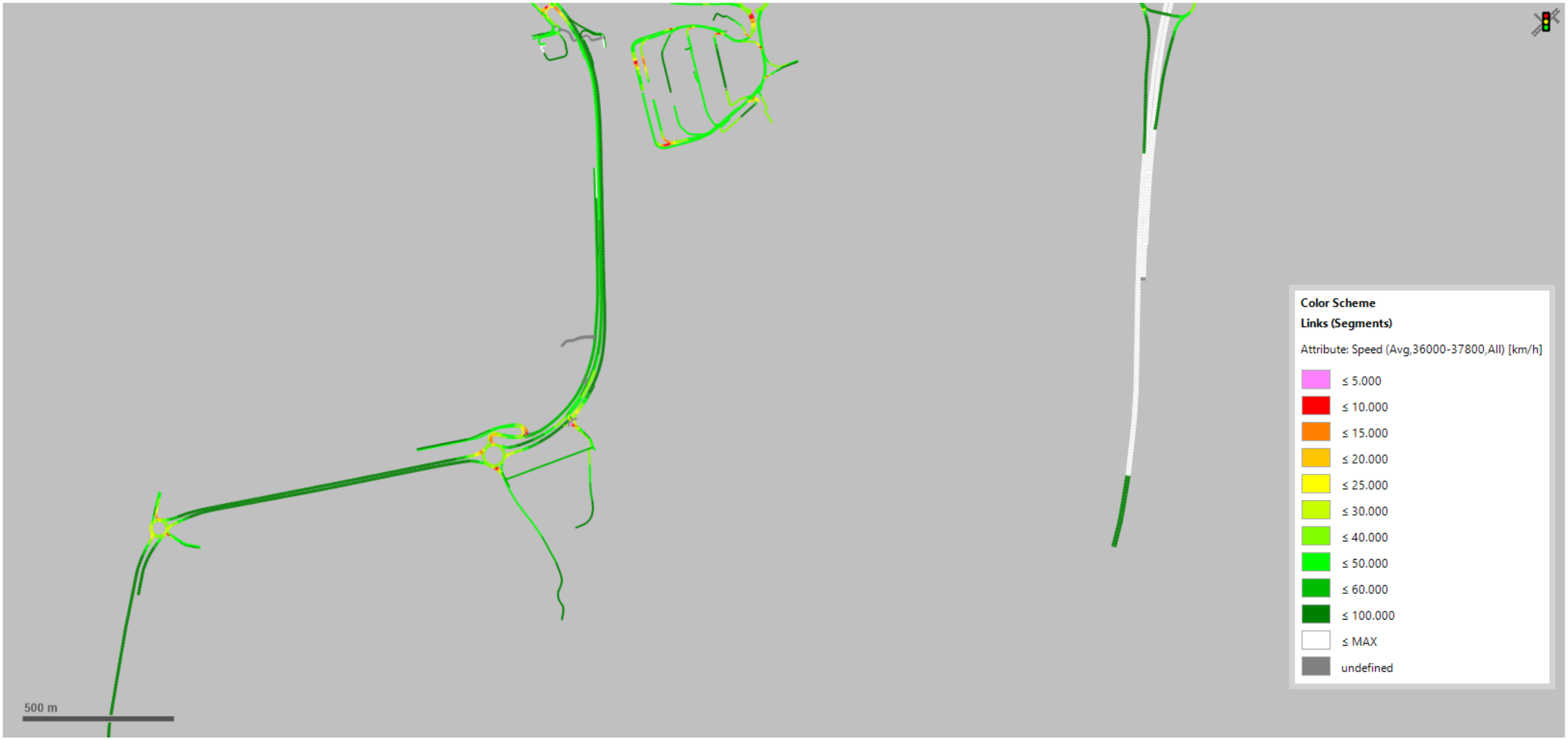
≤ 100.000
≤ MAX
undefined
500 m

16:00-16:30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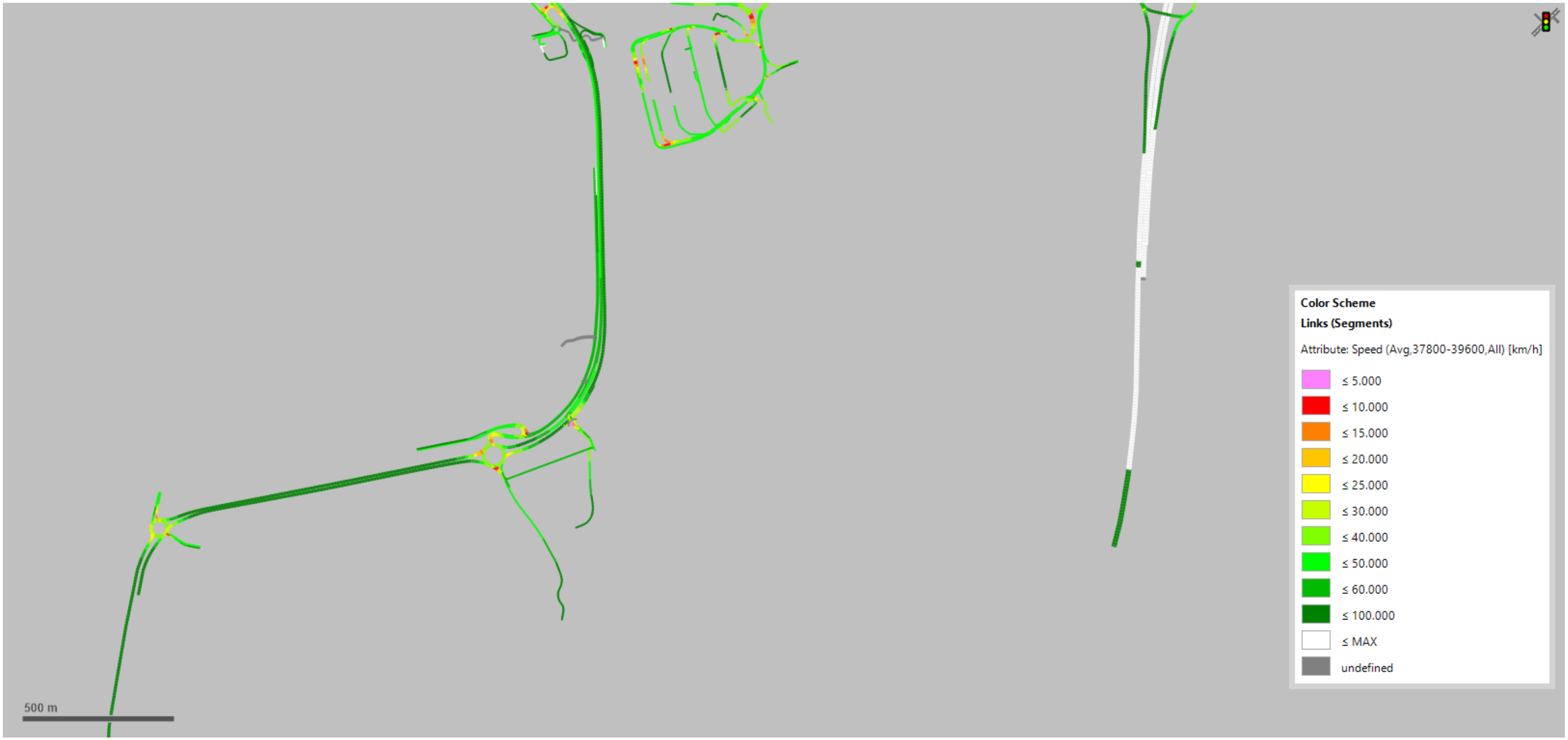
≤ 100.000
≤ MAX
undefined
500 m

16:30-17:00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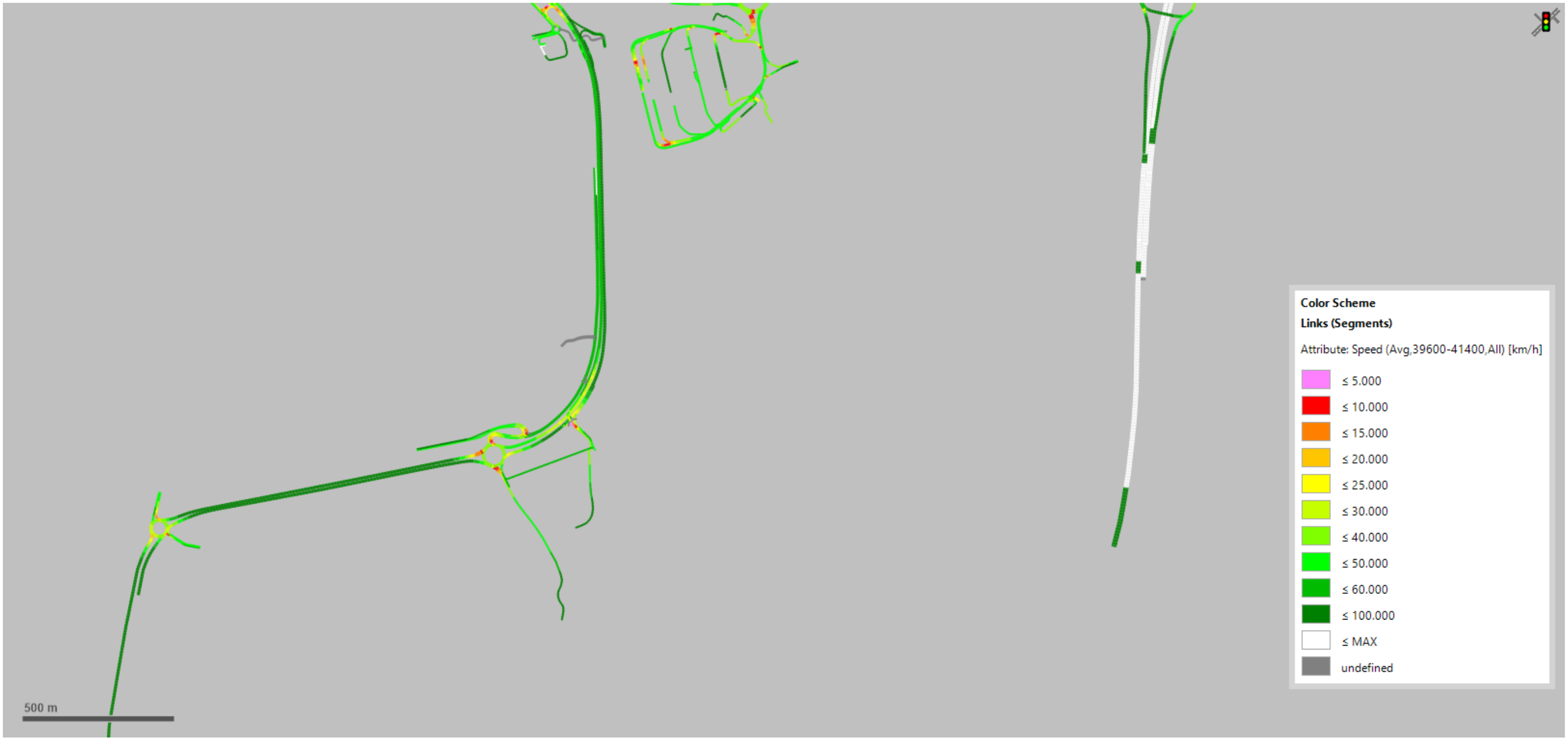
≤ 100.000
≤ MAX
undefined
500 m

17:00-17:30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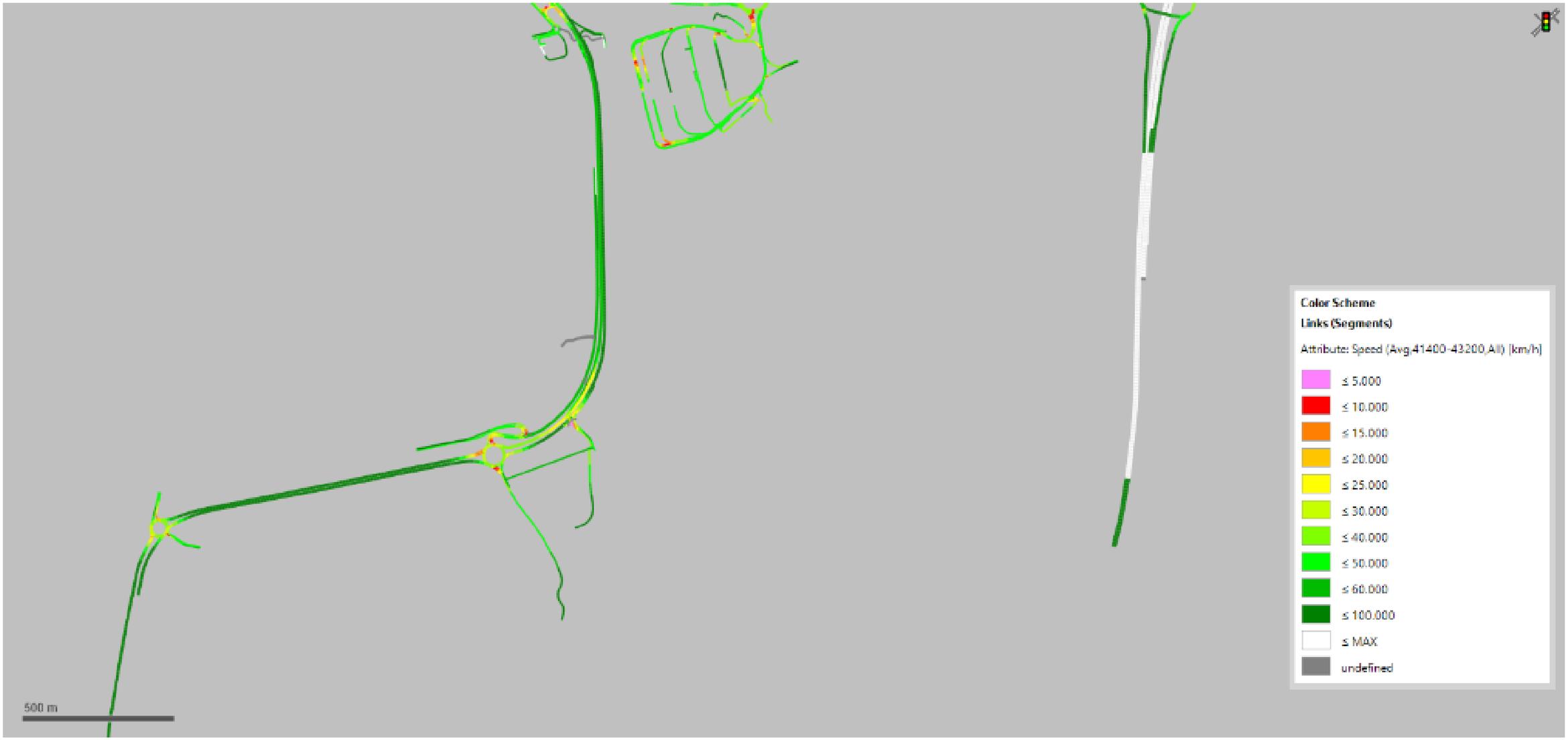
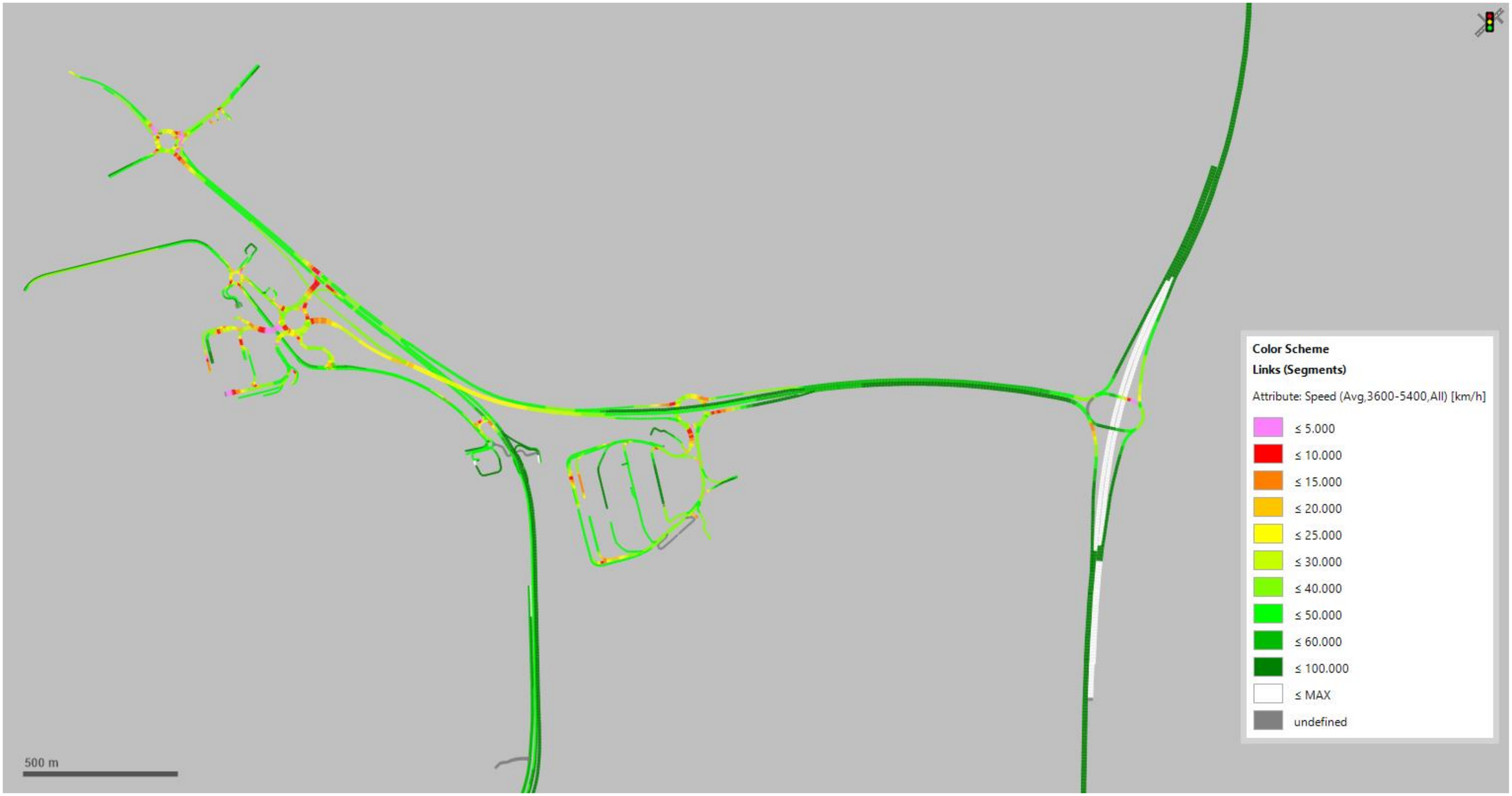
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
undefined
500 m

17:30-18:00


Color Scheme
Links (Segments)
Attribute: Speed (Avg,41400-43200,All) [km/h]
≤ 5.000
≤ 10.000
≤ 15.000
≤ 20.000
≤ 25.000
≤ 30.000
≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
undefined
500 m

2047 with Project - AM peak

07:00 – 07:30



07:30 – 08:00


Color Scheme
Links (Segments)
Attribute: Speed (Avg,5400-7200,All) [km/h]
≤ 5.000
≤ 10.000
≤ 15.000
≤ 20.000
≤ 25.000
≤ 30.000
≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
undefined
500 m

08:00 – 08:30

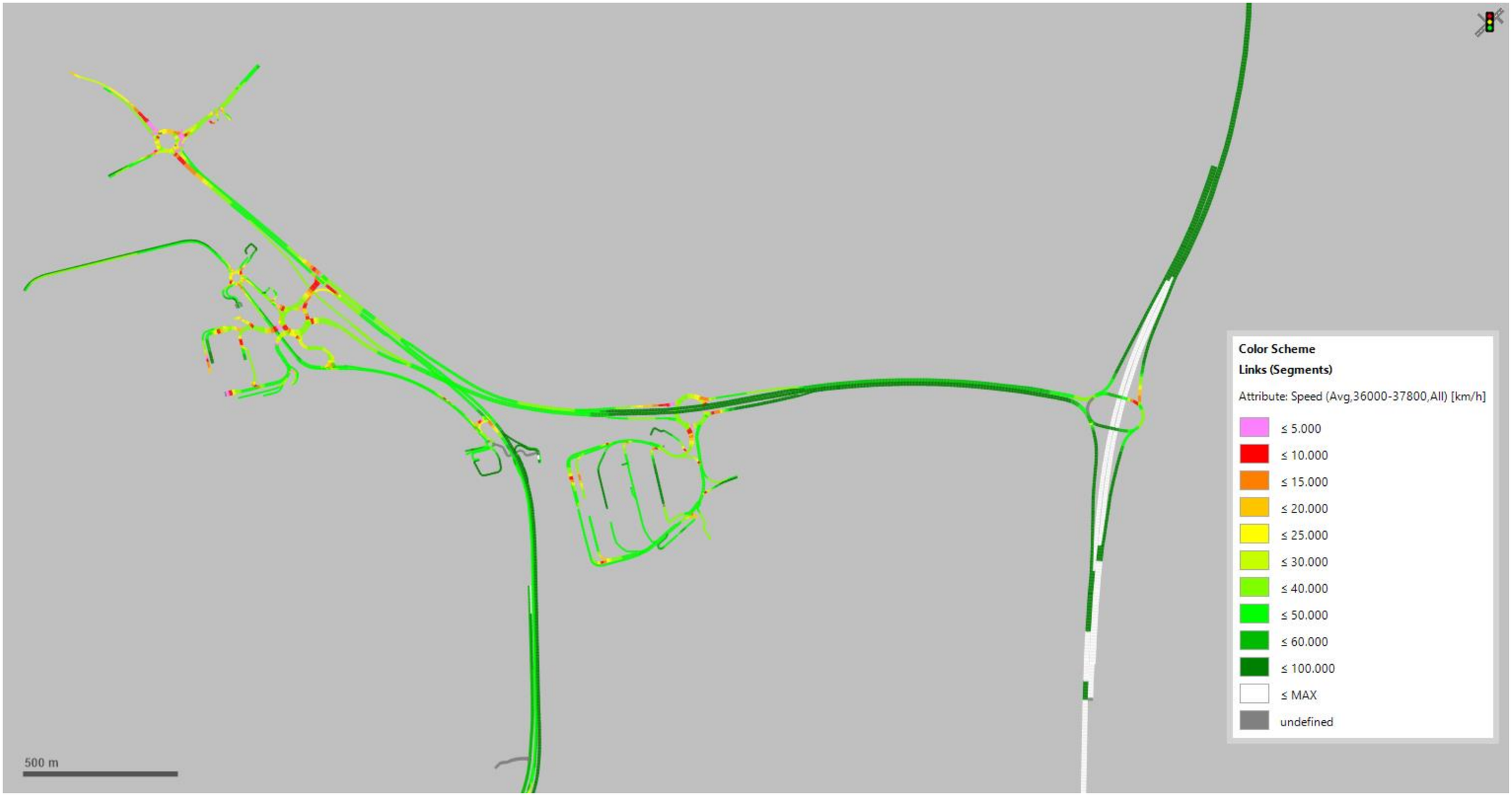

Color Scheme
Links (Segments)
Attribute: Speed (Avg,7200-9000,All) [km/h]
≤ 5.000
≤ 10.000
≤ 15.000
≤ 20.000
≤ 25.000
≤ 30.000
≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
undefined
500 m

08:30 – 09:00


Color Scheme
Links (Segments)
Attribute: Speed (Avg,9000-10800,All) [km/h]
≤ 5.000
≤ 10.000
≤ 15.000
≤ 20.000
≤ 25.000
≤ 30.000
≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
undefined
500 m

2047 with Project - PM peak

16:00 – 16:30



16:30 – 17:00


Color Scheme
Links (Segments)
Attribute: Speed (Avg,37800-39600,All) [km/h]
≤ 5.000
≤ 10.000
≤ 15.000
≤ 20.000
≤ 25.000
≤ 30.000
≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
undefined
500 m

17:00 – 17:30


Color Scheme
Links (Segments)
Attribute: Speed (Avg,39600-41400,All) [km/h]
≤ 5.000
≤ 10.000
≤ 15.000
≤ 20.000
≤ 25.000
≤ 30.000
≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
undefined
500 m

17:30 – 18:00


Color Scheme
Links (Segments)
Attribute: Speed (Avg,41400-43200,All) [km/h]
≤ 5.000
≤ 10.000
≤ 15.000
≤ 20.000
≤ 25.000
≤ 30.000
≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
undefined
500 m

2047 with Project – southern extent of model (London Road)

07:00-07:30

07:30-08:00


Color Scheme
Links (Segments)
Attribute: Speed (Avg,5400-7200,All) [km/h]
≤ 5.000
≤ 10.000
≤ 15.000
≤ 20.000
≤ 25.000
≤ 30.000
≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
undefined
500 m

08:00-08:30


Color Scheme
Links (Segments)
Attribute: Speed (Avg,7200-9000,All) [km/h]
≤ 5.000
≤ 10.000
≤ 15.000
≤ 20.000
≤ 25.000
≤ 30.000
≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
undefined
500 m

08:30-09:00


Color Scheme
Links (Segments)
Attribute: Speed (Avg,9000-10800,All) [km/h]
≤ 5.000
≤ 10.000
≤ 15.000
≤ 20.000
≤ 25.000
≤ 30.000
≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
undefined
500 m

16:00-16:30


Color Scheme
Links (Segments)
Attribute: Speed (Avg,36000-37800,All) [km/h]
≤ 5.000
≤ 10.000
≤ 15.000
≤ 20.000
≤ 25.000
≤ 30.000
≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
undefined
500 m

16:30-17:00


Color Scheme
Links (Segments)
Attribute: Speed (Avg,37800-39600,All) [km/h]
≤ 5.000
≤ 10.000
≤ 15.000
≤ 20.000
≤ 25.000
≤ 30.000
≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
undefined
500 m

17:00-17:30


Color Scheme
Links (Segments)
Attribute: Speed (Avg,39600-41400,All) [km/h]
≤ 5.000
≤ 10.000
≤ 15.000
≤ 20.000
≤ 25.000
≤ 30.000
≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
undefined
500 m

17:30-18:00


Color Scheme
Links (Segments)
Attribute: Speed (Avg,41400-43200,All) [km/h]
≤ 5.000
≤ 10.000
≤ 15.000
≤ 20.000
≤ 25.000
≤ 30.000
≤ 40.000
≤ 50.000
≤ 60.000
≤ 100.000
≤ MAX
undefined
500 m

D. Full journey time results

D.1 Full Tabulated Journey Time Results

Red indicates increase in travel time; blue indicates decrease in travel time

Table D.1.1: Tabulated journey time results, base vs future baseline

Description	Time Period	Travel Time (mm:ss)			Difference in Travel Time (mm:ss)	
		Base	2032 future baseline	2047 future baseline	Base vs 2032 future baseline	2032 vs 2047 future baseline
Route 1-3 - M23 North to South Terminal Roundabout	07:00-08:00	04:28	05:48	07:32	01:20	03:03
	08:00-09:00	04:09	03:47	04:21	00:22	00:12
	16:00-17:00	03:56	03:57	03:38	00:02	00:17
	17:00-18:00	03:57	05:06	07:34	01:08	03:37
Route 3-1 - South Terminal Roundabout to M23 North	07:00-08:00	02:01	02:15	02:16	00:14	00:15
	08:00-09:00	02:01	02:14	02:19	00:13	00:18
	16:00-17:00	02:02	02:12	02:17	00:10	00:15
	17:00-18:00	02:02	02:17	02:18	00:15	00:16
Route 7-2 - Junction 9 to M23 South	07:00-08:00	01:20	01:15	01:21	00:05	00:01
	08:00-09:00	01:12	01:12	01:12	00:00	00:01
	16:00-17:00	01:11	01:08	01:09	00:03	00:02
	17:00-18:00	01:12	01:09	01:10	00:04	00:02
Route 2-7 - M23 South to Junction 9	07:00-08:00	01:54	01:16	01:23	00:39	00:31
	08:00-09:00	01:53	01:13	01:14	00:39	00:39
	16:00-17:00	01:50	01:13	01:14	00:37	00:36
	17:00-18:00	01:50	01:13	01:15	00:38	00:36
Route 3-5 - South Terminal Roundabout to Longbridge Roundabout	07:00-08:00	02:23	03:02	04:20	00:39	01:57
	08:00-09:00	02:23	03:01	03:33	00:39	01:10
	16:00-17:00	02:18	03:02	03:35	00:44	01:17
	17:00-18:00	02:12	03:26	03:34	01:14	01:22
Route 5-3 - Longbridge Roundabout to South Terminal Roundabout	07:00-08:00	02:55	05:26	06:21	02:31	03:26
	08:00-09:00	02:56	08:05	10:01	05:09	07:06

Description	Time Period	Travel Time (mm:ss)			Difference in Travel Time (mm:ss)	
		Base	2032 future baseline	2047 future baseline	Base vs 2032 future baseline	2032 vs 2047 future baseline
	16:00-17:00	03:26	09:16	11:03	05:50	07:37
	17:00-18:00	04:30	11:54	15:02	07:24	10:32
Route 4-6 - North Terminal Roundabout to Lowfield Heath Roundabout	07:00-08:00	05:24	05:49	06:03	00:25	00:40
	08:00-09:00	05:31	06:01	06:12	00:29	00:41
	16:00-17:00	05:25	06:06	06:22	00:41	00:57
	17:00-18:00	05:23	06:23	06:18	01:00	00:55
Route 6-3 - Lowfield Heath Roundabout to South Terminal Roundabout	07:00-08:00	06:29	06:59	07:10	00:30	00:41
	08:00-09:00	06:36	07:25	08:52	00:49	02:16
	16:00-17:00	07:25	09:19	12:23	01:54	04:58
	17:00-18:00	08:02	18:42	24:00	10:40	15:58
Route 4-7 - North Terminal Roundabout to Junction 9	07:00-08:00	02:35	02:48	02:48	00:12	00:13
	08:00-09:00	02:35	02:50	02:51	00:15	00:16
	16:00-17:00	03:04	02:50	03:03	00:14	00:02
	17:00-18:00	03:37	02:49	02:54	00:48	00:43
Route 7-4 - Junction 9 to North Terminal Roundabout	07:00-08:00	03:41	05:50	08:32	02:09	04:51
	08:00-09:00	03:30	03:47	04:40	00:17	01:10
	16:00-17:00	03:17	03:46	03:41	00:29	00:24
	17:00-18:00	03:18	05:03	07:40	01:45	04:22
Route 6-5 - Lowfield Heath Roundabout to Longbridge Roundabout	07:00-08:00	05:44	05:41	05:59	00:02	00:16
	08:00-09:00	05:49	06:10	07:30	00:21	01:41
	16:00-17:00	06:00	08:11	11:14	02:11	05:14
	17:00-18:00	06:01	17:45	22:57	11:44	16:56
Route 5-6 - Longbridge Roundabout to Lowfield Heath Roundabout	07:00-08:00	04:53	07:16	08:10	02:24	03:17
	08:00-09:00	05:04	09:59	11:48	04:56	06:44
	16:00-17:00	04:59	11:02	12:39	06:02	07:40

Description	Time Period	Travel Time (mm:ss)			Difference in Travel Time (mm:ss)	
		Base	2032 future baseline	2047 future baseline	Base vs 2032 future baseline	2032 vs 2047 future baseline
	17:00-18:00	05:31	13:42	16:43	08:11	11:12
Route 7-5 - Junction 9 to Longbridge Roundabout	07:00-08:00	04:39	06:53	09:49	02:14	05:10
	08:00-09:00	04:25	04:54	06:00	00:28	01:34
	16:00-17:00	04:11	05:03	05:13	00:53	01:03
	17:00-18:00	04:06	06:35	09:10	02:30	05:04
Route 5-7 - Longbridge Roundabout to Junction 9	07:00-08:00	03:57	06:23	07:16	02:25	03:18
	08:00-09:00	03:59	08:59	10:49	05:00	06:49
	16:00-17:00	04:29	10:10	11:58	05:41	07:29
	17:00-18:00	05:38	12:46	15:56	07:08	10:18

Red indicates increase in travel time; blue indicates decrease in travel time

Table D.1.2: Tabulated Journey Time Results, future baseline vs with Project

Description	Time Period	Travel Time (mm:ss)			Difference in Travel Time (mm:ss)		
		2032 future baseline	2032 with Project	2047 future baseline	2047 with Project	Base vs 2032 future baseline	2032 vs 2047 future baseline
Route 1-3 - M23 North to South Terminal Roundabout	07:00-08:00	05:48	03:46	07:32	03:57	02:02	03:35
	08:00-09:00	03:47	03:38	04:21	03:41	00:09	00:40
	16:00-17:00	03:57	03:39	03:38	03:42	00:18	00:04
	17:00-18:00	05:06	03:38	07:34	03:41	01:28	03:53
Route 3-1 - South Terminal Roundabout to M23 North	07:00-08:00	02:15	02:43	02:16	02:45	00:28	00:29
	08:00-09:00	02:14	02:41	02:19	02:43	00:27	00:24
	16:00-17:00	02:12	02:42	02:17	02:46	00:29	00:30
	17:00-18:00	02:17	02:44	02:18	02:48	00:27	00:31
Route 7-2 - Junction 9 to M23 South	07:00-08:00	01:15	01:24	01:21	01:29	00:08	00:07
	08:00-09:00	01:12	01:17	01:12	01:18	00:05	00:05
	16:00-17:00	01:08	01:10	01:09	01:12	00:02	00:03
	17:00-18:00	01:09	01:11	01:10	01:14	00:03	00:04
Route 2-7 - M23 South to Junction 9	07:00-08:00	01:16	01:22	01:23	01:28	00:06	00:04
	08:00-09:00	01:13	01:18	01:14	01:19	00:05	00:05
	16:00-17:00	01:13	01:14	01:14	01:15	00:01	00:01
	17:00-18:00	01:13	01:14	01:15	01:15	00:02	00:01
Route 3-5 - South Terminal Roundabout to Longbridge Roundabout	07:00-08:00	03:02	01:04	04:20	01:13	01:58	03:07
	08:00-09:00	03:01	01:27	03:33	01:36	01:34	01:57
	16:00-17:00	03:02	01:07	03:35	01:22	01:55	02:13
	17:00-18:00	03:26	01:08	03:34	01:31	02:18	02:03

Description	Time Period	Travel Time (mm:ss)			Difference in Travel Time (mm:ss)		
		2032 future baseline	2032 with Project	2047 future baseline	2047 with Project	Base vs 2032 future baseline	2032 vs 2047 future baseline
Route 5-3 - Longbridge Roundabout to South Terminal Roundabout	07:00-08:00	05:26	04:23	06:21	04:28	01:04	01:53
	08:00-09:00	08:05	04:34	10:01	04:40	03:31	05:21
	16:00-17:00	09:16	04:38	11:03	05:40	04:38	05:23
	17:00-18:00	11:54	04:43	15:02	06:06	07:11	08:56
Route 4-6 - North Terminal Roundabout to Lowfield Heath Roundabout	07:00-08:00	05:49	04:22	06:03	04:22	01:27	01:41
	08:00-09:00	06:01	04:42	06:12	04:46	01:19	01:26
	16:00-17:00	06:06	04:26	06:22	04:30	01:41	01:52
	17:00-18:00	06:23	04:26	06:18	04:29	01:57	01:49
Route 6-3 - Lowfield Heath Roundabout to South Terminal Roundabout	07:00-08:00	06:59	08:17	07:10	08:26	01:18	01:16
	08:00-09:00	07:25	08:44	08:52	09:35	01:19	00:43
	16:00-17:00	09:19	09:02	12:23	12:32	00:17	00:09
	17:00-18:00	18:42	09:42	24:00	16:41	09:00	07:20
Route 4-7 - North Terminal Roundabout to Junction 9	07:00-08:00	02:48	03:30	02:48	03:33	00:43	00:45
	08:00-09:00	02:50	03:51	02:51	03:56	01:00	01:05
	16:00-17:00	02:50	03:36	03:03	03:42	00:46	00:39
	17:00-18:00	02:49	03:36	02:54	03:41	00:47	00:47
Route 7-4 - Junction 9 to North Terminal Roundabout	07:00-08:00	05:50	03:25	08:32	04:32	02:25	04:00
	08:00-09:00	03:47	03:19	04:40	03:30	00:28	01:10
	16:00-17:00	03:46	03:03	03:41	03:06	00:43	00:34
	17:00-18:00	05:03	03:02	07:40	03:06	02:01	04:34
	07:00-08:00	05:41	06:21	05:59	06:33	00:39	00:33

Description	Time Period	Travel Time (mm:ss)			Difference in Travel Time (mm:ss)		
		2032 future baseline	2032 with Project	2047 future baseline	2047 with Project	Base vs 2032 future baseline	2032 vs 2047 future baseline
Route 6-5 - Lowfield Heath Roundabout to Longbridge Roundabout	08:00-09:00	06:10	08:06	07:30	10:21	01:56	02:50
	16:00-17:00	08:11	06:46	11:14	10:25	01:25	00:48
	17:00-18:00	17:45	07:31	22:57	14:49	10:14	08:07
Route 5-6 - Longbridge Roundabout to Lowfield Heath Roundabout	07:00-08:00	07:16	06:00	08:10	06:03	01:17	02:07
	08:00-09:00	09:59	06:15	11:48	06:20	03:44	05:27
	16:00-17:00	11:02	06:13	12:39	07:13	04:48	05:26
	17:00-18:00	13:42	06:16	16:43	07:36	07:26	09:07
Route 7-5 - Junction 9 to Longbridge roundabout	07:00-08:00	06:53	04:34	09:49	05:28	02:19	04:21
	08:00-09:00	04:54	04:39	06:00	04:49	00:15	01:10
	16:00-17:00	05:03	04:19	05:13	04:37	00:44	00:36
	17:00-18:00	06:35	04:23	09:10	04:53	02:12	04:17
Route 5-7 - Longbridge Roundabout to Junction 9	07:00-08:00	06:23	05:09	07:16	05:14	01:14	02:01
	08:00-09:00	08:59	05:23	10:49	05:30	03:36	05:19
	16:00-17:00	10:10	05:23	11:58	06:25	04:47	05:34
	17:00-18:00	12:46	05:26	15:56	06:48	07:20	09:08

D.2 All Journey Time Graphs

Base vs future baseline

Diagram D.2.1: Base vs future baseline for M23 North to South Terminal roundabout

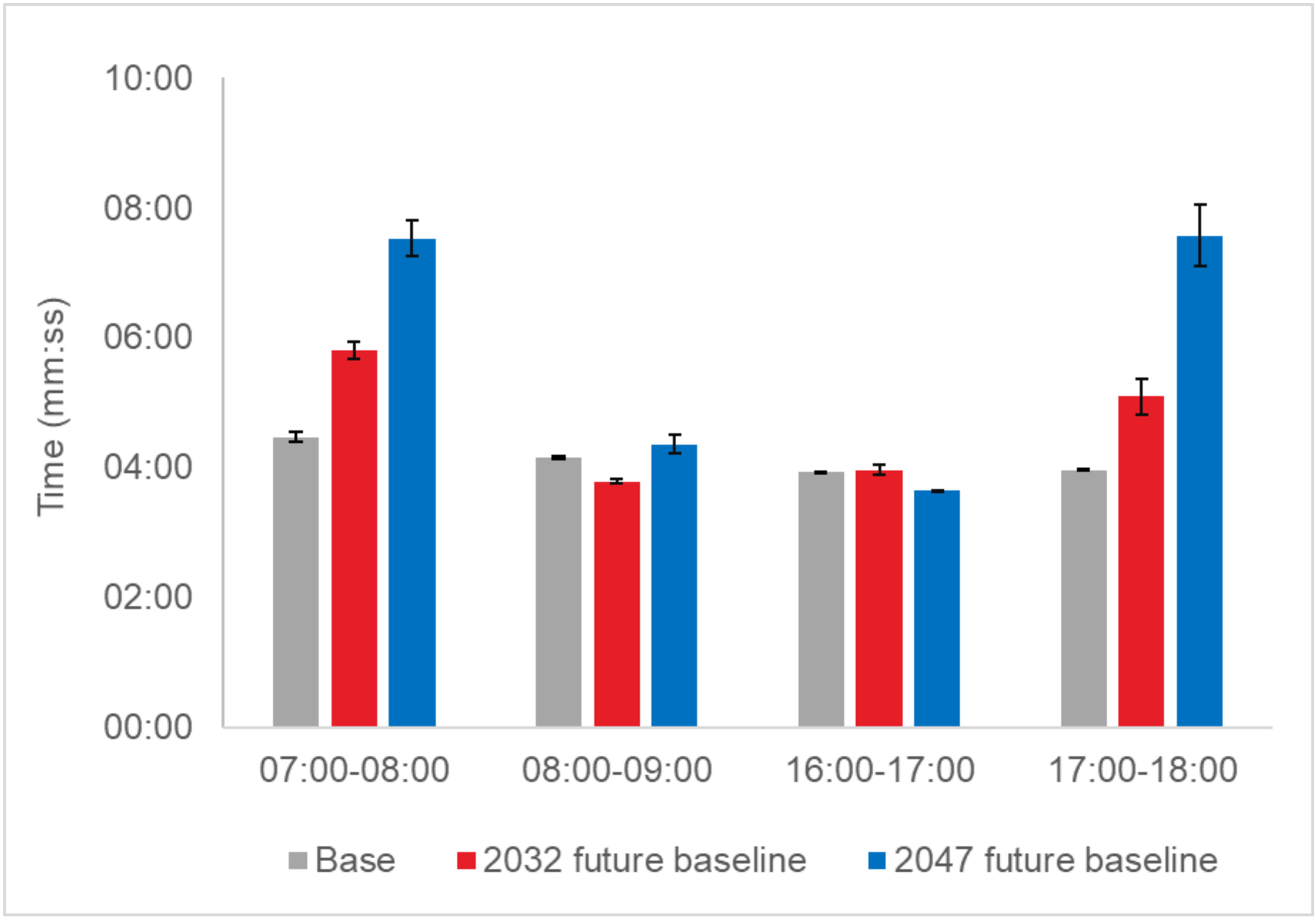


Diagram D.2.2: Base vs future baseline for South Terminal to M23 North

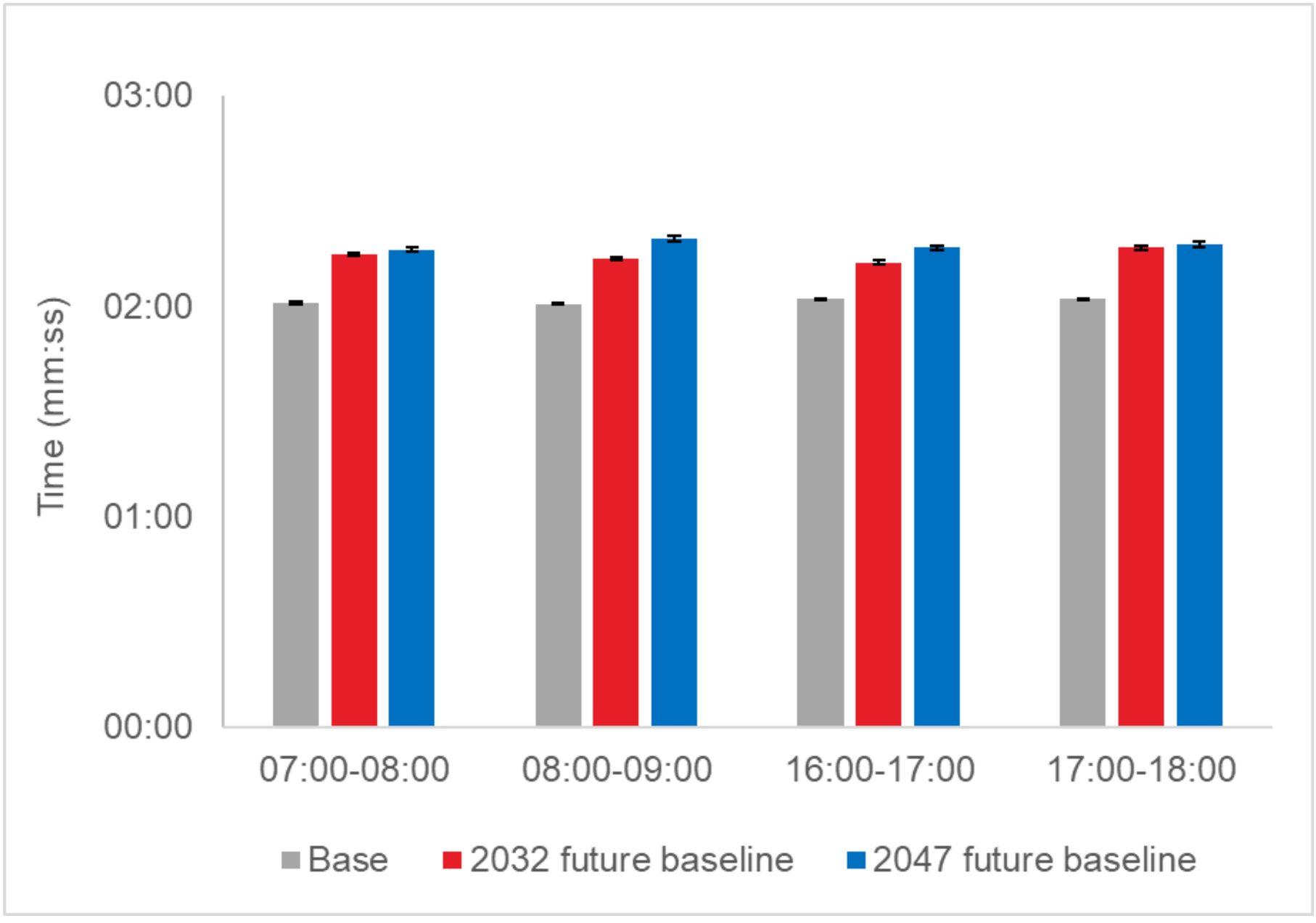


Diagram D.2.3: Base vs future baseline for Junction 9 to M23 South

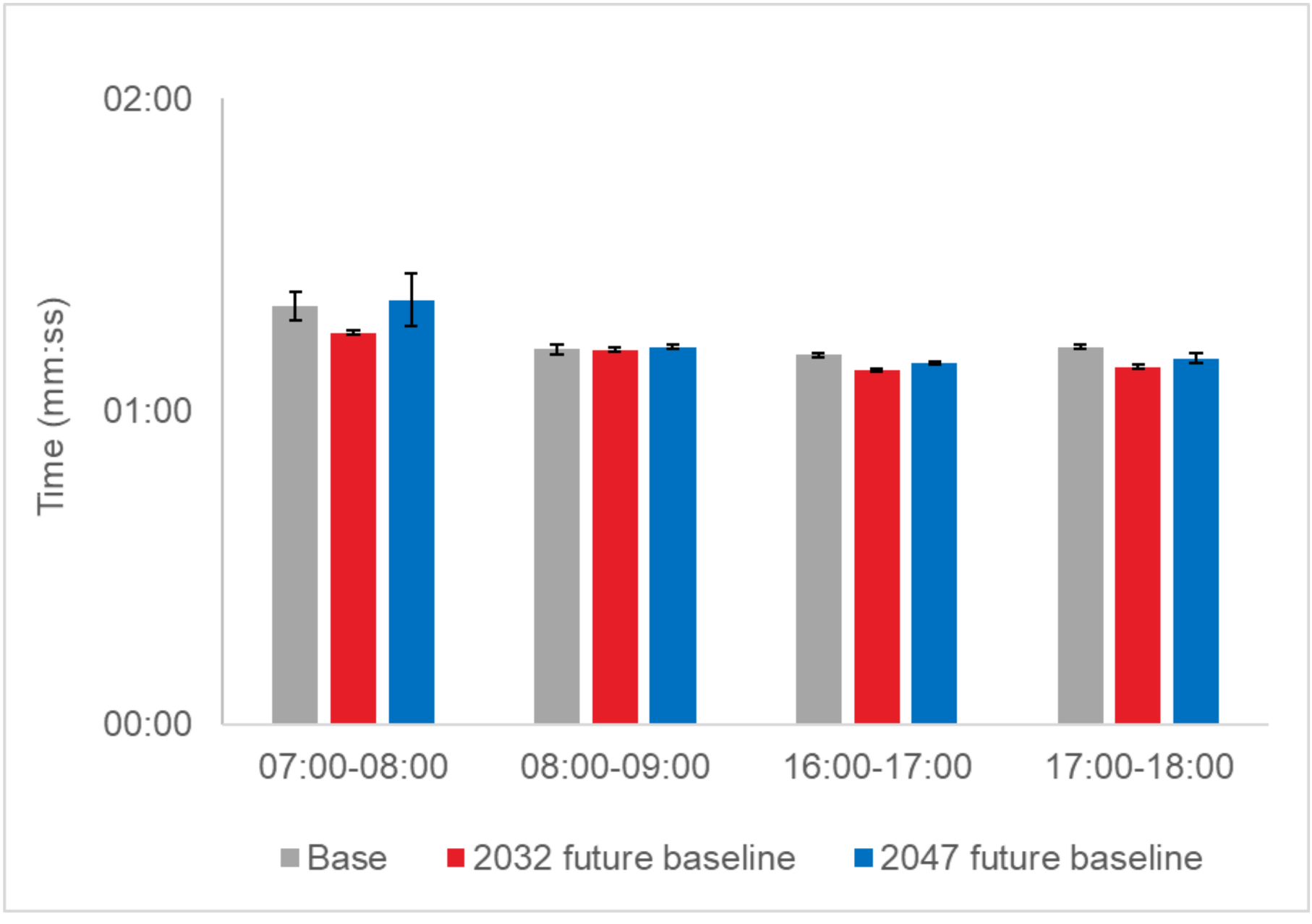


Diagram D.2.4: Base vs future baseline for M23 South to Junction 9

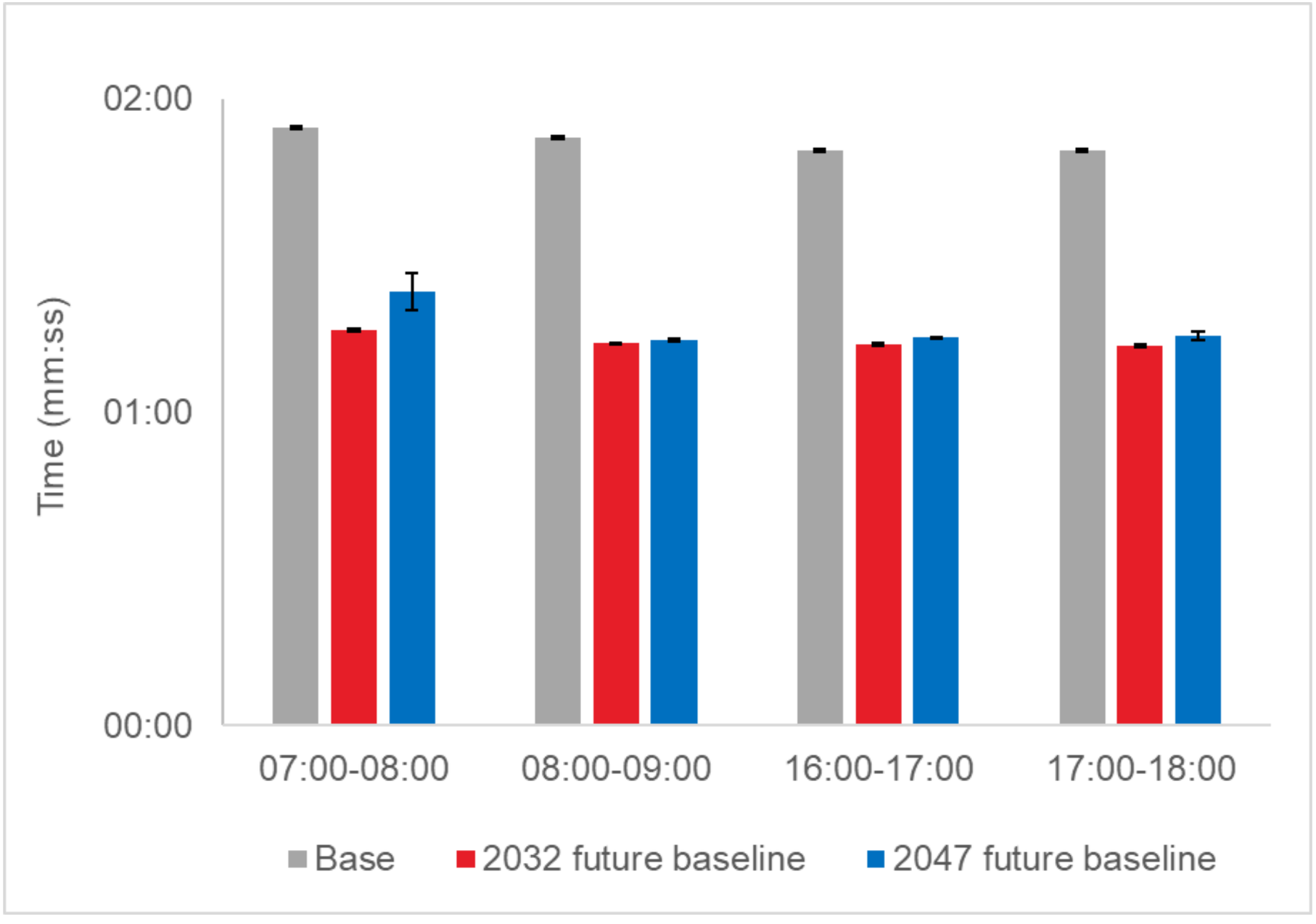


Diagram D.2.5: Base vs future baseline for South Terminal roundabout to Longbridge roundabout

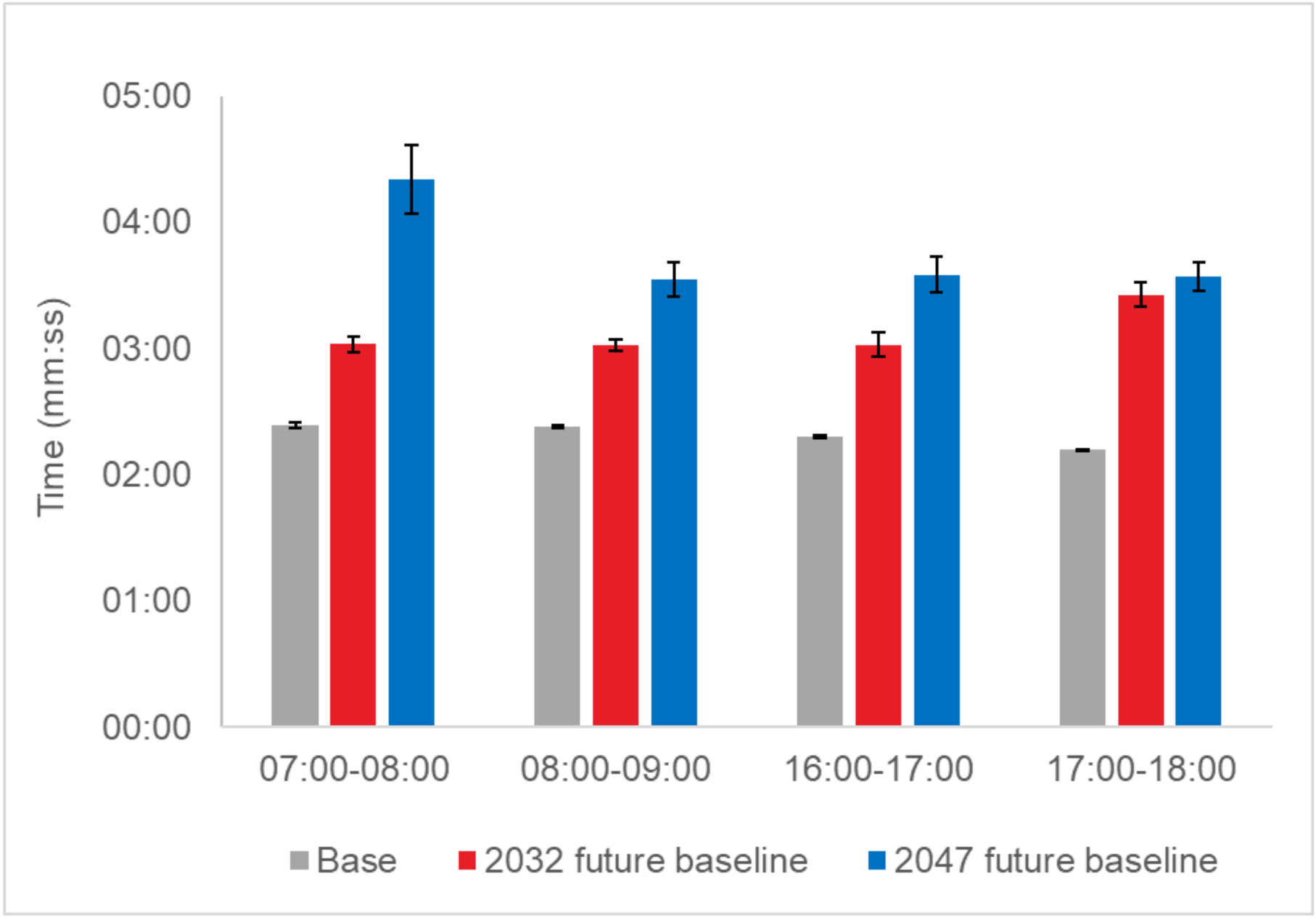


Diagram D.2.6: Base vs future baseline for Longbridge roundabout to South Terminal roundabout

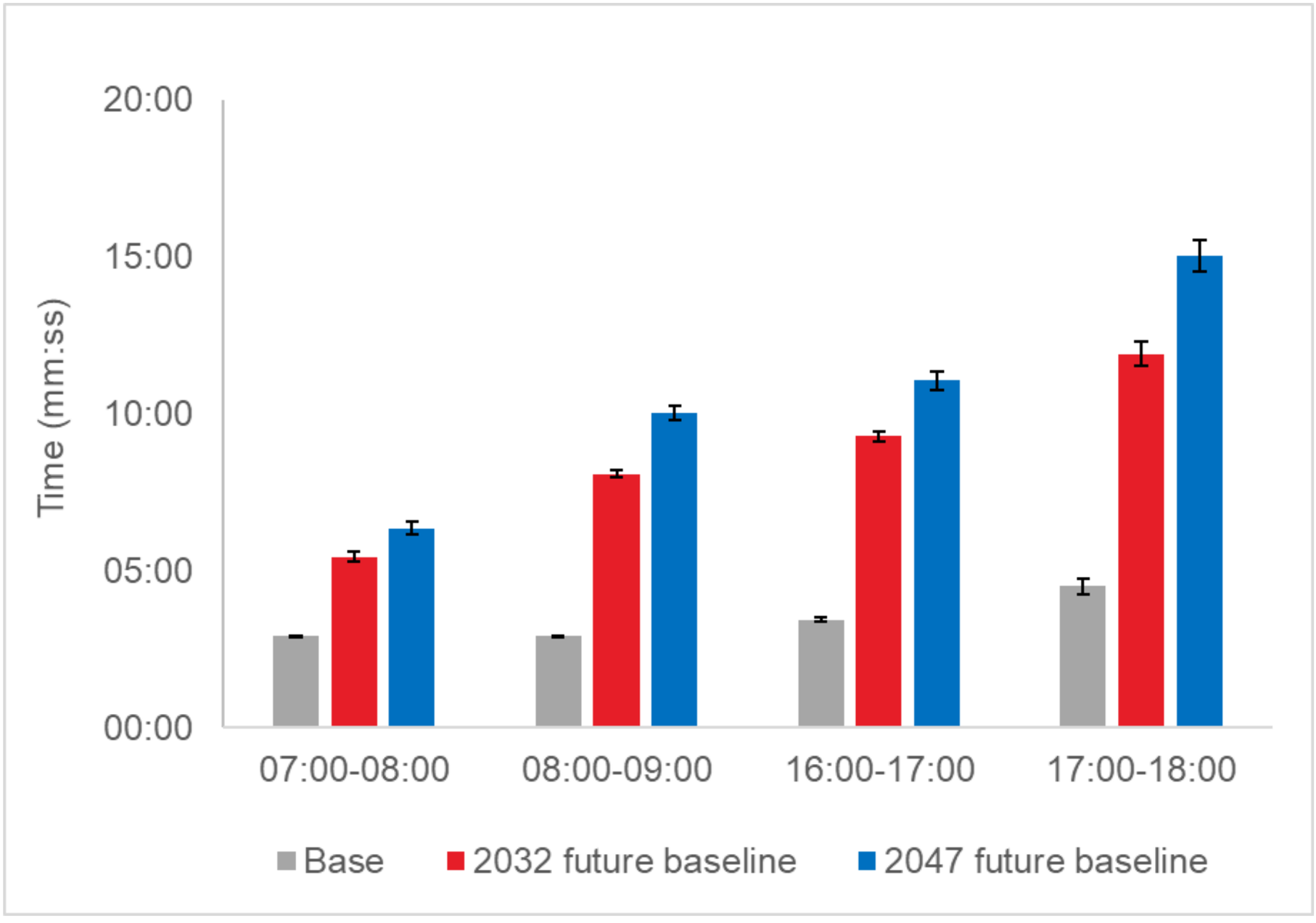


Diagram D.2.7: Base vs future baseline for North Terminal roundabout to Lowfield Heath roundabout

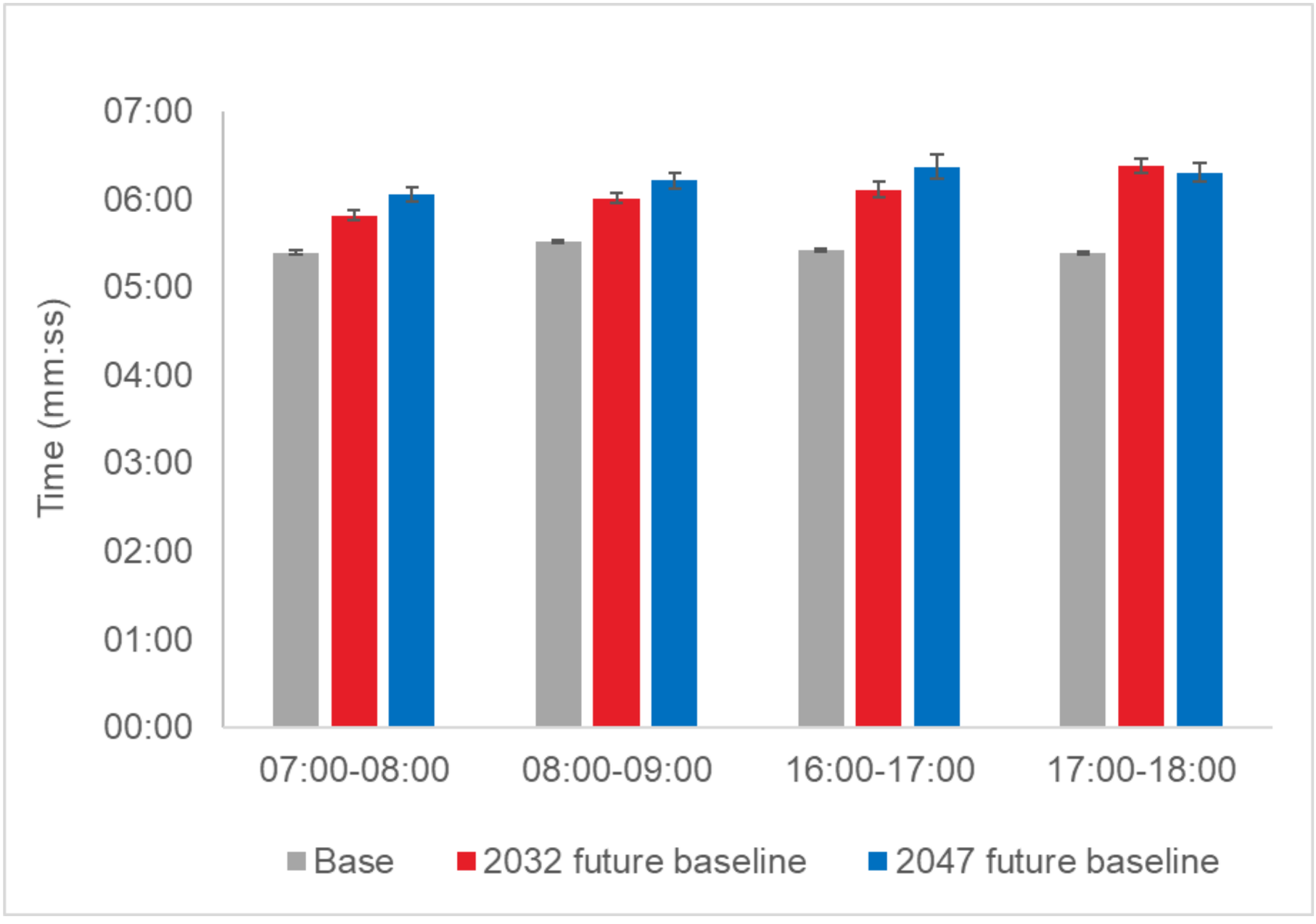


Diagram D.2.8: Base vs future baseline Lowfield Heath roundabout to South Terminal roundabout

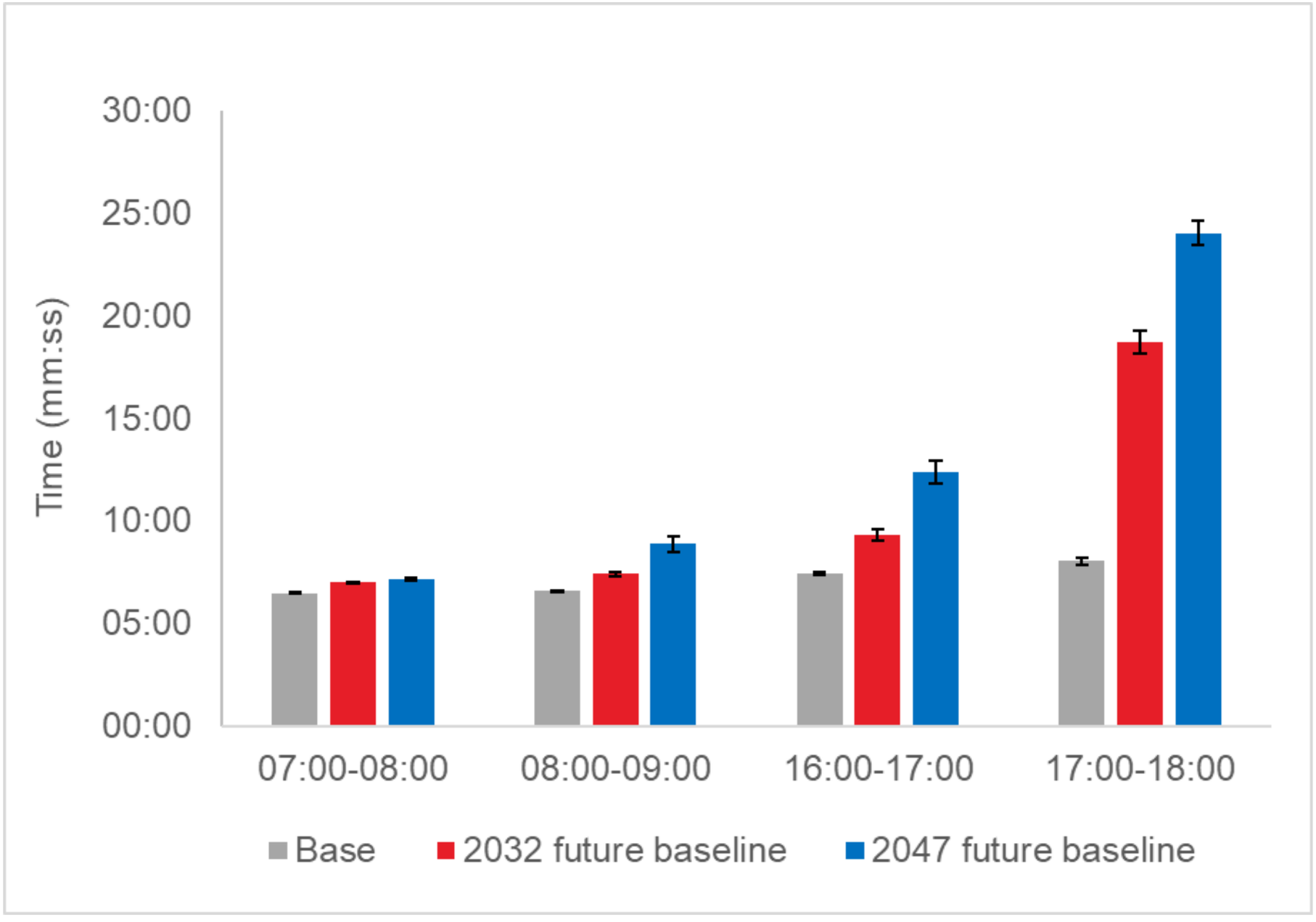


Diagram D.2.9: Base vs future baseline North Terminal Roundabout to Junction 9

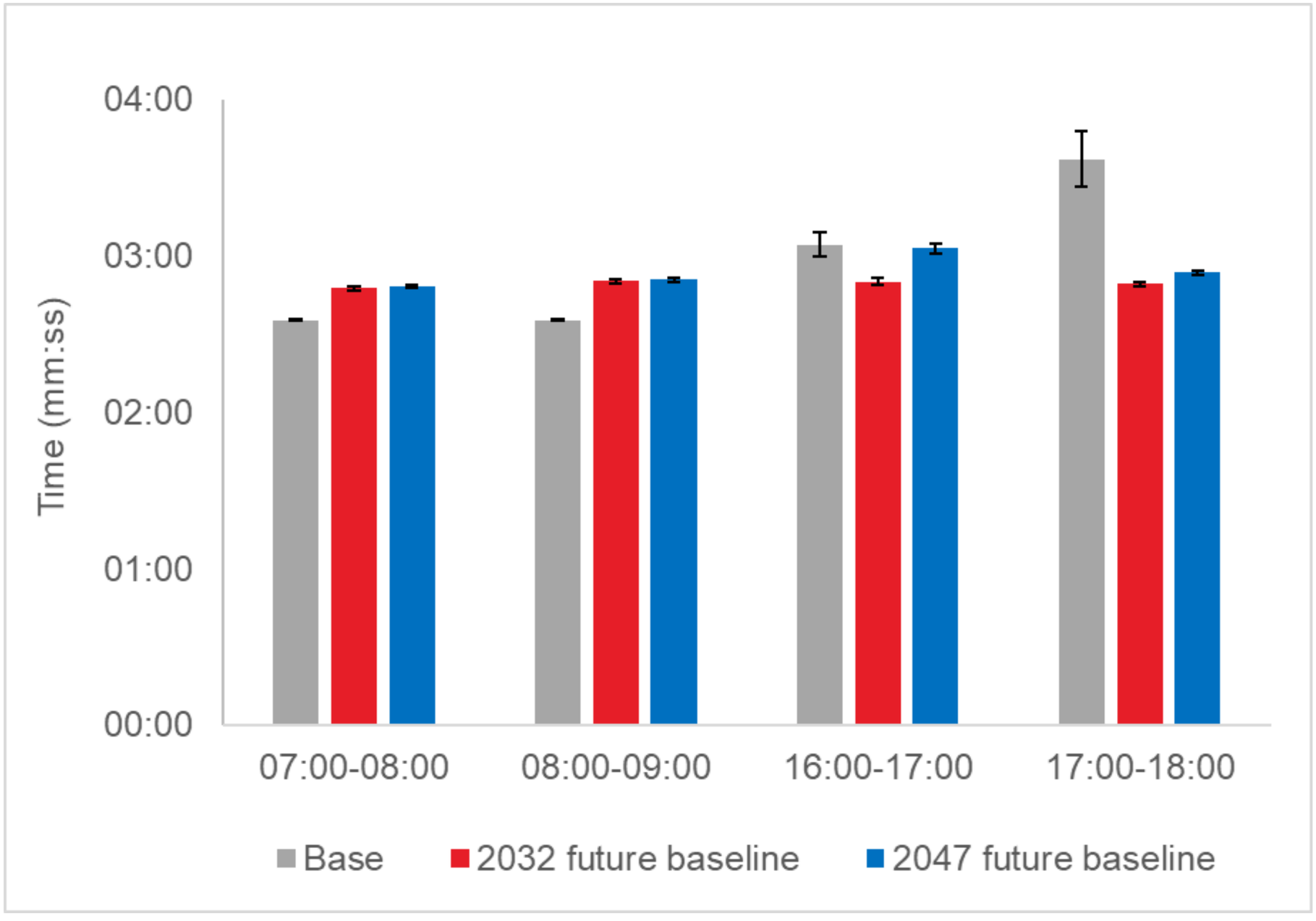


Diagram D.2.10: Base vs future baseline for Junction 9 to North Terminal roundabout

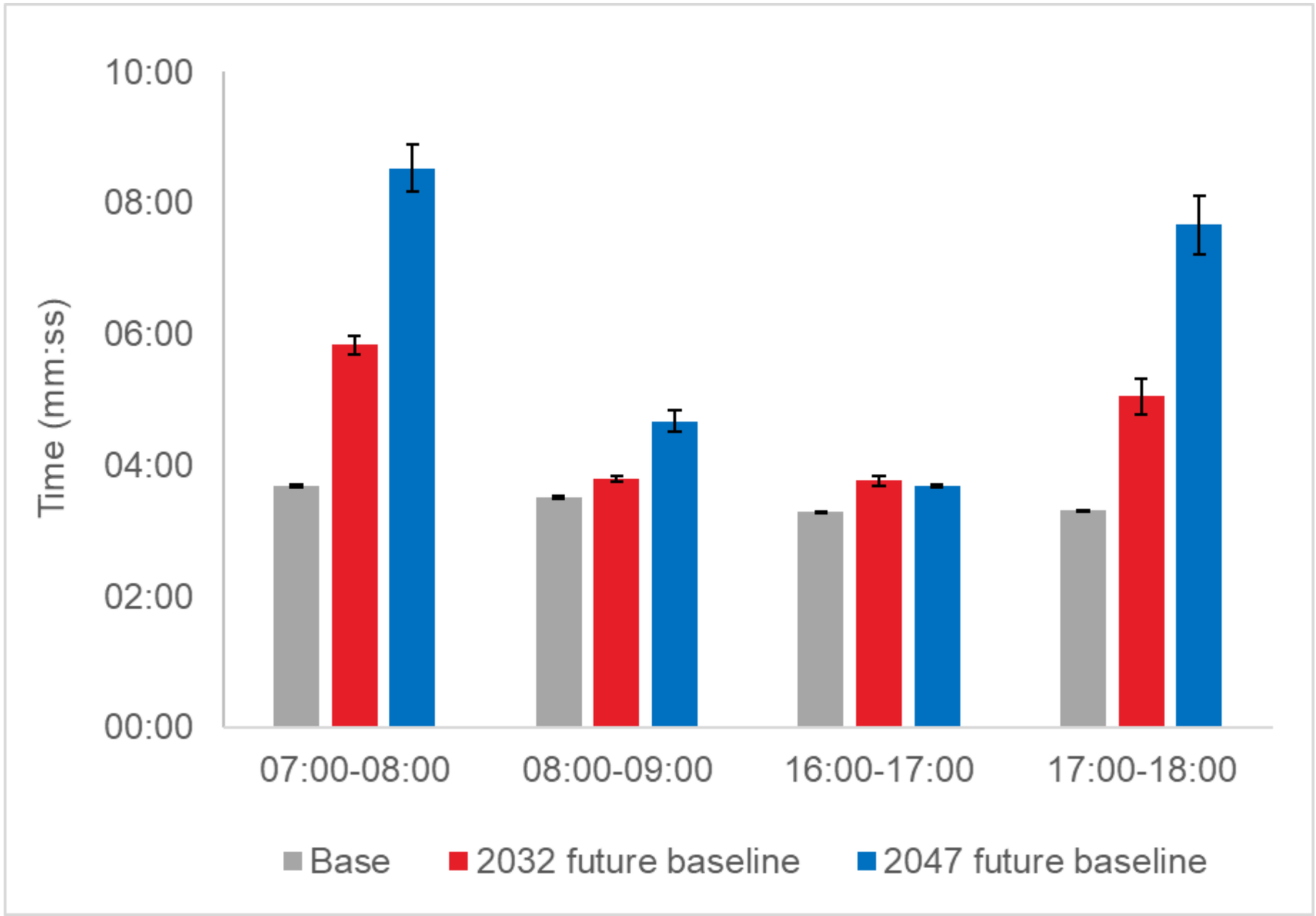


Diagram D.2.11: Base vs future baseline for Lowfield Heath roundabout to Longbridge roundabout

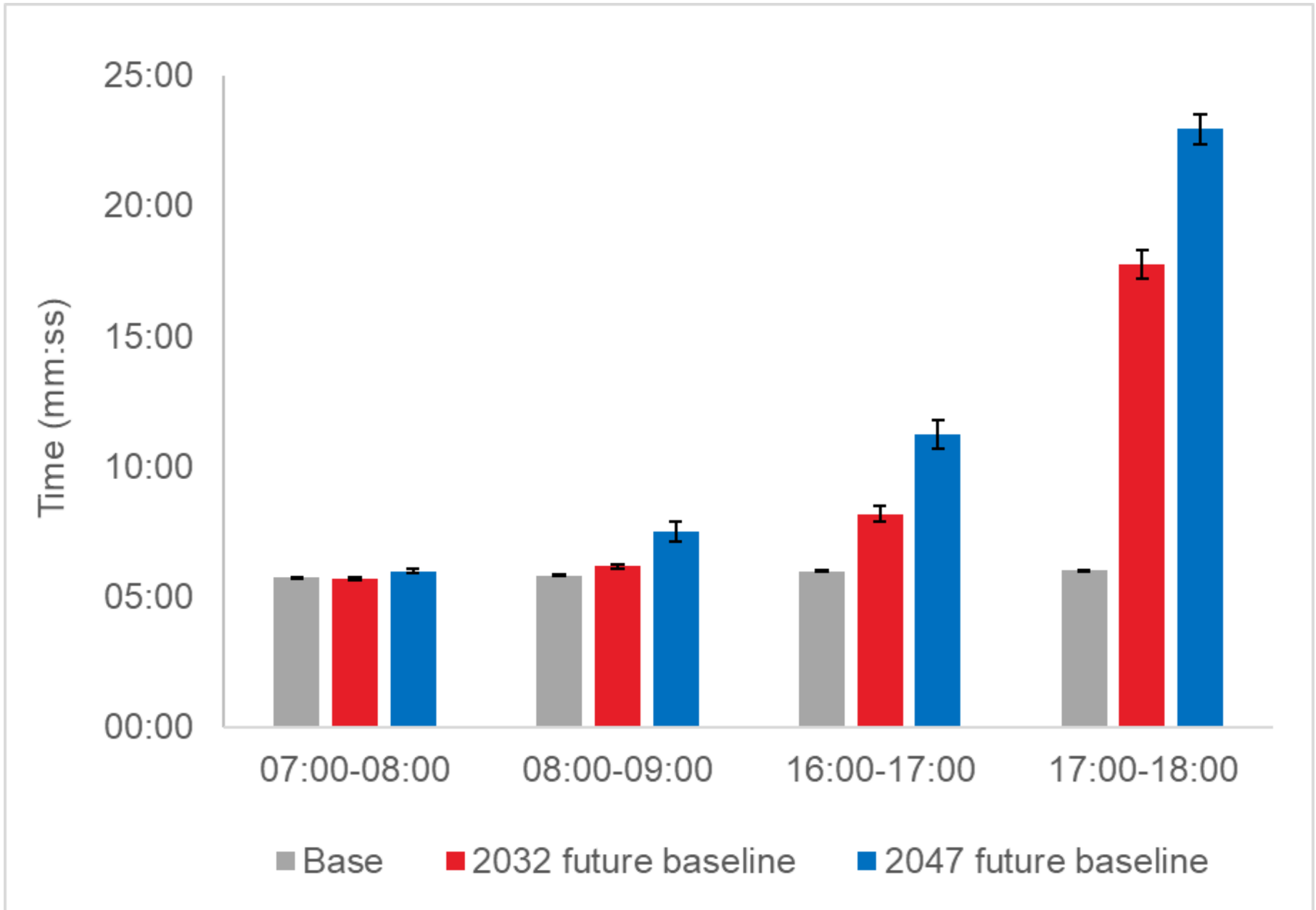


Diagram D.2.12: Base vs future baseline for Longbridge roundabout to Lowfield Heath roundabout

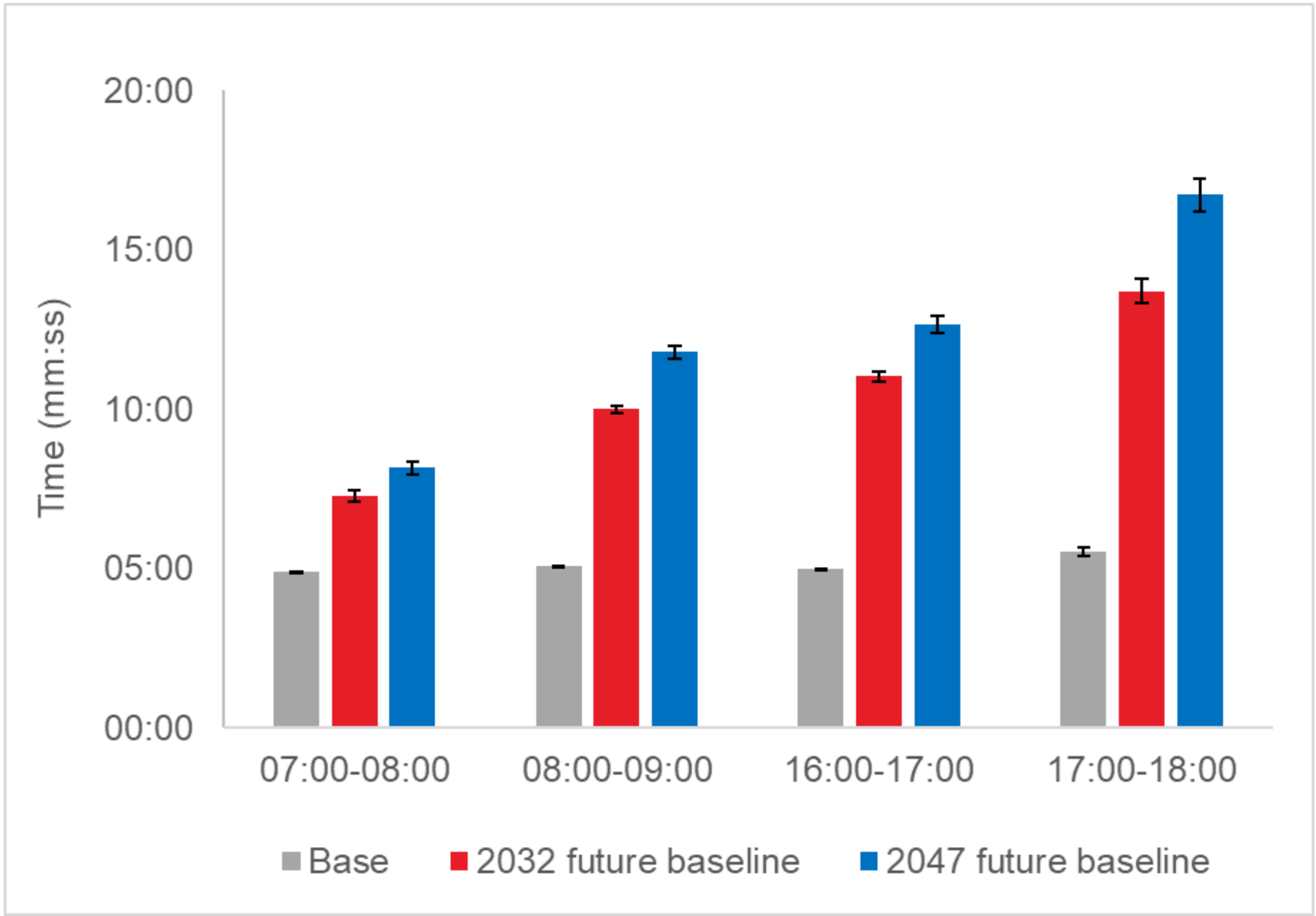


Diagram D.2.13: Base vs future baseline for Junction 9 to Longbridge roundabout

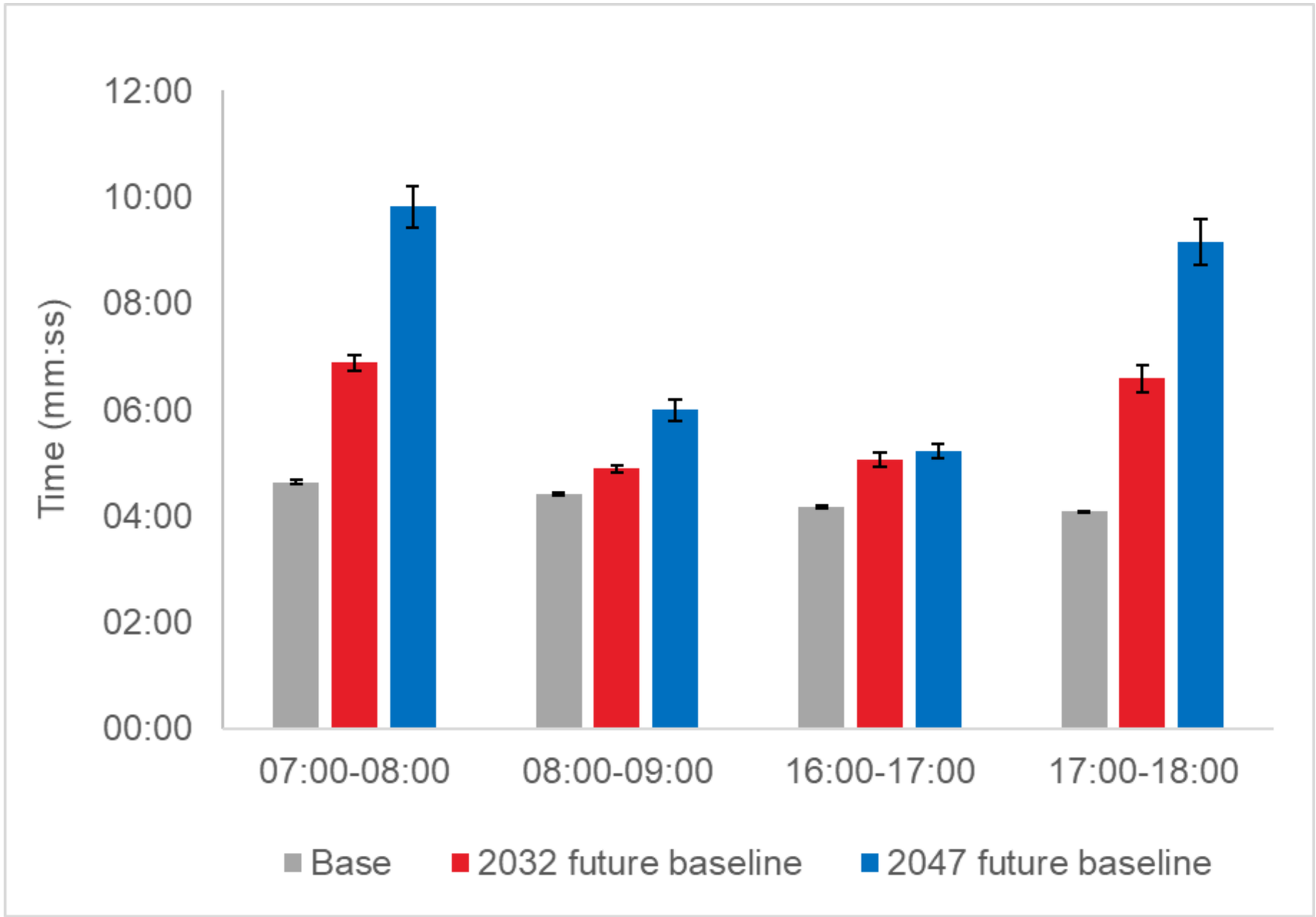
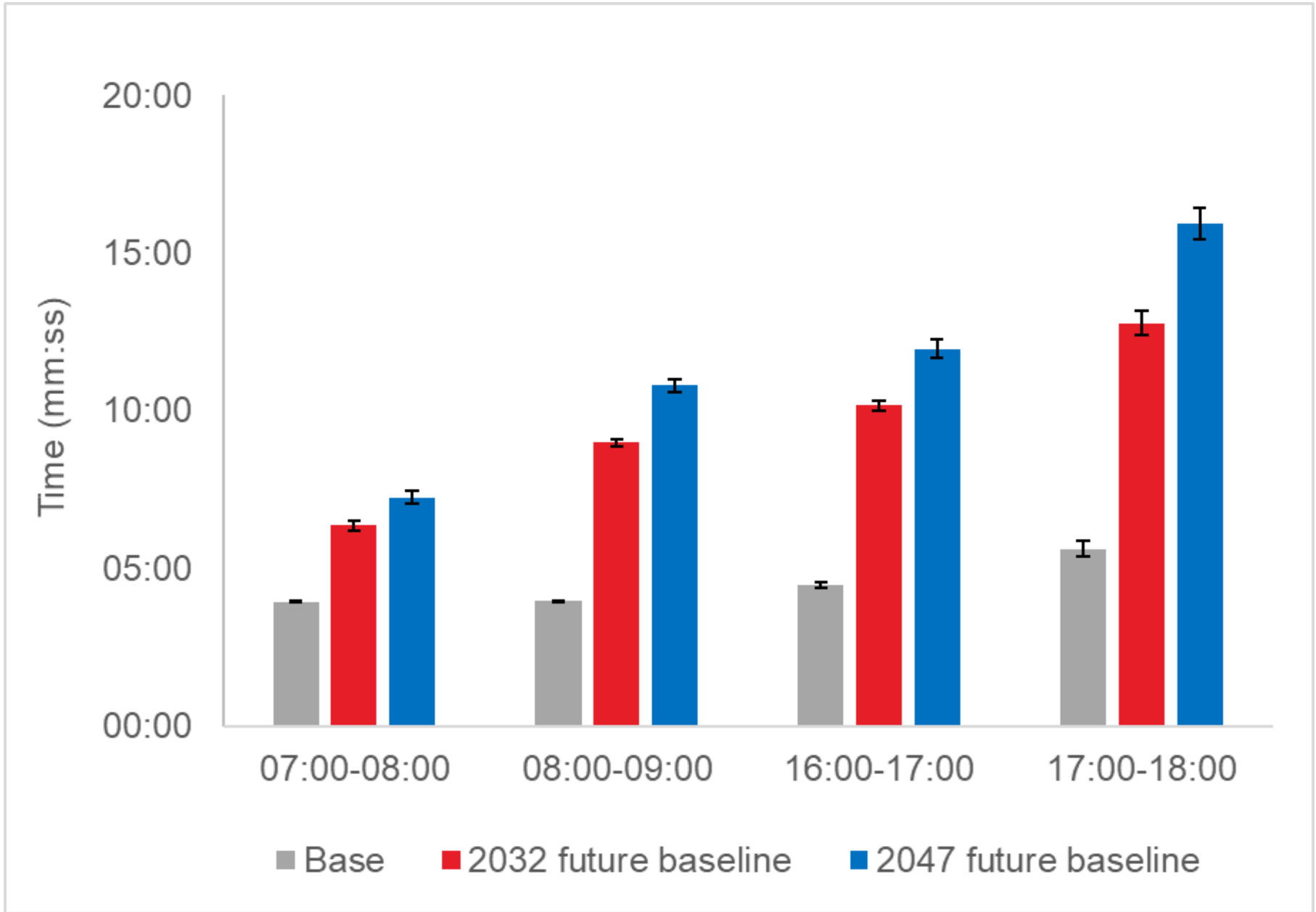


Diagram D.2.14: Base vs future baseline for Longbridge roundabout to Junction 9



Future baseline vs with Project

Diagram D.2.15: future baseline vs with Project for M23 North to South Terminal

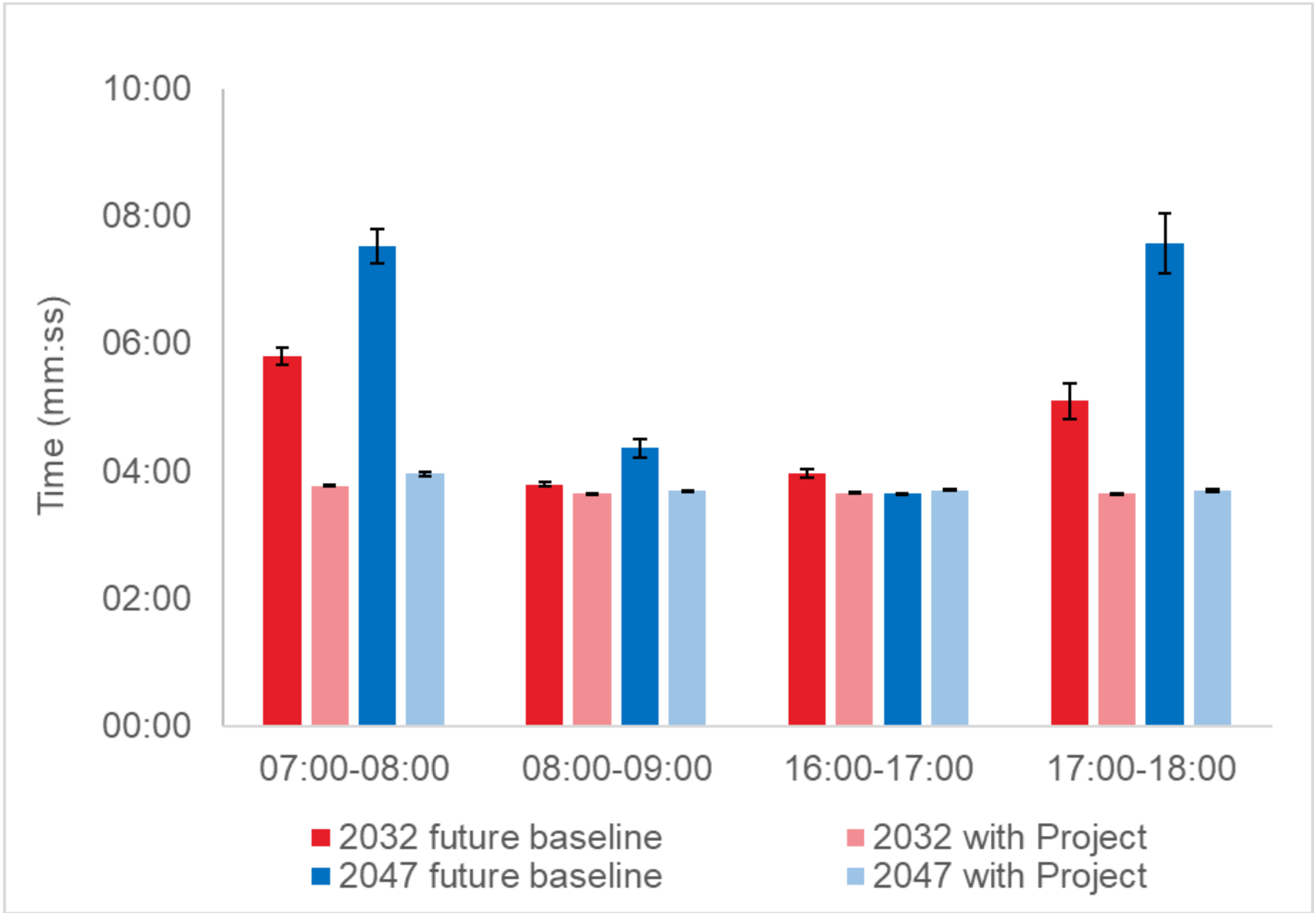


Diagram D.2.16: future baseline vs with Project for South Terminal to M23 North

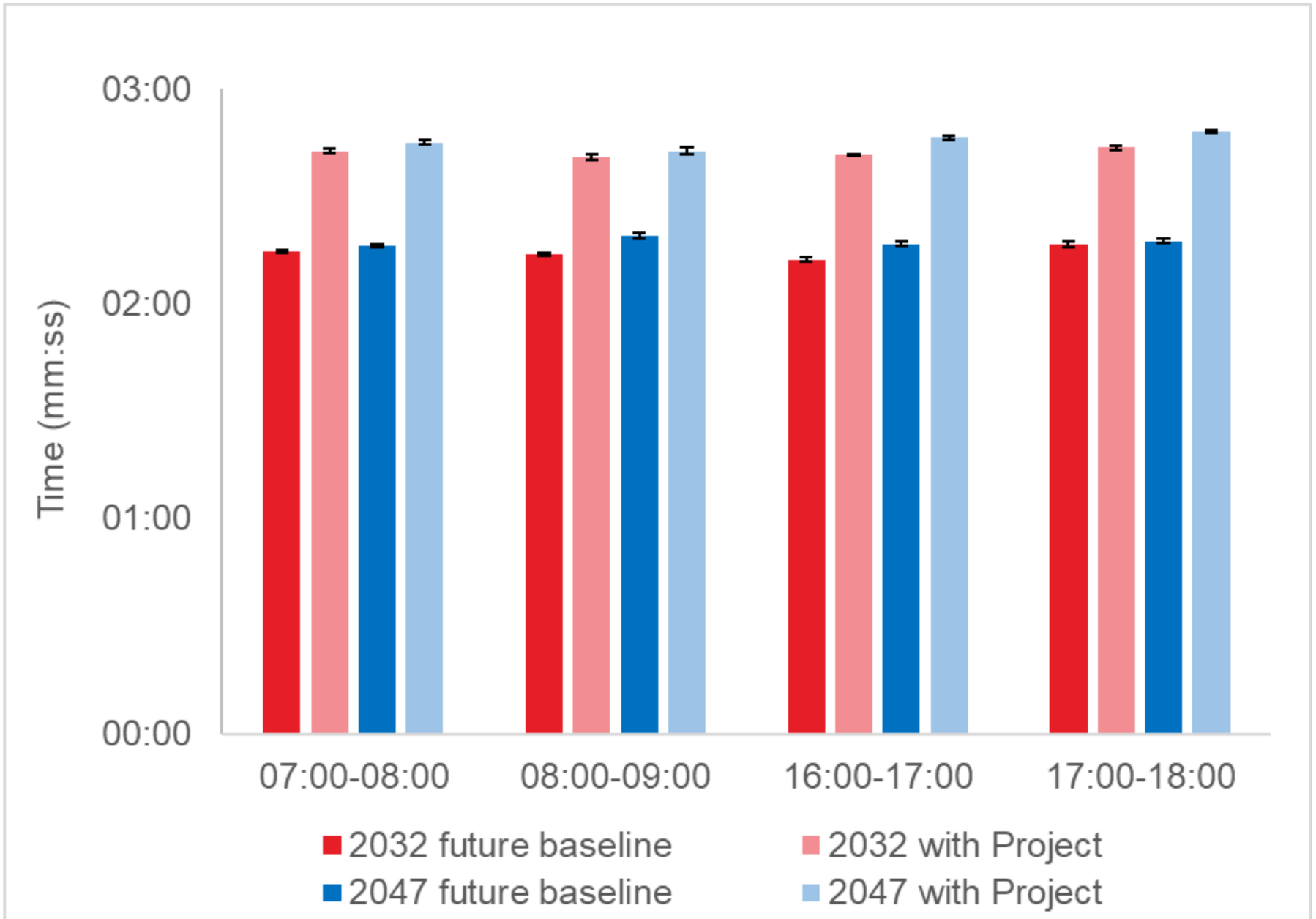


Diagram D.2.17: future baseline vs with Project for Junction 9 to M23 South

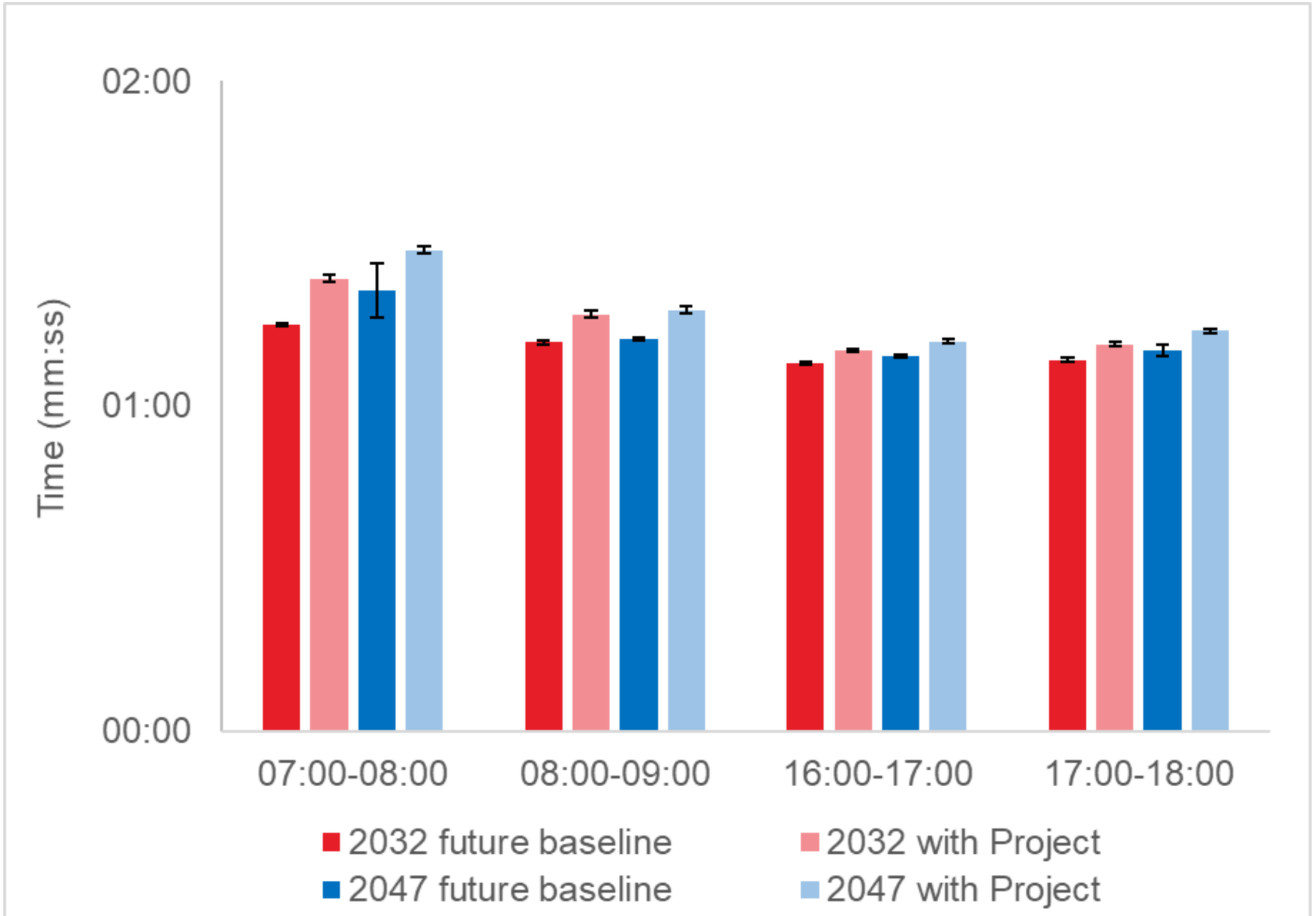


Diagram D.2.18: future baseline vs with Project for M23 South to Junction 9

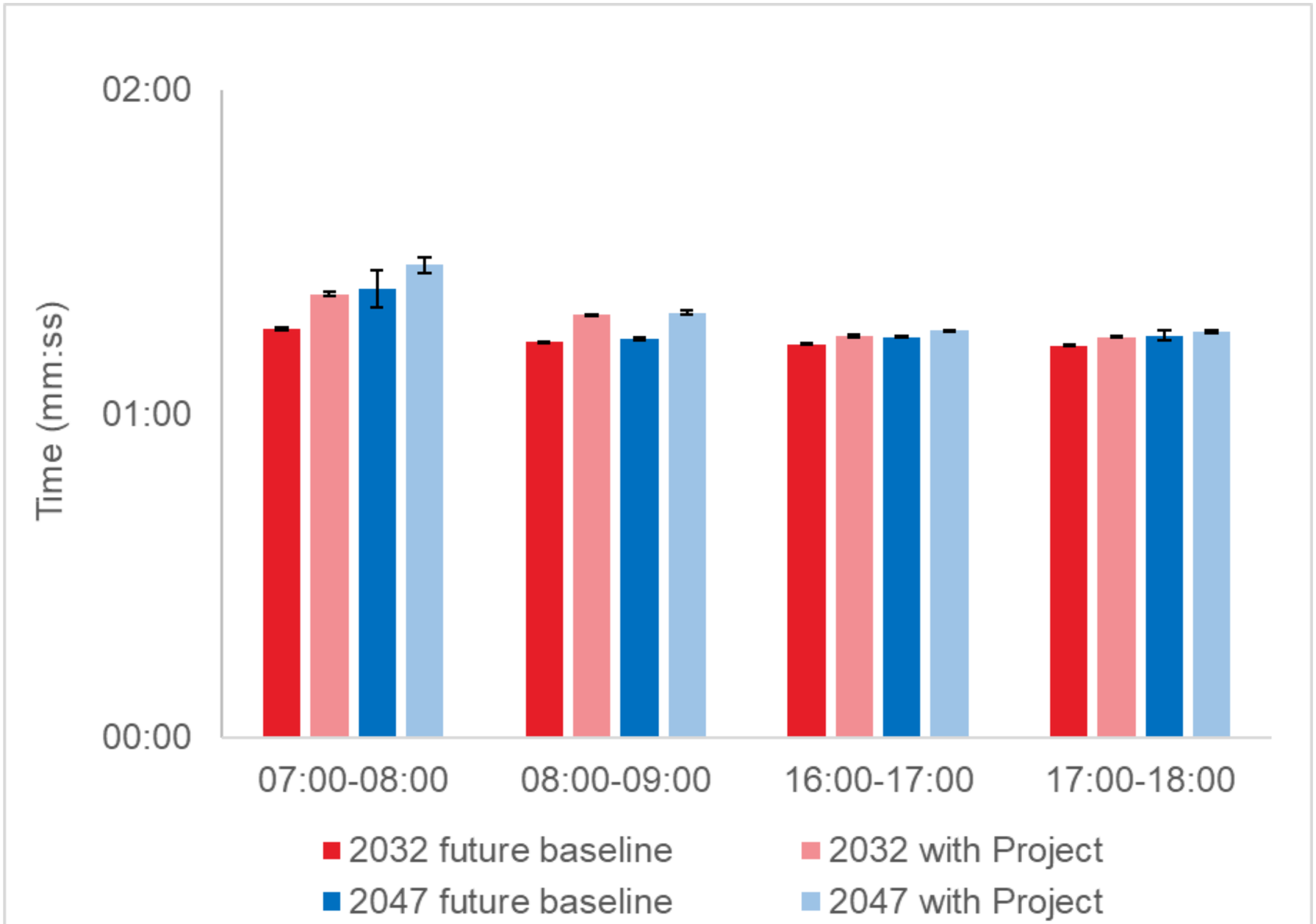


Diagram D.2.19: future baseline vs with Project for South Terminal roundabout to Longbridge roundabout

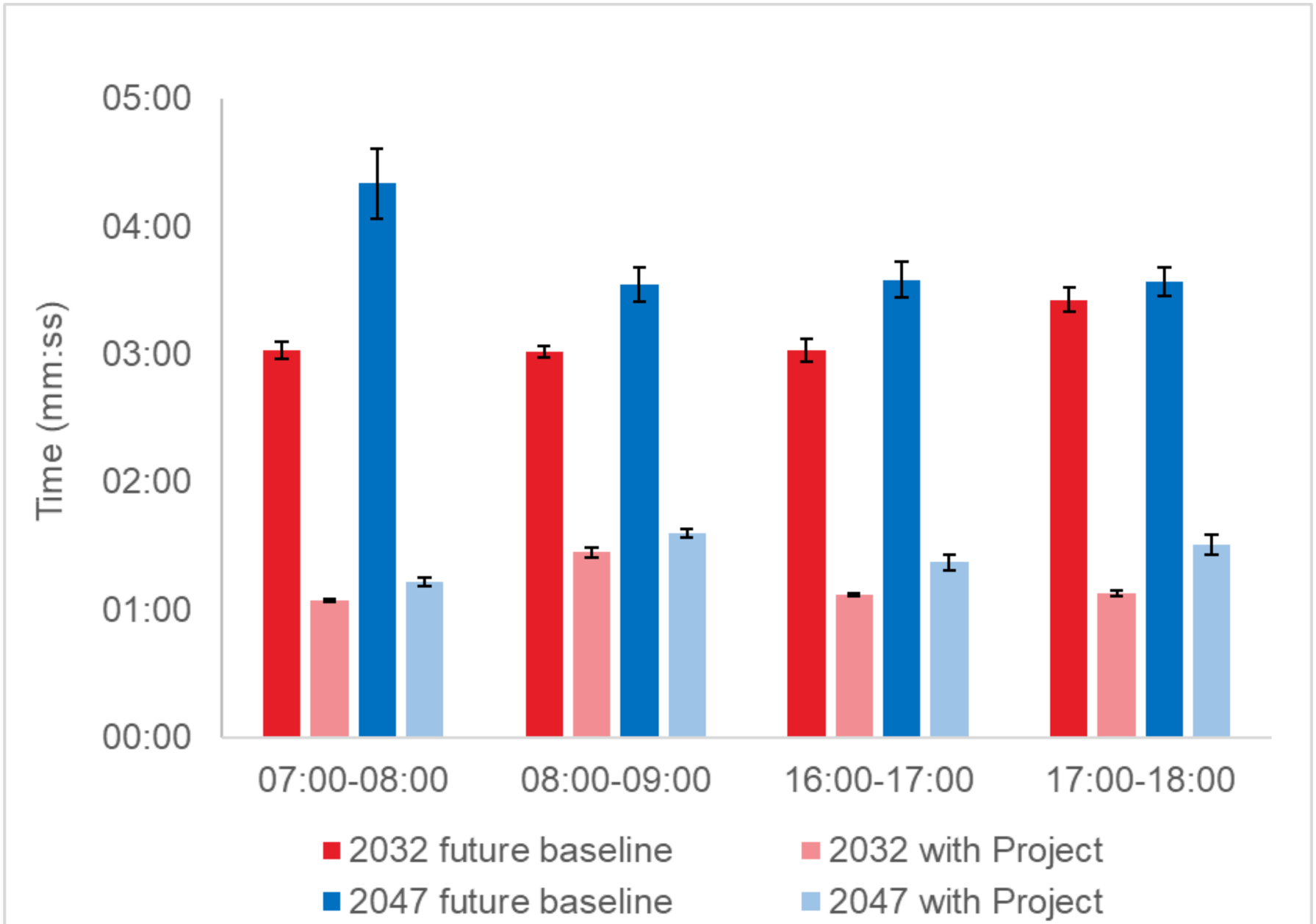


Diagram D.2.20: future baseline vs with Project for Longbridge roundabout to South Terminal roundabout

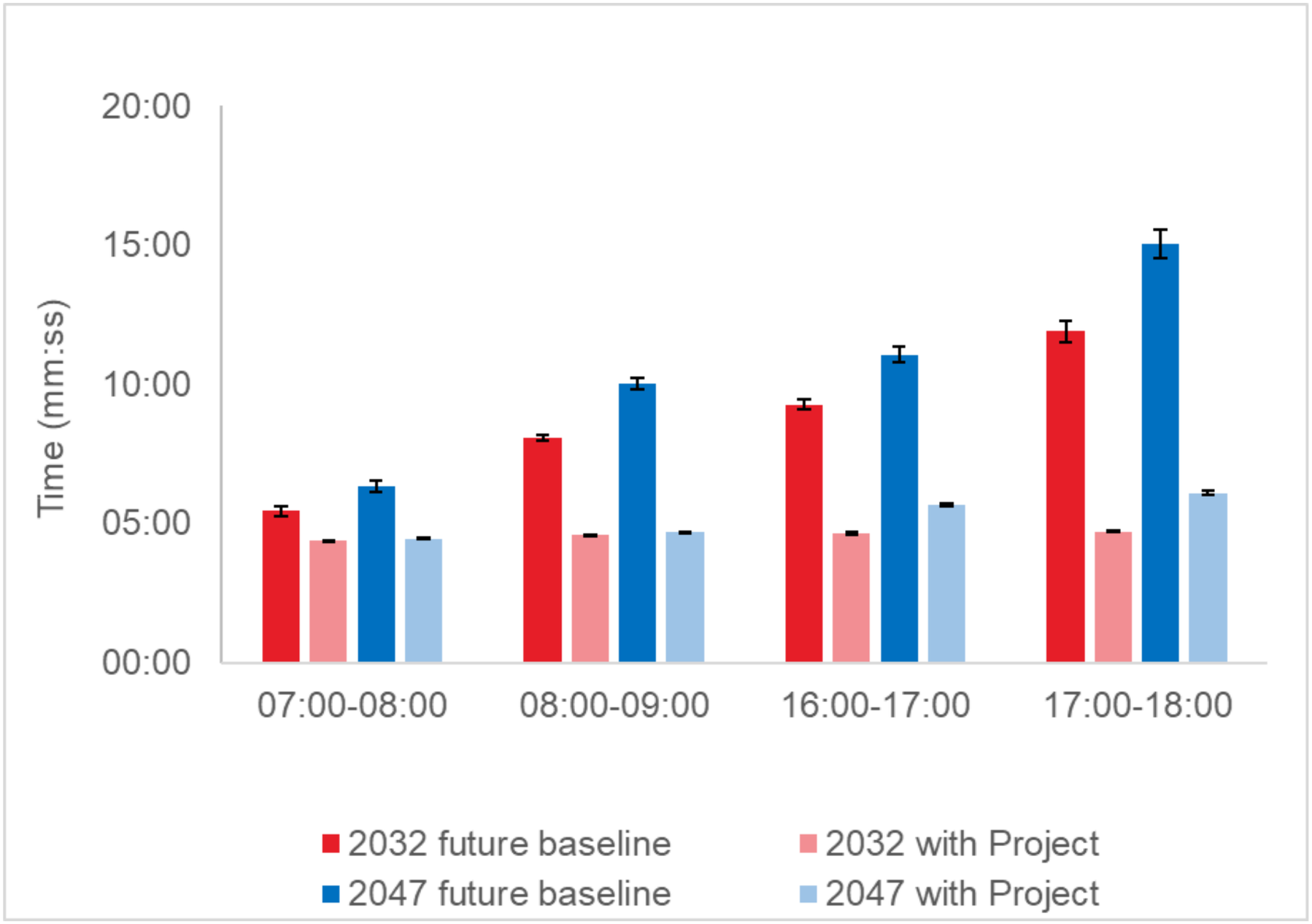


Diagram D.2.21: future baseline vs with Project for North Terminal roundabout to Lowfield Heath roundabout

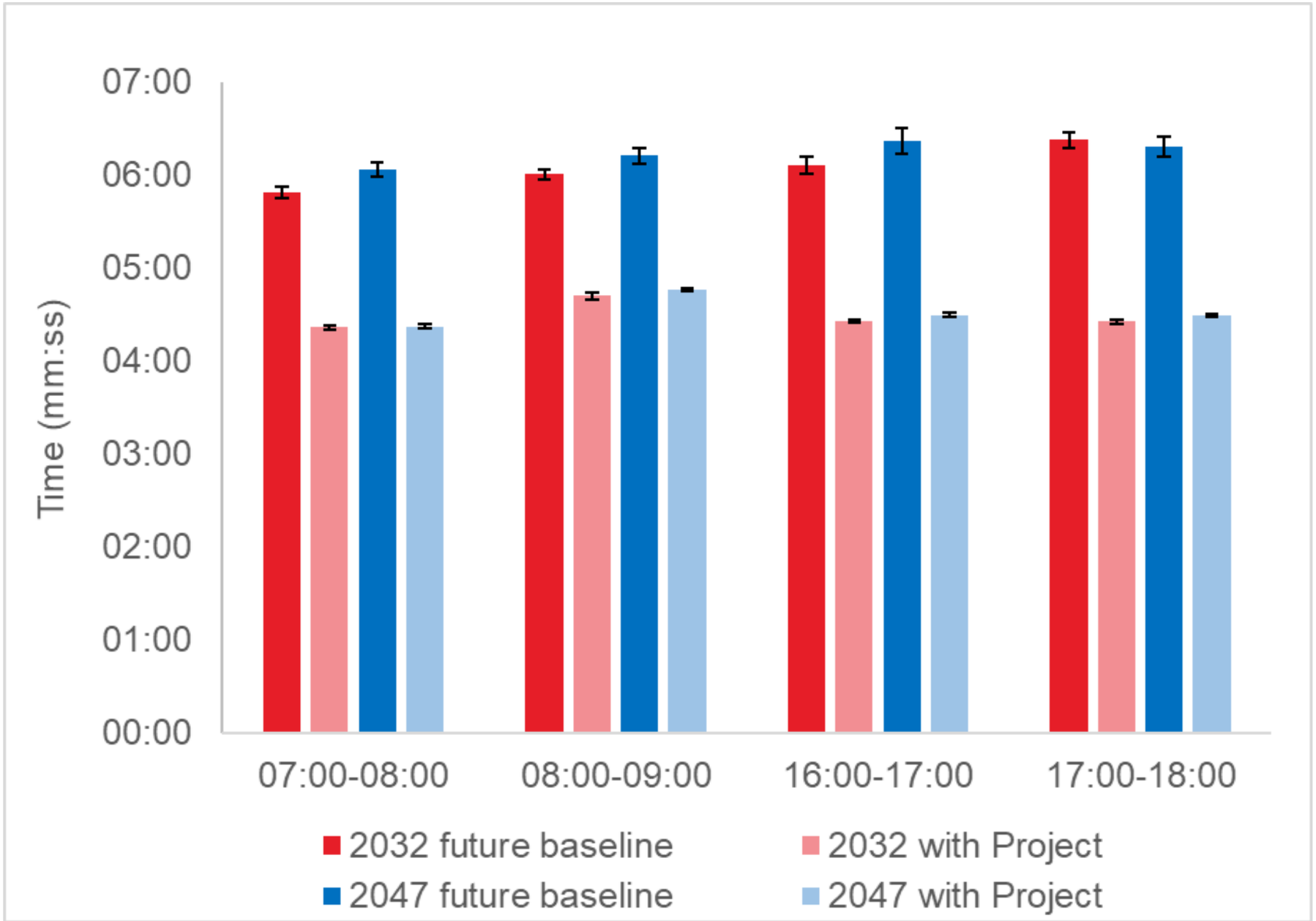


Diagram D.2.22: future baseline vs with Project for Lowfield Heath roundabout to South Terminal roundabout

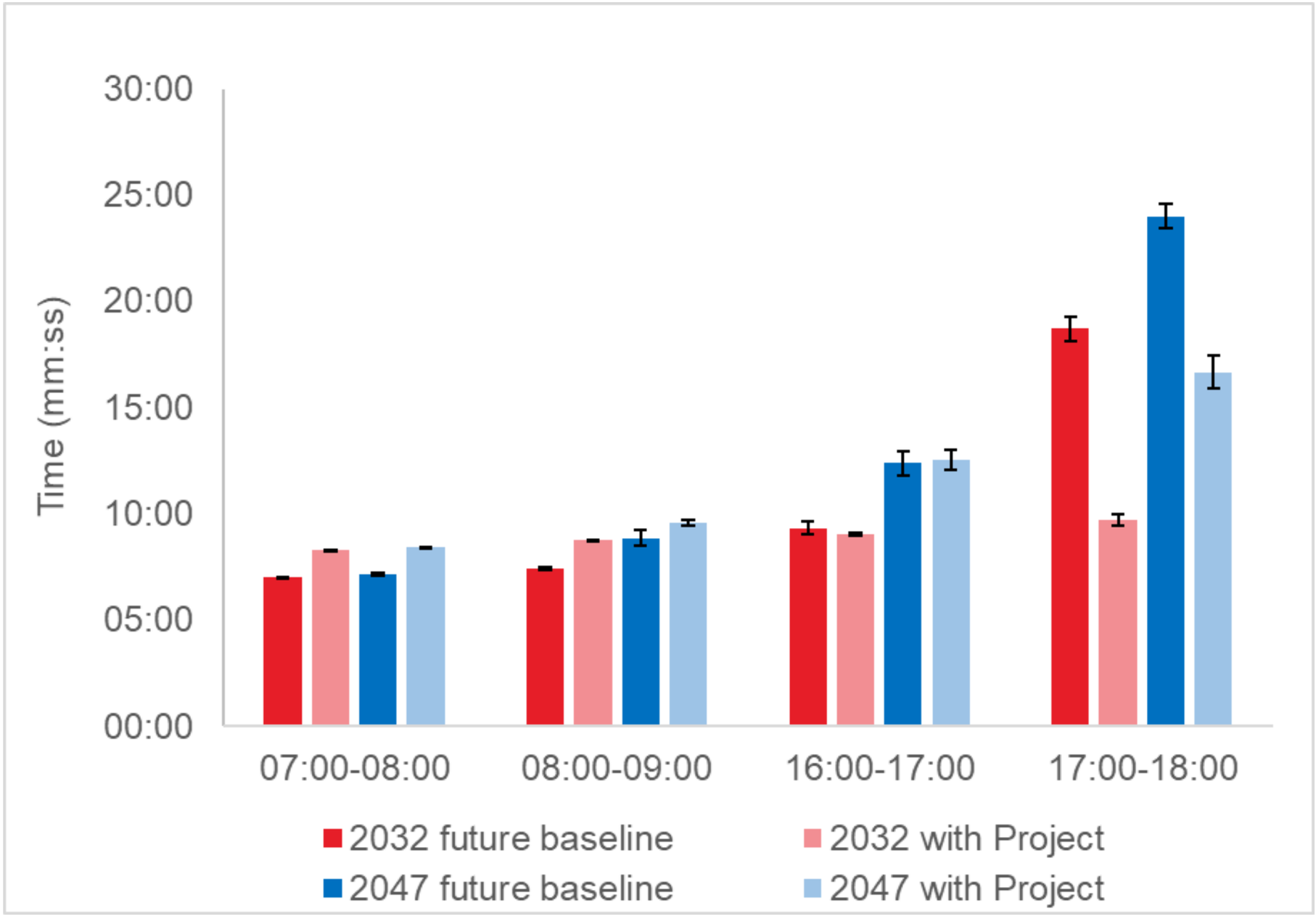


Diagram D.2.23: future baseline vs with Project for North Terminal roundabout to Junction 9

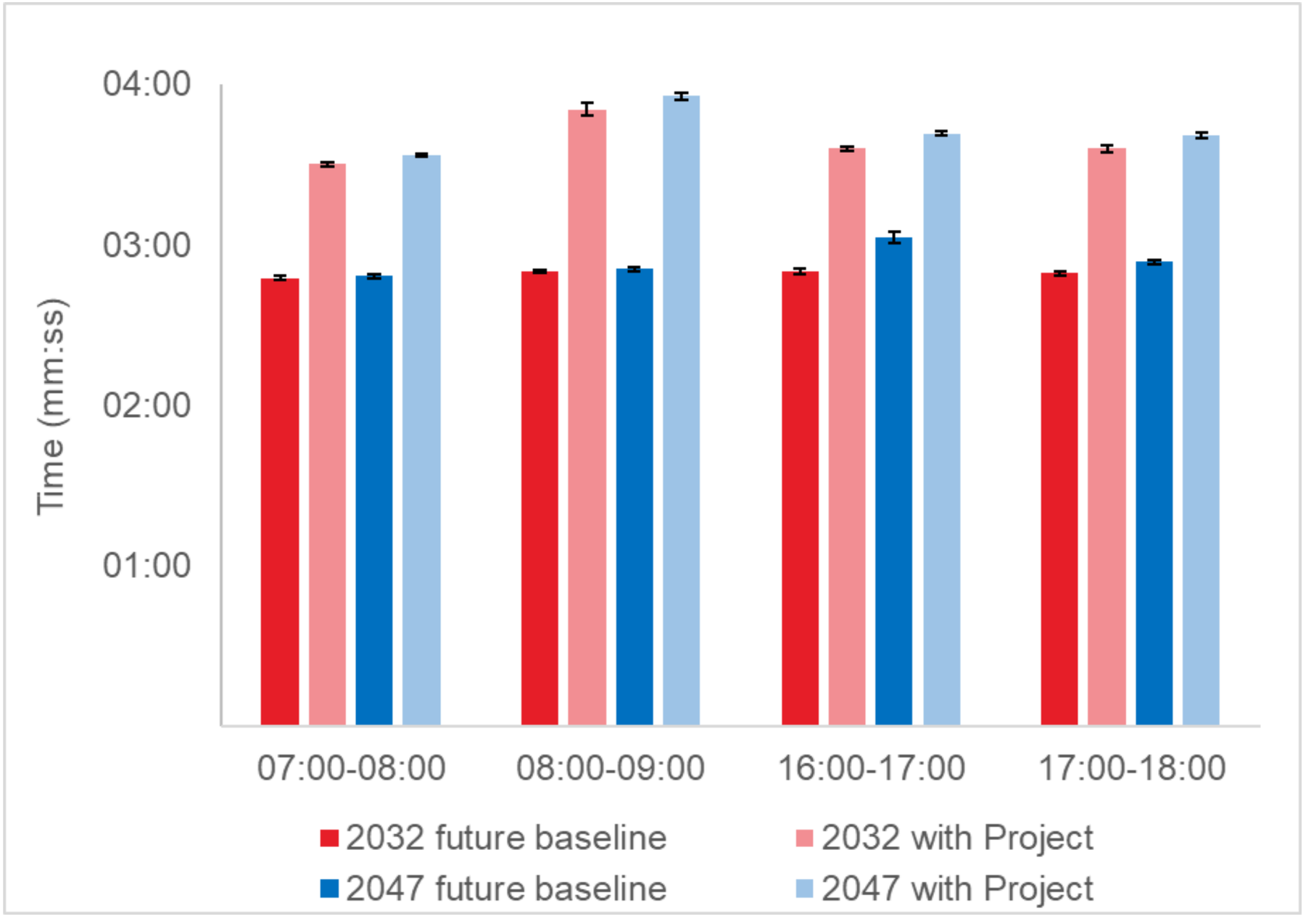


Diagram D.2.24: future baseline vs with Project for Junction 9 to North Terminal roundabout

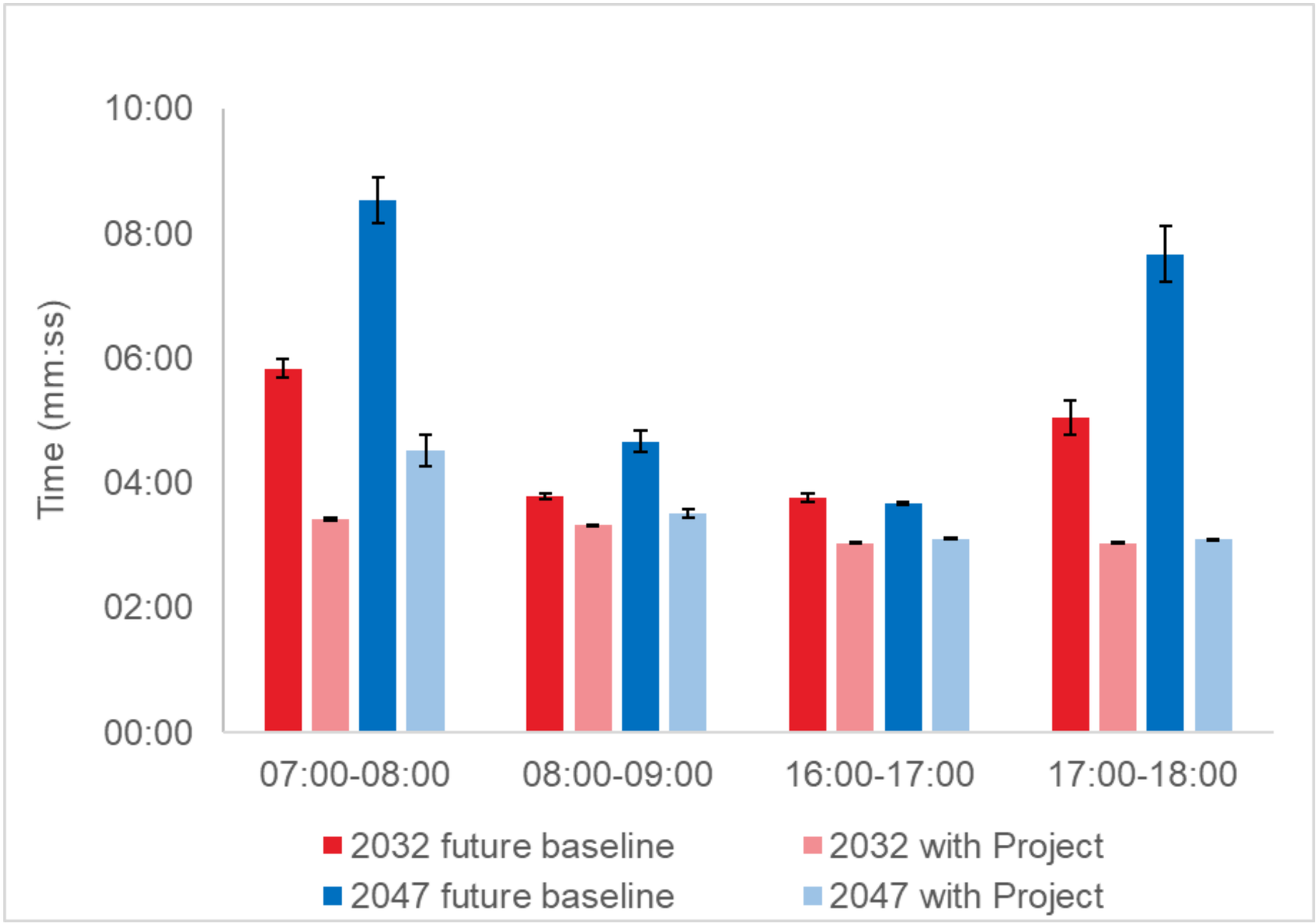


Diagram D.2.25: future baseline vs with Project for Lowfield Heath roundabout to Longbridge roundabout

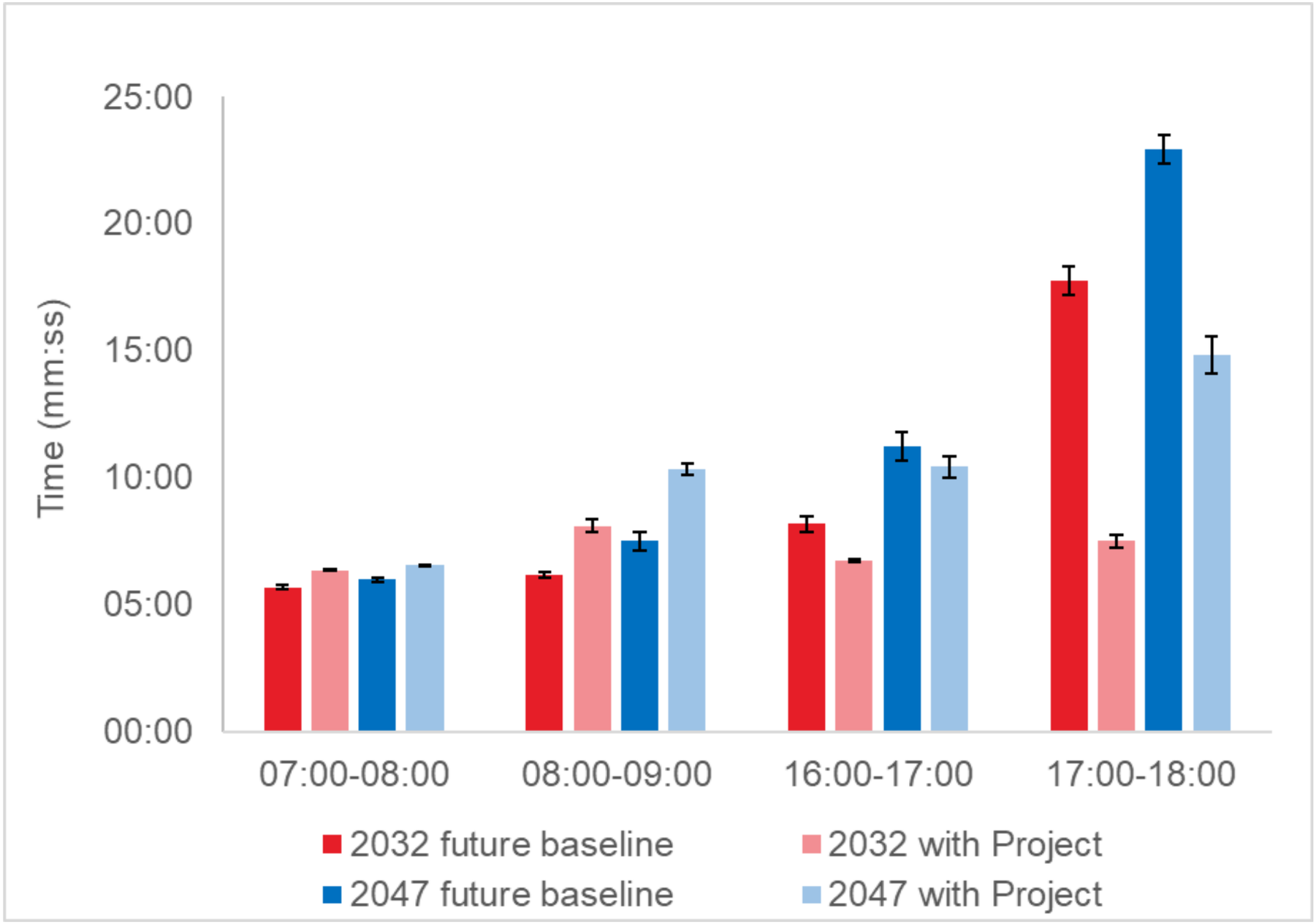


Diagram D.2.26: future baseline vs with Project for Longbridge roundabout to Lowfield Heath roundabout

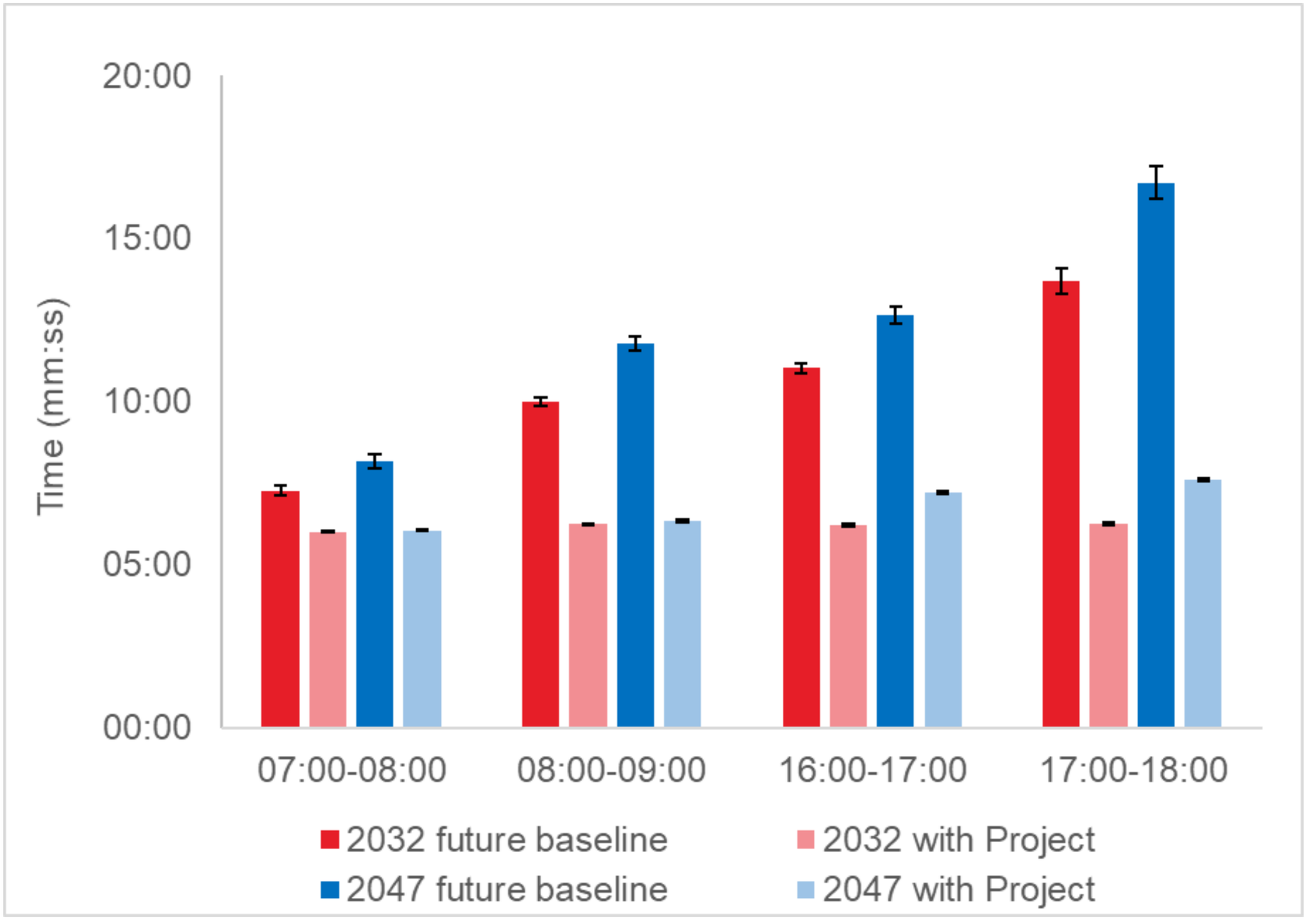


Diagram D.2.27: future baseline vs with Project for Junction 9 to Longbridge roundabout

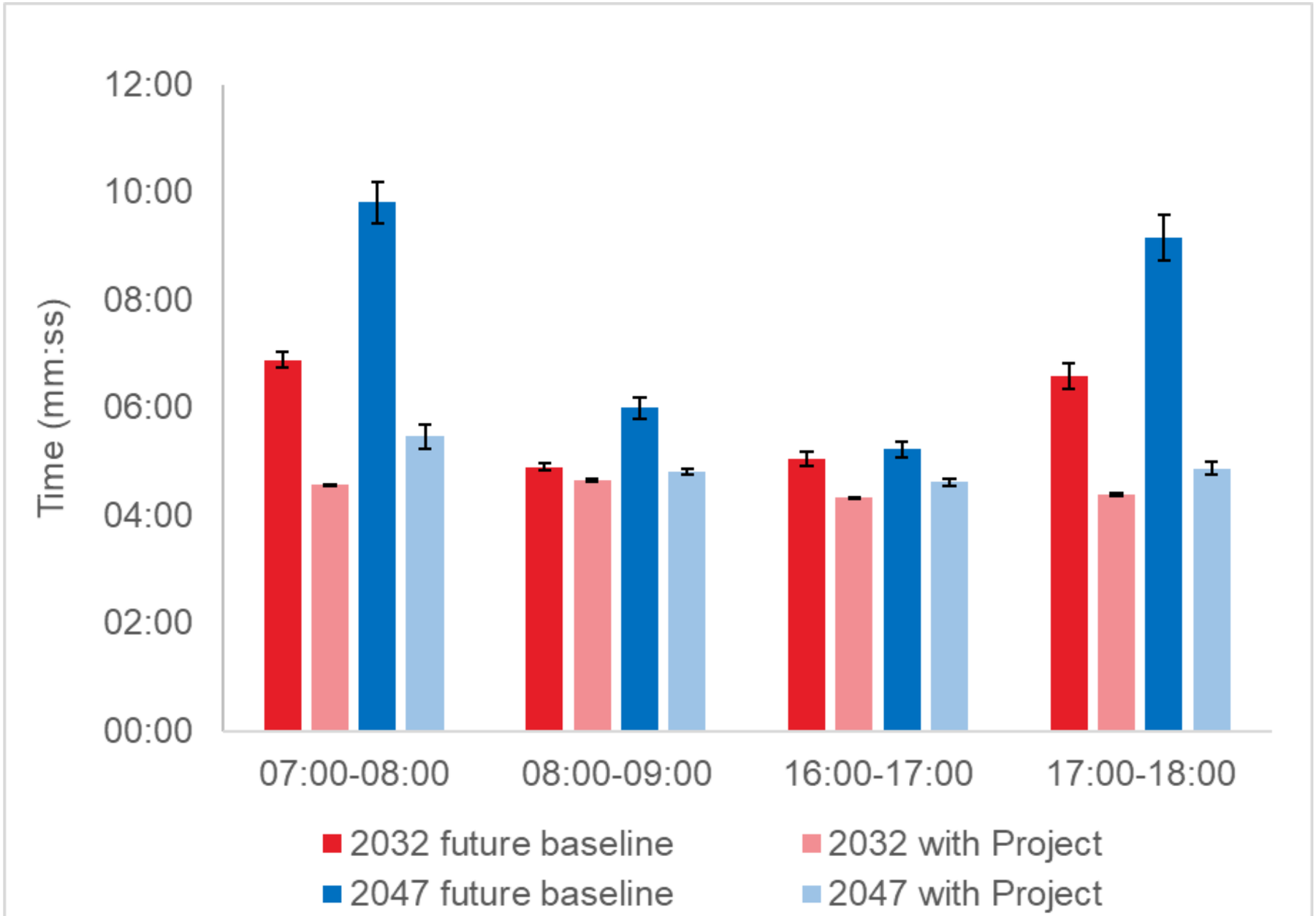


Diagram D.2.28: future baseline vs with Project for Longbridge roundabout to Junction 9